Airport Road Improvements










APPENDICES ESR 1

Municipal Class Environmental Assessment
Airport Road
from 1.0km north of Mayfield Road to 0.6km north of King Street

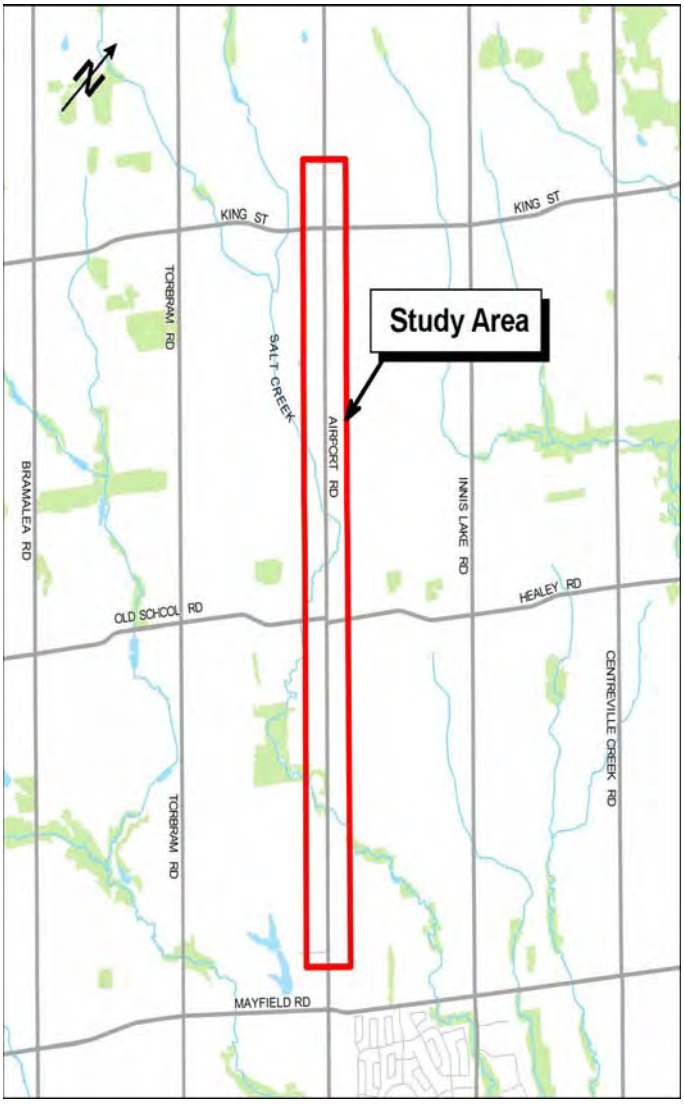
October 2015

Region of Peel
Working for you

D TRAFFIC STUDY & ROUNDABOUT EVALUATIONS

Region of Peel

Airport Road EA
1km north of Mayfield Road to 0.6km north of King Street
Traffic Needs Assessment



Caledon, Ontario

February 2013

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1. Introduction

1.1 Study Purpose

This report documents the traffic study conducted for the needs and justification component of the Class Environmental Assessment for Peel Regional Road 7 (Airport Road) between a point one kilometre north of Mayfield Road and a point 600 metres north of King Street. The traffic study was conducted by the Region of Peel's Traffic Operations group with input from the Region's Traffic Signals and Systems group, Traffic Development group and Transportation Planning group, and the safety performance review was conducted by the Region's Traffic Safety group. **Exhibit 1** provides a map of the study area.

1.2 Background

To determine the traffic needs of the study area a number of previous studies and resources have been consulted including:

- Peel Long Range Transportation Plan, 2012 Update ;
- Caledon Transportation Needs Study Update (CATS) (2009); and
- Region of Peel Transportation Demand Forecasting Model with 2021 and 2031 AM peak hour forecasts.

Automatic traffic recorder (ATR) classification counts were also analyzed for the following intersections:

- Airport Road at 2.1 KM north of Mayfield Road
- Airport Road at 0.21 KM north of Old School Road
- Airport Road at 2.8 KM north of King Street
- King Street at 0.5 KM west of Airport Road

According to the Caledon Transportation Needs Study Update (CATS), Airport Road from north of Mayfield Road to north of King Street is to be widened from two lanes to five lanes by 2019. **Exhibit 2** provides a map of the screenlines with the arrows representing the 2031 capacity deficiency for traffic crossing each screenline. According to **Exhibit 2,** the capacity deficiency is 900Vph for screenline 4B covering Airport Road within the study area.

Exhibit 1: Study Area

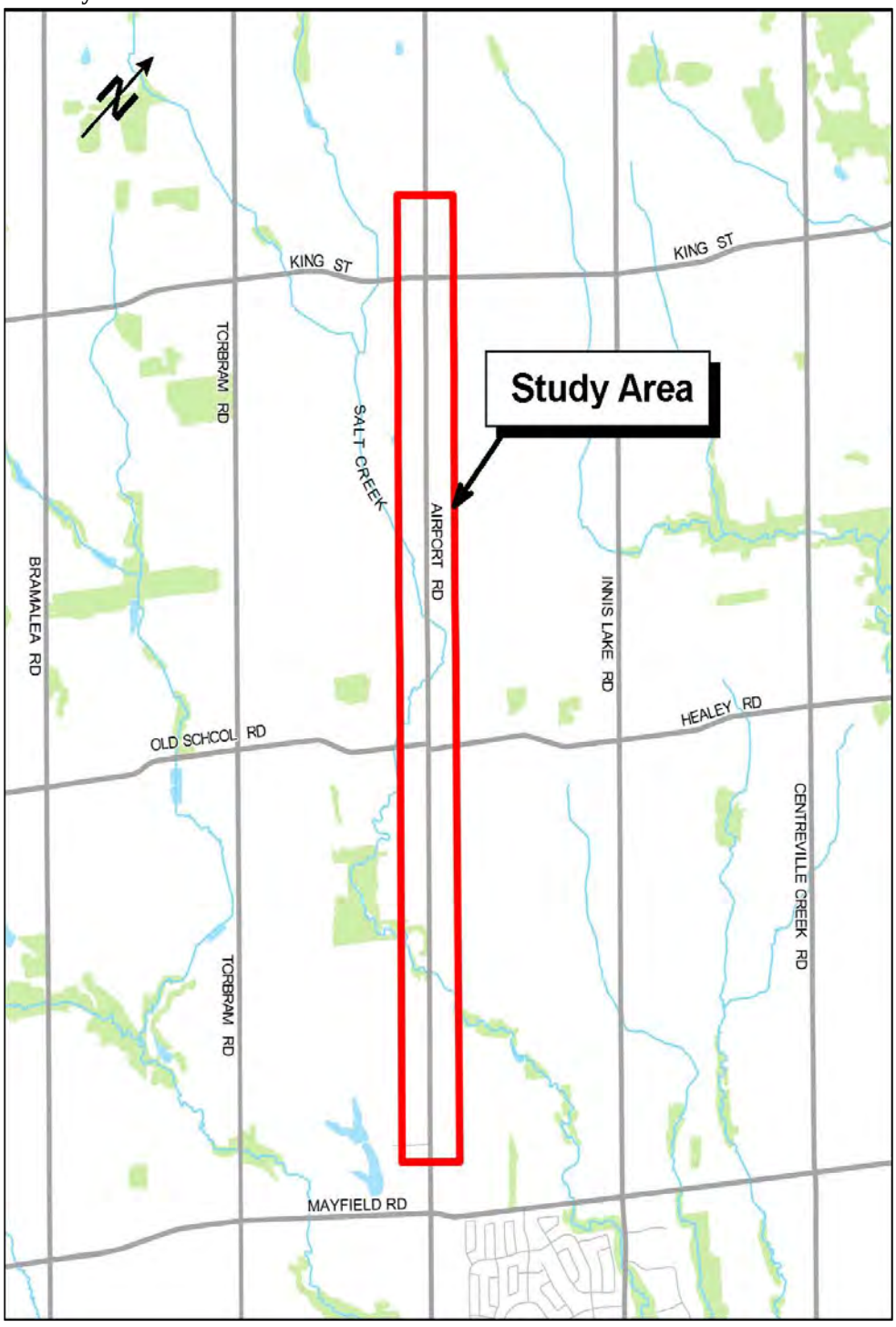
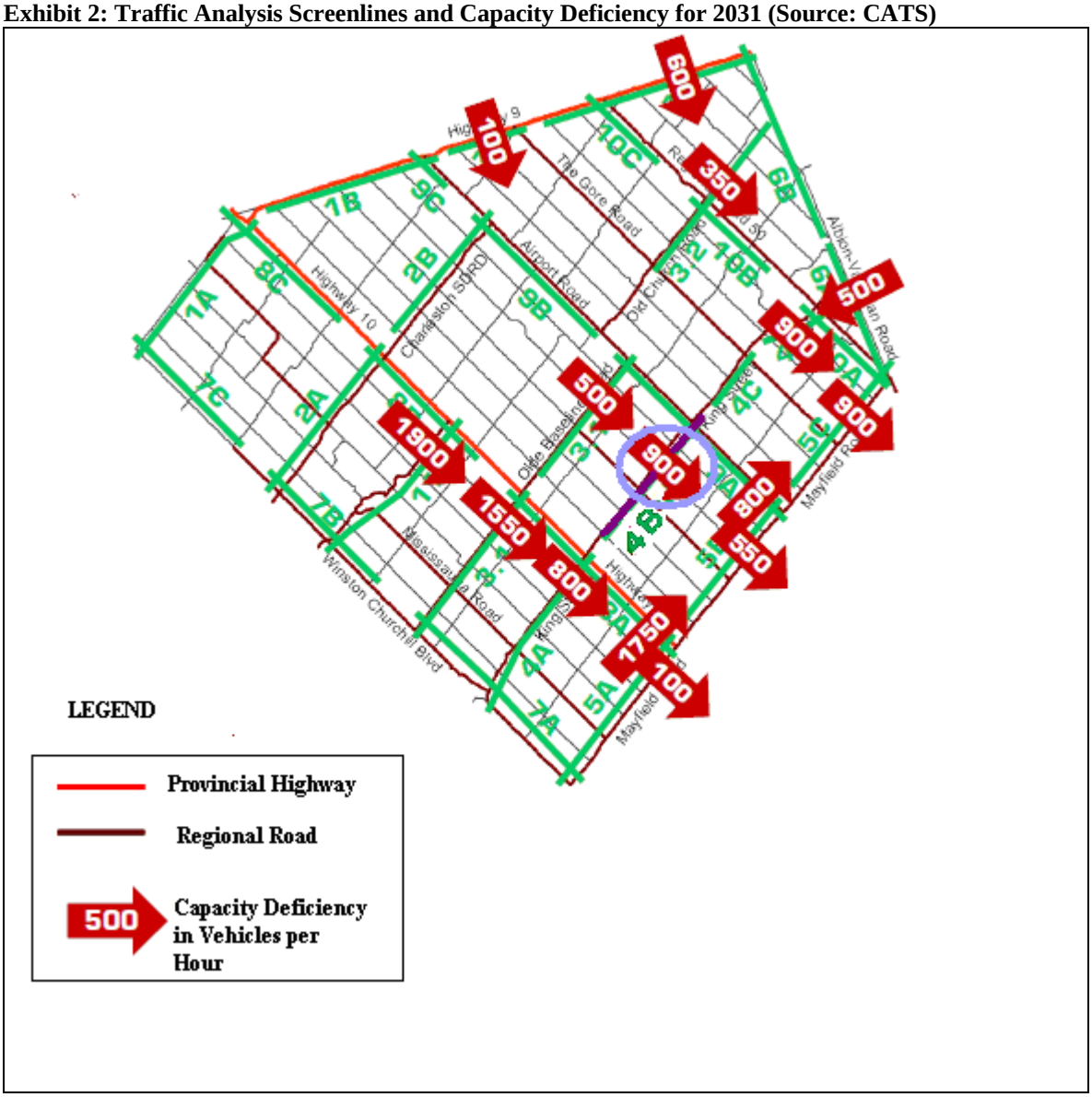


Exhibit 2: Traffic Analysis Screenlines and Capacity Deficiency for 2031 (Source: CATS)



1.3 Traffic Analysis Approach

As a part of conducting this needs assessment, Regional staff took into account existing and forecasted traffic in the study area for the years 2011, 2021, and 2031. Traffic capacity analysis was undertaken for all intersections and road sections in the study area for future road network scenarios. The traffic forecasts were derived by using previous studies and growth factors within the study area.

1.4 Regional and Study Area Context

A significant amount of growth is projected to occur in the Town of Caledon and the Region of Peel, as shown in **Table 1** and **Table 2**. The values provided in **Table 1** indicate the 2011 to 2031 population forecasts. **Table 2** shows the employment forecasts compared to our current 2011 values. The Town of Caledon population and employment

growth on a town-wide level has been projected at 29% and 36% respectively from 2011 to 2021 and at 65% and 74% respectively from 2011 to 2031.

Table 1 – Projected Population Growth

Municipality	2011	2021	2031	10 Year Growth	20 Year Growth
Region of Peel	1,340,125	1,522,158	1,682,864	14%	26%
Town of Caledon	68,362	87,993	113,001	29%	65%

Table 2 – Projected Employment Growth

Municipality	2011	2021	2031	10 Year Growth	20 Year Growth
Region of Peel	685,607	811,792	887,723	18%	29%
Town of Caledon	28,009	38,213	48,756	36%	74%

NOTE – Population and Employment forecasts based on existing approved data from 2009.

The Airport Road corridor is planned to support growth on adjacent lands along the corridor. The corridor right of way is designated as 45 metres in the Regional Official Plan (ROP) which is sufficient to support a four lane cross-section.

Immediately south of the study area is the Tullamore South Industrial Park, which calls for a full build out of 431,000 square metres of industrial and retail lands by 2018. Traffic impact, specifically site trips, documented in the Tullamore Secondary Plan Transportation Impact Study prepared by IBI Group in February 2009 have been incorporated in this Needs Assessment and Safety Performance Report.

The Town of Caledon is also finalizing an Official Plan Review for the Sandhill Commercial/Industrial Centre (Sandhill Land Use Study), located at the northerly limits of the study area. A series of development applications have been received by the Town and Region pertaining to highway commercial and trucking uses, all of which will ultimately impact the capacity and operation of Airport Road in the future.

2. Existing Conditions Analysis

A traffic analysis of the Airport Road corridor from a point one kilometre north of Mayfield Road to 600m north of King Street was based on a number of traffic data and forecasts. The tasks associated with the traffic analysis included:

- A review of existing traffic conditions throughout the corridor;
- Analysis of intersections and midblock road sections;
- A review of existing transportation deficiencies;
- A review of the safety performance for the Airport Road corridor;
- An assessment of future travel demands and deficiencies; and
- Identification of improvements for intersections and road sections to handle future travel demands.

2.1 Existing Road Network

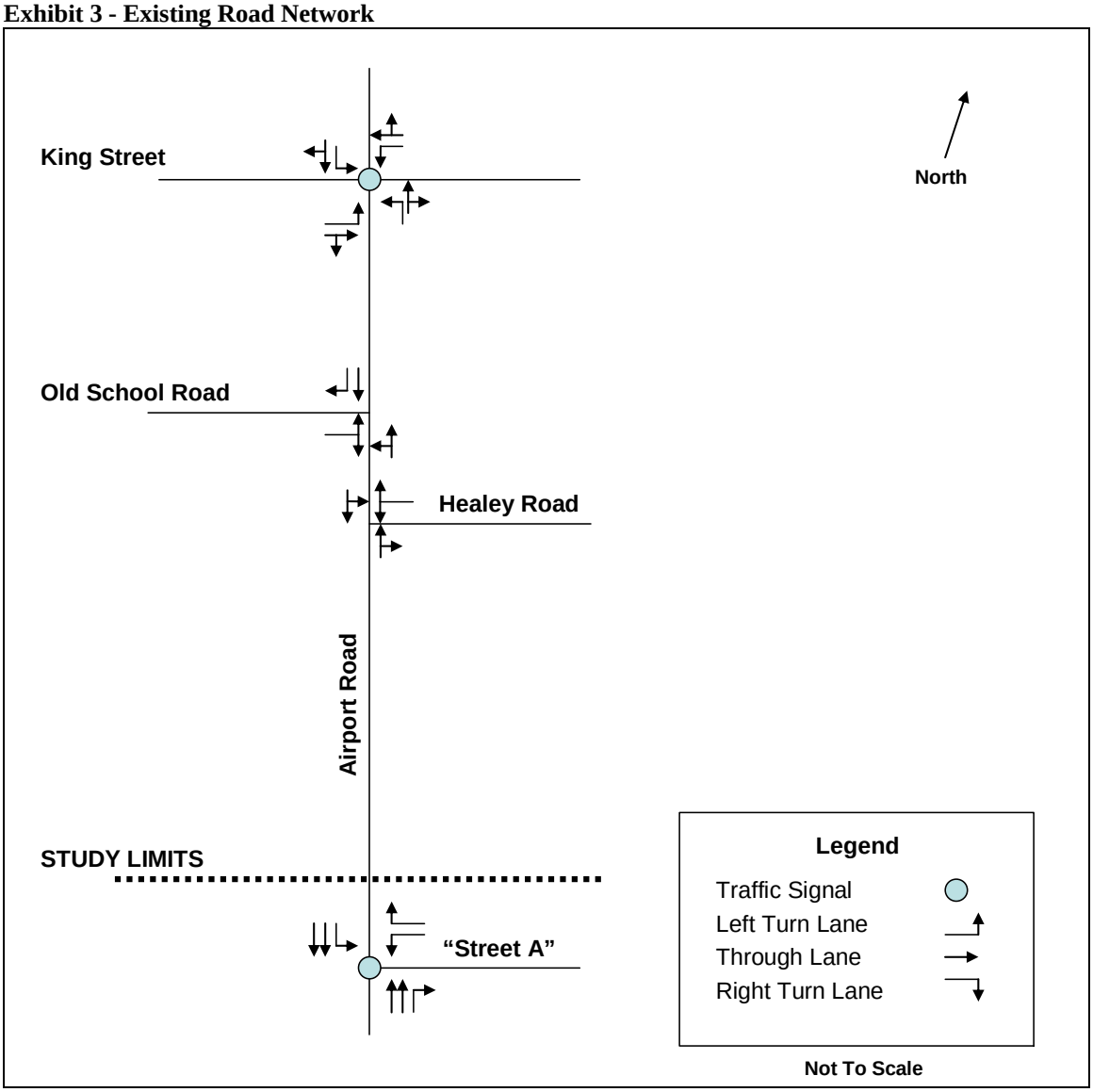
The existing road network for the Airport Road corridor is shown in **Exhibit 3** and a detailed description is provided below:

Airport Road – Regional Road 7 (within the study area) is a two lane north-south major arterial road under the jurisdiction of the Region of Peel. It has a posted speed limit of 80 kilometres per hour except within the settlement community of Sandhill at the northerly limits of the study area where it has a posted speed limit of 60 kilometres per hour. To the south, Airport Road extends to Highway 427 (the boundary between the City of Mississauga and City of Toronto) where it continues as Dixon Road. Northerly, Airport Road extends to Highway 9 (the boundary between the Town of Caledon and Town of Mono) where it continues as Simcoe County Road 18.

King Street - Regional Road 9 is a two lane east-west major arterial road under the jurisdiction of the Region of Peel. The posted speed limit on King Street at Airport Road is 70 kilometres per hour, and is posted at 80 kilometres per hour beyond each side of the intersection. To the west, King Street extends to Halton Hills Side Road 27 (the boundary between the Town of Caledon and Town of Halton Hills) where it transitions southward to become Winston Churchill Boulevard (Regional Road 19). Easterly, King Street extends to Albion-Vaughan Road/Caledon-King Townline South (the boundary between the Town of Caledon and King Township) where it continues as King Road (York Regional Road 11).

Old School Road is a two lane minor arterial road under the jurisdiction of the Town of Caledon and has a posted speed limit of 80 kilometres per hour. Old School Road terminates at Airport Road as an offset intersection with 30 metres of separation from Healey Road, and extends westerly to Winston Churchill Boulevard (the boundary between the Town of Caledon and Town of Halton Hills) where it continues as Halton Hills Side Road 22. Old School Road is currently truck prohibited.

Exhibit 3 - Existing Road Network



Healey Road is a two lane minor arterial road under the jurisdiction of the Town of Caledon and has a posted speed limit of 80 kilometres per hour. Healey Road terminates at Airport Road as an offset intersection with 30 metres of separation from Old School Road, and extends easterly to Queen Street South (Regional Road 50) in Bolton. Healey Road is currently truck prohibited.

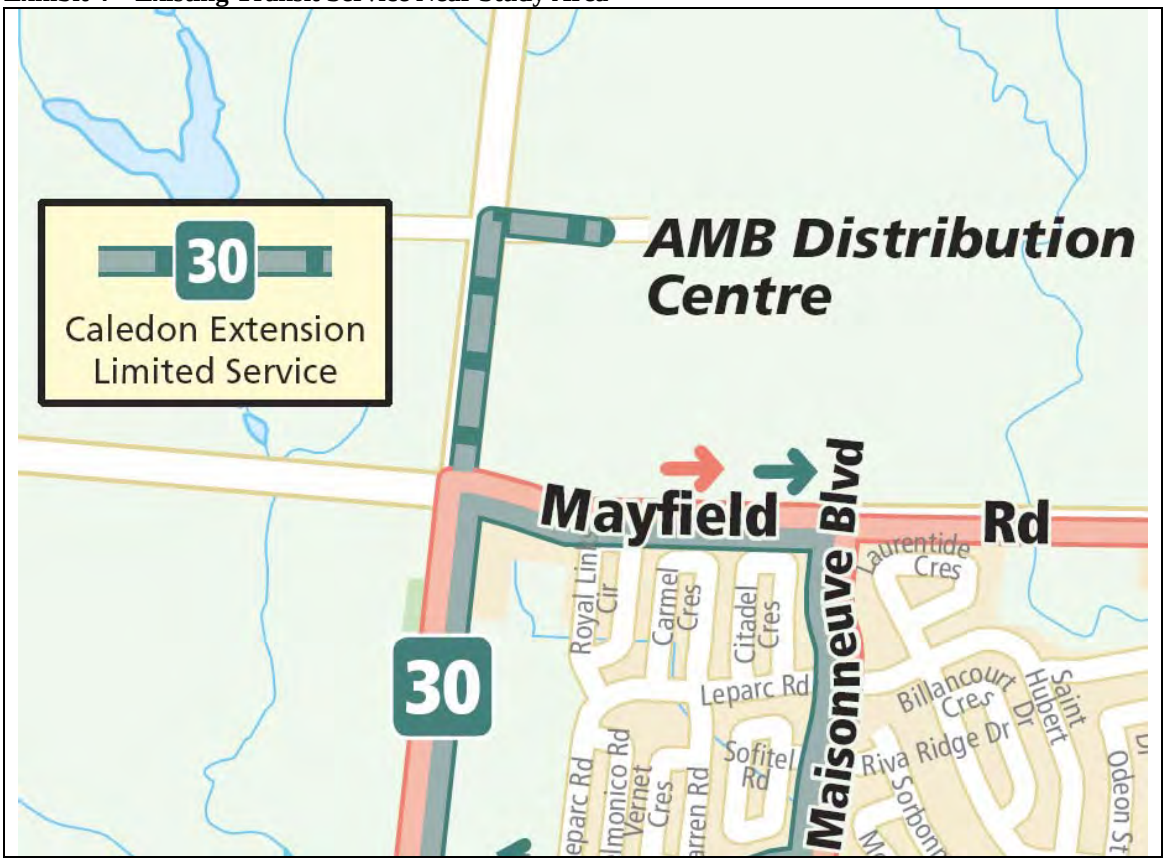
"Street A" currently serves as a private access road immediately south of the study area limits. It intersects with Airport Road as a signalized three-legged intersection, and is being incorporated in this study merely as a checkpoint for north-south volumes on Airport Road since no other municipal streets cross Airport Road south of Healey Road, and since it is the closest signalized intersection to the southerly limits of the study area.

2.2 Transit and Active Transportation

Currently, there is no transit service or active transportation facilities within the study area. The nearest transit stop to the study area is located approximately 0.5 kilometres south of the study area at the intersection of Airport Road and Davis Lane/Purdue Court, and is served by six bus trips per day as part of a three-year trial extension of Brampton Transit Route 30 Airport Road into Caledon for employees at the AMB Distribution Centre (**Exhibit 4**).

The Region's Active Transportation Plan recommends providing a paved shoulder cycling route facility on Airport Road (paved shoulder as per typical requirements for rural roads based on design speed and AADT volumes with bicycle route signs as part of the overall signage strategy). Adding paved shoulders is a way to accommodate cyclists in rural areas. Cyclists will benefit from space outside the general purpose lane. Paved shoulders offer other advantages such as extending the life cycle of the vehicle lanes through improving the lateral support for the roadway structure, reducing maintenance costs associated with the grading of gravel shoulders, and can reduce run-off-the road collisions.

Exhibit 4 – Existing Transit Service Near Study Area



2.3 Sightline Analysis

The criteria used to determine sightline requirements are shown in **Table 3** is based on the TAC (Transportation Association of Canada) Geometric Design Guide "Stopping Sight Distance for Automobiles and Trucks with Antilock Braking Systems" Table 1.2.5.3.

Table 3 – "Stopping Sight Distance for Automobiles and Trucks with Antilock Braking Systems" Table 1.2.5.3 TAC Geometric Design Guide

Design Speed (km/h)	Minimum stopping sight distance (m)
70	95-110
80	115-140
90	130-170

Five locations, as identified in **Table 4**, were found to have deficient/minimum sightlines along Airport.

Table 4 – Addresses of locations with sightline deficiencies along Airport Road

Location (Address #)	Looking North (m)	Looking South (m)
12404	Flat (clear sightlines)	140m
12484	373m	145m
12541	118m	Hill (clear sightlines)
12577	140m	Hill (clear sightlines)
12618	Flat (clear sightlines)	95m

All five locations are within the posted 80km/h zone (assumed 90km/h design speed). It should be noted that all the locations where sightline concerns were noted are in the same general area and are as a result in a change to the vertical curvature of the road.

2.4 Weekday Peak Hour Traffic Volumes

Turning movement counts (TMCs) were conducted by Ontario Traffic Inc. (OTI) and MG8 ENG and were used to create a representation of the existing traffic volumes in the Study Area. **Table 5** summarizes the locations, sources and dates of the TMCs used in the traffic analysis.

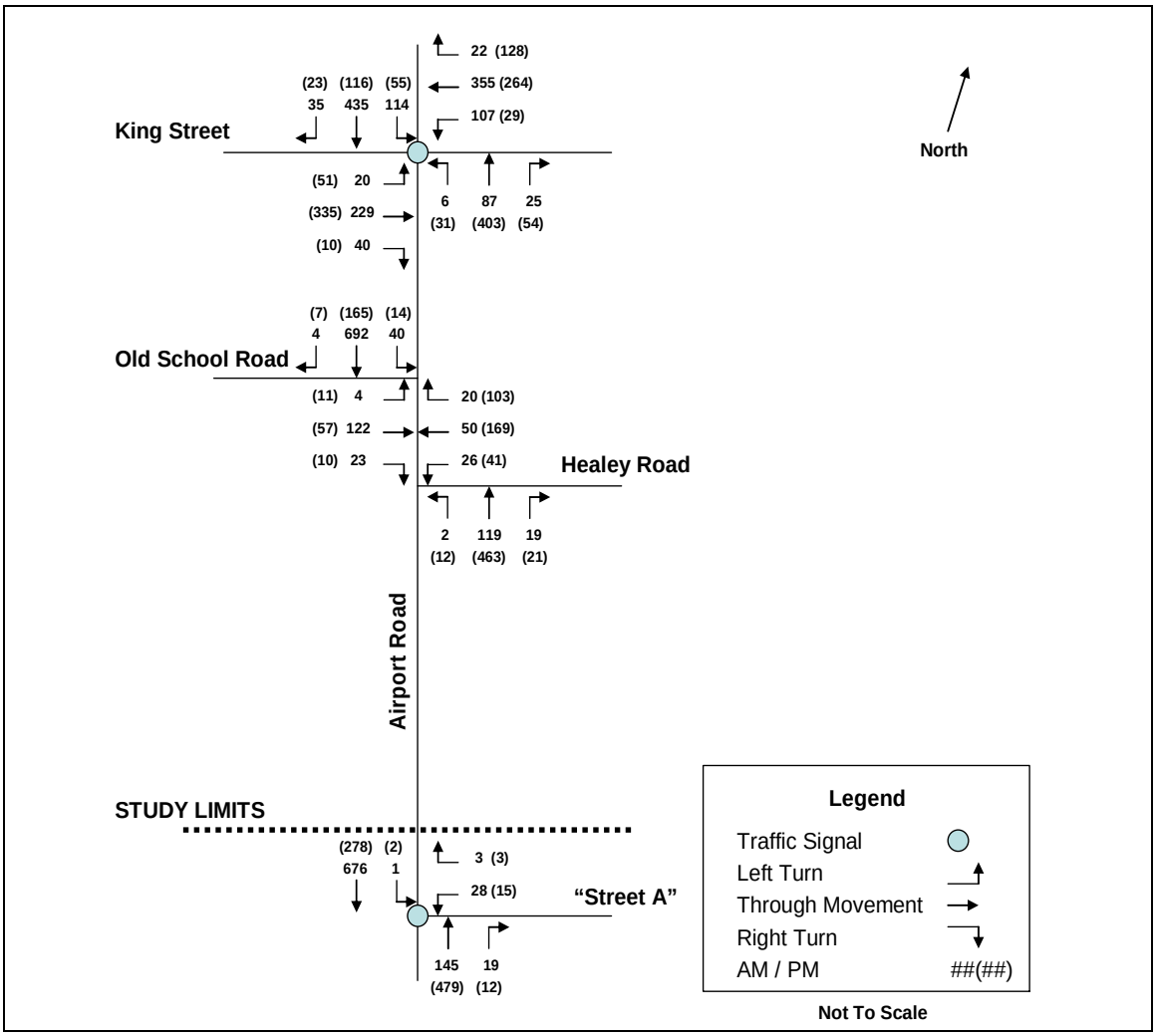
Table 5 – Location, Date and Source of TMCs

Location	Source	Date
Airport Road at King Street	OTI	Tuesday, May 3, 2011
Airport Road at Old School Road/ Healey Road	OTI	Wednesday, November 30, 2011
*Airport Road at "Street A"	MG8 ENG	Tuesday, September 28, 2010

In comparison to neighbouring intersections, north-south volumes were found to be high, and were balanced accordingly.

The existing peak hour TMCs on Airport Road are shown in **Exhibit 5**. The TMCs indicate that the peak direction during the AM and PM peak hours is southbound and northbound, respectively. Southbound through traffic volumes in the AM peak hour range from 435 (at King Street) to 676 (at "Street A") vehicles per hour. During the PM peak hour, northbound traffic volumes range from 479 (at "Street A") to 403 (at King Street) vehicles per hour.

Exhibit 5 –2011 Peak Hour TMCs



Individual peak hour factors (PHFs) were calculated and applied to each turning movement using the 15 minute counts from the TMCs to account for fluctuation of traffic within the peak hour. Adjusting the PHF yields a more conservative value for traffic volume by placing more weight on the highest peak 15 minute volume. The lower the PHF, the higher the volume adjusts. For Airport Road, values ranged from 0.25 to 0.97, suggesting that traffic is not equally distributed throughout the respective peak hours.

2.5 AADT Traffic Volumes

Historical and existing Annual Average Daily Traffic (AADT) volumes on Airport Road were collected by LEA Consulting Ltd. on Tuesday, May 11, 2011. **Table 6** shows the current (2011) AADT volumes on Airport Road within the study limits.

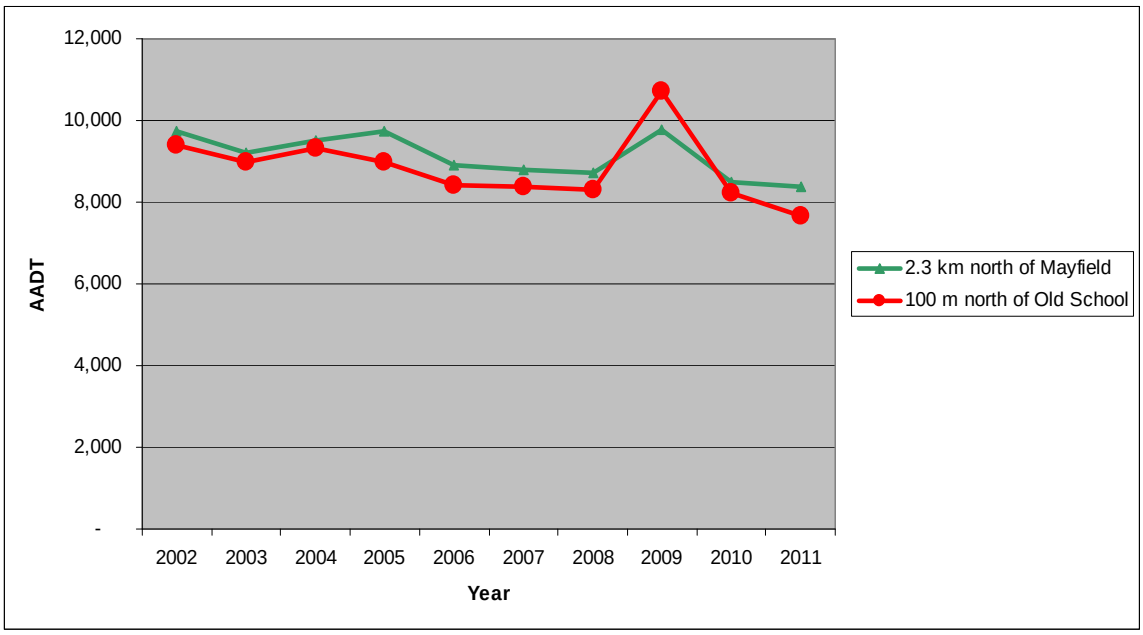
Table 6 – Existing AADT on Airport Road

Location	Northbound AADT	Southbound AADT	Two-way AADT
2.3 kilometres north of Mayfield Road	3,875	4,488	8,363
100 metres north of Old School Road	3,598	4,057	7,655

2.6 Historical Growth

The AADT volumes over the period from 2002 to 2011 on Airport Road within the study area were reviewed in order to determine a historical growth rate. The analysis of the AADT volumes suggests that volumes within the study area are declining by an average of 1-2 percent per annum (see **Exhibit 6**), despite an outlier spike in volumes in 2009.

Exhibit 6 - Historical AADT Trends



2.7 Truck Percentages

Peak hour truck percentages for each approach were obtained using the AM and PM peak TMCs. The intersection truck percentages and volumes (provided in brackets) for the intersections of Airport Road at King Street and Airport Road at Old School Road / Healey Road can be found in **Table 7.**

Table 7 – Truck Percentages and Volumes – (truck volumes shown in brackets)

Intersection	Peak Period	North Approach Truck %	South Approach Truck %	East Approach Truck %	West Approach Truck %
Airport Road and King Street	AM	5% (36)	17% (24)	1% (1)	1% (1)
	PM	12% (22)	5% (22)	1% (2)	1% (1)
Airport Road and Old School Road - Healey Road	AM	8% (45)	22% (26)	3% (15)	7% (19)
	PM	12% (24)	3% (13)	5% (21)	2% (8)

2.8 Traffic Analysis

2.8.1 Link / Mid-block Analysis

A theoretical link capacity of 900 vehicles per hour per lane (the equivalent of LOS D) was applied to the existing volumes to assess a V/C ratio for each link of Airport Road. Based on the link analysis, Airport Road has an existing maximum link V/C ratio of 0.82 in the AM peak hour, which occurs south of Healey Road. The existing PM peak hour has a maximum link V/C ratio of 0.64 occurring north of Old School Road.

2.8.2 Existing Intersection Capacity Analysis

The capacity analysis of each intersection within the study area was based upon the existing intersection lane configurations as shown in **Exhibit 3** and the existing TMCs as shown in **Exhibit 5** and associated PHFs. Analysis was conducted in Synchro 7.0, a traffic software containing an analysis module based upon the ***Highway Capacity Manual (HCM) 2000*** methodology for signalized and unsignalized intersections. The three measures of effectiveness that were chosen to evaluate the operation of intersections are as follows:

- the maximum volume-to-capacity (V/C) ratio for the intersection;
- the level of service (LOS) for signalized intersections based on the average delay per vehicle; and
- the average delay of the intersection measured in seconds.

LOS are given letter designations from ‘A’ to ‘F’ where LOS A represents the best operating conditions and LOS F represents the worst. Typically the Region plans and designs facilities for improvements when LOS reaches D, which is representative of a V/C ratio of 0.90 or better.

Table 8 summarizes the existing V/C ratios and LOS for the study intersections. Detailed Synchro HCM reports are found in **Appendix A**.

Table 8 - Existing Conditions Intersection Capacity Analysis

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / King Street	AM	0.70 (WBTR)	17.4	B
	PM	0.88 (WBTR)	22.1	C
Airport Road / Old School Road	AM	0.58 (EB)	5.4	-
	PM	0.24 (EB)	4.7	-
Airport Road / Healey Road	AM	0.36 (WB)	4.8	-
	PM	0.86 (WB)	15.4	-
Airport Road / “Street A”	AM	0.28 (SBT)	5.2	A
	PM	0.33 (WBL)	4.4	A

Although the intersection of Airport Road and Old School Road / Healey Road is considered to be a single intersection that is offset, the analysis assumed this intersection as two unsignalized three-legged intersections given that an east-west through movement would be required to complete two separate turn movements each subject to its own gap

acceptance as opposed to a single protected movement. Overall, the intersections within the study area operate at acceptable levels of service.

2.8.3 Traffic Control Warrant

The intersections of Airport Road at Old School Road and Airport Road at Healey Road are the only unsignalized intersections within the study area. As such, a preliminary traffic control signals warrant based on the Ontario Traffic Manual (OTM) Book 12 procedures was undertaken. The preliminary signal warrant analysis treated these intersections as a single offset intersection as opposed to two separate intersections. The detailed traffic control signals warrant is found in **Appendix B**. The results of the study are shown in **Table 9**.

Table 9 - Traffic Control Signals Warrant for Airport Road at Old School Road/Healey Road

Warrant	Percent Compliance
Minimum Vehicular Volume Warrant	86
Delay to Cross Traffic Warrant	90
Collision Hazard Warrant	0

OTM Book 12 states that traffic signals must be considered if one of the above warrants is 100% met or two are 80% met. Due to the complexities and unique challenges offset intersections create, a more comprehensive analysis will be conducted, independent of this report to determine if the intersections should be signalized, and if so, if they should be treated as a single or as separate intersections.

2.8.4 Airport and Old School Road / Healey Road Signalized Intersection Capacity Analysis

Capacity analysis was conducted to determine the effects of signalizing the offset intersection of Airport Road and Old School Road / Healey Road. Given that the study area intersections are not within a coordinated network, the lowest recommended value for the cycle length was assumed for each respective peak period as per the optimization feature in Synchro, as lower cycle lengths typically reduce queue lengths. Split phasing for the east-west movements would be required in order to prevent conflict between through movements and turning movements. Eastbound and westbound right turns on red (RTOR) were assumed to be prohibited, as permitting these manoeuvres would effectively permit through movements in the respective directions, resulting in conflict with north-south traffic. **Table 10** summarizes the V/C ratios and LOS for the subject intersection with these improvements. Detailed Synchro HCM reports are found in **Appendix C**.

Table 10 – Signalization of Offset Airport Road / Old School Road – Healey Road

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / Old School Road-Healey Road	AM PM	0.99 (SBTL) 0.91 / 0.91 (WB / NB)	46.3 42.8	D D

The capacity analysis suggests that traffic control signalization increases delay at the intersection and worsens level of service, particularly in the southbound direction during the AM peak hour. This is caused primarily by the introduction of traffic control to

north-south traffic and the inefficient distribution of green time caused by the east-west movements operating separately due to split phasing.

2.8.5 Queuing Analysis

The left and right turn storage needs were calculated using the following methodology as per Regional practice:

Formula m = (Ve x C) / (n x 3600)
Where: m: average number of vehicles arriving at an intersection approach in one cycle
Ve: equivalent hourly volume
C: cycle length in seconds
n: number of lanes used by the equivalent volume
3,600: number of seconds in one hour

The average arrival rate is then multiplied by 7m for cars and a factor of (2.4 x 7m) for heavy vehicles. The value obtained is applied to a LOS table to determine the appropriate storage for LOS C. In addition to the method used by the Region, 95th percentile queues were obtained using synchro.

Priority on which storage lengths are required are based on the larger storage requirement obtained by either method. Regardless of the calculated queues, the Region of Peel uses a minimum storage of 30m for all left turn lanes.

The worst case storage needs between the AM and PM peak periods based on 2011 volumes are indicated in **Table 11.**

Table 11 – Existing Conditions Storage Requirements

Intersection Movement	**Existing Storage (m)**	**Required Storage Region Method (m)**	**Required Storage Synchro 95th percentile (m)**
Airport Road and King Street			
Northbound Left	40	7	6
Southbound Left	35	21	20
Eastbound Left	60	14	16
Westbound Left	35	21	26
Airport Road and Old School Road - Healey Road			
Southbound Right	45	7	2

Based on existing volumes, the queue analysis indicates that all existing storage lengths exceed requirements.

2.8.6 Existing Volumes Roundabout Feasibility and Analysis

Regional practice is to assess all intersections, which are warranted for signals, for the implementation of roundabouts during the EA process. While the initial costs and property needs for roundabouts can be higher, roundabouts can provide a number of benefits over signalized intersections such as a reduction in severe injury collisions,

speed reduction/management, lower maintenance costs and access management via splitter islands, and easily allow u-turning movements through the roundabout.

The intersections of Airport Road and King Street, and Airport Road and Old School Road / Healey Road were evaluated using the Region of Peel's Roundabout Feasibility Screening Tool as well as using ARCADY to further evaluate roundabout capacity and entry lane needs. The roundabout Feasibility Screening Tool is a high level tool used to determine if a subject intersection warrants more detailed analysis for the installation of a roundabout. It takes into consideration the existing traffic volumes, operational concerns, existing traffic control proximity to adjacent signals, vertical geometry and property constraints. Each item is identified as roundabout supportive, non-supportive or neutral.

The Roundabout assessment was Peer Reviewed by Ourston Roundabout Engineering on November 12th, 2012 as found in **Appendix D**. Based on the recommendations in the peer review, adjustments were made to the initial analysis. The revised analysis, which is discussed in this report is in line with the recommendations in the peer review.

ARCADY 8 is a software package for predicting capacities, queues and delays at roundabouts.

The ARCADY assessment was conducted using the geometric parameters as shown in Table 12. It should be noted that roundabouts were assessed by modifying the entry lanes based on three geometric layouts. The flared two lane entry consists of a single approach lane flaring into two entry lanes into the roundabout. The two lane approach and entry indicates that a full two lanes are required upstream of the roundabout as well as two entry lanes.

Table 12 – ARCADY Geometric Parameters

Single-lane Entry		**Flared two-lane entry**		**Two-lane approach and entry**	
R	25	**R**	25	**R**	25
Phi	20	**Phi**	20	**Phi**	20
V	4.25	**V**	4.25	**V**	4
E	4.25	**E**	8	**E**	8
L'	0	**L'**	20	**L'**	10
D	55	**D**	49	**D**	49

R- Entry Radius
Phi- Conflict Angle
D- Inscribed Ciricle Diameter
E- Entry Width
V- Approach Half Width
L' Flare length

In addition to the above noted parameters a y-intercept value of 90% of the capacity prediction was used to account for driver unfamiliarity at roundabouts in North America as compared to the United Kingdom.

The following summarizes the feasibility assessment and ARCADY analysis:

- **Airport Road / King Street – Roundabout Screening Tool-** The screening tool identified that Airport Road and King Street can be considered a candidate for the implementation of a roundabout. Detailed property requirements will need to be scoped based on a preliminary roundabout design. In order to accommodate heavy vehicles and farm equipment, a truck apron would be required in order to due to the larger vehicles' turning swept paths.

- **Airport Road / King Street – ARCADY Analysis-** ARCADY analysis based on 2011 AM and PM peak hour traffic volumes indicate a single lane roundabout would operate at a LOS B and LOS A during the AM and PM peak periods respectively, although the northbound approach would likely start experiencing moderate queuing and delays shortly after construction as it would operate at a LOS C as shown in **Table 13**.

- **Airport Road / Old School Road-Healey Road Roundabout Screening Tool-** The screening tool identified that Airport Road and Old School Road - Healey Road can be considered a candidate for a roundabout. A realignment of Airport Road and Old School Road / Healey Road is recommended and would provide an opportunity to construct a roundabout to correct the current offset at the intersection. Detailed property requirements will need to be scoped based on a preliminary roundabout design. In order to accommodate heavy vehicles and farm equipment, a truck apron would be required in order to due to the larger vehicles' turning swept paths.

- **Airport Road / Old School Road-Healey Road ARCADY Analysis-** ARCADY analysis based on 2011 traffic volumes indicate the roundabout would operate at a LOS A during the AM and PM periods utilizing single lane entries on all approaches as shown in **Table 13**.

Detailed ARCADY reports and the screening tool results can be found in **Appendix E.**

Table 13 – ARCADY Roundabout Analysis 2011 Traffic Volumes

Airport Road and King Street				**Airport Road and Old School Road – Healey Road**			
Approach	**Entry Lanes**	**AM LOS**	**PM LOS**	**Approach**	**Entry Lanes**	**AM LOS**	**PM LOS**
King Street East	Single	A	A	Healey Road	Single	A	A
Airport Road North	Single	C	A	Airport Road North	Single	B	A
King Street West	Single	A	A	Old School Road	Single	A	A
Airport Road South	Single	A	A	Airport Road South	Single	A	A
Overall	Single	B	A	Overall	Single	B	A

2.8.7 Existing Conditions Summary of Recommended Improvements

Based on the analysis in the previous subsections, the following geometric and traffic signal timing modifications are recommended:

- **Airport Road / Old School Road-Healey Road** – A preliminary assessment identified that traffic control signals should be considered. Further analysis is to be conducted independent of this report; and
- **Airport Road / Old School Road-Healey Road** – A realignment of the intersection to not be offset should take place as soon as practicable. However, it is recognized that jog elimination may be most cost effectively co-ordinated with other scheduled improvements.
- **Airport Road** – Sight distance issues were identified at the following addresses along Airport Road: 12404, 12484, 12541, 12577, and 12618. These are as a result of the vertical alignment of the road and should be rectified.

3. Future Conditions Analysis

3.1 Traffic Volume Forecasts

To determine the future need for improvements and lane requirements, travel demand forecasts were created for this review for the 2021 and 2031 horizon years (showing 10- and 20-year growth). Truck percentages were estimated to match existing conditions.

3.1.1 Development in the Study Area

Airport Road is one of the major arterial roads connecting communities in Caledon to Brampton, Toronto and the rest of the Greater Toronto Area. Despite the declining growth rates discussed in Section 3.1.2, substantial growth is projected to continue for the City of Brampton and Town of Caledon in the next 10 to 20 years. The Region's Long Range Transportation Plan, 2012 Update has identified the needs for widening Airport Road from 2 to 4 lanes prior to the 2021 horizon.

As mentioned in Section 2, the Airport Road study area is adjacent to the Tullamore Secondary Plan area, which has an anticipated full build out of 431,000 square metres of industrial and retail lands by 2018. Traffic volumes generated from this area were extracted from the Tullamore Secondary Plan Transportation Impact Study prepared by IBI Group in February 2009, and assigned separately to the 2021 traffic network accordingly, as the site trips exceeded future background traffic generated by the growth rates in **Table 15**. Due to truck restrictions and no documented plans for road improvements along Old School Road or Healey Road, none of the Tullamore Secondary Plan traffic was distributed to these roads. Site trip distribution at the intersection of Airport Road and King Street were distributed based on forecasted trip distribution, as depicted in **Table 14**.

Table 14 - Trip Distribution at Airport Road and King Street to/from South

Peak Period	Direction	West	North	East
AM	Southbound	6%	78%	16%
	Northbound	5%	74%	21%
PM	Southbound	6%	78%	16%
	Northbound	6%	83%	11%

Also acknowledged in Section 2 is the Town of Caledon's recently launched Official Plan Review for the Sandhill Settlement Area, located at the northerly limits of the study area. Based on a review of traffic impact studies associated with the development applications submitted to date, additional traffic anticipated from future developments in this area have been assumed to be accounted for in the background growth rates in Section 3.1.2.

All new developments abutting Regional roads are subject to access management conditions as per the Region's Controlled Access By-Law 59-77, as amended. The by-law requires a minimum spacing from intersections of 300 metres for full movements accesses and 100-130 metres for right-in/right-out accesses (depending on whether the access is on the far side or nearside of the intersection, respectively). The by-law also

speaks to one private residential access and one farming access per property in rural areas, and no access where alternative access is available (e.g. from a local road).

A two way left turn lane was assessed and is recommended throughout the study area as the average number of accesses per kilometre is 12. The density of accesses in the Sandhill area is double the average rate of the study area with approximately 25 accesses. The implementation of a two way left turn lane will reduce friction and the potential for collisions between through vehicles and left turning vehicles which is particularly important along higher speed rural roads.

3.1.2 Growth Rates

Growth rates and rational were provided by the Region's Transportation Planning Group, and are as follows. The Growth Rates for Airport Road and all cross-streets within the study area were determined based on a review of traffic counts in the past 10 years, general travel patterns from the Regional travel demand forecasting model (Emme 3), and population and employment growth in the surrounding study area. The final results are shown in **Table 15.**

Airport Road has 3% annual growth for the next 10 years. The rate is relatively high due to the fact that Airport Road is a major north-south arterial road which crosses into Toronto and major 400-series highways such as 407, 409 and 427 and also connects a few northern communities such as Mono and Collingwood to the south. The growth will decrease to 2% after 10 years because of road capacity restraints and limited growth rate in the long term.

On the other hand, King Street has only a 1% growth rate annually for the next 10 years given that there won't be any major development or new communities along the road in the future. However, the rate will increase to 2% after 10 years since more drivers will use the road as an alternative east-west route as Mayfield Road, located south of King Street, will have longer travel times caused by the commuters from new developments along the road.

Old School Road / Healey Road is the closest east-west road to Mayfield Road for southbound traffic. Therefore, some drivers will use this road instead of Mayfield Road. Even though the growth rate is relatively high, it is not significant in terms of the number of vehicles. The road capacity restraint will also cause in a 1% reduction in annual growth after 10 years.

Table 15 - Annual Growth Rates

Corridor	2011-2021 Growth Rate (%)	2021-2031 Growth Rate (%)
Airport Road	3	2
King Street	1	2
Old School Road- Healey Road	3	2

3.2 2021 Traffic

3.2.1 Link / Mid-block Analysis

Link volumes were calculated based on the Regional travel demand forecasting model which is based on AM peak hour conditions and the existing traffic count. **Table 16** summarizes the AM peak hour link volumes on sections of Airport Road between intersections. PM link volumes were obtained by applying the growth rates to existing traffic count data as summarized in **Table 17**. Using the theoretical link capacity of 900 vehicles per hour per lane, the analysis of 2021 and 2031 forecasted volumes on the existing two lane cross-section of Airport Road suggests that traffic volumes exceed a V/C ratio of 1.0 in 2021 and beyond. However, since intersections with traffic control tend to present greater capacity restraints than free-flow road links, intersection analysis was undertaken.

Table 16 - AM Peak Hour Link Volume Forecasts on Airport Road

Road Segment	2021		2031	
	Southbound	Northbound	Southbound	Northbound
King to Old School/Healey	834	210	998	253
Old School/Healey to "Street A:	1083	228	1302	271

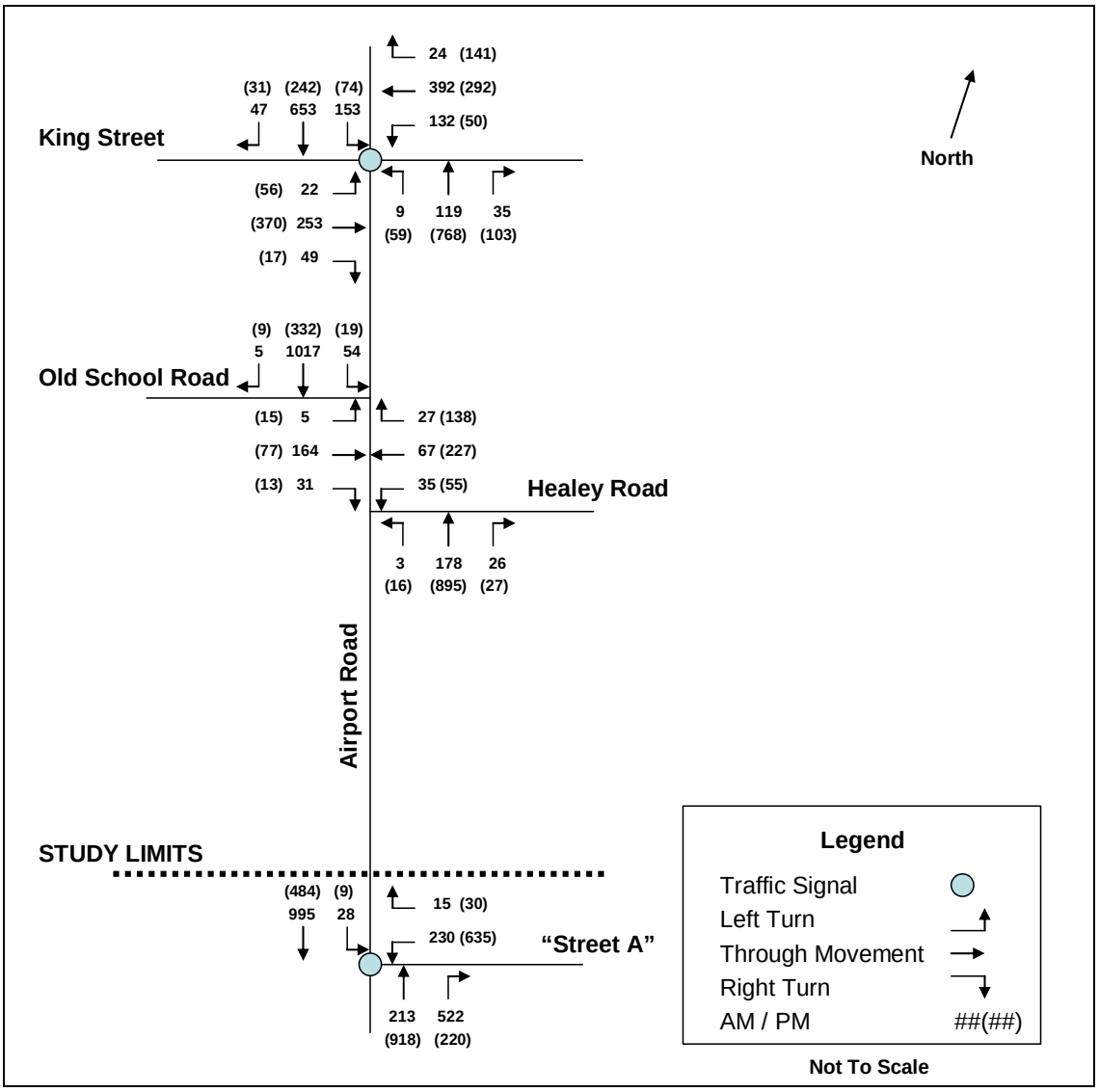
Table 17 – PM Peak Hour Link Volume Forecasts on Airport Road

Road Segment	2021		2031	
	Southbound	Northbound	Southbound	Northbound
King to Old School/Healey	309	1048	353	1218
Old School/Healey to "Street A:	400	948	463	1089

3.2.2 Weekday Peak Hour Traffic Volume

TMC projections for 2021 are shown in **Exhibit 7**. In addition, traffic forecasts from the Regional travel demand forecasting model were compared against the projected volumes presented in the 2009 Caledon Needs Study Update report on a screenline level for validation.

Exhibit 7 - 2021 Peak Hour TMCs



3.2.3 2021 LOS – Do Nothing

Table 18 summarizes the 2021 horizon year V/C ratios and LOS for the study intersections assuming current geometric configurations with no new construction. Since signal timing optimization is relatively simple to implement, optimized signal timings were assumed at the intersection of Airport Road and King Street. Using the intersection optimization features in Synchro, it was determined that allocating additional green time to the north-south phase within the same cycle length (4 seconds greater than the current split of 40 seconds) at the expense of east-west green time would improve operation at the intersection. No changes to the AM peak signal timings were recommended. Detailed Synchro HCM reports are found in **Appendix F**.

Table 18 – 2021 Intersection Operations – Do Nothing

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / King Street	AM	0.80 (SBTR)	19.8	B
	PM	0.87 / 0.86 (WBTR / NBTR)	25.6	C
Airport Road/Old School Road	AM	0.76 (EB)	7.4	-
	PM	0.36 (EB)	5.4	-
Airport Road/Healey Road	AM	0.51 (WB)	6.0	-
	PM	1.56 (WB)	71.9	-
Airport Road / "Street A"	AM	0.67 (WBL)	13.4	B
	PM	0.85 (WBL)	26.7	C

Overall, the intersections within the study area continue to operate at acceptable levels of service with the exception of the intersection of Airport Road and Healey Road during the PM peak period. In particular, the westbound movement operates over one-and-a-half times greater than the capacity of the approach, and delays at the intersection are in excess of one minute.

3.2.4 2021 Intersection Capacity Analysis – Intersection improvements

Table 19 summarizes the 2021 horizon year V/C ratios and LOS at an offset signalized intersection of Airport Road and Old School Road / Healey Road. Detailed Synchro HCM reports are found in **Appendix G**.

Table 19 – 2021 Intersection Operations at Offset Old School Road/Healey Road

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / Old School Road-Healey Road	AM	1.07 (SBTL)	65.0	E
	PM	1.0 (WB) / 1.01 (NB)	64.8	E

The analysis shows that maintaining the offset configuration yields LOS E for both the AM and PM peak periods, operating at or above capacity on the respective critical movements.

Based on the capacity and safety impacts an offset, signalized intersection presents, further analysis was conducted assuming a realigned intersection. Regional practice is to include exclusive left turn lanes at signalized intersections. TAC guidelines specify that an auxiliary right turn lane should be considered when right turning volumes are 10 to 20 percent of the total approach volumes. The eastbound and westbound right turning volumes for the AM and PM peak periods, as well as northbound right turn during the AM period fall within these guidelines. Therefore, auxiliary right turn lanes are recommended on these approaches. Although southbound right turning volumes are low, a southbound right turn taper is recommended in order to reduce interference with through traffic. The addition of auxiliary left and right turning lanes at Airport Road and Old School / Healey Road is summarized in **Table 20**. Detailed Synchro HCM reports are found in **Appendix H.**

Table 20 – 2021 Intersection Operations at Realigned Old School Road - Healey Road with Auxiliary Lanes

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road /	AM	0.85 (SBT)	18.1	B
Old School Road-Healey Road	PM	0.82 (NBT)	17.2	B

The addition of right turn lanes on all approaches at Airport and King Street were analyzed in order to reduce friction and conflicts between through and right turning movements. This summary can be found in **Table 21** and detailed Synchro HCM reports are found in **Appendix I.**

Table 21 – 2021 Intersection Operations at Airport Road and King Street with Auxiliary Lanes

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / King Street	AM PM	0.74 (SBT) 0.77 (NBT)	17.6 18.1	B B

The analysis indicates that all subject intersections in the study area operate at acceptable levels of service with the signalization and realignment of Airport and Old School Road / Healey Road and the addition of auxiliary turning lanes at both intersections.

3.2.5 2021 Roundabout Analysis

Airport Road / King Street - ARCADY Analysis - Analysis based on 2021 traffic volumes indicate a single lane roundabout will operate at an unacceptable LOS F during both the AM and PM peak periods as shown in **Table 22**. Both the north and south approaches operate at a LOS F during the AM and PM peak periods respectively.

Two-lane flared entries were assessed on the northbound and southbound approaches with the analysis indicating they will operate at acceptable levels as shown in **Table 23.** The addition of the two lane entries on the north and south approaches on Airport Road result in the east approach on King Street operating at a LOS F, and, as such, the east leg was also assessed with a flared two-lane entry. This additional flared entry allows the east approach and overall intersection to operate at a LOS A as shown in **Table 24**.

Airport Road / Old School Road-Healey Road ARCADY Analysis - Analysis based on 2021 traffic volumes indicate that a single lane roundabout will operate at an unacceptable LOS F during the AM peak period and LOS D during the PM peak period as shown in **Table 22**. Both the north and south approaches operate at a LOS F during the AM and PM peak periods respectively.

Two-lane flared entries were assessed on the north and south approaches. The additional capacity provided by the two-lane entries allow the roundabout to operate at a LOS A in both the AM and PM periods as shown in **Table 23.**

Detailed ARCADY reports based on 2021 forecast volumes can be found in **Appendix J.**

Table 22 – ARCADY Roundabout Analysis 2021 Traffic Volumes (Single Lane)

Airport Road and King Street				Airport Road and Healey Road - Old School Road			
Approach	Entry Lanes	AM LOS	PM LOS	Approach	Entry Lanes	AM LOS	PM LOS
King Street East	Single	A	C	Healey Road	Single	A	C
Airport Road North	Single	F	A	Airport Road North	Single	F	A
King Street West	Single	B	A	Old School Road	Single	B	A
Airport Road South	Single	A	F	Airport Road South	Single	A	F
Overall	Single	F	F	Overall	Single	F	D

Table 23– ARCADY Roundabout Analysis 2021 Traffic Volumes (Multi Lane Approaches)

Airport Road and King Street				Airport Road and Healey Road - Old School Road			
Approach	**Entry Lanes**	**AM LOS**	**PM LOS**	**Approach**	**Entry Lanes**	**AM LOS**	**PM LOS**
King Street East	Single	A	F	Healey Road	Single	A	C
Airport Road North	Dual	A	A	Airport Road North	Dual	A	A
King Street West	Single	C	A	Old School Road	Single	B	A
Airport Road South	Dual	A	A	Airport Road South	Dual	A	A
Overall	Multi	A	C	Overall	Multi	A	A

Table 24 – ARCADY Roundabout Analysis 2021 Traffic Volumes Airport Road and King Street

Airport Road and King Street			
Approach	**Entry Lanes**	**AM LOS**	**PM LOS**
King Street East	Dual	A	A
Airport Road North	Dual	A	A
King Street West	Single	C	A
Airport Road South	Dual	A	B
Overall	Multi	A	A

3.2.6 2021 LOS – Widen to Four Lanes

Table 25 summarizes the 2021 horizon year V/C ratios and LOS for the study intersections assuming a four-lane cross-section as well as left and right turning lanes on all approaches at the intersections of Airport and Old School / Healey Road and Airport and King Street Detailed Synchro HCM reports are found in **Appendix K.**

Table 25 – 2021 Intersection Operations – Widen to Four Lanes

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / King Street	AM PM	0.57 (WBT) 0.57 (EBT)	13.8 13.9	B B
Airport Road/Old School Road-Healey Road	AM PM	0.48 (SBT) 0.49 (WBT / NBT)	11.5 12.4	B B

The analysis shows that a widening Airport Road and the addition of right and left turn lanes improves LOS at all subject intersections.

3.2.7 2021 Queuing Analysis

Left and right turning storage needs were calculated for the 2021 horizon year using both the Region standards and the synchro 95th percentile queues. The analysis includes the addition of left and right turn auxiliary lanes based on the 2021 recommended lane configuration. Regardless of the calculated queues lengths the Region of Peel uses a minimum storage of 30m for all left turn lanes.

Table 26 – 2021 Storage Requirements – recommended lane configuration

Intersection Movement	Existing Storage (m)	Required Storage Region Method (m)	Required Storage Synchro 95th percentile (m)
Airport Road and King Street			
Northbound Left	40	14	11
Northbound Right	-	21	9
Southbound Left	35	28	26
Southbound Right	-	7	6
Eastbound Left	60	14	11
Eastbound Right	-	14	5
Westbound Left	35	28	20
Westbound Right	-	28	13
Airport Road and Old School - Healey			
Northbound Left	-	7	4
Northbound Right	-	7	5
Southbound Left	-	14	8
Southbound Right	45	7	2
Eastbound Left	-	7	5
Eastbound Right	-	7	6
Westbound Left	-	14	12
Westbound Right	-	28	15

The existing storage lengths exceed the calculated required storage lengths based on 2021 traffic volumes. There are several new auxiliary lanes that will need to be designed based on the minimum storage of 30m for left turn lanes and the storage requirements outlined in **Table 26**.

3.2.8 2021 Summary of Recommended Improvements

A widening of Airport Road to four lanes is recommended by 2021 based on a link capacity of 900 vehicles. In absence of a road widening, sufficient capacity on Airport Road is expected to be available in 2021 with a two-lane cross-section based on the improvements identified in the existing conditions analysis as well as the recommendations below:

- **Airport Road -** Based on the number of developments and full-moves accesses currently in place (especially in the Sandhill area) a two-way left turn lane is recommended to be constructed to reduce friction and conflicts between through movements and left turning vehicles throughout the study area.
- **Airport Road / King Street –** A multilane roundabout with flared two-lane entries on the north, south and east approaches would be required based on 2021 traffic volumes.
- **Airport Road / King Street** – In the absence of a roundabout, the addition of auxiliary right turning lanes on all approaches to separate turning volumes from through movement volumes, increasing intersection safety and capacity.
- **Airport Road / Old School Road-Healey Road –** A multilane roundabout with flared two-lane entries on the north and south approaches would be required based on 2021 traffic volumes.
- **Airport Road / Old School Road – Healey Road** – In the absence of a roundabout, a realignment of the intersection, signalization and the installation of right and left turning auxiliary lanes on all approaches is recommended.

3.3 2031 Traffic

3.3.1 Development in the Study Area

No additional developments within the study area have been identified beyond the 2021 horizon. As such, Tullamore Secondary Plan Transportation site trips used in the 2021 analysis remained constant for the 2031 analysis.

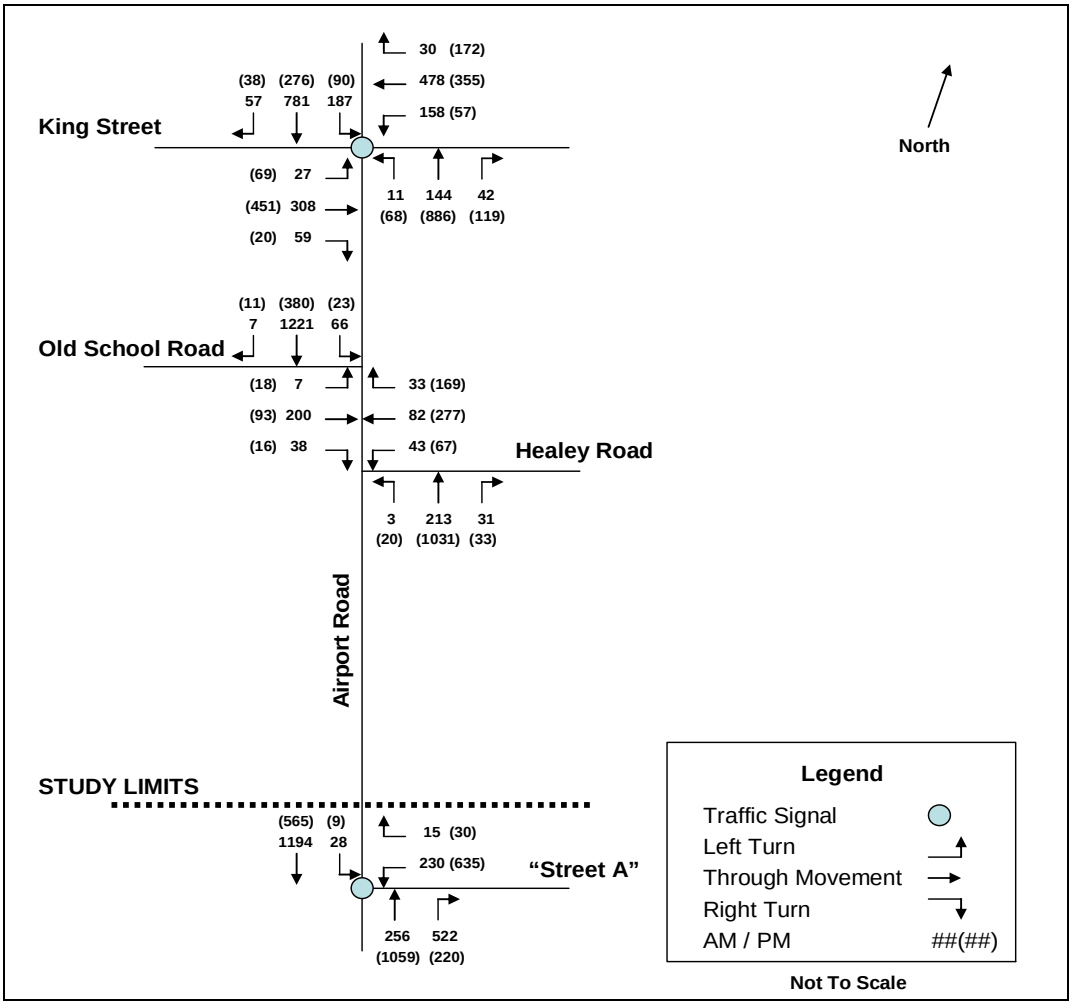
3.3.2 2031 Link / Mid-block Analysis

A theoretical link capacity of 900 vehicles per hour per lane was applied to the existing volumes to assess a V/C ratio for each link of Airport Road. Based on the 2021 link volumes, under the existing 2 lane cross section, Airport Road has a maximum link V/C ratio of 1.44 in the AM peak hour, which occurs south of Healey Road. The existing PM peak hour has a maximum link V/C ratio of 1.35 occurring north of Old School Road.

3.3.3 Weekday Peak Hour Traffic Volumes

TMC projections for 2031 are shown in **Exhibit 8.** Regional traffic forecasts were once again cross-referenced against those in the 2009 Caledon Needs Study Update report.

Exhibit 8 - 2031 Peak Hour TMCs



3.3.4 2031 Level of Service – Do Nothing

Table 27 summarizes the 2031 horizon year V/C ratios and LOS for the study intersections assuming current geometric configurations with no new construction. As in the 2021 "do nothing" analysis, optimized signal timings were assumed at the intersection of Airport Road and King Street. Using intersection optimization features in Synchro, it was determined that increasing the cycle length to 80 seconds during the AM peak period and to 75 seconds during the PM peak period would improve operation at the intersection. Detailed Synchro HCM reports are found in **Appendix L**.

Table 27 – 2031 Intersection Operations – Do Nothing

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / King Street	AM	0.92 (SBTR)	29.1	C
	PM	1.02 / 1.0 (WBTR/ NBTR)	47.8	D
Airport Road / Old School Road	AM	1.26 (EB)	27.2	-
	PM	0.65 (EB)	9.5	-
Airport Road / Healey Road	AM	0.99 (WB)	15.7	-
	PM	2.45 (WB)	171.8	-
Airport Road / "Street A"	AM	0.67 (WBL)	13.4	B
	PM	0.87 (WBL)	28.0	C

Overall, the intersections within the study area operate near or above capacity with poor levels of service, with the exception of the intersection of Airport Road and King Street during the AM peak, and the western leg of the intersection of Airport Road and Old School Road / Healey Road in the PM peak. Of particular note is the westbound movement at the intersection of Airport Road and Old School Road / Healey Road during the PM peak period, which operates at nearly two-and-a-half times greater than the capacity of the approach, and delays at the intersection are just under three minutes.

3.3.5 2031 Intersection Capacity Analysis – Old School Road/Healey Road

Table 28 summarizes the 2031 horizon year V/C ratios and LOS at an offset signalized intersection of Airport Road and Old School Road / Healey Road using the existing lane configurations. Detailed Synchro HCM reports are found in **Appendix M**.

Table 28 – 2031 Intersection Operations at Offset Old School Road / Healey Road Existing Configuration

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / Old School Road-Healey Road	AM	1.18 / 1.14 (EB / SBTR)	99.9	F
	PM	1.18 / 1.14 (NB / WB)	110.8	F

The analysis shows that maintaining the offset configuration yields LOS F for the AM and PM peak periods, with the critical movements operating above capacity.

Using intersection optimization features in Synchro, it was determined that realigning the intersection to not be offset and installing auxiliary left and right turn lanes as per the 2021 recommended scenario would significantly improve operations at the intersection as shown in **Table 29**. Although a realignment of the intersection provides a large improvement, the southbound through movement and northbound through movements are both approaching capacity in the AM and PM peak periods respectively, indicating a widening would be of benefit. Detailed Synchro reports are found in **Appendix N**

Table 29 – 2031 Intersection Operations at Realigned Old School Road / Healey Road with Auxiliary Lanes

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / Old School Road-Healey Road	AM PM	0.97 (SBT) 0.88 (NBT)	29.8 22.1	C C

The addition of right turn lanes on all approaches at Airport Road and King Street as per the recommendations in the 2021 scenario were analyzed. While the addition of the auxiliary lanes provides a little relief in the form of extra capacity, the critical movements are still approaching capacity indicating a widening would be of benefit. This summary can be found in **Table 30** and Detailed Synchro reports are found in **Appendix N**.

Table 30 – 2031 Intersection Operations at Airport Road and King Street with Auxiliary Lanes

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / King Street	AM PM	0.87 (SBT) 0.90 (NBT)	23.0 25.9	C C

3.3.6 2031 LOS – Widen to four lanes

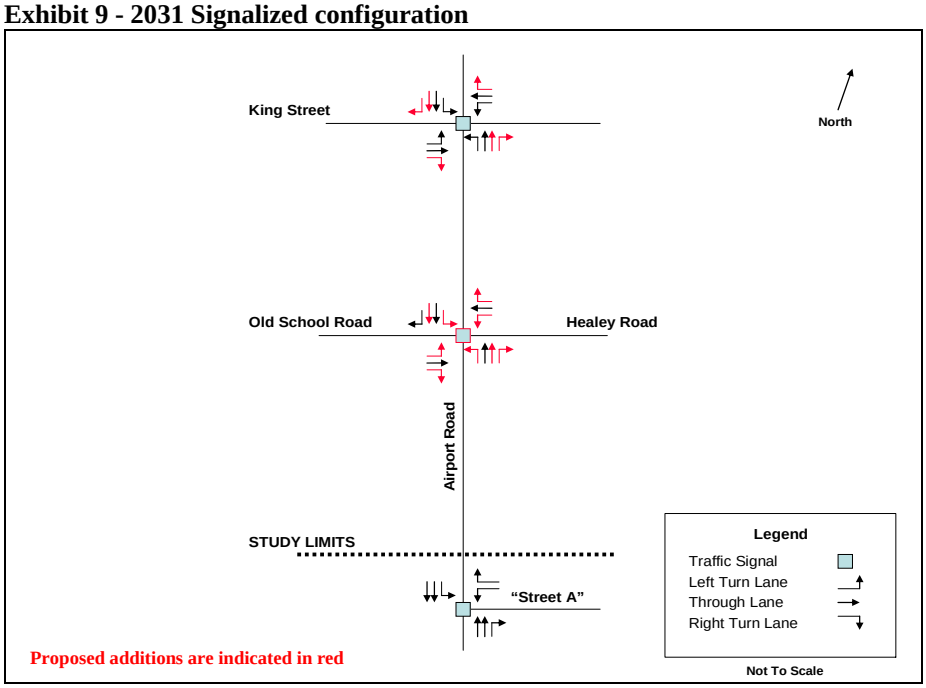
Table 31 summarizes the 2031 horizon year V/C ratios and LOS for the study intersections assuming a four-lane cross-section including the auxiliary lane improvements identified in the 2021 analysis. Detailed Synchro HCM reports are found in **Appendix O**.

Table 31 – 2031 Intersection Operations – Widen to Four Lanes

Intersection	Peak Hour	Max. V/C	Delay (s)	LOS
Airport Road / King Street	AM PM	0.65 (WBT) 0.62 (NBT)	15.5 13.9	B B
Airport Road/Old School Road-Healey Road	AM PM	0.57 (SBT) 0.54 (WBT)	12.8 12.8	B B

The analysis shows that a four-lane widening in addition to left and right turning auxiliary lanes allow the subject intersections to operate at acceptable LOS. The proposed lane configuration based on a signalized scenario is shown in **Exhibit 9.**

Exhibit 9 - 2031 Signalized configuration



3.3.7 2031 Queuing Analysis

Left and right turning storage needs were calculated for the 2031 horizon year and include the addition of left and right turn auxiliary lanes based on the 2031 recommended lane configuration. Regardless of the calculated queues, the Region of Peel uses a minimum storage of 30m for all left turn lanes.

Table 32 – 2031 Storage Requirements – Recommended lane configuration

Intersection Movement	**Existing Storage (m)**	**Required Storage Region Method (m)**	**Required Storage Synchro 95th percentile**
Airport Road and King Street			
Northbound Left	40	14	10
Northbound Right	-	21	7
Southbound Left	35	35	32
Southbound Right	-	14	6
Eastbound Left	60	14	11
Eastbound Right	-	14	6
Westbound Left	35	28	25
Westbound Right	-	35	17
Airport Road and Old School Road / Healey Road			
Northbound Left	-	7	4
Northbound Right	-	7	5
Southbound Left	-	14	9
Southbound Right	45	7	2
Eastbound Left	-	7	5
Eastbound Right	-	7	7
Westbound Left	-	14	13
Westbound Right	-	28	19

The storage lengths for the existing lanes meet or exceed the calculated required storage lengths based on 2031 traffic volumes. There are several new auxiliary lanes that would need to be designed based on the minimum 30m storage for left turn lanes and the storage requirements outlined in **Table 26**.

3.3.8 2031 Roundabout Analysis

Airport Road / King Street ARCADY Analysis - Analysis based on 2031 traffic volumes, using the 2021 approach geometrics (two-lane flared entries on the north, south and east approaches) indicate that the west and north approaches will operate at a LOS F and LOS D respectively during the AM peak period, and the south approach will operate at a LOS F during the PM peak period as shown in **Table 33**.

Based on these results, a two-lane entry was added to the west approach and the model was updated to reflect a widening to 4 lanes on Airport Road. The additional west approach lanes in combination with a the 2 approach lanes (due to the widening) and 2 entry lanes into the roundabout on the north and south approaches allow the roundabout to operate at a LOS A in both the AM and PM peak periods as shown in **Table 34**.

Airport Road / Old School Road-Healey Road ARCADY Analysis - Analysis based on 2031 traffic volumes and using the 2021 approach geometrics (two-lane entries on the north and south approaches) indicate that a roundabout would operate at an unacceptable LOS E during the PM peak, with the Healey Road (east approach) operating at a LOS F (95th percentile queues in excess of 63 vehicles and delays over two minutes) as shown in **Table 33**. It should be noted that although the Old School Road (west approach) operates at a LOS D queues in the model are acceptable at a 95th percentile queue of 8 vehicles and a half of a minute delay.

Both a right turn bypass and two-lane entries were assessed for Healey Road using both a 2 lane cross section (**Table 36)** and 4 lane cross section (**Table 35**) on Airport Road. Based on the analysis using either a right turn bypass or a two-lane entry on Healey Road would allow the approach to operate at acceptable levels of service.

In the 2 lane cross section scenario, the north approach on Airport Road operates at a LOS C with 95th percentile queues of 20 vehicles and a delay of approximately 15 seconds. A full widening to a 4 lane cross section was modelled as to determine the effects of a four-lane widening on Airport Road in the study area. The widening allows the north approach and overall roundabout to operate at a LOS A during the AM and PM peak periods.

Detailed ARCADY reports are found in **Appendix P.**

Table 33 – 2031 ARCADY Roundabout Analysis- (lane configuration as per 2021 analysis)

Airport Road and King Street				Airport Road and Healey / Old School Road			
Approach	**Entry Lanes**	**AM LOS**	**PM LOS**	**Approach**	**Entry Lanes**	**AM LOS**	**PM LOS**
King Street East	Dual	A	B	Healey Road	Single	A	F
Airport Road North	Dual	D	A	Airport Road North	Dual	C	A
King Street West	Single	F	B	Old School Road	Single	D	A
Airport Road South	Dual	A	F	Airport Road South	Dual	A	A
Overall	Multi	D	D	Overall	Multi	B	E

Table 34 – 2031 ARCADY Roundabout Analysis Airport Road and King Street 4 lane widening

Airport Road and King Street – With Widening			
Approach	**Entry Lanes**	**AM LOS**	**PM LOS**
King Street East	Dual	A	B
Airport Road North	Dual	A	A
King Street West	Dual	A	A
Airport Road South	Dual	A	B
Overall	2-lane	A	A

Table 35 – 2031 ARCADY Roundabout Analysis Airport Road and Healey Road – Old School Road Healey Road RT Bypass vs. Two-Lane Entry 2-Lane cross section

Airport Road and Healey / Old School Road				Airport Road and Healey / Old School Road			
Approach	**Entry Lanes**	**AM LOS**	**PM LOS**	**Approach**	**Entry Lanes**	**AM LOS**	**PM LOS**
Healey Road	Single + RT Bypass	A	C	Healey Road	Dual	A	A
Airport Road North	Dual	C	A	Airport Road North	Dual	C	A
Old School Road	Single	D	A	Old School Road	Single	D	A
Airport Road South	Dual	A	A	Airport Road South	Dual	A	A
Overall	Multi	B	B	Overall	Multi	B	A

Table 36 – 2031 ARCADY Roundabout Analysis Airport Road and Healey Road – Old School Road Healey Road RT Bypass vs Two-Lane Entry 4-Lane cross section

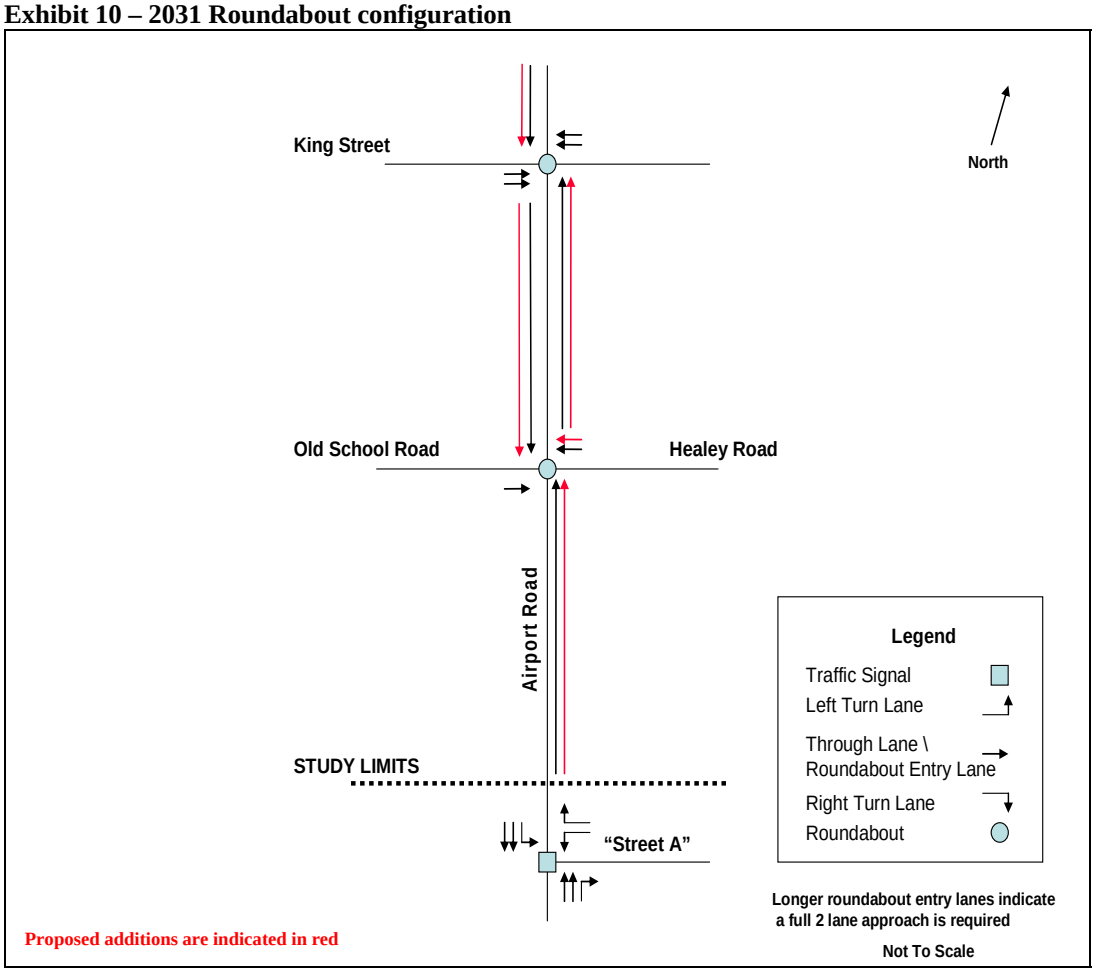
Airport Road and Healey / Old School Road				Airport Road and Healey / Old School Road			
Approach	**Entry Lanes**	**AM LOS**	**PM LOS**	**Approach**	**Entry Lanes**	**AM LOS**	**PM LOS**
Healey Road	Single + RT Bypass	A	C	Healey Road	Dual	A	A
Airport Road North	Dual	A	A	Airport Road North	Dual	A	A
Old School Road	Single	D	A	Old School Road	Single	D	A
Airport Road South	Dual	A	A	Airport Road South	Dual	A	A
Overall	Multi	A	A	Overall	Multi	A	A

Based on the roundabout assessment, a full two-lane roundabout is recommended at Airport Road and King Street with a four lane widening (two-lane approaches) required northbound and southbound on Airport Road. King Street operates well with flared two lane entries (1 approach lane in advance of the roundabout). At Airport Road and Old School Road / Healey Road a multi-lane roundabout is recommended with a four lane widening (two-lane approaches) recommended northbound and southbound on Airport Road. Healey Road will require either a right turn bypass or a two lane entry. The two lane flared entry provides more capacity than the right turn bypass and is the recommended option. It is recommended that Old School Road operate with a single entry lane.

The proposed roundabout configuration is shown in **Exhibit 10.**

The roundabout(s) could be constructed in stages such that the 2021 recommended configuration be constructed as an interim stage, expanding the roundabouts to the ultimate 2031 configuration when required.

Exhibit 10 – 2031 Roundabout configuration



3.3.9 Summary of Recommended Improvements for 2031

Based on the analysis in the previous subsections, the following improvements will be required by 2031:

- **Airport Road** - A four lane widening through the study area is required.
- **Airport Road / Old School Road–Healey Road –** A partial two-lane roundabout is recommended with two-lane entries and approaches on the north and south approaches and either a right turn bypass or a flared two lane entry on Healey Road (east approach).
- **Airport Road / King Street –** A full two-lane roundabout is recommended with flared two-lane entries on the east and west approaches, with a two lane approaches and entries northbound and southbound on Airport Road.
- **Airport Road / Old School Road-Healey Road** – In the absence of the implementation of a roundabout at this intersection, the addition of auxiliary left and right turning lanes on all approaches to separate turning volumes from through movement volumes, increasing intersection safety and capacity are recommended.
- **Airport Road / King Street** – In the absence of the implementation of a roundabout at this intersection, the addition of auxiliary left and right turning lanes on all approaches to separate turning volumes from through movement volumes, increasing intersection safety and capacity are recommended.

4. Summary of Traffic Needs Assessment

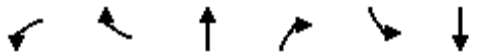
Regional staff assessed the short term and long term needs for improvement on Airport Road and determined the ultimate lane requirements based on the 2021 and 2031 planning horizons.

The following is a summary of the traffic needs assessment findings:

- A preliminary traffic control signal assessment indicates that currently traffic signals must be considered at the intersection of Airport Road and Old School Road / Healey Road based on the OTM Book 12 warrant. Further signal analysis will be conducted independent of this report;
- A realignment of the intersection of Airport Road and Old School Road / Healey Road is recommended to occur as soon as is feasible.
- By 2031, a road widening to five lanes (four through lanes and a centre two way left turn) on Airport Road within the study will be required based on link level volumes and signal/roundabout analysis.
- Sight distance deficiencies were identified at the following addresses along Airport Road: 12404, 12484, 12541, 12577, and 12618 as a result of the vertical alignment of the road and should be rectified.
- Based on the number of developments and full-moves accesses currently in place, specifically in the Sandhill area, a two-way left turn lane is recommended to be constructed to reduce friction and conflicts between through movements and left turning vehicles.
- **Airport Road / King Street –** A full two-lane roundabout is recommended by 2031 with flared two-lane entries on the east and west approaches, with two- lane approaches and entries on the northbound and southbound on Airport Road.
- **Airport Road / Old School Road–Healey Road –** A partial two-lane roundabout is recommended by 2031 with two-lane entries and approaches on the north and south approaches and either a right turn bypass or a flared two lane entry on Healey Road (east approach).
- It is recommended that the roundabout(s) be designed and constructed in a staged approach such that the 2021 roundabout(s) are designed as an interim stage in an effort to minimize future throw away costs and property impacts, once capacity dictates that the roundabouts need to be expanded to the 2031 lane requirements.

Appendix A

Existing Conditions Intersection Capacity Analysis



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	40	4	199	20	4	777
v/c Ratio	0.25	0.04	0.08	0.02	0.00	0.26
Control Delay	50.2	29.3	2.9	1.5	4.0	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.2	29.3	2.9	1.5	4.0	3.3
Queue Length 50th (m)	8.6	0.0	4.9	0.0	0.2	23.1
Queue Length 95th (m)	14.1	2.6	6.7	1.8	0.3	31.2
Internal Link Dist (m)	124.0		413.6			265.7
Turn Bay Length (m)				145.0	70.0	
Base Capacity (vph)	375	224	2404	1133	1008	3005
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.02	0.08	0.02	0.00	0.26

Intersection Summary

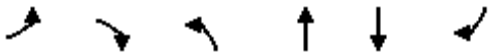
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	28	3	145	19	1	676
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.7	3.5	3.5	3.7
Total Lost time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1352	799	2808	1320	1785	3510
Flt Permitted	0.95	1.00	1.00	1.00	0.63	1.00
Satd. Flow (perm)	1352	799	2808	1320	1178	3510
Peak-hour factor, PHF	0.70	0.75	0.73	0.95	0.25	0.87
Adj. Flow (vph)	40	4	199	20	4	777
RTOR Reduction (vph)	0	4	0	4	0	0
Lane Group Flow (vph)	40	0	199	16	4	777
Heavy Vehicles (%)	32%	100%	30%	21%	0%	4%
Turn Type		Perm		Perm	Perm	
Protected Phases	4		2			6
Permitted Phases		4		2	6	
Actuated Green, G (s)	7.3	7.3	89.7	89.7	89.7	89.7
Effective Green, g (s)	7.3	7.3	89.7	89.7	89.7	89.7
Actuated g/C Ratio	0.07	0.07	0.80	0.80	0.80	0.80
Clearance Time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	88	52	2253	1059	945	2816
v/s Ratio Prot	c0.03		0.07			c0.22
v/s Ratio Perm		0.00		0.01	0.00	
v/c Ratio	0.45	0.01	0.09	0.02	0.00	0.28
Uniform Delay, d1	50.3	48.9	2.4	2.2	2.2	2.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.6	0.1	0.1	0.0	0.0	0.2
Delay (s)	57.9	48.9	2.4	2.2	2.2	3.0
Level of Service	E	D	A	A	A	A
Approach Delay (s)	57.1		2.4			3.0
Approach LOS	E		A			A

Intersection Summary			
HCM Average Control Delay	5.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	111.8	Sum of lost time (s)	14.8
Intersection Capacity Utilization	41.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	26	70	121	19	162	715
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.72	0.80	0.84	0.68	0.74	0.94
Hourly flow rate (vph)	36	88	144	28	219	761
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1356	158			172	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1356	158			172	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	74	90			84	
cM capacity (veh/h)	138	893			1411	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	124	172	980
Volume Left	36	0	219
Volume Right	88	28	0
cSH	343	1700	1411
Volume to Capacity	0.36	0.10	0.16
Queue Length 95th (m)	12.2	0.0	4.2
Control Delay (s)	21.3	0.0	3.5
Lane LOS	C		A
Approach Delay (s)	21.3	0.0	3.5
Approach LOS	C		

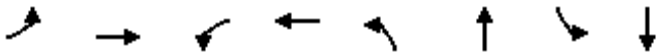
Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	4	145	52	139	732	4
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.25	0.73	0.68	0.91	0.93	0.50
Hourly flow rate (vph)	16	199	76	153	787	8
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1093	787	795			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1093	787	795			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	49	91			
cM capacity (veh/h)	217	393	826			

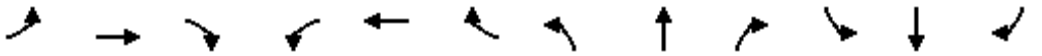
Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	215	229	787	8
Volume Left	16	76	0	0
Volume Right	199	0	0	8
cSH	371	826	1700	1700
Volume to Capacity	0.58	0.09	0.46	0.00
Queue Length 95th (m)	26.6	2.3	0.0	0.0
Control Delay (s)	27.2	3.9	0.0	0.0
Lane LOS	D	A		
Approach Delay (s)	27.2	3.9	0.0	
Approach LOS	D			

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		



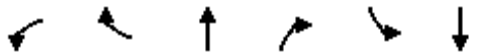
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	32	323	116	418	16	148	136	525
v/c Ratio	0.18	0.56	0.41	0.71	0.09	0.20	0.24	0.64
Control Delay	20.2	22.3	23.5	27.4	11.7	9.0	12.0	17.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	22.3	23.5	27.4	11.7	9.0	12.0	17.2
Queue Length 50th (m)	2.9	32.1	11.5	46.0	1.1	8.0	9.8	47.2
Queue Length 95th (m)	6.1	52.3	25.1	74.8	1.6	14.3	18.2	75.2
Internal Link Dist (m)		1346.7		1342.5		2950.1		3069.4
Turn Bay Length (m)	60.0		35.0		40.0		35.0	
Base Capacity (vph)	203	674	335	690	197	868	650	961
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.48	0.35	0.61	0.08	0.17	0.21	0.55

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	229	40	107	355	22	6	87	25	114	435	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.99		1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1428	1779		1716	1840		975	1558		1700	1748	
Flt Permitted	0.36	1.00		0.50	1.00		0.35	1.00		0.66	1.00	
Satd. Flow (perm)	546	1779		898	1840		360	1558		1186	1748	
Peak-hour factor, PHF	0.63	0.87	0.67	0.92	0.93	0.61	0.38	0.78	0.69	0.84	0.89	0.97
Adj. Flow (vph)	32	263	60	116	382	36	16	112	36	136	489	36
RTOR Reduction (vph)	0	12	0	0	5	0	0	17	0	0	4	0
Lane Group Flow (vph)	32	311	0	116	413	0	16	131	0	136	521	0
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	83%	21%	12%	5%	9%	6%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)	20.2	20.2		20.2	20.2		29.9	29.9		29.9	29.9	
Effective Green, g (s)	20.2	20.2		20.2	20.2		29.9	29.9		29.9	29.9	
Actuated g/C Ratio	0.32	0.32		0.32	0.32		0.47	0.47		0.47	0.47	
Clearance Time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	174	568		287	587		170	736		560	826	
v/s Ratio Prot		0.18			c0.22			0.08			c0.30	
v/s Ratio Perm	0.06			0.13			0.04			0.11		
v/c Ratio	0.18	0.55		0.40	0.70		0.09	0.18		0.24	0.63	
Uniform Delay, d1	15.6	17.8		16.8	18.9		9.2	9.6		10.0	12.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.1	1.9		1.9	4.8		0.5	0.2		0.5	2.2	
Delay (s)	16.7	19.7		18.8	23.7		9.7	9.9		10.4	14.7	
Level of Service	B	B		B	C		A	A		B	B	
Approach Delay (s)		19.4			22.6			9.9			13.9	
Approach LOS		B			C			A			B	

Intersection Summary			
HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	63.3	Sum of lost time (s)	13.2
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	28	6	551	38	4	302
v/c Ratio	0.18	0.04	0.19	0.05	0.01	0.10
Control Delay	49.7	27.7	2.8	1.2	3.5	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.7	27.7	2.8	1.2	3.5	2.6
Queue Length 50th (m)	6.0	0.0	15.2	0.0	0.2	7.6
Queue Length 95th (m)	8.5	1.8	19.8	0.0	0.5	11.3
Internal Link Dist (m)	124.0		413.6			265.7
Turn Bay Length (m)				145.0	70.0	
Base Capacity (vph)	389	337	2935	828	481	2963
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.07	0.02	0.19	0.05	0.01	0.10

Intersection Summary

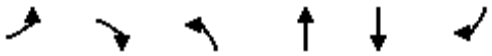
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	15	3	479	12	2	278
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.7	3.5	3.5	3.7
Total Lost time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1405	1201	3411	956	1190	3444
Flt Permitted	0.95	1.00	1.00	1.00	0.45	1.00
Satd. Flow (perm)	1405	1201	3411	956	559	3444
Peak-hour factor, PHF	0.53	0.50	0.87	0.32	0.50	0.92
Adj. Flow (vph)	28	6	551	38	4	302
RTOR Reduction (vph)	0	6	0	7	0	0
Lane Group Flow (vph)	28	0	551	31	4	302
Heavy Vehicles (%)	27%	33%	7%	67%	50%	6%
Turn Type		Perm		Perm	Perm	
Protected Phases	4		2			6
Permitted Phases		4		2	6	
Actuated Green, G (s)	6.9	6.9	90.5	90.5	90.5	90.5
Effective Green, g (s)	6.9	6.9	90.5	90.5	90.5	90.5
Actuated g/C Ratio	0.06	0.06	0.81	0.81	0.81	0.81
Clearance Time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	86	74	2751	771	451	2778
v/s Ratio Prot	c0.02		c0.16			0.09
v/s Ratio Perm		0.00		0.03	0.01	
v/c Ratio	0.33	0.00	0.20	0.04	0.01	0.11
Uniform Delay, d1	50.4	49.4	2.5	2.2	2.1	2.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.6	0.1	0.2	0.1	0.0	0.1
Delay (s)	55.0	49.5	2.7	2.3	2.1	2.4
Level of Service	E	D	A	A	A	A
Approach Delay (s)	54.0		2.6			2.4
Approach LOS	D		A			A

Intersection Summary			
HCM Average Control Delay	4.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.21		
Actuated Cycle Length (s)	112.2	Sum of lost time (s)	14.8
Intersection Capacity Utilization	35.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	41	272	475	20	71	175
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.85	0.70	0.94	0.63	0.85	0.97
Hourly flow rate (vph)	48	389	505	32	84	180
Pedestrians			4			
Lane Width (m)			3.7			
Walking Speed (m/s)			4.0			
Percent Blockage			0			
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	873	521			537	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	873	521			537	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	84	30			92	
cM capacity (veh/h)	297	557			1021	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	437	537	264
Volume Left	48	0	84
Volume Right	389	32	0
cSH	508	1700	1021
Volume to Capacity	0.86	0.32	0.08
Queue Length 95th (m)	69.2	0.0	2.0
Control Delay (s)	41.7	0.0	3.4
Lane LOS	E		A
Approach Delay (s)	41.7	0.0	3.4
Approach LOS	E		

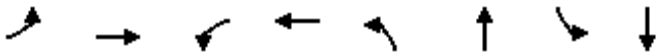
Intersection Summary			
Average Delay	15.4		
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	11	67	181	566	179	7
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.55	0.93	0.65	0.92	0.95	0.58
Hourly flow rate (vph)	20	72	278	615	188	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1361	188	200			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1361	188	200			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	92	80			
cM capacity (veh/h)	131	856	1366			

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	92	894	188	12
Volume Left	20	278	0	0
Volume Right	72	0	0	12
cSH	390	1366	1700	1700
Volume to Capacity	0.24	0.20	0.11	0.01
Queue Length 95th (m)	6.9	5.8	0.0	0.0
Control Delay (s)	17.1	4.4	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	17.1	4.4	0.0	
Approach LOS	C			

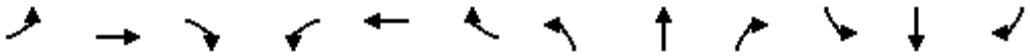
Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	64.0%	ICU Level of Service	B
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	76	410	44	560	44	514	76	155
v/c Ratio	0.59	0.63	0.21	0.88	0.08	0.62	0.28	0.21
Control Delay	42.9	24.4	20.4	38.8	10.4	16.7	14.2	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.9	24.4	20.4	38.8	10.4	16.7	14.2	9.5
Queue Length 50th (m)	8.3	45.1	4.1	64.9	2.9	43.8	5.5	8.9
Queue Length 95th (m)	15.3	67.4	8.1	#80.0	5.9	70.6	10.5	18.5
Internal Link Dist (m)		1346.7		1342.5		2950.1		3069.4
Turn Bay Length (m)	60.0		35.0		40.0		35.0	
Base Capacity (vph)	134	671	213	654	613	969	317	872
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.61	0.21	0.86	0.07	0.53	0.24	0.18

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	335	10	29	264	128	31	403	54	55	116	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1716	1874		1439	1753		1684	1832		1668	1640	
Flt Permitted	0.21	1.00		0.39	1.00		0.66	1.00		0.34	1.00	
Satd. Flow (perm)	375	1874		595	1753		1167	1832		604	1640	
Peak-hour factor, PHF	0.67	0.85	0.63	0.66	0.74	0.63	0.70	0.92	0.71	0.72	0.94	0.72
Adj. Flow (vph)	76	394	16	44	357	203	44	438	76	76	123	32
RTOR Reduction (vph)	0	2	0	0	29	0	0	9	0	0	14	0
Lane Group Flow (vph)	76	408	0	44	531	0	44	505	0	76	141	0
Heavy Vehicles (%)	4%	2%	0%	24%	4%	3%	6%	3%	0%	7%	16%	4%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)	22.6	22.6		22.6	22.6		29.5	29.5		29.5	29.5	
Effective Green, g (s)	22.6	22.6		22.6	22.6		29.5	29.5		29.5	29.5	
Actuated g/C Ratio	0.35	0.35		0.35	0.35		0.45	0.45		0.45	0.45	
Clearance Time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	130	649		206	607		527	828		273	741	
v/s Ratio Prot		0.22			c0.30			c0.28			0.09	
v/s Ratio Perm	0.20			0.07			0.04			0.13		
v/c Ratio	0.58	0.63		0.21	0.88		0.08	0.61		0.28	0.19	
Uniform Delay, d1	17.5	17.8		15.1	20.0		10.2	13.5		11.2	10.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	10.0	2.7		1.1	14.3		0.1	1.9		1.2	0.3	
Delay (s)	27.5	20.5		16.2	34.3		10.3	15.4		12.4	11.0	
Level of Service	C	C		B	C		B	B		B	B	
Approach Delay (s)		21.6			33.0			15.0			11.5	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	22.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	65.3	Sum of lost time (s)	13.2
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix B

Traffic Control Signals Warrant for Airport Road at Old School Road/Healey Road

Ontario Traffic Inc.

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 7:15:00
To: 8:15:00

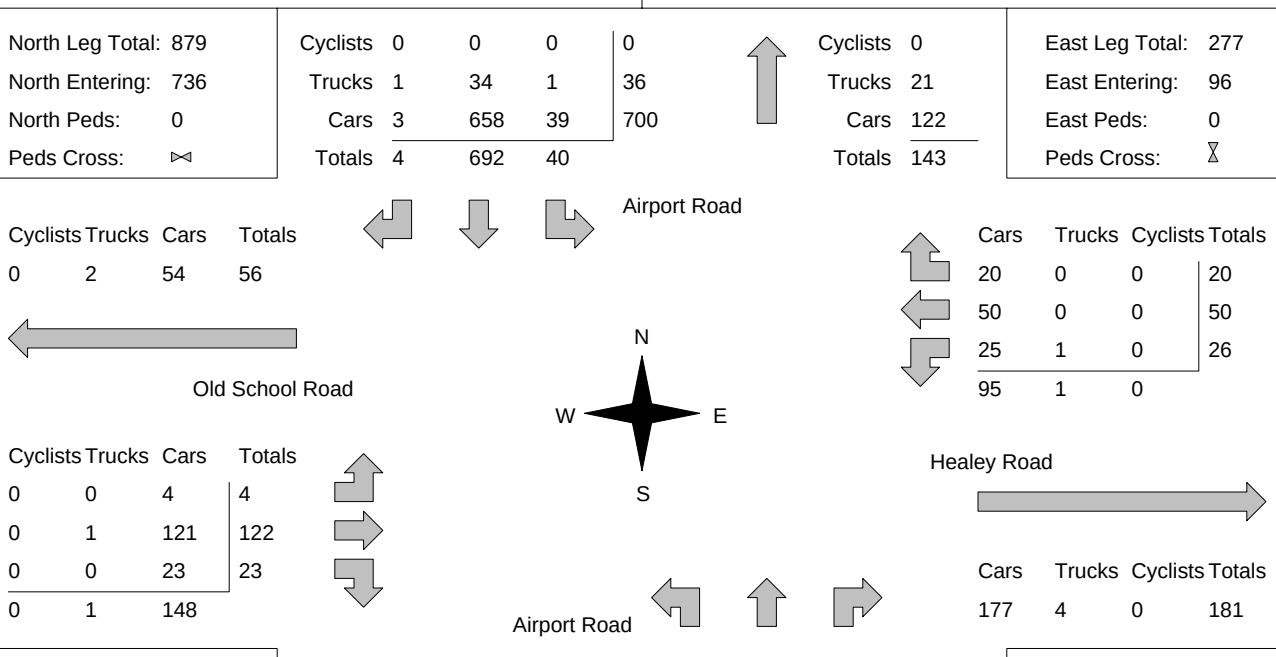
Municipality: Peel
Site #: 0000720589
Intersection: Airport Road & Old School Road/He
TFR File #: 11
Count date: 30-Nov-11

Weather conditions:
Cloudy

Person(s) who counted:
Valeri Zirianov
Valentina Zirianov

**** Non-Signalized Intersection ****

Major Road: Airport Road runs N/S



Comments

Ontario Traffic Inc.

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 14:00:00

One Hour Peak
From: 13:00:00
To: 14:00:00

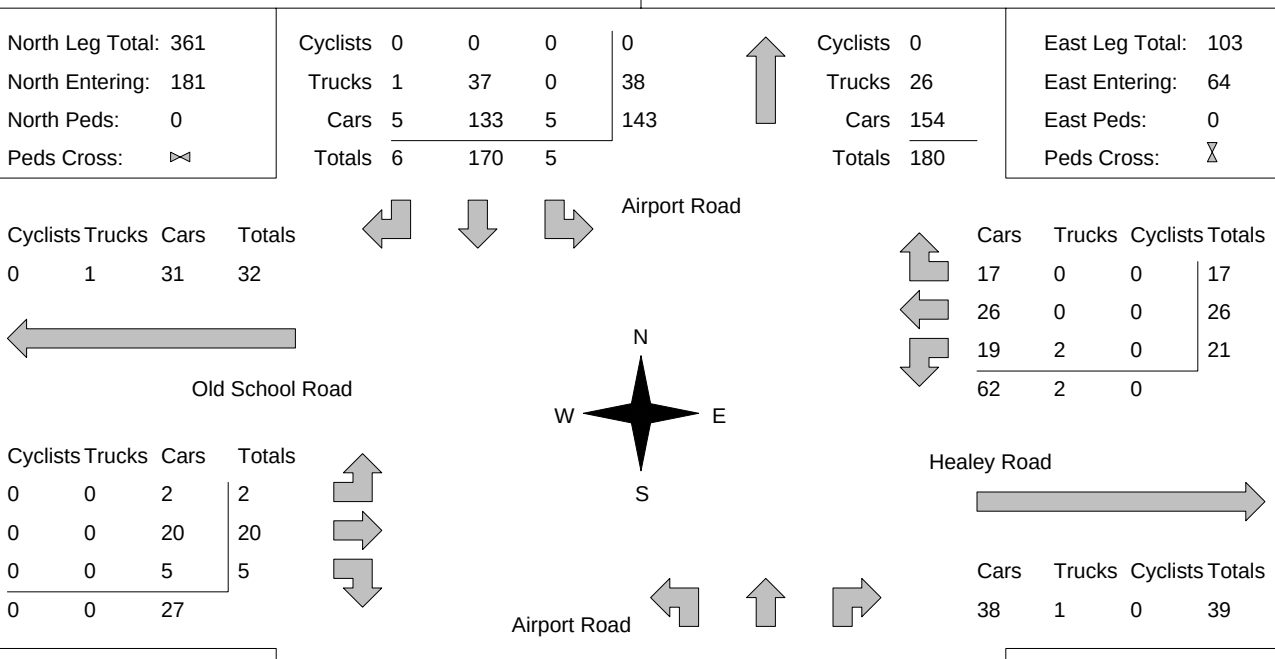
Municipality: Peel
Site #: 0000720589
Intersection: Airport Road & Old School Road/He
TFR File #: 11
Count date: 30-Nov-11

Weather conditions:
Cloudy

Person(s) who counted:
Valeri Zirianov
Valentina Zirianov

**** Non-Signalized Intersection ****

Major Road: Airport Road runs N/S



Comments

Ontario Traffic Inc.

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:30:00
To: 17:30:00

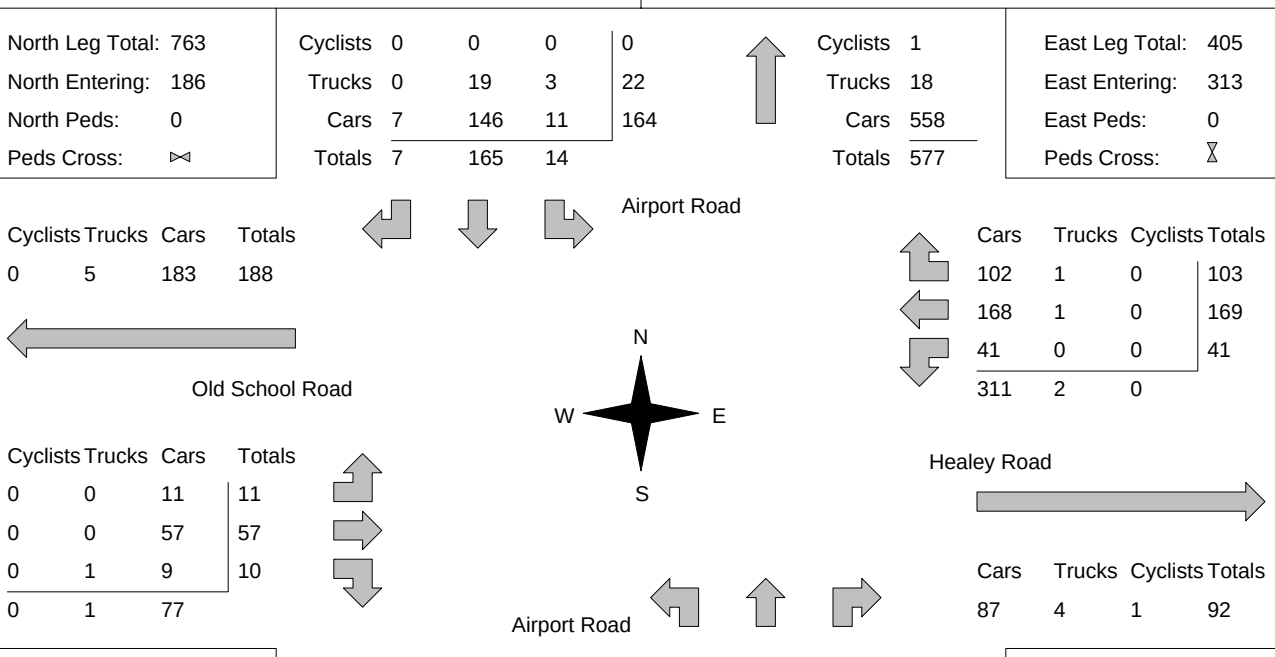
Municipality: Peel
Site #: 0000720589
Intersection: Airport Road & Old School Road/He
TFR File #: 11
Count date: 30-Nov-11

Weather conditions:
Cloudy

Person(s) who counted:
Valeri Zirianov
Valentina Zirianov

**** Non-Signalized Intersection ****

Major Road: Airport Road runs N/S



Comments

Ontario Traffic Inc.

Total Count Diagram

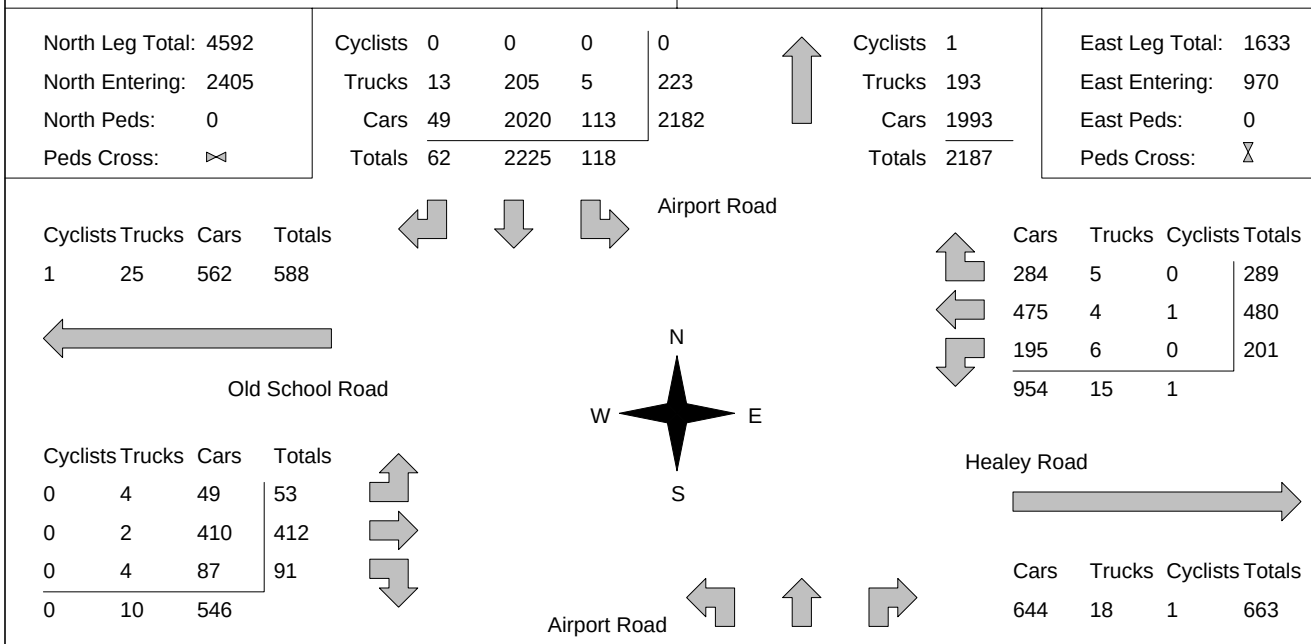
Municipality: Peel
Site #: 0000720589
Intersection: Airport Road & Old School Road/He
TFR File #: 11
Count date: 30-Nov-11

Weather conditions:
Cloudy

Person(s) who counted:
Valeri Zirianov
Valentina Zirianov

**** Non-Signalized Intersection ****

Major Road: Airport Road runs N/S



Comments

Ontario Traffic Inc.
Traffic Count Summary

Intersection: Airport Road & Old School Road/H | **Count Date:** 30-Nov-11 | **Municipality:** Peel

North Approach Totals

Hour Ending	Includes Cars, Trucks, & Cyclists: Left	Thru	Right	Grand Total	Total Peds	North/South Total Approaches
7:00:00	0	3	0	3	0	3
8:00:00	37	662	4	703	0	838
9:00:00	26	502	8	536	0	708
11:00:00	0	0	0	0	0	0
12:00:00	6	200	5	211	0	359
13:00:00	9	197	8	214	0	360
14:00:00	5	170	6	181	0	356
15:00:00	0	2	0	2	0	2
16:00:00	11	164	12	187	0	527
17:00:00	11	178	11	200	0	668
18:00:00	13	147	8	168	0	608
Totals:	118	2225	62	2405	0	4429

South Approach Totals

Hour Ending	Includes Cars, Trucks, & Cyclists: Left	Thru	Right	Grand Total	Total Peds
7:00:00	0	0	0	0	1
8:00:00	3	111	21	135	1
9:00:00	3	149	20	172	0
11:00:00	0	0	0	0	0
12:00:00	0	138	10	148	0
13:00:00	2	133	11	146	2
14:00:00	0	161	14	175	2
15:00:00	0	0	0	0	0
16:00:00	9	307	24	340	1
17:00:00	13	433	22	468	3
18:00:00	16	413	11	440	2
Totals:	46	1845	133	2024	12

East Approach Totals

Hour Ending	Includes Cars, Trucks, & Cyclists: Left	Thru	Right	Grand Total	Total Peds	East/West Total Approaches
7:00:00	0	0	0	0	0	0
8:00:00	24	52	16	92	0	243
9:00:00	34	37	30	101	0	203
11:00:00	0	0	0	0	0	0
12:00:00	12	14	17	43	0	64
13:00:00	12	13	10	35	0	67
14:00:00	21	26	17	64	0	91
15:00:00	0	0	0	0	0	0
16:00:00	30	66	33	129	0	203
17:00:00	33	150	77	260	0	346
18:00:00	35	122	89	246	0	309
Totals:	201	480	289	970	0	1526

West Approach Totals

Hour Ending	Includes Cars, Trucks, & Cyclists: Left	Thru	Right	Grand Total	Total Peds
7:00:00	0	0	0	0	0
8:00:00	4	127	20	151	0
9:00:00	11	67	24	102	0
11:00:00	0	0	0	0	0
12:00:00	5	10	6	21	0
13:00:00	5	16	11	32	0
14:00:00	2	20	5	27	0
15:00:00	0	0	0	0	0
16:00:00	9	60	5	74	0
17:00:00	7	65	14	86	0
18:00:00	10	47	6	63	0
Totals:	53	412	91	556	0

Calculated Values for Traffic Crossing Major Street

Hours Ending:	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00
Crossing Values:	156	112	31	35	51	106	193	169

Ontario Traffic Inc.

Count Date: 30-Nov-11
Intersection: Airport Road & Old School Road/Heale **Municipality:** Peel
Major Road: Airport Road **Major Road Runs:** N/S one lane each way
Operating Speed of Major Road: 80 km/hr **Operating under free flow conditions**

Warrant #1: Minimum Vehicular Volumes.

A. All Approaches. **80% Satisfied**

No. of Lanes	Minimum Requirements					Hours Ending								
	1 Lane Each Way		2 Lanes Each Way		3 Lanes									
Flow Condition	1 Lane F. Flow (Code 1)	1 Lane R. Flow (Code 2)	2 Lane F. Flow (Code 3)	2 Lane R. Flow (Code 4)	or More R. Flow (Code 5)	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00	Percentage Warrant
100%	480	720	600	900	1125	1081	911	423	427	447	730	1014	917	100%
80%	385	575	480	720	900									Yes: / No: X
All Approaches	100% Fulfilled					100	100				100	100	100	500
	80% Fulfilled							80	80	80				240
	Actual % if Below 80%													0

Total:	740
Actual Average (Total/8):	93%

B. Minor Street Both Approaches.

100%	120	170	120	170	170	243	203	64	67	91	203	346	309	100%
80%	95	135	95	135	135									Yes: / No: X
Minor Street Both Approaches	100% Fulfilled					100	100				100	100	100	500
	80% Fulfilled													0
	Actual % if Below 80%							53	56	76				185

Total:	685
Actual Average (Total/8):	86%

Ontario Traffic Inc.

Count Date: 30-Nov-11
Intersection: Airport Road & Old School Road/Heale **Municipality:** Peel
Major Road: Airport Road **Major Road Runs:** N/S one lane each way
Operating Speed of Major Road: 80 km/hr **Operating under free flow conditions**

Warrant #2: Delay to Cross Traffic.

A. Major Street Both Approaches. **80% Satisfied**

No. of Lanes	Minimum Requirements					Hours Ending								Percentage Warrant
	1 Lane Each Way		2 Lanes Each Way		3 Lanes									
Flow Condition	1 Lane F. Flow (Code 1)	1 Lane R. Flow (Code 2)	2 Lane F. Flow (Code 3)	2 Lane R. Flow (Code 4)	or More R. Flow (Code 5)	8:00	9:00	12:00	13:00	14:00	16:00	17:00	18:00	
100%	480	720	600	900	1125	838	708	359	360	356	527	668	608	100%
80%	385	575	480	720	900									Yes: / No: X
All Approaches	100% Fulfilled					100	100				100	100	100	500
	80% Fulfilled													0
	Actual % if Below 80%							75	75	74				224
													Total:	724
													Actual Average (Total/8):	90%

B. Traffic Crossing Major Street.

100%	50	75	50	75	75	156	112	31	35	51	106	193	169	100%
80%	40	60	40	60	60									Yes: / No: X
All Approaches	100% Fulfilled					100	100			100	100	100	100	600
	80% Fulfilled													0
	Actual % if Below 80%							62	70					132
													Total:	732
													Actual Average (Total/8):	92%

Ontario Traffic Inc.

Count Date: 30-Nov-11
Intersection: Airport Road & Old School Road/Heale **Municipality:** Peel
Major Road: Airport Road **Major Road Runs:** N/S one lane each way
Operating Speed of Major Road: 80 km/hr **Operating under free flow conditions**

Warrant #3: Accident Experience.

Not Satisfied

A. Reportable accidents within a twelve month period averaged over 36 consequtive months susceptible to correction by a traffic signal.

Minimum Requirements	Actual Number of Accidents	Average Number of Accidents	Fulfilled
5	0 in 3 years	0 per year	0%

B. Adequate trial of less restrictive remedies has failed to reduce accident frequency.	Yes
C. Either Warrant 1 (Minimum Vehicular Volume) or Warrant 2 (Delay to Cross Traffic) satisfied 80% or more.	Yes

Warrant #4: Combination Warrant.
(Used if no warrant satisfied 100%)

Satisfied

Minimum Requirements	Warrant Satisfied 80% or More	Fulfilled
Two Warrants Satisfied 80%	Warrant 1 (Minimum Vehicular Volume) Warrant 2 (Delay to Cross Traffic) Warrant 3 (Accident Experience)	Yes Yes No

Conclusion: Traffic signal warranted.

Ontario Traffic Inc.

Count Date: 30-Nov-11 Site #: 0000720589

Interval Time	Passenger Cars - North Approach						Trucks - North Approach						Cyclists - North Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		North Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15:00	3	3	132	129	2	2	0	0	5	5	0	0	0	0	0	0	0	0	0	0
7:30:00	14	11	312	180	3	1	1	1	10	5	0	0	0	0	0	0	0	0	0	0
7:45:00	25	11	481	169	4	1	1	0	19	9	0	0	0	0	0	0	0	0	0	0
8:00:00	36	11	635	154	4	0	1	0	30	11	0	0	0	0	0	0	0	0	0	0
8:15:00	42	6	790	155	5	1	1	0	39	9	1	1	0	0	0	0	0	0	0	0
8:30:00	52	10	901	111	7	2	1	0	47	8	2	1	0	0	0	0	0	0	0	0
8:45:00	57	5	1014	113	7	0	1	0	52	5	2	0	0	0	0	0	0	0	0	0
9:00:00	62	5	1101	87	10	3	1	0	66	14	2	0	0	0	0	0	0	0	0	0
9:00:15	62	0	1101	0	10	0	1	0	66	0	2	0	0	0	0	0	0	0	0	0
11:00:00	62	0	1101	0	10	0	1	0	66	0	2	0	0	0	0	0	0	0	0	0
11:15:00	64	2	1139	38	10	0	1	0	73	7	3	1	0	0	0	0	0	0	0	0
11:30:00	65	1	1207	68	11	1	1	0	77	4	3	0	0	0	0	0	0	0	0	0
11:45:00	67	2	1250	43	12	1	2	1	82	5	3	0	0	0	0	0	0	0	0	0
12:00:00	67	0	1283	33	14	2	2	0	84	2	3	0	0	0	0	0	0	0	0	0
12:15:00	69	2	1330	47	15	1	2	0	88	4	4	1	0	0	0	0	0	0	0	0
12:30:00	73	4	1376	46	15	0	2	0	94	6	6	2	0	0	0	0	0	0	0	0
12:45:00	76	3	1420	44	17	2	2	0	98	4	6	0	0	0	0	0	0	0	0	0
13:00:00	76	0	1457	37	19	2	2	0	107	9	6	0	0	0	0	0	0	0	0	0
13:15:00	76	0	1478	21	20	1	2	0	116	9	6	0	0	0	0	0	0	0	0	0
13:30:00	78	2	1518	40	21	1	2	0	121	5	6	0	0	0	0	0	0	0	0	0
13:45:00	79	1	1553	35	22	1	2	0	127	6	6	0	0	0	0	0	0	0	0	0
14:00:00	81	2	1590	37	24	2	2	0	144	17	7	1	0	0	0	0	0	0	0	0
14:00:36	81	0	1591	1	24	0	2	0	144	0	7	0	0	0	0	0	0	0	0	0
15:00:00	81	0	1592	1	24	0	2	0	144	0	7	0	0	0	0	0	0	0	0	0
15:15:00	82	1	1622	30	27	3	2	0	149	5	7	0	0	0	0	0	0	0	0	0
15:30:00	84	2	1661	39	27	0	2	0	153	4	8	1	0	0	0	0	0	0	0	0
15:45:00	86	2	1689	28	31	4	2	0	158	5	9	1	0	0	0	0	0	0	0	0
16:00:00	92	6	1735	46	34	3	2	0	165	7	9	0	0	0	0	0	0	0	0	0
16:15:00	94	2	1776	41	36	2	2	0	172	7	10	1	0	0	0	0	0	0	0	0
16:30:00	95	1	1817	41	38	2	2	0	180	8	13	3	0	0	0	0	0	0	0	0
16:45:00	101	6	1852	35	41	3	2	0	185	5	13	0	0	0	0	0	0	0	0	0
17:00:00	102	1	1887	35	41	0	3	1	191	6	13	0	0	0	0	0	0	0	0	0
17:15:00	105	3	1926	39	43	2	4	1	195	4	13	0	0	0	0	0	0	0	0	0
17:30:00	106	1	1963	37	45	2	5	1	199	4	13	0	0	0	0	0	0	0	0	0
17:45:00	110	4	1989	26	47	2	5	0	204	5	13	0	0	0	0	0	0	0	0	0
18:00:00	113	3	2020	31	49	2	5	0	205	1	13	0	0	0	0	0	0	0	0	0
18:00:15	113	0	2020	0	49	0	5	0	205	0	13	0	0	0	0	0	0	0	0	0

Ontario Traffic Inc.

Count Date: 30-Nov-11 Site #: 0000720589

Interval Time	Passenger Cars - East Approach						Trucks - East Approach						Cyclists - East Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		East Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15:00	7	7	12	12	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30:00	10	3	31	19	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45:00	16	6	38	7	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00:00	24	8	52	14	16	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15:00	32	8	62	10	23	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0
8:30:00	43	11	72	10	26	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45:00	50	7	81	9	29	3	2	1	1	1	0	0	0	0	0	0	0	0	0	0
9:00:00	55	5	88	7	45	16	3	1	1	0	1	1	0	0	0	0	0	0	0	0
9:00:15	55	0	88	0	45	0	3	0	1	0	1	0	0	0	0	0	0	0	0	0
11:00:00	55	0	88	0	45	0	3	0	1	0	1	0	0	0	0	0	0	0	0	0
11:15:00	56	1	92	4	50	5	3	0	1	0	1	0	0	0	1	1	0	0	0	0
11:30:00	58	2	94	2	54	4	3	0	1	0	1	0	0	0	1	0	0	0	0	0
11:45:00	65	7	97	3	59	5	3	0	1	0	2	1	0	0	1	0	0	0	0	0
12:00:00	67	2	101	4	61	2	3	0	1	0	2	0	0	0	1	0	0	0	0	0
12:15:00	69	2	104	3	65	4	3	0	1	0	2	0	0	0	1	0	0	0	0	0
12:30:00	73	4	106	2	67	2	3	0	1	0	2	0	0	0	1	0	0	0	0	0
12:45:00	77	4	111	5	69	2	3	0	1	0	2	0	0	0	1	0	0	0	0	0
13:00:00	79	2	114	3	71	2	3	0	1	0	2	0	0	0	1	0	0	0	0	0
13:15:00	83	4	119	5	76	5	4	1	1	0	2	0	0	0	1	0	0	0	0	0
13:30:00	87	4	123	4	83	7	5	1	1	0	2	0	0	0	1	0	0	0	0	0
13:45:00	93	6	128	5	87	4	5	0	1	0	2	0	0	0	1	0	0	0	0	0
14:00:00	98	5	140	12	88	1	5	0	1	0	2	0	0	0	1	0	0	0	0	0
14:00:36	98	0	140	0	88	0	5	0	1	0	2	0	0	0	1	0	0	0	0	0
15:00:00	98	0	140	0	88	0	5	0	1	0	2	0	0	0	1	0	0	0	0	0
15:15:00	106	8	150	10	94	6	5	0	1	0	2	0	0	0	1	0	0	0	0	0
15:30:00	113	7	169	19	101	7	6	1	1	0	2	0	0	0	1	0	0	0	0	0
15:45:00	121	8	181	12	109	8	6	0	3	2	2	0	0	0	1	0	0	0	0	0
16:00:00	127	6	204	23	121	12	6	0	3	0	2	0	0	0	1	0	0	0	0	0
16:15:00	134	7	225	21	136	15	6	0	3	0	4	2	0	0	1	0	0	0	0	0
16:30:00	143	9	262	37	148	12	6	0	3	0	4	0	0	0	1	0	0	0	0	0
16:45:00	151	8	285	23	167	19	6	0	3	0	5	1	0	0	1	0	0	0	0	0
17:00:00	160	9	354	69	195	28	6	0	3	0	5	0	0	0	1	0	0	0	0	0
17:15:00	172	12	378	24	217	22	6	0	4	1	5	0	0	0	1	0	0	0	0	0
17:30:00	184	12	430	52	250	33	6	0	4	0	5	0	0	0	1	0	0	0	0	0
17:45:00	188	4	459	29	263	13	6	0	4	0	5	0	0	0	1	0	0	0	0	0
18:00:00	195	7	475	16	284	21	6	0	4	0	5	0	0	0	1	0	0	0	0	0
18:00:15	195	0	475	0	284	0	6	0	4	0	5	0	0	0	1	0	0	0	0	0

Ontario Traffic Inc.

Count Date: 30-Nov-11 Site #: 0000720589

Interval Time	Passenger Cars - South Approach						Trucks - South Approach						Cyclists - South Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		South Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
7:15:00	1	1	20	20	3	3	0	0	3	3	0	0	0	0	0	0	0	0	2	1
7:30:00	1	0	44	24	6	3	0	0	10	7	1	1	0	0	0	0	0	0	2	0
7:45:00	1	0	75	31	12	6	1	1	14	4	2	1	0	0	0	0	0	0	2	0
8:00:00	2	1	95	20	19	7	1	0	16	2	2	0	0	0	0	0	0	0	2	0
8:15:00	2	0	118	23	20	1	1	0	24	8	2	0	0	0	0	0	0	0	2	0
8:30:00	2	0	144	26	26	6	1	0	30	6	2	0	0	0	0	0	0	0	2	0
8:45:00	4	2	177	33	32	6	1	0	38	8	3	1	0	0	0	0	0	0	2	0
9:00:00	5	1	212	35	38	6	1	0	48	10	3	0	0	0	0	0	0	0	2	0
9:00:15	5	0	212	0	38	0	1	0	48	0	3	0	0	0	0	0	0	0	2	0
11:00:00	5	0	212	0	38	0	1	0	48	0	3	0	0	0	0	0	0	0	2	0
11:15:00	5	0	250	38	40	2	1	0	54	6	3	0	0	0	0	0	0	0	2	0
11:30:00	5	0	272	22	42	2	1	0	63	9	4	1	0	0	0	0	0	0	2	0
11:45:00	5	0	299	27	44	2	1	0	68	5	4	0	0	0	0	0	0	0	2	0
12:00:00	5	0	325	26	47	3	1	0	73	5	4	0	0	0	0	0	0	0	2	0
12:15:00	5	0	351	26	48	1	1	0	81	8	5	1	0	0	0	0	0	0	2	0
12:30:00	6	1	375	24	51	3	1	0	88	7	5	0	0	0	0	0	0	0	3	1
12:45:00	6	0	401	26	53	2	1	0	96	8	5	0	0	0	0	0	0	0	3	0
13:00:00	7	1	428	27	57	4	1	0	103	7	5	0	0	0	0	0	0	0	4	1
13:15:00	7	0	469	41	59	2	1	0	116	13	5	0	0	0	0	0	0	0	4	0
13:30:00	7	0	503	34	63	4	1	0	120	4	5	0	0	0	0	0	0	0	5	1
13:45:00	7	0	526	23	64	1	1	0	125	5	6	1	0	0	0	0	0	0	5	0
14:00:00	7	0	563	37	70	6	1	0	129	4	6	0	0	0	0	0	0	0	6	1
14:00:36	7	0	563	0	70	0	1	0	129	0	6	0	0	0	0	0	0	0	6	0
15:00:00	7	0	563	0	70	0	1	0	129	0	6	0	0	0	0	0	0	0	6	0
15:15:00	9	2	629	66	75	5	1	0	135	6	6	0	0	0	0	0	0	0	6	0
15:30:00	13	4	693	64	79	4	1	0	142	7	6	0	0	0	0	0	0	0	7	1
15:45:00	14	1	766	73	86	7	2	1	148	6	8	2	0	0	0	0	0	0	7	0
16:00:00	14	0	848	82	92	6	3	1	151	3	8	0	0	0	0	0	0	0	7	0
16:15:00	18	4	928	80	98	6	4	1	154	3	9	1	0	0	0	0	0	0	8	1
16:30:00	23	5	1025	97	100	2	4	0	158	4	10	1	0	0	0	0	0	0	8	0
16:45:00	24	1	1142	117	106	6	5	1	164	6	11	1	0	0	0	0	0	0	8	0
17:00:00	25	1	1261	119	110	4	5	0	170	6	11	0	0	0	1	1	1	1	10	2
17:15:00	30	5	1368	107	111	1	8	3	175	5	11	0	0	0	1	0	1	0	12	2
17:30:00	31	1	1470	102	119	8	8	0	175	0	11	0	0	0	1	0	1	0	12	0
17:45:00	34	3	1570	100	120	1	8	0	181	6	11	0	0	0	1	0	1	0	12	0
18:00:00	38	4	1660	90	121	1	8	0	184	3	11	0	0	0	1	0	1	0	12	0
18:00:15	38	0	1660	0	121	0	8	0	184	0	11	0	0	0	1	0	1	0	12	0

Ontario Traffic Inc.

Count Date: 30-Nov-11 Site #: 0000720589

Interval Time	Passenger Cars - West Approach						Trucks - West Approach						Cyclists - West Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		West Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15:00	0	0	23	23	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30:00	0	0	40	17	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45:00	0	0	84	44	13	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00:00	4	4	127	43	20	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15:00	4	0	144	17	26	6	0	0	1	1	0	0	0	0	0	0	0	0	0	0
8:30:00	6	2	165	21	33	7	1	1	1	0	1	1	0	0	0	0	0	0	0	0
8:45:00	10	4	183	18	39	6	1	0	1	0	1	0	0	0	0	0	0	0	0	0
9:00:00	13	3	193	10	43	4	2	1	1	0	1	0	0	0	0	0	0	0	0	0
9:00:15	13	0	193	0	43	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0
11:00:00	13	0	193	0	43	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0
11:15:00	13	0	195	2	45	2	2	0	1	0	1	0	0	0	0	0	0	0	0	0
11:30:00	15	2	199	4	48	3	3	1	1	0	1	0	0	0	0	0	0	0	0	0
11:45:00	17	2	202	3	49	1	3	0	1	0	1	0	0	0	0	0	0	0	0	0
12:00:00	17	0	203	1	49	0	3	0	1	0	1	0	0	0	0	0	0	0	0	0
12:15:00	18	1	207	4	52	3	3	0	1	0	1	0	0	0	0	0	0	0	0	0
12:30:00	19	1	211	4	57	5	3	0	1	0	1	0	0	0	0	0	0	0	0	0
12:45:00	19	0	214	3	58	1	3	0	1	0	1	0	0	0	0	0	0	0	0	0
13:00:00	22	3	219	5	59	1	3	0	1	0	2	1	0	0	0	0	0	0	0	0
13:15:00	22	0	223	4	60	1	3	0	1	0	2	0	0	0	0	0	0	0	0	0
13:30:00	24	2	229	6	61	1	3	0	1	0	2	0	0	0	0	0	0	0	0	0
13:45:00	24	0	233	4	62	1	3	0	1	0	2	0	0	0	0	0	0	0	0	0
14:00:00	24	0	239	6	64	2	3	0	1	0	2	0	0	0	0	0	0	0	0	0
14:00:36	24	0	239	0	64	0	3	0	1	0	2	0	0	0	0	0	0	0	0	0
15:00:00	24	0	239	0	64	0	3	0	1	0	2	0	0	0	0	0	0	0	0	0
15:15:00	27	3	251	12	64	0	3	0	1	0	2	0	0	0	0	0	0	0	0	0
15:30:00	30	3	268	17	66	2	3	0	2	1	2	0	0	0	0	0	0	0	0	0
15:45:00	31	1	281	13	68	2	3	0	2	0	2	0	0	0	0	0	0	0	0	0
16:00:00	33	2	298	17	69	1	3	0	2	0	2	0	0	0	0	0	0	0	0	0
16:15:00	34	1	319	21	74	5	3	0	2	0	2	0	0	0	0	0	0	0	0	0
16:30:00	34	0	334	15	76	2	4	1	2	0	3	1	0	0	0	0	0	0	0	0
16:45:00	36	2	349	15	78	2	4	0	2	0	3	0	0	0	0	0	0	0	0	0
17:00:00	39	3	363	14	81	3	4	0	2	0	4	1	0	0	0	0	0	0	0	0
17:15:00	44	5	377	14	82	1	4	0	2	0	4	0	0	0	0	0	0	0	0	0
17:30:00	45	1	391	14	85	3	4	0	2	0	4	0	0	0	0	0	0	0	0	0
17:45:00	46	1	406	15	86	1	4	0	2	0	4	0	0	0	0	0	0	0	0	0
18:00:00	49	3	410	4	87	1	4	0	2	0	4	0	0	0	0	0	0	0	0	0
18:00:15	49	0	410	0	87	0	4	0	2	0	4	0	0	0	0	0	0	0	0	0

Appendix C

Signalization of Offset Airport Road / Old School Road – Healey Road

Lane Group	EBT	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	221	139	172	784	8
v/c Ratio	0.73	0.52	0.29	1.00	0.01
Control Delay	51.0	42.0	16.5	58.3	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	51.0	42.0	16.5	58.3	11.0
Queue Length 50th (m)	36.1	22.0	16.7	~135.2	0.3
Queue Length 95th (m)	44.0	27.9	29.3	#213.0	1.4
Internal Link Dist (m)	3361.2	290.8	1946.4	2950.1	
Turn Bay Length (m)					45.0
Base Capacity (vph)	313	307	603	786	569
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.71	0.45	0.29	1.00	0.01

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	122	23	25	50	20	2	119	19	40	692	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)		7.0			7.0			7.3			7.3	7.3
Lane Util. Factor		1.00			1.00			1.00			1.00	1.00
Frt		0.98			0.97			0.98			1.00	0.85
Flt Protected		1.00			0.99			1.00			1.00	1.00
Satd. Flow (prot)		1825			1787			1596			1826	1278
Flt Permitted		1.00			0.99			0.84			0.97	1.00
Satd. Flow (perm)		1825			1787			1344			1776	1278
Peak-hour factor, PHF	0.25	0.69	0.82	0.72	0.66	0.71	0.50	0.85	0.68	0.83	0.94	0.50
Adj. Flow (vph)	16	177	28	35	76	28	4	140	28	48	736	8
RTOR Reduction (vph)	0	0	0	0	0	0	0	8	0	0	0	3
Lane Group Flow (vph)	0	221	0	0	139	0	0	164	0	0	784	5
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	18%	11%	3%	5%	25%
Turn Type	Split			Split			Perm			Perm		Perm
Protected Phases	4	4		2	2			1			1	
Permitted Phases							1			1		1
Actuated Green, G (s)		14.4			13.0			38.8			38.8	38.8
Effective Green, g (s)		14.4			13.0			38.8			38.8	38.8
Actuated g/C Ratio		0.16			0.15			0.44			0.44	0.44
Clearance Time (s)		7.0			7.0			7.3			7.3	7.3
Vehicle Extension (s)		5.0			5.0			5.0			5.0	5.0
Lane Grp Cap (vph)		300			265			596			788	567
v/s Ratio Prot		c0.12			c0.08							
v/s Ratio Perm								0.12			c0.44	0.00
v/c Ratio		0.74			0.52			0.28			0.99	0.01
Uniform Delay, d1		34.7			34.4			15.4			24.3	13.6
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		10.9			3.5			0.5			30.7	0.0
Delay (s)		45.7			37.9			16.0			54.9	13.6
Level of Service		D			D			B			D	B
Approach Delay (s)		45.7			37.9			16.0			54.5	
Approach LOS		D			D			B			D	

Intersection Summary			
HCM Average Control Delay	46.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	87.5	Sum of lost time (s)	21.3
Intersection Capacity Utilization	84.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	96	457	566	196	12
v/c Ratio	0.38	0.90	0.89	0.36	0.02
Control Delay	38.7	53.1	46.4	24.2	10.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	38.7	53.1	46.4	24.2	10.7
Queue Length 50th (m)	14.8	74.1	89.8	24.4	0.0
Queue Length 95th (m)	28.8	68.3	#161.7	44.4	1.9
Internal Link Dist (m)	3361.2	290.8	1946.4	2950.1	
Turn Bay Length (m)					45.0
Base Capacity (vph)	324	519	633	544	583
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.30	0.88	0.89	0.36	0.02

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	57	10	41	169	103	12	462	20	14	165	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)		7.0			7.0			7.3			7.3	7.3
Lane Util. Factor		1.00			1.00			1.00			1.00	1.00
Frpb, ped/bikes		0.99			1.00			1.00			1.00	1.00
Flpb, ped/bikes		1.00			1.00			1.00			1.00	1.00
Frt		0.98			0.96			0.99			1.00	0.85
Flt Protected		0.99			0.99			1.00			0.99	1.00
Satd. Flow (prot)		1779			1780			1796			1688	1597
Flt Permitted		0.99			0.99			0.97			0.89	1.00
Satd. Flow (perm)		1779			1780			1750			1510	1597
Peak-hour factor, PHF	0.55	0.95	0.63	0.85	0.61	0.78	0.38	0.92	0.63	0.58	0.96	0.58
Adj. Flow (vph)	20	60	16	48	277	132	32	502	32	24	172	12
RTOR Reduction (vph)	0	0	0	0	0	0	0	3	0	0	0	8
Lane Group Flow (vph)	0	96	0	0	457	0	0	563	0	0	196	4
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	12%	0%
Turn Type	Split			Split			Perm			Perm		Perm
Protected Phases	4	4		2	2			1			1	
Permitted Phases							1			1		1
Actuated Green, G (s)		9.7			23.9			30.1			30.1	30.1
Effective Green, g (s)		9.7			23.9			30.1			30.1	30.1
Actuated g/C Ratio		0.11			0.28			0.35			0.35	0.35
Clearance Time (s)		7.0			7.0			7.3			7.3	7.3
Vehicle Extension (s)		5.0			5.0			5.0			5.0	5.0
Lane Grp Cap (vph)		203			500			620			535	566
v/s Ratio Prot		c0.05			c0.26							
v/s Ratio Perm								c0.32			0.13	0.00
v/c Ratio		0.47			0.91			0.91			0.37	0.01
Uniform Delay, d1		35.3			29.6			26.1			20.4	17.8
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		3.6			22.1			18.1			0.9	0.0
Delay (s)		38.9			51.7			44.2			21.3	17.8
Level of Service		D			D			D			C	B
Approach Delay (s)		38.9			51.7			44.2			21.1	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	42.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	21.3
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Appendix D

Roundabout Peer Review

Ourston Roundabout Engineering
A Member of The Sernas Group Inc. Canada

MEMORANDUM

To: **The Regional Municipality of Peel**

From: **Ourston Roundabout Engineering**

Date: **November 2, 2012**

Subject: **Airport Road Roundabout Capacity Analysis Review**

This memo details our review of the capacity analysis of roundabouts at two potential locations: Airport Road at King Street, and Airport Road at Old School Road/Healey Road. The initial capacity analysis was performed by the Region of Peel using the ARCADY 8 software package.

Airport Road at King Street

Turning movement forecasts were entered correctly as per the forecasts provided. Several geometric parameters were slightly unrealistic (e.g. using 4.50 metres instead of the effective maximum 4.25 metres for single-lane entry widths), and the analysis was not run using a y-intercept adjustment.[1]

Using typical default parameters, a full two-lane roundabout would be required by 2031. Adding right-turn channelizations on any leg would not avoid the need for a two-lane entry. Northbound and southbound approaches and entries would need to be two lanes, and eastbound and westbound entries could flare from one-lane approaches to two lanes.

The interim 2021 scenario could be staged such that the eastbound entry need only be one lane. The 2011 counts indicate that the roundabout could open in a single-lane configuration, although the southbound entry would likely start experiencing moderate queues and delays shortly after construction (estimated to be 2013 or 2014).

Airport Road at Old School Road/Healey Road

Turning movement forecasts were entered incorrectly for the 2011 a.m. peak hour, and (although insignificant to the results) the 2021 p.m. peak hour eastbound right-turn movement should be 13 vehicles instead of 19 vehicles as per the forecasts provided. Several geometric parameters were slightly unrealistic, and the analysis was not run using a y-intercept adjustment.

---

[1] Based on observations of at-capacity roundabouts in North America, adjusting the y-intercept of the capacity prediction to 90% of its predicted value is appropriate to account for driver unfamiliarity at roundabouts compared to the United Kingdom. It is expected that a lower capacity adjustment will be more appropriate beyond the 20-year horizon.

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Using typical default parameters, a partial two-lane roundabout would be required by 2031. Flared two-lane entries would be needed northbound and southbound along Airport Road, a single-lane entry is sufficient eastbound on Old School Road, and either a flared two-lane entry or a single-lane entry with a right-turn bypass would be needed for the westbound approach on Healey Road.

The interim 2021 scenario would be of similar configuration except that the eastbound entry could remain one lane without a right-turn channelization. The 2011 traffic counts indicate that a single-lane configuration would operate well.

Recommendations

At Airport Road and King Street, should a roundabout proceed as the preferred alternative we recommend construction of a partial two-lane design: two-lane entries northbound and southbound, and single-lane entries eastbound and westbound. When queues and delays are observed to be consistently high, the roundabout would require expansion to two-lane entries on all legs, assuming two-lane approaches north-south and one-lane approaches east-west.

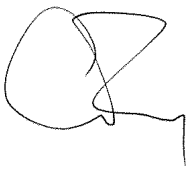
At Airport Road and Old School Road and Healey Road, should a roundabout proceed as the preferred alternative we recommend construction of a single-lane design at the outset, with future expansion to flared two-lane entries northbound and southbound on Airport Road when queues and delays are observed to be consistently high.

A further staging consideration is the expansion of Airport Road to a four-lane cross-section, as is indicated by the Approach Road Half-Width parameters used in the analysis. The timing of the widening may affect capacity at the roundabouts and vice-versa.

We hope the foregoing is helpful. Please advise if you have any questions or require further information.

Yours truly,

OURSTON ROUNDABOUT ENGINEERING (CANADA)
(A Member of The Sernas Group Inc.)



Clayton Rudy, EIT
Project Coordinator

Philip Weber, P.Eng.
Senior Project Manager

/cr

Appendix E

ARCADY Roundabout Analysis 2011
Traffic Volumes
and
Roundabout Screening Tool Results

Airport Road at Old School / Healey Road 2011

Single Lane Roundabout
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	4.25	0.00	25.00	55.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	4.25	0.00	25.00	55.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	single lane -2 lane cross section - 2011 (Existing)							
Healey Road	0.10	?	3.61	0.09	A	10.21	B	22% [Airport Road North]
Airport Road North	2.84	7.00	12.93	0.75	B			
Old School Road	0.29	?	6.37	0.23	A			
Airport Road South	0.21	?	4.87	0.17	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	single lane -2 lane cross section- 2011 (Existing)							
Healey Road	0.62	1.00	6.52	0.38	A	6.10	A	71% [Healey Road]
Airport Road North	0.29	?	5.04	0.22	A			
Old School Road	0.09	?	3.75	0.08	A			
Airport Road South	1.00	?	6.64	0.50	A			

Airport Road at King Street 2011

Single Lane Roundabout
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
King Street East	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	4.25	0.00	25.00	55.00	20.00	
King Street West	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	4.25	0.00	25.00	55.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	DC Single lane- 2 lane cross section - 2011 (Existing)							
King Street East	0.97	?	6.63	0.50	A	11.99	B	10% [Airport Road North]
Airport Road North	3.29	10.00	19.10	0.78	C			
King Street West	0.78	1.00	8.92	0.44	A			
Airport Road South	0.21	?	5.83	0.17	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	DC Single lane- 2 lane cross section - 2011 (Existing)							
King Street East	1.18	?	9.24	0.54	A	8.05	A	34% [Airport Road South]
Airport Road North	0.33	?	5.57	0.25	A			
King Street West	0.72	1.00	5.99	0.42	A			
Airport Road South	1.44	1.00	9.76	0.59	A			

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Roundabout Feasibility Screening Tool

		Roundabout Supportive?
1)	Project name, File #, Intersection Location (B/C/M, Street name, distance from major intersections, etc.): Airport Road and Old School Road/Healey Road, approximately 3km south of King Street and approximately 3km north of Mayfield Road	
2)	Brief description of Intersection (No. of legs, Lanes on each leg, Total AADT, ADDT on each road). Attach or sketch a diagram of existing and horizon year TMCs: 4-leg offset intersection: EB and WB legs each will have one travel lanes per direction, NB and SB legs will have 1-2 travel lane(s) per direction Existing AADT on Airport Road 8,400 Existing AADT on Old School Road 1,000 Existing AADT on Healey Road 1,500 See attached for existing AM / PM TMCs	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
3)	What operational problems are being experienced at this location? Delays on Old School Road and Healey Road currently at LOS D/LOS E	**YES** ☒ **NO** ☐ **NEUTRAL** ☐
4)	Is it a new intersection or a retrofit of an existing intersection? If existing, what is the existing type of traffic control? Retrofit of existing offset two-way stop controlled intersection.	**YES** ☒ **NO** ☐ **NEUTRAL** ☐

5)	Is the intersection near a major intersection or a railroad crossing? If so, how close and what type of traffic control exists at the adjacent intersection(s)? Will queues be a problem? Describe the corridor (eg.: average intersection spacing). Closest major intersection is signalized and about 2km to the south (Street A). Queues are not expected to be a problem. Average intersection spacing along this portion of Airport Road is 2-3km.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
6)	Would the intersection be located within a coordinated signal network? The signal network along this segment of Airport Road is not suitable for coordination due to the average intersection spacing of 2-3km and rural conditions.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
7)	Would the intersection be located on a preferred roundabout corridor? If yes why? The Airport Road corridor is a preferred roundabout corridor because it would maintain existing free-flow operation on Airport Road. Converting the signalized intersection of Airport Road and King Street would establish a 6km-long free-flow corridor.	**YES** ☒ **NO** ☐ **NEUTRAL** ☐
8)	What is the collision history of the intersection over the past five years? Is there a collision problem that needs to be addressed? There were two property damage only collisions at this intersection between 2006-2010, which are too few to establish a trend that can be rectified by improvements.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
9)	Is the intersection scheduled for improvements or is it located within a corridor that is scheduled for improvements in the next 10 years? What is the ultimate cross-section of the approaching legs? Airport Road is scheduled to be widened from two to five lanes by 2019.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒

10)	Are there expected to be special users at this intersection in the near future (ie. a person with disability, pedestrians, cyclists, large agricultural machinery, horses, etc.)? If yes, what special considerations would be required? There is a moderate volume of through truck traffic on Airport Road (5-7% heavy vehicles). Farm vehicles use this corridor. Few pedestrians have been observed within this segment of Airport Road.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
11)	What traditional improvements are proposed for this intersection (traffic signals, all-way stop, auxiliary lanes, off-set re-alignment, etc)? Single left turn lanes on the northbound and southbound approaches, traffic control (signals or roundabout) and offset realignment are proposed.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
12)	If traffic signals are considered, does it meet the warrant for the horizon year? Traffic signals are currently warranted.	**YES** ☒ **NO** ☐ **NEUTRAL** ☐
13)	What size of roundabout is being considered for this intersection (ie. single, two, three lane entry)? Please attach a Traffic Flow Worksheet, a lane configuration diagram and a sketch of how a roundabout would fit into the ROW. A roundabout with one-lane entries on all legs would result in an Inscribed Circle Diameter (ICD) of 40m, though such a roundabout would be near capacity by 2031. Traffic assessment indicates that a single-lane roundabout would function poorer than a two-lane roundabout. A roundabout with two-lane entries on the Airport Road legs would result in an ICD of at least 55m.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
14)	Are there property constraints at/near the intersection or is it restricted by a watercourse/parks/cemeteries/etc? If yes, what are they? A house exists at the northeast corner very close to the road right-of-way. Private driveways are located opposite each offset east-west leg.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒

15) Terrain – Is the area on a grade/flat/rolling?

The surrounding area is flat.

YES ☒
NO ☐
NEUTRAL ☐

16) 20 Year Life Cycle Cost Estimate

Injury Collision Cost (ICC): _____

Discount Rate (i): _____

YES ☐
NO ☐
NEUTRAL ☐

20 YEAR LIFE- CYCLE COST COMPARISON		
Cost Item	Other Traffic Control	Roundabout
Implementation Cost	$	$
Injury Collision Cost (Present Value)	$	$
Total Life Cycle Cost	$	$

Notes:

- Implementation Cost
  = sum of costs for construction, property, utility relocation, illumination, engineering (20%), contingency (20%) and maintenance (5%)
- Present Value of 20 Year Injury Collision Cost
  = expected annual collision frequency x ICC $((1+i)^{20}-1)/i(1+i)^{20}$
- Monte Carlo Analysis may be required. If so, a range for the implementation cost (i.e. 10%, 50%, 90% probability) is required

17)	Conclusions and Recommendations: A roundabout is recommended at this intersection. A single-lane roundabout will have less impact than a two-lane roundabout due to its smaller footprint, though traffic assessment indicates that it will operate at a poor level of service by 2031. A two-lane roundabout will require a roundabout that is slightly larger than the standard ROW along Airport Road. Significant property acquisition would be required for both offset intersection realignment or a roundabout. Truck volumes are expected to be 5% to 7% along Airport Road; this volume of trucks should have negligible effects on operating speeds through the roundabout and not increase delay significantly. The average arterial speed along Airport Road is high due to the existing free flow conditions with no interrupted flow, and a roundabout will help to maintain this condition. Consideration for farm vehicles should be made when designing a roundabout at this location.	**YES** ☒ **NO** ☐

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Roundabout Feasibility Screening Tool

		Roundabout Supportive?
1)	Project name, File #, Intersection Location (B/C/M, Street name, distance from major intersections, etc.): Airport Road and King Street	
2)	Brief description of Intersection (No. of legs, Lanes on each leg, Total AADT, ADDT on each road). Attach or sketch a diagram of existing and horizon year TMCs: 4-leg offset intersection: EB and WB legs each have one travel lanes per direction, NB and SB legs will have 1-2 travel lane(s) per direction Existing AADT on Airport Road 4,100 Existing AADT on Old School Road 3,600 See attached for existing AM / PM TMCs	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
3)	What operational problems are being experienced at this location? Minor delays on King Street with LOS D	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
4)	Is it a new intersection or a retrofit of an existing intersection? If existing, what is the existing type of traffic control? Existing signalized intersection with fully actuated control and no pedestrian push buttons	**YES** ☒ **NO** ☐ **NEUTRAL** ☐

5)	Is the intersection near a major intersection or a railroad crossing? If so, how close and what type of traffic control exists at the adjacent intersection(s)? Will queues be a problem? Describe the corridor (eg.: average intersection spacing). Subject intersection is a major intersection, with minor queuing. Nearest signalized intersection approximately 4-5km in all directions.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
6)	Would the intersection be located within a coordinated signal network? The signal network along this segment of Airport Road is not suitable for coordination due to the average intersection spacing of 2-3km and rural conditions.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
7)	Would the intersection be located on a preferred roundabout corridor? If yes why? The Airport Road corridor is a preferred roundabout corridor because it would increase free-flow operation on Airport Road northerly to Olde Base Line Road. Converting the signalized intersection of Airport Road and King Street would establish a 6km-long free-flow corridor along Airport Road and an 8km-long free-flow corridor along King Street.	**YES** ☒ **NO** ☐ **NEUTRAL** ☐
8)	What is the collision history of the intersection over the past five years? Is there a collision problem that needs to be addressed? -	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
9)	Is the intersection scheduled for improvements or is it located within a corridor that is scheduled for improvements in the next 10 years? What is the ultimate cross-section of the approaching legs? Airport Road is scheduled to be widened from two to five lanes by 2019.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒

10)	Are there expected to be special users at this intersection in the near future (ie. a person with disability, pedestrians, cyclists, large agricultural machinery, horses, etc.)? If yes, what special considerations would be required? There is a moderate volume of through truck traffic on Airport Road (5-7% heavy vehicles) and King Street (2-5%). Farm vehicles use the two corridors. Few pedestrians have been observed at this intersection.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
11)	What traditional improvements are proposed for this intersection (traffic signals, all-way stop, auxiliary lanes, off-set re-alignment, etc)? Northbound and westbound right turn lane in 2031	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
12)	If traffic signals are considered, does it meet the warrant for the horizon year? Exist	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
13)	What size of roundabout is being considered for this intersection (ie. single, two, three lane entry)? Please attach a Traffic Flow Worksheet, a lane configuration diagram and a sketch of how a roundabout would fit into the ROW. A roundabout with one-lane entries on all legs would result in an Inscribed Circle Diameter (ICD) of 40m, though such a roundabout would be near capacity by 2031. Traffic assessment indicates that a single-lane roundabout would function poorer than a two-lane roundabout. A roundabout with two-lane entries on the Airport Road legs would result in an ICD of at least 55m.	**YES** ☐ **NO** ☐ **NEUTRAL** ☒
14)	Are there property constraints at/near the intersection or is it restricted by a watercourse/parks/cemeteries/etc? If yes, what are they? Two structures exist on the north side of the intersection and are spaced approximately 30 metres apart, requiring a new roundabout to be constructed south of the intersection. Approved developments on the southeast corner further inhibit the ability to construct a roundabout.	**YES** ☐ **NO** ☒ **NEUTRAL** ☐

15) Terrain – Is the area on a grade/flat/rolling?

The surrounding area is flat.

YES ☒
NO ☐
NEUTRAL ☐

16) 20 Year Life Cycle Cost Estimate

Injury Collision Cost (ICC): _____

Discount Rate (i): _____

YES ☐
NO ☐
NEUTRAL ☐

20 YEAR LIFE- CYCLE COST COMPARISON		
Cost Item	Other Traffic Control	Roundabout
Implementation Cost	$	$
Injury Collision Cost (Present Value)	$	$
Total Life Cycle Cost	$	$

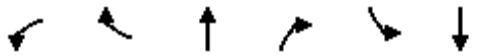
Notes:

- Implementation Cost
  = sum of costs for construction, property, utility relocation, illumination, engineering (20%), contingency (20%) and maintenance (5%)
- Present Value of 20 Year Injury Collision Cost
  = expected annual collision frequency x ICC $((1+i)^{20}-1)/i(1+i)^{20}$
- Monte Carlo Analysis may be required. If so, a range for the implementation cost (i.e. 10%, 50%, 90% probability) is required

17)	Conclusions and Recommendations: A roundabout is recommended at this intersection. A single-lane roundabout will have less impact than a two-lane roundabout due to its smaller footprint, though traffic assessment indicates that it will operate at a poor level of service by 2031. A two-lane roundabout will require a roundabout that is slightly larger than the available ROW along Airport Road. Significant property acquisition would be required for the roundabout. Truck volumes on both should have negligible effects on operating speeds through the roundabout and not increase delay significantly. The average arterial speed along Airport Road is high due to the existing free flow conditions with no interrupted flow, and a roundabout will help to maintain this condition. Traffic control exists currently in the form of traffic control signals.	**YES** ☐ **NO** ☒

Appendix F

2021 Intersection Operations – Do Nothing



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	230	15	213	522	28	995
v/c Ratio	0.67	0.05	0.11	0.49	0.04	0.43
Control Delay	48.8	14.7	7.5	2.5	7.9	9.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.8	14.7	7.5	2.5	7.9	9.9
Queue Length 50th (m)	43.4	0.0	7.6	0.0	1.8	46.1
Queue Length 95th (m)	67.9	5.2	14.7	12.5	5.9	72.5
Internal Link Dist (m)	124.0		413.6			265.7
Turn Bay Length (m)				145.0	70.0	
Base Capacity (vph)	589	537	1981	1061	719	2328
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.03	0.11	0.49	0.04	0.43

Intersection Summary

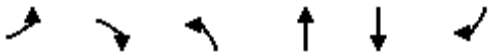
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	230	15	213	522	28	995
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.7	3.5	3.5	3.7
Total Lost time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1684	1507	3017	1342	1684	3544
Flt Permitted	0.95	1.00	1.00	1.00	0.62	1.00
Satd. Flow (perm)	1684	1507	3017	1342	1096	3544
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	230	15	213	522	28	995
RTOR Reduction (vph)	0	12	0	179	0	0
Lane Group Flow (vph)	230	3	213	343	28	995
Heavy Vehicles (%)	6%	6%	21%	19%	6%	3%
Turn Type		Perm		Perm	Perm	
Protected Phases	4		2			6
Permitted Phases		4		2	6	
Actuated Green, G (s)	21.3	21.3	69.2	69.2	69.2	69.2
Effective Green, g (s)	21.3	21.3	69.2	69.2	69.2	69.2
Actuated g/C Ratio	0.20	0.20	0.66	0.66	0.66	0.66
Clearance Time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	341	305	1983	882	720	2329
v/s Ratio Prot	c0.14		0.07			c0.28
v/s Ratio Perm		0.00		0.26	0.03	
v/c Ratio	0.67	0.01	0.11	0.39	0.04	0.43
Uniform Delay, d1	38.8	33.6	6.7	8.3	6.4	8.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.7	0.0	0.1	1.3	0.1	0.6
Delay (s)	45.5	33.6	6.8	9.6	6.5	9.2
Level of Service	D	C	A	A	A	A
Approach Delay (s)	44.8		8.8			9.1
Approach LOS	D		A			A

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	105.3	Sum of lost time (s)	14.8
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	35	94	181	26	218	1048
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	35	94	181	26	218	1048
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1678	194			207	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1678	194			207	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	60	89			84	
cM capacity (veh/h)	87	853			1370	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	129	207	1266
Volume Left	35	0	218
Volume Right	94	26	0
cSH	251	1700	1370
Volume to Capacity	0.51	0.12	0.16
Queue Length 95th (m)	20.4	0.0	4.3
Control Delay (s)	33.5	0.0	4.2
Lane LOS	D		A
Approach Delay (s)	33.5	0.0	4.2
Approach LOS	D		

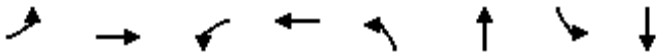
Intersection Summary			
Average Delay	6.0		
Intersection Capacity Utilization	96.0%	ICU Level of Service	F
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	5	195	70	205	1071	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	195	70	205	1071	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1416	1071	1076			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1416	1071	1076			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	28	89			
cM capacity (veh/h)	136	270	648			

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	200	275	1071	5
Volume Left	5	70	0	0
Volume Right	195	0	0	5
cSH	263	648	1700	1700
Volume to Capacity	0.76	0.11	0.63	0.00
Queue Length 95th (m)	42.3	2.7	0.0	0.0
Control Delay (s)	51.9	3.9	0.0	0.0
Lane LOS	F	A		
Approach Delay (s)	51.9	3.9	0.0	
Approach LOS	F			

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	91.0%	ICU Level of Service	E
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	22	302	132	416	9	154	153	700
v/c Ratio	0.14	0.54	0.46	0.72	0.08	0.20	0.27	0.81
Control Delay	19.1	22.2	24.8	28.4	12.1	9.1	12.1	24.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.1	22.2	24.8	28.4	12.1	9.1	12.1	24.2
Queue Length 50th (m)	2.0	29.7	13.3	45.8	0.6	8.7	11.2	73.1
Queue Length 95th (m)	6.9	51.0	28.2	74.4	3.1	18.2	22.3	#134.8
Internal Link Dist (m)		1346.7		1342.5		2950.1		3069.4
Turn Bay Length (m)	60.0		35.0		40.0		35.0	
Base Capacity (vph)	183	635	325	653	117	822	606	910
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.48	0.41	0.64	0.08	0.19	0.25	0.77

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	253	49	132	392	24	9	119	35	153	653	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1428	1785		1716	1855		1020	1570		1700	1763	
Flt Permitted	0.35	1.00		0.51	1.00		0.21	1.00		0.66	1.00	
Satd. Flow (perm)	524	1785		928	1855		227	1570		1180	1763	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	22	253	49	132	392	24	9	119	35	153	653	47
RTOR Reduction (vph)	0	10	0	0	3	0	0	15	0	0	4	0
Lane Group Flow (vph)	22	292	0	132	413	0	9	139	0	153	696	0
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	75%	20%	12%	5%	8%	6%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)	20.5	20.5		20.5	20.5		32.5	32.5		32.5	32.5	
Effective Green, g (s)	20.5	20.5		20.5	20.5		32.5	32.5		32.5	32.5	
Actuated g/C Ratio	0.31	0.31		0.31	0.31		0.49	0.49		0.49	0.49	
Clearance Time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	162	553		287	574		111	771		579	866	
v/s Ratio Prot		0.16			c0.22			0.09			c0.40	
v/s Ratio Perm	0.04			0.14			0.04			0.13		
v/c Ratio	0.14	0.53		0.46	0.72		0.08	0.18		0.26	0.80	
Uniform Delay, d1	16.5	18.9		18.4	20.3		8.9	9.4		9.9	14.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	1.7		2.4	5.3		0.7	0.2		0.5	6.2	
Delay (s)	17.3	20.6		20.8	25.6		9.6	9.6		10.4	20.4	
Level of Service	B	C		C	C		A	A		B	C	
Approach Delay (s)		20.4			24.4			9.6			18.6	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	19.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	66.2	Sum of lost time (s)	13.2
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	635	30	918	220	9	484
v/c Ratio	0.85	0.04	0.62	0.28	0.06	0.33
Control Delay	37.9	5.2	27.7	4.4	24.4	22.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.9	5.2	27.7	4.4	24.4	22.9
Queue Length 50th (m)	111.1	0.0	74.7	0.0	1.1	33.7
Queue Length 95th (m)	156.2	4.7	121.1	15.8	5.2	58.5
Internal Link Dist (m)	124.0		413.6			265.7
Turn Bay Length (m)				145.0	70.0	
Base Capacity (vph)	1031	934	1480	775	154	1466
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.03	0.62	0.28	0.06	0.33

Intersection Summary

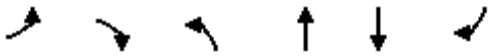
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	635	30	918	220	9	484
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.7	3.5	3.5	3.7
Total Lost time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1716	1536	3510	1536	1716	3476
Flt Permitted	0.95	1.00	1.00	1.00	0.20	1.00
Satd. Flow (perm)	1716	1536	3510	1536	364	3476
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	635	30	918	220	9	484
RTOR Reduction (vph)	0	17	0	127	0	0
Lane Group Flow (vph)	635	13	918	93	9	484
Heavy Vehicles (%)	4%	4%	4%	4%	4%	5%
Turn Type		Perm		Perm	Perm	
Protected Phases	4		2			6
Permitted Phases		4		2	6	
Actuated Green, G (s)	45.2	45.2	43.9	43.9	43.9	43.9
Effective Green, g (s)	45.2	45.2	43.9	43.9	43.9	43.9
Actuated g/C Ratio	0.44	0.44	0.42	0.42	0.42	0.42
Clearance Time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	747	668	1483	649	154	1469
v/s Ratio Prot	c0.37		c0.26			0.14
v/s Ratio Perm		0.01		0.06	0.02	
v/c Ratio	0.85	0.02	0.62	0.14	0.06	0.33
Uniform Delay, d1	26.3	16.7	23.5	18.4	17.8	20.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.0	0.0	1.9	0.5	0.7	0.6
Delay (s)	36.3	16.7	25.4	18.9	18.5	20.7
Level of Service	D	B	C	B	B	C
Approach Delay (s)	35.4		24.2			20.7
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	103.9	Sum of lost time (s)	14.8
Intersection Capacity Utilization	72.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	55	366	911	27	95	345
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	55	366	911	27	95	345
Pedestrians			4			
Lane Width (m)			3.7			
Walking Speed (m/s)			4.0			
Percent Blockage			0			
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1464	924			938	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1464	924			938	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	56	0			87	
cM capacity (veh/h)	124	328			722	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	421	938	440
Volume Left	55	0	95
Volume Right	366	27	0
cSH	270	1700	722
Volume to Capacity	1.56	0.55	0.13
Queue Length 95th (m)	191.3	0.0	3.4
Control Delay (s)	303.3	0.0	3.7
Lane LOS	F		A
Approach Delay (s)	303.3	0.0	3.7
Approach LOS	F		

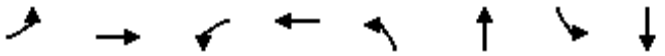
Intersection Summary			
Average Delay	71.9		
Intersection Capacity Utilization	108.6%	ICU Level of Service	G
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	15	90	243	1033	351	9
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	15	90	243	1033	351	9
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1870	351	360			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1870	351	360			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	87	80			
cM capacity (veh/h)	64	695	1193			

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	105	1276	351	9
Volume Left	15	243	0	0
Volume Right	90	0	0	9
cSH	288	1193	1700	1700
Volume to Capacity	0.36	0.20	0.21	0.01
Queue Length 95th (m)	12.2	5.8	0.0	0.0
Control Delay (s)	24.5	5.4	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	24.5	5.4	0.0	
Approach LOS	C			

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	102.7%	ICU Level of Service	G
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	56	387	50	433	59	866	74	273
v/c Ratio	0.45	0.77	0.35	0.87	0.10	0.86	0.59	0.29
Control Delay	34.4	35.7	28.7	43.4	8.5	25.0	36.0	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.4	35.7	28.7	43.4	8.5	25.0	36.0	9.3
Queue Length 50th (m)	6.1	46.0	5.3	49.8	3.5	88.8	6.1	16.9
Queue Length 95th (m)	#17.7	#84.3	14.7	#97.2	8.6	#165.1	#26.8	29.8
Internal Link Dist (m)		1346.7		1342.5		2950.1		3069.4
Turn Bay Length (m)	60.0		35.0		40.0		35.0	
Base Capacity (vph)	128	513	146	506	569	1004	125	929
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.75	0.34	0.86	0.10	0.86	0.59	0.29

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	56	370	17	50	292	141	59	764	102	74	242	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1716	1872		1526	1763		1684	1836		1668	1700	
Flt Permitted	0.26	1.00		0.33	1.00		0.59	1.00		0.13	1.00	
Satd. Flow (perm)	469	1872		535	1763		1048	1836		230	1700	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	56	370	17	50	292	141	59	764	102	74	242	31
RTOR Reduction (vph)	0	2	0	0	25	0	0	7	0	0	6	0
Lane Group Flow (vph)	56	385	0	50	408	0	59	859	0	74	267	0
Heavy Vehicles (%)	4%	2%	1%	17%	4%	3%	6%	3%	1%	7%	12%	4%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)	18.6	18.6		18.6	18.6		37.8	37.8		37.8	37.8	
Effective Green, g (s)	18.6	18.6		18.6	18.6		37.8	37.8		37.8	37.8	
Actuated g/C Ratio	0.27	0.27		0.27	0.27		0.54	0.54		0.54	0.54	
Clearance Time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	125	500		143	471		569	997		125	923	
v/s Ratio Prot		0.21			c0.23			c0.47			0.16	
v/s Ratio Perm	0.12			0.09			0.06			0.32		
v/c Ratio	0.45	0.77		0.35	0.87		0.10	0.86		0.59	0.29	
Uniform Delay, d1	21.2	23.5		20.6	24.3		7.7	13.7		10.7	8.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	8.2		3.1	16.6		0.2	8.4		10.9	0.4	
Delay (s)	26.5	31.8		23.7	40.9		7.9	22.1		21.6	9.0	
Level of Service	C	C		C	D		A	C		C	A	
Approach Delay (s)		31.1			39.1			21.2			11.7	
Approach LOS		C			D			C			B	

Intersection Summary			
HCM Average Control Delay	25.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	69.6	Sum of lost time (s)	13.2
Intersection Capacity Utilization	105.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Appendix G

2021 Intersection Operations at Offset Old School Road/Healey Road

Lane Group	EBT	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	200	129	207	54	1022
v/c Ratio	0.60	0.50	0.20	0.07	0.86
Control Delay	39.6	36.1	6.3	6.2	21.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	39.6	36.1	6.3	6.2	21.5
Queue Length 50th (m)	29.8	17.7	11.4	3.0	120.9
Queue Length 95th (m)	50.9	34.5	21.0	7.2	#230.9
Internal Link Dist (m)	3361.2	290.8	1946.4		2950.1
Turn Bay Length (m)				40.0	
Base Capacity (vph)	389	304	1081	777	1237
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.51	0.42	0.19	0.07	0.83

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

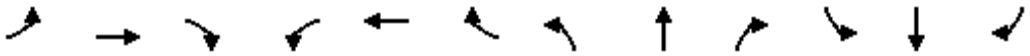
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)		7.0			7.0			7.3		7.3	7.3	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frt		0.98			0.97			0.98		1.00	1.00	
Flt Protected		1.00			0.99			1.00		0.95	1.00	
Satd. Flow (prot)		1822			1782			1605		1733	1827	
Flt Permitted		0.99			0.77			0.99		0.63	1.00	
Satd. Flow (perm)		1808			1387			1588		1146	1827	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
RTOR Reduction (vph)	0	7	0	0	11	0	0	6	0	0	0	0
Lane Group Flow (vph)	0	193	0	0	118	0	0	201	0	54	1022	0
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	18%	11%	3%	5%	25%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		15.3			15.3			56.0		56.0	56.0	
Effective Green, g (s)		15.3			15.3			56.0		56.0	56.0	
Actuated g/C Ratio		0.18			0.18			0.65		0.65	0.65	
Clearance Time (s)		7.0			7.0			7.3		7.3	7.3	
Vehicle Extension (s)		5.0			5.0			5.0		5.0	5.0	
Lane Grp Cap (vph)		323			248			1039		750	1195	
v/s Ratio Prot											c0.56	
v/s Ratio Perm		c0.11			0.09			0.13		0.05		
v/c Ratio		0.60			0.48			0.19		0.07	0.85	
Uniform Delay, d1		32.3			31.6			5.9		5.4	11.6	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		4.4			3.0			0.2		0.1	6.8	
Delay (s)		36.7			34.6			6.1		5.5	18.4	
Level of Service		D			C			A		A	B	
Approach Delay (s)		36.7			34.6			6.1			17.7	
Approach LOS		D			C			A			B	

Intersection Summary			
HCM Average Control Delay	19.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	85.6	Sum of lost time (s)	14.3
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBT	SBL	SBT
Lane Group Flow (vph)	105	420	938	19	341
v/c Ratio	0.23	0.89	0.91	0.08	0.35
Control Delay	24.8	52.3	31.8	10.2	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	24.8	52.3	31.8	10.2	11.7
Queue Length 50th (m)	12.9	65.0	136.1	1.4	29.8
Queue Length 95th (m)	25.7	#116.4	#225.6	4.7	46.7
Internal Link Dist (m)	3361.2	290.8	1946.4		2950.1
Turn Bay Length (m)				40.0	
Base Capacity (vph)	464	488	1034	236	976
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.86	0.91	0.08	0.35

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

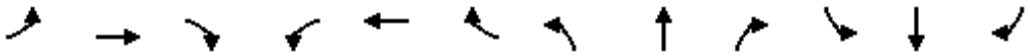


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	77	13	55	227	138	16	895	27	19	332	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)		7.0			7.0			7.3		7.3	7.3	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00			1.00		1.00	1.00	
Flpb, ped/bikes		1.00			1.00			1.00		1.00	1.00	
Frt		0.98			0.96			1.00		1.00	1.00	
Flt Protected		0.99			0.99			1.00		0.95	1.00	
Satd. Flow (prot)		1805			1766			1828		1475	1713	
Flt Permitted		0.90			0.94			0.99		0.27	1.00	
Satd. Flow (perm)		1632			1668			1814		415	1713	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	77	13	55	227	138	16	895	27	19	332	9
RTOR Reduction (vph)	0	6	0	0	20	0	0	1	0	0	1	0
Lane Group Flow (vph)	0	99	0	0	400	0	0	937	0	19	340	0
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	12%	0%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)		24.1			24.1			50.7		50.7	50.7	
Effective Green, g (s)		24.1			24.1			50.7		50.7	50.7	
Actuated g/C Ratio		0.27			0.27			0.57		0.57	0.57	
Clearance Time (s)		7.0			7.0			7.3		7.3	7.3	
Vehicle Extension (s)		5.0			5.0			5.0		5.0	5.0	
Lane Grp Cap (vph)		441			451			1032		236	975	
v/s Ratio Prot											0.20	
v/s Ratio Perm		0.06			c0.24			c0.52		0.05		
v/c Ratio		0.22			0.89			0.91		0.08	0.35	
Uniform Delay, d1		25.2			31.2			17.1		8.7	10.3	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.5			19.8			12.0		0.3	0.5	
Delay (s)		25.8			51.0			29.1		9.0	10.8	
Level of Service		C			D			C		A	B	
Approach Delay (s)		25.8			51.0			29.1			10.7	
Approach LOS		C			D			C			B	

Intersection Summary			
HCM Average Control Delay	30.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	89.1	Sum of lost time (s)	14.3
Intersection Capacity Utilization	103.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Appendix H

2021 Intersection Operations at Realigned Old School Road - Healey Road with Auxiliary Lanes



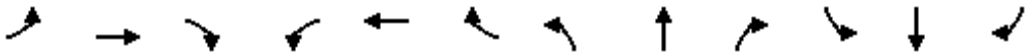
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
v/c Ratio	0.02	0.53	0.11	0.18	0.21	0.09	0.03	0.16	0.03	0.07	0.85	0.01
Control Delay	27.0	36.5	16.3	30.0	29.6	11.9	6.3	6.2	2.3	5.8	20.4	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.0	36.5	16.3	30.0	29.6	11.9	6.3	6.2	2.3	5.8	20.4	5.0
Queue Length 50th (m)	0.6	20.6	1.2	4.1	8.0	0.0	0.1	8.7	0.0	2.5	100.0	0.2
Queue Length 95th (m)	3.2	37.0	7.4	11.2	17.5	5.8	1.0	16.1	2.3	6.2	#192.9	1.2
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		7.0	30.0		30.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	252	350	318	222	353	322	110	1083	950	770	1197	837
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.47	0.10	0.16	0.19	0.08	0.03	0.16	0.03	0.07	0.85	0.01

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1860	1597	1716	1879	1597	1190	1656	1439	1733	1830	1278
Flt Permitted	0.71	1.00	1.00	0.65	1.00	1.00	0.13	1.00	1.00	0.64	1.00	1.00
Satd. Flow (perm)	1340	1860	1597	1180	1879	1597	168	1656	1439	1177	1830	1278
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
RTOR Reduction (vph)	0	0	18	0	0	23	0	0	9	0	0	0
Lane Group Flow (vph)	5	164	14	35	67	5	3	178	17	54	1017	5
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	16%	11%	3%	5%	25%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	13.3	13.3	13.3	13.3	13.3	13.3	52.2	52.2	52.2	52.2	52.2	52.2
Effective Green, g (s)	13.3	13.3	13.3	13.3	13.3	13.3	52.2	52.2	52.2	52.2	52.2	52.2
Actuated g/C Ratio	0.17	0.17	0.17	0.17	0.17	0.17	0.65	0.65	0.65	0.65	0.65	0.65
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	223	310	266	197	313	266	110	1083	941	770	1197	836
v/s Ratio Prot		c0.09			0.04			0.11			c0.56	
v/s Ratio Perm	0.00		0.01	0.03		0.00	0.02		0.01	0.05		0.00
v/c Ratio	0.02	0.53	0.05	0.18	0.21	0.02	0.03	0.16	0.02	0.07	0.85	0.01
Uniform Delay, d1	27.8	30.4	27.9	28.6	28.7	27.8	4.9	5.3	4.8	5.0	10.7	4.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	3.1	0.2	0.9	0.7	0.1	0.2	0.2	0.0	0.1	6.4	0.0
Delay (s)	27.9	33.5	28.1	29.5	29.5	27.8	5.1	5.5	4.8	5.1	17.2	4.8
Level of Service	C	C	C	C	C	C	A	A	A	A	B	A
Approach Delay (s)		32.5			29.1			5.4			16.5	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	18.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	79.8	Sum of lost time (s)	14.3
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

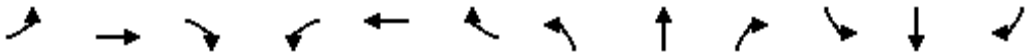


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	22	253	49	132	392	24	9	119	35	153	653	47
v/c Ratio	0.13	0.46	0.10	0.42	0.70	0.05	0.07	0.15	0.05	0.25	0.74	0.06
Control Delay	19.6	22.4	6.8	23.8	28.3	7.9	10.8	10.1	3.5	11.4	19.9	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.6	22.4	6.8	23.8	28.3	7.9	10.8	10.1	3.5	11.4	19.9	5.7
Queue Length 50th (m)	1.9	24.0	0.3	12.3	40.5	0.1	0.5	7.3	0.0	10.0	58.6	1.3
Queue Length 95th (m)	6.4	41.4	6.2	25.5	65.6	4.2	2.7	14.7	3.4	19.6	94.5	5.4
Internal Link Dist (m)		1346.7			1342.5			2950.1			3069.4	
Turn Bay Length (m)	30.0		14.0	30.0		28.0	30.0		21.0	35.0		14.0
Base Capacity (vph)	195	630	576	366	648	519	150	872	814	664	968	854
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.40	0.09	0.36	0.60	0.05	0.06	0.14	0.04	0.23	0.67	0.06

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	253	49	132	392	24	9	119	35	153	653	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1428	1830	1521	1716	1883	1401	1020	1601	1426	1700	1779	1507
Flt Permitted	0.38	1.00	1.00	0.59	1.00	1.00	0.26	1.00	1.00	0.68	1.00	1.00
Satd. Flow (perm)	565	1830	1521	1064	1883	1401	275	1601	1426	1218	1779	1507
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	22	253	49	132	392	24	9	119	35	153	653	47
RTOR Reduction (vph)	0	0	31	0	0	16	0	0	17	0	0	11
Lane Group Flow (vph)	22	253	18	132	392	8	9	119	18	153	653	36
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	75%	20%	12%	5%	8%	6%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	19.5	19.5	19.5	19.5	19.5	19.5	32.3	32.3	32.3	32.3	32.3	32.3
Effective Green, g (s)	19.5	19.5	20.5	19.5	19.5	20.5	32.3	32.3	33.3	32.3	32.3	33.3
Actuated g/C Ratio	0.30	0.30	0.32	0.30	0.30	0.32	0.50	0.50	0.51	0.50	0.50	0.51
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	170	549	480	319	565	442	137	796	731	605	884	772
v/s Ratio Prot		0.14			c0.21			0.07			c0.37	
v/s Ratio Perm	0.04		0.01	0.12		0.01	0.03		0.01	0.13		0.02
v/c Ratio	0.13	0.46	0.04	0.41	0.69	0.02	0.07	0.15	0.02	0.25	0.74	0.05
Uniform Delay, d1	16.6	18.5	15.4	18.2	20.1	15.3	8.5	8.9	7.8	9.4	13.0	7.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	1.3	0.1	1.8	4.7	0.0	0.4	0.2	0.0	0.5	4.0	0.1
Delay (s)	17.3	19.8	15.5	20.0	24.8	15.4	8.9	9.1	7.9	9.9	16.9	8.0
Level of Service	B	B	B	C	C	B	A	A	A	A	B	A
Approach Delay (s)		18.9			23.2			8.8			15.2	
Approach LOS		B			C			A			B	

Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



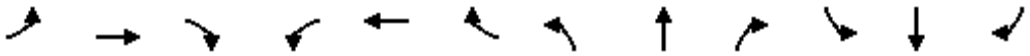
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	15	77	13	55	227	138	16	895	27	19	332	9
v/c Ratio	0.07	0.20	0.04	0.21	0.61	0.32	0.03	0.82	0.03	0.13	0.32	0.01
Control Delay	23.0	24.3	12.3	25.0	32.6	7.1	6.6	19.9	5.3	9.2	8.4	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.0	24.3	12.3	25.0	32.6	7.1	6.6	19.9	5.3	9.2	8.4	4.2
Queue Length 50th (m)	1.4	7.6	0.0	5.5	24.7	0.0	0.8	78.9	0.9	0.9	18.6	0.1
Queue Length 95th (m)	5.5	17.0	3.6	13.5	43.3	11.4	2.8	#150.6	3.4	3.8	31.0	1.5
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		7.0	30.0		30.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	238	414	320	290	409	455	472	1102	892	152	1051	956
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.19	0.04	0.19	0.56	0.30	0.03	0.81	0.03	0.13	0.32	0.01

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	77	13	55	227	138	16	895	27	19	332	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1879	1410	1770	1860	1581	1342	1847	1490	1475	1762	1597
Flt Permitted	0.58	1.00	1.00	0.71	1.00	1.00	0.56	1.00	1.00	0.16	1.00	1.00
Satd. Flow (perm)	1085	1879	1410	1317	1860	1581	792	1847	1490	255	1762	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	77	13	55	227	138	16	895	27	19	332	9
RTOR Reduction (vph)	0	0	10	0	0	110	0	0	3	0	0	3
Lane Group Flow (vph)	15	77	3	55	227	28	16	895	24	19	332	6
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	9%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	13.7	13.7	13.7	13.7	13.7	13.7	40.3	40.3	40.3	40.3	40.3	40.3
Effective Green, g (s)	13.7	13.7	13.7	13.7	13.7	13.7	40.3	40.3	40.3	40.3	40.3	40.3
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20	0.20	0.59	0.59	0.59	0.59	0.59	0.59
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	218	377	283	264	373	317	467	1090	879	150	1040	942
v/s Ratio Prot		0.04			c0.12			c0.48			0.19	
v/s Ratio Perm	0.01		0.00	0.04		0.02	0.02		0.02	0.07		0.00
v/c Ratio	0.07	0.20	0.01	0.21	0.61	0.09	0.03	0.82	0.03	0.13	0.32	0.01
Uniform Delay, d1	22.1	22.8	21.9	22.8	24.9	22.2	5.9	11.1	5.8	6.2	7.1	5.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.6	0.0	0.8	4.1	0.2	0.1	5.7	0.0	0.8	0.4	0.0
Delay (s)	22.4	23.3	21.9	23.6	29.0	22.5	5.9	16.8	5.9	7.0	7.4	5.8
Level of Service	C	C	C	C	C	C	A	B	A	A	A	A
Approach Delay (s)		23.0			26.1			16.3			7.4	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	17.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	68.3	Sum of lost time (s)	14.3
Intersection Capacity Utilization	80.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	56	370	17	50	292	141	59	764	102	74	242	31
v/c Ratio	0.22	0.72	0.04	0.30	0.58	0.26	0.10	0.78	0.12	0.41	0.27	0.04
Control Delay	21.9	31.3	12.5	25.4	26.5	5.2	9.0	20.0	4.4	18.7	10.0	3.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	31.3	12.5	25.4	26.5	5.2	9.0	20.0	4.4	18.7	10.0	3.2
Queue Length 50th (m)	5.1	39.4	0.6	4.7	29.7	0.0	3.3	68.6	2.2	5.0	14.9	0.0
Queue Length 95th (m)	13.0	64.3	4.2	12.8	50.1	10.1	8.2	#109.8	7.8	15.6	26.1	3.0
Internal Link Dist (m)		1346.7			1342.5			2950.1			3069.4	
Turn Bay Length (m)	30.0		14.0	30.0		28.0	30.0		21.0	35.0		14.0
Base Capacity (vph)	274	565	505	182	555	586	596	1030	923	189	948	885
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.65	0.03	0.27	0.53	0.24	0.10	0.74	0.11	0.39	0.26	0.04

Intersection Summary

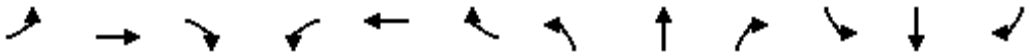
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	56	370	17	50	292	141	59	764	102	74	242	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1716	1883	1581	1526	1847	1551	1684	1865	1581	1668	1715	1536
Flt Permitted	0.50	1.00	1.00	0.38	1.00	1.00	0.61	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	911	1883	1581	605	1847	1551	1078	1865	1581	342	1715	1536
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	56	370	17	50	292	141	59	764	102	74	242	31
RTOR Reduction (vph)	0	0	7	0	0	100	0	0	27	0	0	14
Lane Group Flow (vph)	56	370	10	50	292	41	59	764	75	74	242	17
Heavy Vehicles (%)	4%	2%	1%	17%	4%	3%	6%	3%	1%	7%	12%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	18.4	18.4	18.4	18.4	18.4	18.4	35.5	35.5	35.5	35.5	35.5	35.5
Effective Green, g (s)	18.4	18.4	19.4	18.4	18.4	19.4	35.5	35.5	36.5	35.5	35.5	36.5
Actuated g/C Ratio	0.27	0.27	0.29	0.27	0.27	0.29	0.53	0.53	0.54	0.53	0.53	0.54
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	250	516	457	166	506	448	570	987	860	181	907	836
v/s Ratio Prot		c0.20			0.16			c0.41			0.14	
v/s Ratio Perm	0.06		0.01	0.08		0.03	0.05		0.05	0.22		0.01
v/c Ratio	0.22	0.72	0.02	0.30	0.58	0.09	0.10	0.77	0.09	0.41	0.27	0.02
Uniform Delay, d1	18.8	22.0	17.1	19.3	21.0	17.4	7.9	12.6	7.3	9.5	8.7	7.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	5.8	0.0	2.1	2.5	0.2	0.2	4.5	0.1	3.1	0.3	0.0
Delay (s)	19.8	27.8	17.1	21.4	23.5	17.6	8.0	17.1	7.4	12.6	9.0	7.1
Level of Service	B	C	B	C	C	B	A	B	A	B	A	A
Approach Delay (s)		26.4			21.6			15.4			9.6	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	18.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	67.1	Sum of lost time (s)	13.2
Intersection Capacity Utilization	95.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix I

2021 Intersection Operations at Airport Road and King Street with Auxiliary Lanes



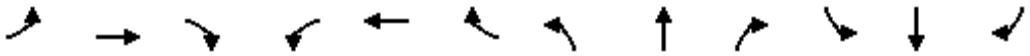
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
v/c Ratio	0.02	0.53	0.11	0.18	0.21	0.09	0.03	0.16	0.03	0.07	0.85	0.01
Control Delay	27.0	36.5	16.3	30.0	29.6	11.9	6.3	6.2	2.3	5.8	20.4	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.0	36.5	16.3	30.0	29.6	11.9	6.3	6.2	2.3	5.8	20.4	5.0
Queue Length 50th (m)	0.6	20.6	1.2	4.1	8.0	0.0	0.1	8.7	0.0	2.5	100.0	0.2
Queue Length 95th (m)	3.2	37.0	7.4	11.2	17.5	5.8	1.0	16.1	2.3	6.2	#192.9	1.2
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		7.0	30.0		30.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	252	350	318	222	353	322	110	1083	950	770	1197	837
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.47	0.10	0.16	0.19	0.08	0.03	0.16	0.03	0.07	0.85	0.01

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1860	1597	1716	1879	1597	1190	1656	1439	1733	1830	1278
Flt Permitted	0.71	1.00	1.00	0.65	1.00	1.00	0.13	1.00	1.00	0.64	1.00	1.00
Satd. Flow (perm)	1340	1860	1597	1180	1879	1597	168	1656	1439	1177	1830	1278
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
RTOR Reduction (vph)	0	0	18	0	0	23	0	0	9	0	0	0
Lane Group Flow (vph)	5	164	14	35	67	5	3	178	17	54	1017	5
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	16%	11%	3%	5%	25%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	13.3	13.3	13.3	13.3	13.3	13.3	52.2	52.2	52.2	52.2	52.2	52.2
Effective Green, g (s)	13.3	13.3	13.3	13.3	13.3	13.3	52.2	52.2	52.2	52.2	52.2	52.2
Actuated g/C Ratio	0.17	0.17	0.17	0.17	0.17	0.17	0.65	0.65	0.65	0.65	0.65	0.65
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	223	310	266	197	313	266	110	1083	941	770	1197	836
v/s Ratio Prot		c0.09			0.04			0.11			c0.56	
v/s Ratio Perm	0.00		0.01	0.03		0.00	0.02		0.01	0.05		0.00
v/c Ratio	0.02	0.53	0.05	0.18	0.21	0.02	0.03	0.16	0.02	0.07	0.85	0.01
Uniform Delay, d1	27.8	30.4	27.9	28.6	28.7	27.8	4.9	5.3	4.8	5.0	10.7	4.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	3.1	0.2	0.9	0.7	0.1	0.2	0.2	0.0	0.1	6.4	0.0
Delay (s)	27.9	33.5	28.1	29.5	29.5	27.8	5.1	5.5	4.8	5.1	17.2	4.8
Level of Service	C	C	C	C	C	C	A	A	A	A	B	A
Approach Delay (s)		32.5			29.1			5.4			16.5	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	18.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	79.8	Sum of lost time (s)	14.3
Intersection Capacity Utilization	86.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

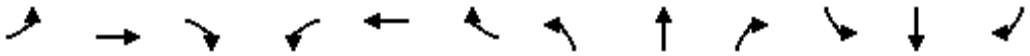


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	22	253	49	132	392	24	9	119	35	153	653	47
v/c Ratio	0.13	0.46	0.10	0.42	0.70	0.05	0.07	0.15	0.05	0.25	0.74	0.06
Control Delay	19.6	22.4	6.8	23.8	28.3	7.9	10.8	10.1	3.5	11.4	19.9	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.6	22.4	6.8	23.8	28.3	7.9	10.8	10.1	3.5	11.4	19.9	5.7
Queue Length 50th (m)	1.9	24.0	0.3	12.3	40.5	0.1	0.5	7.3	0.0	10.0	58.6	1.3
Queue Length 95th (m)	6.4	41.4	6.2	25.5	65.6	4.2	2.7	14.7	3.4	19.6	94.5	5.4
Internal Link Dist (m)		1346.7			1342.5			2950.1			3069.4	
Turn Bay Length (m)	30.0		14.0	30.0		28.0	30.0		21.0	35.0		14.0
Base Capacity (vph)	195	630	576	366	648	519	150	872	814	664	968	854
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.40	0.09	0.36	0.60	0.05	0.06	0.14	0.04	0.23	0.67	0.06

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	253	49	132	392	24	9	119	35	153	653	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1428	1830	1521	1716	1883	1401	1020	1601	1426	1700	1779	1507
Flt Permitted	0.38	1.00	1.00	0.59	1.00	1.00	0.26	1.00	1.00	0.68	1.00	1.00
Satd. Flow (perm)	565	1830	1521	1064	1883	1401	275	1601	1426	1218	1779	1507
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	22	253	49	132	392	24	9	119	35	153	653	47
RTOR Reduction (vph)	0	0	31	0	0	16	0	0	17	0	0	11
Lane Group Flow (vph)	22	253	18	132	392	8	9	119	18	153	653	36
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	75%	20%	12%	5%	8%	6%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	19.5	19.5	19.5	19.5	19.5	19.5	32.3	32.3	32.3	32.3	32.3	32.3
Effective Green, g (s)	19.5	19.5	20.5	19.5	19.5	20.5	32.3	32.3	33.3	32.3	32.3	33.3
Actuated g/C Ratio	0.30	0.30	0.32	0.30	0.30	0.32	0.50	0.50	0.51	0.50	0.50	0.51
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	170	549	480	319	565	442	137	796	731	605	884	772
v/s Ratio Prot		0.14			c0.21			0.07			c0.37	
v/s Ratio Perm	0.04		0.01	0.12		0.01	0.03		0.01	0.13		0.02
v/c Ratio	0.13	0.46	0.04	0.41	0.69	0.02	0.07	0.15	0.02	0.25	0.74	0.05
Uniform Delay, d1	16.6	18.5	15.4	18.2	20.1	15.3	8.5	8.9	7.8	9.4	13.0	7.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	1.3	0.1	1.8	4.7	0.0	0.4	0.2	0.0	0.5	4.0	0.1
Delay (s)	17.3	19.8	15.5	20.0	24.8	15.4	8.9	9.1	7.9	9.9	16.9	8.0
Level of Service	B	B	B	C	C	B	A	A	A	A	B	A
Approach Delay (s)		18.9			23.2			8.8			15.2	
Approach LOS		B			C			A			B	

Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



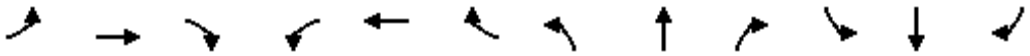
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	15	77	13	55	227	138	16	895	27	19	332	9
v/c Ratio	0.07	0.20	0.04	0.21	0.61	0.32	0.03	0.82	0.03	0.13	0.32	0.01
Control Delay	23.0	24.3	12.3	25.0	32.6	7.1	6.6	19.9	5.3	9.2	8.4	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.0	24.3	12.3	25.0	32.6	7.1	6.6	19.9	5.3	9.2	8.4	4.2
Queue Length 50th (m)	1.4	7.6	0.0	5.5	24.7	0.0	0.8	78.9	0.9	0.9	18.6	0.1
Queue Length 95th (m)	5.5	17.0	3.6	13.5	43.3	11.4	2.8	#150.6	3.4	3.8	31.0	1.5
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		7.0	30.0		30.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	238	414	320	290	409	455	472	1102	892	152	1051	956
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.19	0.04	0.19	0.56	0.30	0.03	0.81	0.03	0.13	0.32	0.01

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	77	13	55	227	138	16	895	27	19	332	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1879	1410	1770	1860	1581	1342	1847	1490	1475	1762	1597
Flt Permitted	0.58	1.00	1.00	0.71	1.00	1.00	0.56	1.00	1.00	0.16	1.00	1.00
Satd. Flow (perm)	1085	1879	1410	1317	1860	1581	792	1847	1490	255	1762	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	77	13	55	227	138	16	895	27	19	332	9
RTOR Reduction (vph)	0	0	10	0	0	110	0	0	3	0	0	3
Lane Group Flow (vph)	15	77	3	55	227	28	16	895	24	19	332	6
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	9%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	13.7	13.7	13.7	13.7	13.7	13.7	40.3	40.3	40.3	40.3	40.3	40.3
Effective Green, g (s)	13.7	13.7	13.7	13.7	13.7	13.7	40.3	40.3	40.3	40.3	40.3	40.3
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20	0.20	0.59	0.59	0.59	0.59	0.59	0.59
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	218	377	283	264	373	317	467	1090	879	150	1040	942
v/s Ratio Prot		0.04			c0.12			c0.48			0.19	
v/s Ratio Perm	0.01		0.00	0.04		0.02	0.02		0.02	0.07		0.00
v/c Ratio	0.07	0.20	0.01	0.21	0.61	0.09	0.03	0.82	0.03	0.13	0.32	0.01
Uniform Delay, d1	22.1	22.8	21.9	22.8	24.9	22.2	5.9	11.1	5.8	6.2	7.1	5.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.6	0.0	0.8	4.1	0.2	0.1	5.7	0.0	0.8	0.4	0.0
Delay (s)	22.4	23.3	21.9	23.6	29.0	22.5	5.9	16.8	5.9	7.0	7.4	5.8
Level of Service	C	C	C	C	C	C	A	B	A	A	A	A
Approach Delay (s)		23.0			26.1			16.3			7.4	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	17.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	68.3	Sum of lost time (s)	14.3
Intersection Capacity Utilization	80.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	56	370	17	50	292	141	59	764	102	74	242	31
v/c Ratio	0.22	0.72	0.04	0.30	0.58	0.26	0.10	0.78	0.12	0.41	0.27	0.04
Control Delay	21.9	31.3	12.5	25.4	26.5	5.2	9.0	20.0	4.4	18.7	10.0	3.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	31.3	12.5	25.4	26.5	5.2	9.0	20.0	4.4	18.7	10.0	3.2
Queue Length 50th (m)	5.1	39.4	0.6	4.7	29.7	0.0	3.3	68.6	2.2	5.0	14.9	0.0
Queue Length 95th (m)	13.0	64.3	4.2	12.8	50.1	10.1	8.2	#109.8	7.8	15.6	26.1	3.0
Internal Link Dist (m)		1346.7			1342.5			2950.1			3069.4	
Turn Bay Length (m)	30.0		14.0	30.0		28.0	30.0		21.0	35.0		14.0
Base Capacity (vph)	274	565	505	182	555	586	596	1030	923	189	948	885
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.65	0.03	0.27	0.53	0.24	0.10	0.74	0.11	0.39	0.26	0.04

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	56	370	17	50	292	141	59	764	102	74	242	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1716	1883	1581	1526	1847	1551	1684	1865	1581	1668	1715	1536
Flt Permitted	0.50	1.00	1.00	0.38	1.00	1.00	0.61	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	911	1883	1581	605	1847	1551	1078	1865	1581	342	1715	1536
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	56	370	17	50	292	141	59	764	102	74	242	31
RTOR Reduction (vph)	0	0	7	0	0	100	0	0	27	0	0	14
Lane Group Flow (vph)	56	370	10	50	292	41	59	764	75	74	242	17
Heavy Vehicles (%)	4%	2%	1%	17%	4%	3%	6%	3%	1%	7%	12%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	18.4	18.4	18.4	18.4	18.4	18.4	35.5	35.5	35.5	35.5	35.5	35.5
Effective Green, g (s)	18.4	18.4	19.4	18.4	18.4	19.4	35.5	35.5	36.5	35.5	35.5	36.5
Actuated g/C Ratio	0.27	0.27	0.29	0.27	0.27	0.29	0.53	0.53	0.54	0.53	0.53	0.54
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	250	516	457	166	506	448	570	987	860	181	907	836
v/s Ratio Prot		c0.20			0.16			c0.41			0.14	
v/s Ratio Perm	0.06		0.01	0.08		0.03	0.05		0.05	0.22		0.01
v/c Ratio	0.22	0.72	0.02	0.30	0.58	0.09	0.10	0.77	0.09	0.41	0.27	0.02
Uniform Delay, d1	18.8	22.0	17.1	19.3	21.0	17.4	7.9	12.6	7.3	9.5	8.7	7.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	5.8	0.0	2.1	2.5	0.2	0.2	4.5	0.1	3.1	0.3	0.0
Delay (s)	19.8	27.8	17.1	21.4	23.5	17.6	8.0	17.1	7.4	12.6	9.0	7.1
Level of Service	B	C	B	C	C	B	A	B	A	B	A	A
Approach Delay (s)		26.4			21.6			15.4			9.6	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM Average Control Delay	18.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	67.1	Sum of lost time (s)	13.2
Intersection Capacity Utilization	95.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix J

ARCADY Roundabout Analysis 2021
Traffic Volumes

Airport Road at King Street 2021

Single Lane Roundabout
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
King Street East	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	4.25	0.00	25.00	55.00	20.00	
King Street West	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	4.25	0.00	25.00	55.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Single lane all approaches -2 lane cross section - 2021							
King Street East	1.29	1.00	7.79	0.57	A	134.63	F	-19% [Airport Road North]
Airport Road North	76.21	126.00	281.86	1.17	F			
King Street West	1.29	2.00	13.28	0.57	B			
Airport Road South	0.26	?	5.26	0.21	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Single lane all approaches -2 lane cross section - 2021							
King Street East	3.12	10.00	21.92	0.77	C	260.81	F	-26% [Airport Road South]
Airport Road North	0.82	1.00	7.79	0.45	A			
King Street West	1.09	?	8.10	0.52	A			
Airport Road South	134.84	200.00	577.78	1.30	F			

Airport Road at King Street 2021

Multilane Roundabout N,S approaches
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
King Street East	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	8.00	20.00	25.00	48.00	20.00	
King Street West	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	8.00	20.00	25.00	48.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Dual lane North South approaches - 2 lane - 2021							
King Street East	1.29	1.00	7.79	0.57	A	9.92	A	11% [King Street West]
Airport Road North	2.45	4.00	9.56	0.71	A			
King Street West	1.72	4.00	17.82	0.64	C			
Airport Road South	0.15	?	3.01	0.13	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Dual lane North South approaches - 2 lane - 2021							
King Street East	8.75	35.00	63.43	0.93	F	21.65	C	-5% [King Street East]
Airport Road North	0.39	?	3.71	0.28	A			
King Street West	1.09	?	8.09	0.52	A			
Airport Road South	3.84	11.00	13.91	0.80	B			

Airport Road at King Street 2021

Multilane Roundabout N,S,E approach
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
King Street East	4.25	8.00	20.00	25.00	48.00	20.00	
Airport Road North	4.25	8.00	20.00	25.00	48.00	20.00	
King Street West	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	8.00	20.00	25.00	48.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Dual lane East, North, South approaches - 2021							
King Street East	0.56	1.00	3.36	0.36	A	8.68	A	11% [King Street West]
Airport Road North	2.45	4.00	9.57	0.71	A			
King Street West	1.72	4.00	17.82	0.64	C			
Airport Road South	0.15	?	3.01	0.13	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Dual lane East, North, South approaches - 2021							
King Street East	1.09	?	7.44	0.52	A	9.80	A	12% [Airport Road South]
Airport Road North	0.39	?	3.73	0.28	A			
King Street West	1.09	?	8.10	0.52	A			
Airport Road South	3.84	11.00	13.91	0.80	B			

Airport Road at Old School / Healey Road 2021

Single Lane Roundabout
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	4.25	0.00	25.00	55.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	4.25	0.00	25.00	55.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	single lane 2 lane cross section - 2021							
Healey Road	0.15	?	3.92	0.13	A	127.16	F	-17% [Airport Road North]
Airport Road North	67.69	125.00	188.50	1.11	F			
Old School Road	0.61	1.00	10.07	0.38	B			
Airport Road South	0.35	?	5.49	0.26	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	single lane 2 lane cross section- 2021							
Healey Road	2.57	7.00	20.82	0.73	C	33.68	D	-5% [Airport Road South]
Airport Road North	0.77	1.00	7.00	0.44	A			
Old School Road	0.14	?	4.43	0.12	A			
Airport Road South	14.45	58.00	53.20	0.96	F			

Airport Road at Old School / Healey Road 2021

Multi Lane Roundabout N,S Approaches
2 Lane Cross Section

Roundabout Geometry

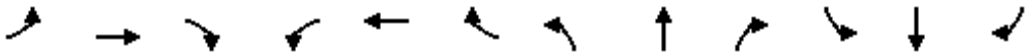
Leg	V - Approach road half-width (m)	E - Entry width (m)	I' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	8.00	20.00	25.00	49.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	8.00	20.00	25.00	49.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual Entry 2 lane cross section - 2021							
Healey Road	0.15	?	3.92	0.13	A	7.02	A	21% [Old School Road]
Airport Road North	2.37	3.00	7.31	0.71	A			
Old School Road	0.74	2.00	12.30	0.43	B			
Airport Road South	0.20	?	3.09	0.16	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual Entry 2 lane cross section - 2021							
Healey Road	2.69	8.00	21.69	0.74	C	8.58	A	6% [Healey Road]
Airport Road North	0.38	?	3.42	0.27	A			
Old School Road	0.14	?	4.43	0.12	A			
Airport Road South	1.58	2.00	5.55	0.61	A			

Appendix K

2021 Intersection Operations – Widen to Four Lanes

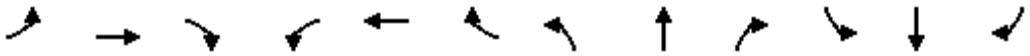


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
v/c Ratio	0.02	0.46	0.09	0.15	0.18	0.08	0.02	0.09	0.03	0.08	0.48	0.01
Control Delay	22.6	29.7	9.5	25.1	24.9	9.9	7.3	6.7	3.2	7.3	9.4	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.6	29.7	9.5	25.1	24.9	9.9	7.3	6.7	3.2	7.3	9.4	6.0
Queue Length 50th (m)	0.5	18.2	0.0	3.7	7.0	0.0	0.1	4.2	0.0	2.4	32.0	0.2
Queue Length 95th (m)	2.8	32.8	5.6	10.0	15.5	5.2	1.2	9.4	2.8	7.5	55.5	1.4
Internal Link Dist (m)		3361.2			629.9			1946.4			2950.1	
Turn Bay Length (m)	30.0		14.0	30.0		14.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	408	567	508	359	572	505	192	1914	886	710	2114	778
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.29	0.06	0.10	0.12	0.05	0.02	0.09	0.03	0.08	0.48	0.01

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1860	1597	1716	1879	1597	1190	3147	1439	1733	3476	1278
Flt Permitted	0.71	1.00	1.00	0.65	1.00	1.00	0.25	1.00	1.00	0.64	1.00	1.00
Satd. Flow (perm)	1340	1860	1597	1180	1879	1597	315	3147	1439	1167	3476	1278
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	164	31	35	67	27	3	178	26	54	1017	5
RTOR Reduction (vph)	0	0	25	0	0	22	0	0	10	0	0	1
Lane Group Flow (vph)	5	164	6	35	67	5	3	178	16	54	1017	4
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	16%	11%	3%	5%	25%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	14.0	14.0	14.0	14.0	14.0	14.0	44.0	44.0	44.0	44.0	44.0	44.0
Effective Green, g (s)	14.0	14.0	14.0	14.0	14.0	14.0	44.0	44.0	44.0	44.0	44.0	44.0
Actuated g/C Ratio	0.19	0.19	0.19	0.19	0.19	0.19	0.61	0.61	0.61	0.61	0.61	0.61
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	259	360	309	228	364	309	192	1915	876	710	2115	778
v/s Ratio Prot		c0.09			0.04			0.06			c0.29	
v/s Ratio Perm	0.00		0.00	0.03		0.00	0.01		0.01	0.05		0.00
v/c Ratio	0.02	0.46	0.02	0.15	0.18	0.02	0.02	0.09	0.02	0.08	0.48	0.01
Uniform Delay, d1	23.6	25.8	23.6	24.2	24.4	23.6	5.6	5.9	5.6	5.8	7.8	5.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	1.9	0.1	0.7	0.5	0.0	0.1	0.0	0.0	0.1	0.4	0.0
Delay (s)	23.7	27.7	23.6	24.9	24.9	23.6	5.7	5.9	5.6	5.9	8.2	5.6
Level of Service	C	C	C	C	C	C	A	A	A	A	A	A
Approach Delay (s)		27.0			24.6			5.9			8.1	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	11.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	72.3	Sum of lost time (s)	14.3
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

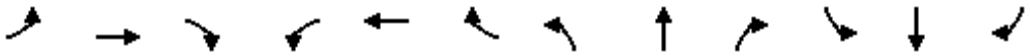


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	22	253	49	132	392	24	9	119	35	153	653	47
v/c Ratio	0.09	0.38	0.08	0.34	0.57	0.04	0.06	0.10	0.06	0.31	0.47	0.07
Control Delay	13.0	15.7	4.1	16.2	18.8	5.1	14.7	12.9	5.5	16.1	15.4	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.0	15.7	4.1	16.2	18.8	5.1	14.7	12.9	5.5	16.1	15.4	5.0
Queue Length 50th (m)	1.5	18.9	0.0	9.6	31.8	0.0	0.5	3.7	0.0	10.1	24.5	0.0
Queue Length 95th (m)	4.9	32.6	4.6	19.9	51.6	3.2	3.3	9.4	4.5	25.7	45.0	5.2
Internal Link Dist (m)		1346.7			1342.5			2950.1			130.4	
Turn Bay Length (m)	30.0		14.0	35.0		28.0	30.0		21.0	35.0		28.0
Base Capacity (vph)	360	984	866	585	1012	788	178	1361	681	542	1512	725
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.26	0.06	0.23	0.39	0.03	0.05	0.09	0.05	0.28	0.43	0.06

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	253	49	132	392	24	9	119	35	153	653	47
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1428	1830	1521	1716	1883	1401	1020	3042	1426	1700	3380	1507
Flt Permitted	0.45	1.00	1.00	0.60	1.00	1.00	0.37	1.00	1.00	0.68	1.00	1.00
Satd. Flow (perm)	670	1830	1521	1088	1883	1401	398	3042	1426	1211	3380	1507
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	22	253	49	132	392	24	9	119	35	153	653	47
RTOR Reduction (vph)	0	0	30	0	0	15	0	0	20	0	0	27
Lane Group Flow (vph)	22	253	19	132	392	9	9	119	15	153	653	20
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	75%	20%	12%	5%	8%	6%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	21.5	21.5	21.5	21.5	21.5	21.5	24.3	24.3	24.3	24.3	24.3	24.3
Effective Green, g (s)	21.5	21.5	22.5	21.5	21.5	22.5	24.3	24.3	25.3	24.3	24.3	25.3
Actuated g/C Ratio	0.36	0.36	0.38	0.36	0.36	0.38	0.41	0.41	0.43	0.41	0.41	0.43
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	244	667	580	396	686	534	164	1253	611	499	1392	646
v/s Ratio Prot		0.14			c0.21			0.04			c0.19	
v/s Ratio Perm	0.03		0.01	0.12		0.01	0.02		0.01	0.13		0.01
v/c Ratio	0.09	0.38	0.03	0.33	0.57	0.02	0.05	0.09	0.02	0.31	0.47	0.03
Uniform Delay, d1	12.3	13.8	11.4	13.6	15.1	11.4	10.4	10.6	9.7	11.7	12.6	9.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.8	0.0	1.0	1.8	0.0	0.3	0.1	0.0	0.7	0.5	0.0
Delay (s)	12.7	14.6	11.5	14.6	16.9	11.4	10.7	10.7	9.8	12.4	13.2	9.8
Level of Service	B	B	B	B	B	B	B	B	A	B	B	A
Approach Delay (s)		14.0			16.1			10.5			12.8	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	13.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	59.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

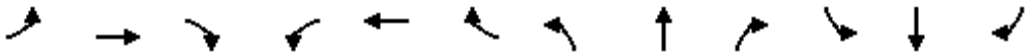


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	15	77	13	55	227	138	16	895	27	19	332	9
v/c Ratio	0.05	0.17	0.04	0.17	0.49	0.30	0.04	0.49	0.03	0.08	0.19	0.01
Control Delay	17.9	19.2	9.5	19.6	24.2	9.7	9.3	11.4	6.8	10.3	9.0	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	19.2	9.5	19.6	24.2	9.7	9.3	11.4	6.8	10.3	9.0	5.6
Queue Length 50th (m)	1.2	6.6	0.0	4.7	21.1	3.9	0.8	29.4	0.8	0.9	9.0	0.0
Queue Length 95th (m)	4.7	14.6	3.1	11.6	37.2	14.3	3.6	51.2	4.2	4.3	17.8	1.9
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		14.0	30.0		14.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	409	663	512	467	656	618	421	1898	810	241	1811	868
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.12	0.03	0.12	0.35	0.22	0.04	0.47	0.03	0.08	0.18	0.01

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	77	13	55	227	138	16	895	27	19	332	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1879	1427	1777	1860	1581	1342	3510	1490	1475	3349	1597
Flt Permitted	0.62	1.00	1.00	0.71	1.00	1.00	0.55	1.00	1.00	0.29	1.00	1.00
Satd. Flow (perm)	1159	1879	1427	1322	1860	1581	779	3510	1490	445	3349	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	15	77	13	55	227	138	16	895	27	19	332	9
RTOR Reduction (vph)	0	0	10	0	0	69	0	0	5	0	0	4
Lane Group Flow (vph)	15	77	3	55	227	69	16	895	22	19	332	5
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	9%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	15.5	15.5	15.5	15.5	15.5	15.5	32.9	32.9	32.9	32.9	32.9	32.9
Effective Green, g (s)	15.5	15.5	15.5	15.5	15.5	15.5	32.9	32.9	32.9	32.9	32.9	32.9
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25	0.25	0.52	0.52	0.52	0.52	0.52	0.52
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	287	465	353	327	460	391	409	1842	782	234	1757	838
v/s Ratio Prot		0.04			c0.12			c0.26			0.10	
v/s Ratio Perm	0.01		0.00	0.04		0.04	0.02		0.01	0.04		0.00
v/c Ratio	0.05	0.17	0.01	0.17	0.49	0.18	0.04	0.49	0.03	0.08	0.19	0.01
Uniform Delay, d1	18.0	18.5	17.8	18.5	20.2	18.6	7.2	9.5	7.2	7.4	7.9	7.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.4	0.0	0.5	1.7	0.5	0.1	0.4	0.0	0.3	0.1	0.0
Delay (s)	18.2	18.9	17.8	19.0	22.0	19.0	7.3	9.9	7.2	7.7	8.0	7.1
Level of Service	B	B	B	B	C	B	A	A	A	A	A	A
Approach Delay (s)		18.6			20.6			9.8			7.9	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	62.7	Sum of lost time (s)	14.3
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	56	370	17	50	292	141	59	764	102	74	242	31
v/c Ratio	0.16	0.57	0.03	0.20	0.46	0.23	0.13	0.49	0.13	0.31	0.17	0.04
Control Delay	14.7	20.1	7.9	15.9	18.0	7.2	13.4	14.9	4.6	18.1	12.3	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.7	20.1	7.9	15.9	18.0	7.2	13.4	14.9	4.6	18.1	12.3	5.2
Queue Length 50th (m)	4.1	31.3	0.3	3.7	23.6	3.9	3.6	29.2	0.7	4.9	7.8	0.0
Queue Length 95th (m)	10.2	51.1	3.2	9.8	39.9	12.6	10.9	50.2	8.1	15.6	16.1	4.0
Internal Link Dist (m)		1346.7			1342.5			2950.1			204.9	
Turn Bay Length (m)	30.0		14.0	30.0		28.0	40.0		21.0	35.0		28.0
Base Capacity (vph)	482	898	786	348	881	808	487	1621	796	251	1491	744
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.41	0.02	0.14	0.33	0.17	0.12	0.47	0.13	0.29	0.16	0.04

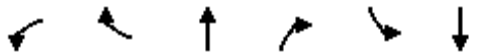
Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	56	370	17	50	292	141	59	764	102	74	242	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1716	1883	1581	1526	1847	1551	1684	3544	1581	1668	3259	1536
Flt Permitted	0.56	1.00	1.00	0.45	1.00	1.00	0.60	1.00	1.00	0.31	1.00	1.00
Satd. Flow (perm)	1011	1883	1581	729	1847	1551	1066	3544	1581	548	3259	1536
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	56	370	17	50	292	141	59	764	102	74	242	31
RTOR Reduction (vph)	0	0	8	0	0	54	0	0	48	0	0	17
Lane Group Flow (vph)	56	370	9	50	292	87	59	764	54	74	242	14
Heavy Vehicles (%)	4%	2%	1%	17%	4%	3%	6%	3%	1%	7%	12%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	21.3	21.3	21.3	21.3	21.3	21.3	27.1	27.1	27.1	27.1	27.1	27.1
Effective Green, g (s)	21.3	21.3	22.3	21.3	21.3	22.3	27.1	27.1	28.1	27.1	27.1	28.1
Actuated g/C Ratio	0.35	0.35	0.36	0.35	0.35	0.36	0.44	0.44	0.46	0.44	0.44	0.46
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	350	651	572	252	639	561	469	1559	721	241	1434	701
v/s Ratio Prot		c0.20			0.16			c0.22			0.07	
v/s Ratio Perm	0.06		0.01	0.07		0.06	0.06		0.03	0.13		0.01
v/c Ratio	0.16	0.57	0.02	0.20	0.46	0.16	0.13	0.49	0.07	0.31	0.17	0.02
Uniform Delay, d1	14.0	16.4	12.6	14.2	15.7	13.3	10.2	12.3	9.4	11.2	10.4	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	1.9	0.0	0.8	1.1	0.3	0.3	0.5	0.1	1.5	0.1	0.0
Delay (s)	14.4	18.3	12.6	15.0	16.7	13.6	10.5	12.8	9.5	12.7	10.6	9.2
Level of Service	B	B	B	B	B	B	B	B	A	B	B	A
Approach Delay (s)		17.6			15.6			12.3			10.9	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	61.6	Sum of lost time (s)	13.2
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix L

2031 Intersection Operations – Do Nothing



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	230	15	256	522	28	1194
v/c Ratio	0.67	0.05	0.13	0.49	0.04	0.51
Control Delay	48.8	14.7	7.6	2.5	7.9	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.8	14.7	7.6	2.5	7.9	11.0
Queue Length 50th (m)	43.4	0.0	9.3	0.0	1.8	60.0
Queue Length 95th (m)	67.9	5.2	17.4	12.5	5.9	93.2
Internal Link Dist (m)	124.0		413.6			265.7
Turn Bay Length (m)				145.0	70.0	
Base Capacity (vph)	589	537	1981	1061	690	2328
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.03	0.13	0.49	0.04	0.51

Intersection Summary

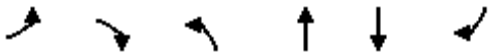
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	230	15	256	522	28	1194
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.7	3.5	3.5	3.7
Total Lost time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1684	1507	3017	1342	1684	3544
Flt Permitted	0.95	1.00	1.00	1.00	0.59	1.00
Satd. Flow (perm)	1684	1507	3017	1342	1052	3544
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	230	15	256	522	28	1194
RTOR Reduction (vph)	0	12	0	179	0	0
Lane Group Flow (vph)	230	3	256	343	28	1194
Heavy Vehicles (%)	6%	6%	21%	19%	6%	3%
Turn Type		Perm		Perm	Perm	
Protected Phases	4		2			6
Permitted Phases		4		2	6	
Actuated Green, G (s)	21.3	21.3	69.2	69.2	69.2	69.2
Effective Green, g (s)	21.3	21.3	69.2	69.2	69.2	69.2
Actuated g/C Ratio	0.20	0.20	0.66	0.66	0.66	0.66
Clearance Time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	341	305	1983	882	691	2329
v/s Ratio Prot	c0.14		0.08			c0.34
v/s Ratio Perm		0.00		0.26	0.03	
v/c Ratio	0.67	0.01	0.13	0.39	0.04	0.51
Uniform Delay, d1	38.8	33.6	6.8	8.3	6.4	9.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.7	0.0	0.1	1.3	0.1	0.8
Delay (s)	45.5	33.6	6.9	9.6	6.5	10.1
Level of Service	D	C	A	A	A	B
Approach Delay (s)	44.8		8.7			10.1
Approach LOS	D		A			B

Intersection Summary			
HCM Average Control Delay	13.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	105.3	Sum of lost time (s)	14.8
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	43	115	216	31	265	1258
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	43	115	216	31	265	1258
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	2020	232			247	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2020	232			247	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	15	86			80	
cM capacity (veh/h)	51	813			1325	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	158	247	1523
Volume Left	43	0	265
Volume Right	115	31	0
cSH	159	1700	1325
Volume to Capacity	0.99	0.15	0.20
Queue Length 95th (m)	57.9	0.0	5.7
Control Delay (s)	126.4	0.0	6.8
Lane LOS	F		A
Approach Delay (s)	126.4	0.0	6.8
Approach LOS	F		

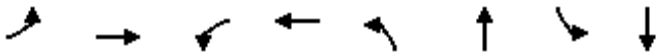
Intersection Summary			
Average Delay	15.7		
Intersection Capacity Utilization	113.6%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	7	238	85	246	1286	7
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	7	238	85	246	1286	7
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1702	1286	1293			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1702	1286	1293			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	0	84			
cM capacity (veh/h)	86	202	536			

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	245	331	1286	7
Volume Left	7	85	0	0
Volume Right	238	0	0	7
cSH	194	536	1700	1700
Volume to Capacity	1.26	0.16	0.76	0.00
Queue Length 95th (m)	100.8	4.3	0.0	0.0
Control Delay (s)	200.4	5.1	0.0	0.0
Lane LOS	F	A		
Approach Delay (s)	200.4	5.1	0.0	
Approach LOS	F			

Intersection Summary			
Average Delay	27.2		
Intersection Capacity Utilization	109.1%	ICU Level of Service	H
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	27	367	158	508	11	186	187	838
v/c Ratio	0.28	0.64	0.70	0.86	0.17	0.23	0.32	0.92
Control Delay	29.0	28.1	42.9	41.8	18.5	10.0	13.3	35.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.0	28.1	42.9	41.8	18.5	10.0	13.3	35.1
Queue Length 50th (m)	3.0	45.0	20.6	70.4	0.8	12.4	15.7	111.0
Queue Length 95th (m)	10.2	72.3	#48.6	#121.7	4.6	23.5	29.1	#189.9
Internal Link Dist (m)		1346.7		1342.5		2950.1		3069.4
Turn Bay Length (m)	60.0		35.0		40.0		35.0	
Base Capacity (vph)	101	596	234	612	65	819	591	914
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.62	0.68	0.83	0.17	0.23	0.32	0.92

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	308	59	158	478	30	11	144	42	187	781	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1428	1786		1716	1854		1008	1560		1700	1763	
Flt Permitted	0.21	1.00		0.39	1.00		0.12	1.00		0.64	1.00	
Satd. Flow (perm)	309	1786		713	1854		125	1560		1146	1763	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	27	308	59	158	478	30	11	144	42	187	781	57
RTOR Reduction (vph)	0	9	0	0	3	0	0	13	0	0	3	0
Lane Group Flow (vph)	27	358	0	158	505	0	11	173	0	187	835	0
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	77%	21%	12%	5%	8%	6%
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)	25.0	25.0		25.0	25.0		40.8	40.8		40.8	40.8	
Effective Green, g (s)	25.0	25.0		25.0	25.0		40.8	40.8		40.8	40.8	
Actuated g/C Ratio	0.32	0.32		0.32	0.32		0.52	0.52		0.52	0.52	
Clearance Time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	98	565		226	587		65	806		592	911	
v/s Ratio Prot		0.20			c0.27			0.11			c0.47	
v/s Ratio Perm	0.09			0.22			0.09			0.16		
v/c Ratio	0.28	0.63		0.70	0.86		0.17	0.21		0.32	0.92	
Uniform Delay, d1	20.2	23.1		23.7	25.4		10.1	10.4		11.0	17.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.2	3.2		11.4	13.3		2.6	0.3		0.6	14.3	
Delay (s)	23.4	26.3		35.1	38.7		12.7	10.7		11.7	31.8	
Level of Service	C	C		D	D		B	B		B	C	
Approach Delay (s)		26.1			37.8			10.8			28.1	
Approach LOS		C			D			B			C	

Intersection Summary			
HCM Average Control Delay	29.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	79.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	106.9%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	635	30	1059	220	9	565
v/c Ratio	0.87	0.04	0.69	0.28	0.08	0.37
Control Delay	41.0	6.6	29.3	4.1	24.6	23.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.0	6.6	29.3	4.1	24.6	23.1
Queue Length 50th (m)	117.5	0.4	94.2	0.0	1.1	41.9
Queue Length 95th (m)	165.2	5.3	140.0	15.1	5.2	65.9
Internal Link Dist (m)	124.0		413.6			265.7
Turn Bay Length (m)				145.0	70.0	
Base Capacity (vph)	945	858	1525	792	119	1510
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.03	0.69	0.28	0.08	0.37

Intersection Summary

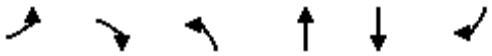
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	635	30	1059	220	9	565
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.7	3.5	3.5	3.7
Total Lost time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1716	1536	3510	1536	1716	3476
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1716	1536	3510	1536	273	3476
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	635	30	1059	220	9	565
RTOR Reduction (vph)	0	15	0	124	0	0
Lane Group Flow (vph)	635	15	1059	96	9	565
Heavy Vehicles (%)	4%	4%	4%	4%	4%	5%
Turn Type		Perm		Perm	Perm	
Protected Phases	4		2			6
Permitted Phases		4		2	6	
Actuated Green, G (s)	46.0	46.0	46.8	46.8	46.8	46.8
Effective Green, g (s)	46.0	46.0	46.8	46.8	46.8	46.8
Actuated g/C Ratio	0.43	0.43	0.43	0.43	0.43	0.43
Clearance Time (s)	8.2	8.2	6.6	6.6	6.6	6.6
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	734	657	1527	668	119	1512
v/s Ratio Prot	c0.37		c0.30			0.16
v/s Ratio Perm		0.01		0.06	0.03	
v/c Ratio	0.87	0.02	0.69	0.14	0.08	0.37
Uniform Delay, d1	28.0	17.8	24.6	18.3	17.8	20.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.3	0.0	2.6	0.5	1.2	0.7
Delay (s)	39.3	17.8	27.2	18.8	19.0	21.2
Level of Service	D	B	C	B	B	C
Approach Delay (s)	38.3		25.8			21.2
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	28.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	107.6	Sum of lost time (s)	14.8
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	67	446	1051	33	116	397
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	67	446	1051	33	116	397
Pedestrians			4			
Lane Width (m)			3.7			
Walking Speed (m/s)			4.0			
Percent Blockage			0			
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1700	1068			1084	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1700	1068			1084	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	20	0			82	
cM capacity (veh/h)	84	271			636	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	513	1084	513
Volume Left	67	0	116
Volume Right	446	33	0
cSH	210	1700	636
Volume to Capacity	2.45	0.64	0.18
Queue Length 95th (m)	322.8	0.0	5.0
Control Delay (s)	701.9	0.0	4.9
Lane LOS	F		A
Approach Delay (s)	701.9	0.0	4.9
Approach LOS	F		

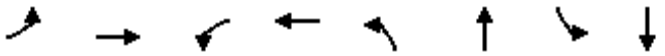
Intersection Summary			
Average Delay	171.8		
Intersection Capacity Utilization	125.9%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	18	110	297	1200	403	11
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	110	297	1200	403	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	2197	403	414			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2197	403	414			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	51	83	74			
cM capacity (veh/h)	37	650	1140			

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	128	1497	403	11
Volume Left	18	297	0	0
Volume Right	110	0	0	11
cSH	195	1140	1700	1700
Volume to Capacity	0.65	0.26	0.24	0.01
Queue Length 95th (m)	29.6	8.0	0.0	0.0
Control Delay (s)	52.8	8.4	0.0	0.0
Lane LOS	F	A		
Approach Delay (s)	52.8	8.4	0.0	
Approach LOS	F			

Intersection Summary			
Average Delay	9.5		
Intersection Capacity Utilization	118.6%	ICU Level of Service	H
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	69	471	57	527	68	1005	90	314
v/c Ratio	0.79	0.89	0.61	1.02	0.13	1.00	0.96	0.34
Control Delay	83.7	48.2	55.5	73.2	9.2	47.6	108.5	10.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.7	48.2	55.5	73.2	9.2	47.6	108.5	10.4
Queue Length 50th (m)	9.0	63.4	7.0	~73.4	4.4	130.0	11.3	21.7
Queue Length 95th (m)	#31.4	#115.5	#24.8	#133.5	10.2	#218.8	#26.7	36.8
Internal Link Dist (m)		1346.7		1342.5		2950.1		3069.4
Turn Bay Length (m)	60.0		35.0		40.0		35.0	
Base Capacity (vph)	87	527	93	516	535	1005	94	924
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.79	0.89	0.61	1.02	0.13	1.00	0.96	0.34

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	69	451	20	57	355	172	68	886	119	90	276	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.95		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1545	1872		1513	1762		1684	1836		1668	1685	
Flt Permitted	0.19	1.00		0.21	1.00		0.56	1.00		0.10	1.00	
Satd. Flow (perm)	310	1872		331	1762		984	1836		172	1685	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	69	451	20	57	355	172	68	886	119	90	276	38
RTOR Reduction (vph)	0	2	0	0	23	0	0	6	0	0	6	0
Lane Group Flow (vph)	69	469	0	57	504	0	68	999	0	90	308	0
Heavy Vehicles (%)	4%	2%	1%	18%	4%	3%	6%	3%	1%	7%	13%	4%
Parking (#/hr)	0											
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		2			2			1			1	
Permitted Phases	2			2			1			1		
Actuated Green, G (s)	21.0	21.0		21.0	21.0		40.8	40.8		40.8	40.8	
Effective Green, g (s)	21.0	21.0		21.0	21.0		40.8	40.8		40.8	40.8	
Actuated g/C Ratio	0.28	0.28		0.28	0.28		0.54	0.54		0.54	0.54	
Clearance Time (s)	7.0	7.0		7.0	7.0		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Grp Cap (vph)	87	524		93	493		535	999		94	917	
v/s Ratio Prot		0.25			c0.29			c0.54			0.18	
v/s Ratio Perm	0.22			0.17			0.07			0.52		
v/c Ratio	0.79	0.89		0.61	1.02		0.13	1.00		0.96	0.34	
Uniform Delay, d1	25.0	25.9		23.5	27.0		8.4	17.1		16.3	9.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	42.1	18.6		16.1	46.3		0.2	28.2		79.5	0.5	
Delay (s)	67.1	44.6		39.5	73.3		8.6	45.3		95.7	10.0	
Level of Service	E	D		D	E		A	D		F	A	
Approach Delay (s)		47.4			70.0			43.0			29.1	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM Average Control Delay	47.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	118.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Appendix M

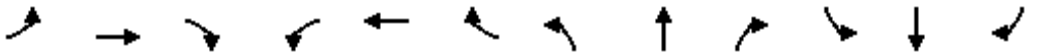
2031 Intersection Operations at Offset Old School Road - Healey Road Existing Configuration

Lane Group	EBT	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	245	158	247	1287	7
v/c Ratio	1.18	0.84	0.33	1.14	0.01
Control Delay	175.3	99.2	13.3	100.9	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	175.3	99.2	13.3	100.9	8.6
Queue Length 50th (m)	~87.4	46.9	30.5	~445.7	0.5
Queue Length 95th (m)	#142.3	#85.1	46.7	#526.4	2.4
Internal Link Dist (m)	3361.2	290.8	1946.4	2950.1	
Turn Bay Length (m)					45.0
Base Capacity (vph)	207	190	750	1130	817
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.18	0.83	0.33	1.14	0.01

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)		7.0			7.0			7.3			7.3	7.3
Lane Util. Factor		1.00			1.00			1.00			1.00	1.00
Frt		0.98			0.97			0.98			1.00	0.85
Flt Protected		1.00			0.99			1.00			1.00	1.00
Satd. Flow (prot)		1822			1782			1630			1827	1278
Flt Permitted		1.00			0.99			0.72			0.97	1.00
Satd. Flow (perm)		1822			1782			1168			1769	1278
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
RTOR Reduction (vph)	0	0	0	0	0	0	0	4	0	0	0	1
Lane Group Flow (vph)	0	245	0	0	158	0	0	243	0	0	1287	6
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	16%	11%	3%	5%	25%
Turn Type	Split			Split			Perm			Perm		Perm
Protected Phases	4	4		2	2			1			1	
Permitted Phases							1			1		1
Actuated Green, G (s)		17.0			15.9			95.7			95.7	95.7
Effective Green, g (s)		17.0			15.9			95.7			95.7	95.7
Actuated g/C Ratio		0.11			0.11			0.64			0.64	0.64
Clearance Time (s)		7.0			7.0			7.3			7.3	7.3
Vehicle Extension (s)		5.0			5.0			5.0			5.0	5.0
Lane Grp Cap (vph)		207			189			746			1129	816
v/s Ratio Prot		c0.13			c0.09							
v/s Ratio Perm								0.21			c0.73	0.00
v/c Ratio		1.18			0.84			0.33			1.14	0.01
Uniform Delay, d1		66.4			65.7			12.4			27.1	9.8
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		120.9			28.6			0.5			74.0	0.0
Delay (s)		187.4			94.3			12.9			101.1	9.9
Level of Service		F			F			B			F	A
Approach Delay (s)		187.4			94.3			12.9			100.6	
Approach LOS		F			F			B			F	

Intersection Summary			
HCM Average Control Delay	99.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	149.9	Sum of lost time (s)	21.3
Intersection Capacity Utilization	126.9%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	127	513	1084	403	11
v/c Ratio	0.73	1.14	1.18	0.51	0.01
Control Delay	89.2	135.9	127.5	27.4	10.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	89.2	135.9	127.5	27.4	10.4
Queue Length 50th (m)	37.2	~178.1	~388.1	78.1	0.3
Queue Length 95th (m)	#65.3	#247.8	#469.3	108.4	3.7
Internal Link Dist (m)	3361.2	290.8	1946.4	2950.1	
Turn Bay Length (m)					45.0
Base Capacity (vph)	181	450	916	798	813
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.70	1.14	1.18	0.51	0.01

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

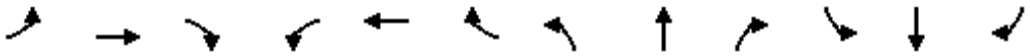
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	93	16	67	277	169	20	1031	33	23	380	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)		7.0			7.0			7.3			7.3	7.3
Lane Util. Factor		1.00			1.00			1.00			1.00	1.00
Frpb, ped/bikes		1.00			1.00			1.00			1.00	1.00
Flpb, ped/bikes		1.00			1.00			1.00			1.00	1.00
Frt		0.98			0.96			1.00			1.00	0.85
Flt Protected		0.99			0.99			1.00			1.00	1.00
Satd. Flow (prot)		1802			1768			1827			1746	1597
Flt Permitted		0.99			0.99			0.99			0.90	1.00
Satd. Flow (perm)		1802			1768			1806			1574	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	93	16	67	277	169	20	1031	33	23	380	11
RTOR Reduction (vph)	0	0	0	0	0	0	0	1	0	0	0	4
Lane Group Flow (vph)	0	127	0	0	513	0	0	1083	0	0	403	7
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	9%	0%
Turn Type	Split			Split			Perm			Perm		Perm
Protected Phases	4	4		2	2			1			1	
Permitted Phases							1			1		1
Actuated Green, G (s)		14.5			38.0			75.7			75.7	75.7
Effective Green, g (s)		14.5			38.0			75.7			75.7	75.7
Actuated g/C Ratio		0.10			0.25			0.51			0.51	0.51
Clearance Time (s)		7.0			7.0			7.3			7.3	7.3
Vehicle Extension (s)		5.0			5.0			5.0			5.0	5.0
Lane Grp Cap (vph)		175			449			914			797	809
v/s Ratio Prot		c0.07			c0.29							
v/s Ratio Perm								c0.60			0.26	0.00
v/c Ratio		0.73			1.14			1.18			0.51	0.01
Uniform Delay, d1		65.6			55.7			36.9			24.5	18.3
Progression Factor		1.00			1.00			1.00			1.00	1.00
Incremental Delay, d2		16.8			87.7			94.3			1.1	0.0
Delay (s)		82.3			143.4			131.2			25.5	18.3
Level of Service		F			F			F			C	B
Approach Delay (s)		82.3			143.4			131.2			25.3	
Approach LOS		F			F			F			C	

Intersection Summary			
HCM Average Control Delay	110.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	149.5	Sum of lost time (s)	21.3
Intersection Capacity Utilization	119.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Appendix N

2031 Intersection Operations at Airport Road and King Street with Auxiliary Lanes



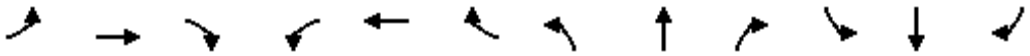
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
v/c Ratio	0.03	0.68	0.14	0.29	0.28	0.12	0.05	0.19	0.03	0.08	0.97	0.01
Control Delay	32.0	48.4	17.6	38.7	35.7	12.7	7.7	5.8	1.9	5.4	35.7	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.0	48.4	17.6	38.7	35.7	12.7	7.7	5.8	1.9	5.4	35.7	4.6
Queue Length 50th (m)	0.9	30.1	1.5	6.1	11.5	0.0	0.2	11.1	0.0	3.2	166.6	0.3
Queue Length 95th (m)	4.4	#50.7	9.1	15.0	23.2	7.1	1.1	18.6	2.3	7.0	#271.0	1.5
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		14.0	30.0		14.0	40.0		7.0	40.0		7.0
Base Capacity (vph)	219	308	287	155	311	292	55	1134	995	781	1253	875
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.65	0.13	0.28	0.26	0.11	0.05	0.19	0.03	0.08	0.97	0.01

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1860	1597	1716	1879	1597	1190	1656	1439	1733	1830	1278
Flt Permitted	0.70	1.00	1.00	0.52	1.00	1.00	0.06	1.00	1.00	0.62	1.00	1.00
Satd. Flow (perm)	1322	1860	1597	938	1879	1597	81	1656	1439	1140	1830	1278
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
RTOR Reduction (vph)	0	0	23	0	0	28	0	0	10	0	0	0
Lane Group Flow (vph)	7	200	15	43	82	5	3	213	21	66	1221	7
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	16%	11%	3%	5%	25%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	14.3	14.3	14.3	14.3	14.3	14.3	62.1	62.1	62.1	62.1	62.1	62.1
Effective Green, g (s)	14.3	14.3	14.3	14.3	14.3	14.3	62.1	62.1	62.1	62.1	62.1	62.1
Actuated g/C Ratio	0.16	0.16	0.16	0.16	0.16	0.16	0.68	0.68	0.68	0.68	0.68	0.68
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	208	293	252	148	296	252	55	1134	985	781	1253	875
v/s Ratio Prot		c0.11			0.04			0.13			c0.67	
v/s Ratio Perm	0.01		0.01	0.05		0.00	0.04		0.01	0.06		0.01
v/c Ratio	0.03	0.68	0.06	0.29	0.28	0.02	0.05	0.19	0.02	0.08	0.97	0.01
Uniform Delay, d1	32.3	36.1	32.5	33.7	33.6	32.3	4.7	5.2	4.6	4.8	13.5	4.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	8.2	0.2	2.3	1.1	0.1	0.9	0.2	0.0	0.1	19.6	0.0
Delay (s)	32.5	44.3	32.7	36.0	34.7	32.4	5.6	5.3	4.6	4.9	33.2	4.5
Level of Service	C	D	C	D	C	C	A	A	A	A	C	A
Approach Delay (s)		42.1			34.6			5.3			31.6	
Approach LOS		D			C			A			C	

Intersection Summary			
HCM Average Control Delay	29.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.7	Sum of lost time (s)	14.3
Intersection Capacity Utilization	99.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



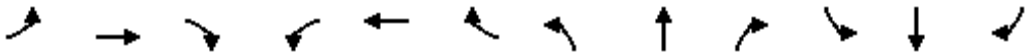
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	27	308	59	158	478	30	11	144	42	187	781	57
v/c Ratio	0.23	0.55	0.11	0.58	0.83	0.06	0.13	0.18	0.06	0.31	0.87	0.07
Control Delay	24.1	24.4	5.8	30.1	36.8	10.3	14.1	10.4	3.3	12.3	28.9	5.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.1	24.4	5.8	30.1	36.8	10.3	14.1	10.4	3.3	12.3	28.9	5.4
Queue Length 50th (m)	2.4	30.3	0.0	15.7	52.4	0.9	0.7	9.0	0.0	12.6	79.2	1.5
Queue Length 95th (m)	8.2	50.9	6.4	32.5	#94.0	5.6	3.5	17.4	3.7	24.1	#143.3	5.9
Internal Link Dist (m)		1346.7			1342.5			2950.1			3069.4	
Turn Bay Length (m)	60.0		21.0	35.0		21.0	40.0		21.0	35.0		21.0
Base Capacity (vph)	119	582	545	283	599	478	84	805	758	599	895	795
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.53	0.11	0.56	0.80	0.06	0.13	0.18	0.06	0.31	0.87	0.07

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	308	59	158	478	30	11	144	42	187	781	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1428	1830	1521	1716	1883	1401	1020	1601	1426	1700	1779	1507
Flt Permitted	0.25	1.00	1.00	0.49	1.00	1.00	0.16	1.00	1.00	0.67	1.00	1.00
Satd. Flow (perm)	377	1830	1521	893	1883	1401	167	1601	1426	1190	1779	1507
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	27	308	59	158	478	30	11	144	42	187	781	57
RTOR Reduction (vph)	0	0	40	0	0	13	0	0	20	0	0	15
Lane Group Flow (vph)	27	308	19	158	478	17	11	144	22	187	781	42
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	75%	20%	12%	5%	8%	6%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	21.2	21.2	21.2	21.2	21.2	21.2	34.8	34.8	34.8	34.8	34.8	34.8
Effective Green, g (s)	21.2	21.2	22.2	21.2	21.2	22.2	34.8	34.8	35.8	34.8	34.8	35.8
Actuated g/C Ratio	0.31	0.31	0.32	0.31	0.31	0.32	0.50	0.50	0.52	0.50	0.50	0.52
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	115	561	488	274	577	449	84	805	738	598	895	780
v/s Ratio Prot		0.17			c0.25			0.09			c0.44	
v/s Ratio Perm	0.07		0.01	0.18		0.01	0.07		0.02	0.16		0.03
v/c Ratio	0.23	0.55	0.04	0.58	0.83	0.04	0.13	0.18	0.03	0.31	0.87	0.05
Uniform Delay, d1	17.9	20.0	16.2	20.2	22.3	16.2	9.2	9.4	8.2	10.1	15.2	8.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.2	1.9	0.1	4.6	10.6	0.1	1.5	0.2	0.0	0.6	10.1	0.1
Delay (s)	20.1	21.9	16.2	24.8	33.0	16.2	10.6	9.6	8.2	10.8	25.4	8.4
Level of Service	C	C	B	C	C	B	B	A	A	B	C	A
Approach Delay (s)		21.0			30.3			9.4			21.7	
Approach LOS		C			C			A			C	

Intersection Summary			
HCM Average Control Delay	23.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	69.2	Sum of lost time (s)	13.2
Intersection Capacity Utilization	101.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			



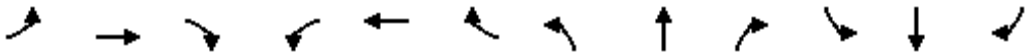
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	18	93	16	67	277	168	20	1031	33	23	380	11
v/c Ratio	0.13	0.27	0.06	0.28	0.81	0.45	0.04	0.88	0.03	0.21	0.34	0.01
Control Delay	29.8	30.2	13.6	31.5	50.7	16.9	5.8	23.0	4.6	12.0	7.8	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.8	30.2	13.6	31.5	50.7	16.9	5.8	23.0	4.6	12.0	7.8	3.9
Queue Length 50th (m)	2.1	11.2	0.0	8.1	37.4	8.0	0.9	106.0	1.2	1.2	22.0	0.2
Queue Length 95th (m)	7.3	22.7	4.5	18.2	#71.2	23.5	3.1	#195.7	3.8	5.1	35.0	1.7
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		14.0	30.0		14.0	40.0		7.0	40.0		7.0
Base Capacity (vph)	140	353	278	244	350	380	477	1175	950	108	1121	1018
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.26	0.06	0.27	0.79	0.44	0.04	0.88	0.03	0.21	0.34	0.01

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	93	16	67	277	168	20	1031	33	23	380	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1879	1408	1768	1860	1581	1342	1847	1490	1475	1762	1597
Flt Permitted	0.40	1.00	1.00	0.70	1.00	1.00	0.53	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)	744	1879	1408	1297	1860	1581	751	1847	1490	171	1762	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	93	16	67	277	168	20	1031	33	23	380	11
RTOR Reduction (vph)	0	0	13	0	0	82	0	0	3	0	0	3
Lane Group Flow (vph)	18	93	3	67	277	86	20	1031	30	23	380	8
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	9%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	14.7	14.7	14.7	14.7	14.7	14.7	50.7	50.7	50.7	50.7	50.7	50.7
Effective Green, g (s)	14.7	14.7	14.7	14.7	14.7	14.7	50.7	50.7	50.7	50.7	50.7	50.7
Actuated g/C Ratio	0.18	0.18	0.18	0.18	0.18	0.18	0.64	0.64	0.64	0.64	0.64	0.64
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	137	347	260	239	343	292	478	1175	948	109	1121	1016
v/s Ratio Prot		0.05			c0.15			c0.56			0.22	
v/s Ratio Perm	0.02		0.00	0.05		0.05	0.03		0.02	0.13		0.01
v/c Ratio	0.13	0.27	0.01	0.28	0.81	0.29	0.04	0.88	0.03	0.21	0.34	0.01
Uniform Delay, d1	27.2	27.9	26.6	28.0	31.1	28.0	5.4	11.9	5.4	6.1	6.7	5.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.9	0.0	1.3	14.7	1.2	0.1	8.2	0.0	2.0	0.4	0.0
Delay (s)	28.1	28.8	26.6	29.3	45.8	29.2	5.5	20.2	5.4	8.1	7.1	5.3
Level of Service	C	C	C	C	D	C	A	C	A	A	A	A
Approach Delay (s)		28.4			38.2			19.5			7.1	
Approach LOS		C			D			B			A	

Intersection Summary			
HCM Average Control Delay	22.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	79.7	Sum of lost time (s)	14.3
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	69	451	20	57	355	172	68	886	119	90	276	38
v/c Ratio	0.34	0.85	0.04	0.50	0.68	0.32	0.12	0.90	0.13	0.89	0.30	0.04
Control Delay	25.4	41.0	8.6	38.8	29.9	9.0	9.2	29.6	2.2	89.9	10.5	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.4	41.0	8.6	38.8	29.9	9.0	9.2	29.6	2.2	89.9	10.5	3.0
Queue Length 50th (m)	6.5	50.7	0.0	5.7	37.6	4.8	3.9	89.3	0.0	9.0	17.4	0.0
Queue Length 95th (m)	16.2	#93.3	4.0	#18.8	61.8	16.7	9.2	#160.0	5.7	#33.9	30.0	3.3
Internal Link Dist (m)		1346.7			1342.5			2950.1			3069.4	
Turn Bay Length (m)	60.0			35.0			40.0			35.0		
Base Capacity (vph)	208	541	491	117	531	549	553	985	912	101	907	851
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.83	0.04	0.49	0.67	0.31	0.12	0.90	0.13	0.89	0.30	0.04

Intersection Summary

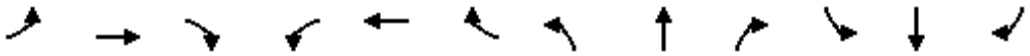
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	69	451	20	57	355	172	68	886	119	90	276	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1716	1883	1581	1526	1847	1551	1684	1865	1581	1668	1715	1536
Flt Permitted	0.40	1.00	1.00	0.25	1.00	1.00	0.59	1.00	1.00	0.11	1.00	1.00
Satd. Flow (perm)	724	1883	1581	407	1847	1551	1046	1865	1581	191	1715	1536
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	69	451	20	57	355	172	68	886	119	90	276	38
RTOR Reduction (vph)	0	0	14	0	0	82	0	0	54	0	0	17
Lane Group Flow (vph)	69	451	6	57	355	90	68	886	65	90	276	21
Heavy Vehicles (%)	4%	2%	1%	17%	4%	3%	6%	3%	1%	7%	12%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	19.6	19.6	19.6	19.6	19.6	19.6	36.8	36.8	36.8	36.8	36.8	36.8
Effective Green, g (s)	19.6	19.6	20.6	19.6	19.6	20.6	36.8	36.8	37.8	36.8	36.8	37.8
Actuated g/C Ratio	0.28	0.28	0.30	0.28	0.28	0.30	0.53	0.53	0.54	0.53	0.53	0.54
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	204	530	468	115	520	459	553	986	859	101	907	834
v/s Ratio Prot		c0.24			0.19			c0.48			0.16	
v/s Ratio Perm	0.10		0.00	0.14		0.06	0.07		0.04	0.47		0.01
v/c Ratio	0.34	0.85	0.01	0.50	0.68	0.20	0.12	0.90	0.08	0.89	0.30	0.02
Uniform Delay, d1	19.9	23.6	17.3	20.9	22.2	18.3	8.3	14.7	7.6	14.6	9.2	7.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.1	13.5	0.0	6.9	4.7	0.4	0.2	11.5	0.1	58.8	0.4	0.0
Delay (s)	21.9	37.2	17.3	27.7	27.0	18.7	8.5	26.2	7.7	73.5	9.6	7.4
Level of Service	C	D	B	C	C	B	A	C	A	E	A	A
Approach Delay (s)		34.5			24.6			23.0			23.6	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	69.6	Sum of lost time (s)	13.2
Intersection Capacity Utilization	105.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Appendix O

2031 Intersection Operations – Widen to Four Lanes

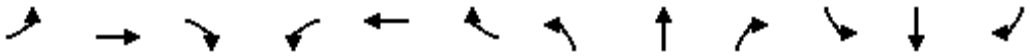


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
v/c Ratio	0.03	0.54	0.11	0.20	0.22	0.10	0.02	0.11	0.03	0.09	0.57	0.01
Control Delay	23.4	32.9	10.6	26.8	26.1	9.5	7.7	6.9	3.0	7.6	10.7	6.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	32.9	10.6	26.8	26.1	9.5	7.7	6.9	3.0	7.6	10.7	6.3
Queue Length 50th (m)	0.7	23.5	0.4	4.7	9.0	0.0	0.2	5.4	0.0	3.2	45.1	0.2
Queue Length 95th (m)	3.4	40.6	6.7	12.1	18.9	5.8	1.2	10.9	3.0	8.8	71.6	1.7
Internal Link Dist (m)		3361.2			629.9			1946.4			2950.1	
Turn Bay Length (m)	30.0		14.0	30.0		14.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	341	480	437	280	485	437	144	1940	899	695	2143	789
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.42	0.09	0.15	0.17	0.08	0.02	0.11	0.03	0.09	0.57	0.01

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1860	1597	1716	1879	1597	1190	3147	1439	1733	3476	1278
Flt Permitted	0.70	1.00	1.00	0.60	1.00	1.00	0.19	1.00	1.00	0.62	1.00	1.00
Satd. Flow (perm)	1322	1860	1597	1086	1879	1597	233	3147	1439	1128	3476	1278
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	7	200	38	43	82	33	3	213	31	66	1221	7
RTOR Reduction (vph)	0	0	27	0	0	26	0	0	12	0	0	1
Lane Group Flow (vph)	7	200	11	43	82	7	3	213	19	66	1221	6
Heavy Vehicles (%)	0%	1%	0%	4%	0%	0%	50%	16%	11%	3%	5%	25%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	15.4	15.4	15.4	15.4	15.4	15.4	47.8	47.8	47.8	47.8	47.8	47.8
Effective Green, g (s)	15.4	15.4	15.4	15.4	15.4	15.4	47.8	47.8	47.8	47.8	47.8	47.8
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20	0.20	0.62	0.62	0.62	0.62	0.62	0.62
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	263	370	317	216	373	317	144	1941	888	696	2144	788
v/s Ratio Prot		c0.11			0.04			0.07			c0.35	
v/s Ratio Perm	0.01		0.01	0.04		0.00	0.01		0.01	0.06		0.00
v/c Ratio	0.03	0.54	0.03	0.20	0.22	0.02	0.02	0.11	0.02	0.09	0.57	0.01
Uniform Delay, d1	25.0	27.9	25.0	25.9	26.0	25.0	5.8	6.1	5.8	6.0	8.8	5.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	2.8	0.1	1.0	0.6	0.1	0.1	0.1	0.0	0.1	0.6	0.0
Delay (s)	25.1	30.7	25.1	26.9	26.6	25.0	5.9	6.2	5.8	6.2	9.3	5.7
Level of Service	C	C	C	C	C	C	A	A	A	A	A	A
Approach Delay (s)		29.7			26.4			6.1			9.2	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	77.5	Sum of lost time (s)	14.3
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

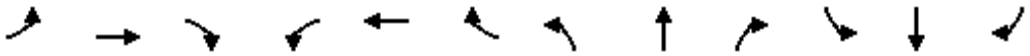


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	27	308	59	158	478	30	11	144	42	187	781	57
v/c Ratio	0.13	0.43	0.09	0.41	0.65	0.05	0.09	0.12	0.07	0.39	0.58	0.09
Control Delay	13.6	16.0	4.3	17.4	20.3	4.6	16.7	14.0	5.3	18.5	18.1	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.6	16.0	4.3	17.4	20.3	4.6	16.7	14.0	5.3	18.5	18.1	4.8
Queue Length 50th (m)	1.8	23.7	0.3	12.1	41.1	0.0	0.8	5.4	0.0	15.0	36.1	0.0
Queue Length 95th (m)	6.0	39.9	5.3	24.4	65.6	3.6	3.9	11.0	4.9	31.6	55.5	5.6
Internal Link Dist (m)		1346.7			1342.5			2950.1			130.4	
Turn Bay Length (m)	30.0		14.0	35.0		28.0	30.0		21.0	35.0		28.0
Base Capacity (vph)	259	896	795	485	922	723	125	1239	628	482	1377	670
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.34	0.07	0.33	0.52	0.04	0.09	0.12	0.07	0.39	0.57	0.09

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	308	59	158	478	30	11	144	42	187	781	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1428	1830	1521	1716	1883	1401	1020	3042	1426	1700	3380	1507
Flt Permitted	0.35	1.00	1.00	0.55	1.00	1.00	0.29	1.00	1.00	0.66	1.00	1.00
Satd. Flow (perm)	528	1830	1521	992	1883	1401	306	3042	1426	1182	3380	1507
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	27	308	59	158	478	30	11	144	42	187	781	57
RTOR Reduction (vph)	0	0	32	0	0	18	0	0	24	0	0	33
Lane Group Flow (vph)	27	308	27	158	478	12	11	144	18	187	781	24
Heavy Vehicles (%)	25%	5%	5%	4%	2%	14%	75%	20%	12%	5%	8%	6%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	25.0	25.0	25.0	25.0	25.0	25.0	25.7	25.7	25.7	25.7	25.7	25.7
Effective Green, g (s)	25.0	25.0	26.0	25.0	25.0	26.0	25.7	25.7	26.7	25.7	25.7	26.7
Actuated g/C Ratio	0.39	0.39	0.41	0.39	0.39	0.41	0.40	0.40	0.42	0.40	0.40	0.42
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	207	716	619	388	737	570	123	1223	596	475	1359	630
v/s Ratio Prot		0.17			c0.25			0.05			c0.23	
v/s Ratio Perm	0.05		0.02	0.16		0.01	0.04		0.01	0.16		0.02
v/c Ratio	0.13	0.43	0.04	0.41	0.65	0.02	0.09	0.12	0.03	0.39	0.57	0.04
Uniform Delay, d1	12.5	14.2	11.4	14.1	15.9	11.3	11.8	12.0	11.0	13.6	14.9	11.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.9	0.1	1.5	2.7	0.0	0.7	0.1	0.0	1.1	0.9	0.1
Delay (s)	13.1	15.1	11.5	15.5	18.6	11.4	12.5	12.1	11.0	14.7	15.8	11.1
Level of Service	B	B	B	B	B	B	B	B	B	B	B	B
Approach Delay (s)		14.4			17.5			11.9			15.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	15.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	63.9	Sum of lost time (s)	13.2
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

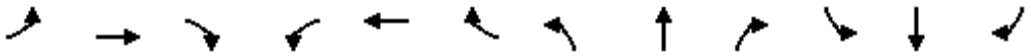


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	18	93	16	67	277	169	20	1031	33	23	380	11
v/c Ratio	0.06	0.18	0.04	0.19	0.54	0.37	0.06	0.68	0.05	0.16	0.26	0.02
Control Delay	13.2	14.1	7.2	14.6	19.4	13.5	9.6	14.4	6.7	12.7	9.9	5.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.2	14.1	7.2	14.6	19.4	13.5	9.6	14.4	6.7	12.7	9.9	5.4
Queue Length 50th (m)	1.0	5.5	0.0	4.0	18.4	8.1	0.9	34.7	0.8	1.1	10.2	0.0
Queue Length 95th (m)	4.2	13.0	2.9	10.5	34.3	19.0	3.7	51.1	4.2	4.8	17.0	1.9
Internal Link Dist (m)		3361.2			290.8			1946.4			2950.1	
Turn Bay Length (m)	30.0		14.0	30.0		14.0	30.0		7.0	30.0		7.0
Base Capacity (vph)	343	582	454	405	576	516	320	1512	650	145	1442	694
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.16	0.04	0.17	0.48	0.33	0.06	0.68	0.05	0.16	0.26	0.02

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	93	16	67	277	169	20	1031	33	23	380	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1879	1429	1779	1860	1581	1342	3510	1489	1475	3349	1597
Flt Permitted	0.59	1.00	1.00	0.70	1.00	1.00	0.53	1.00	1.00	0.22	1.00	1.00
Satd. Flow (perm)	1107	1879	1429	1305	1860	1581	744	3510	1489	336	3349	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	93	16	67	277	169	20	1031	33	23	380	11
RTOR Reduction (vph)	0	0	12	0	0	28	0	0	9	0	0	6
Lane Group Flow (vph)	18	93	4	67	277	141	20	1031	24	23	380	5
Confl. Peds. (#/hr)			4	4								
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	0%	10%	0%	1%	1%	33%	4%	5%	21%	9%	0%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	13.3	13.3	13.3	13.3	13.3	13.3	20.9	20.9	20.9	20.9	20.9	20.9
Effective Green, g (s)	13.3	13.3	13.3	13.3	13.3	13.3	20.9	20.9	20.9	20.9	20.9	20.9
Actuated g/C Ratio	0.27	0.27	0.27	0.27	0.27	0.27	0.43	0.43	0.43	0.43	0.43	0.43
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.3	7.3	7.3	7.3	7.3
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	304	515	392	358	510	434	321	1513	642	145	1443	688
v/s Ratio Prot		0.05			c0.15			c0.29			0.11	
v/s Ratio Perm	0.02		0.00	0.05		0.09	0.03		0.02	0.07		0.00
v/c Ratio	0.06	0.18	0.01	0.19	0.54	0.33	0.06	0.68	0.04	0.16	0.26	0.01
Uniform Delay, d1	13.0	13.4	12.8	13.5	15.0	14.0	8.1	11.1	8.0	8.4	8.9	7.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.4	0.0	0.5	2.1	0.9	0.2	1.7	0.1	1.1	0.2	0.0
Delay (s)	13.2	13.8	12.8	14.0	17.1	14.9	8.2	12.8	8.0	9.5	9.1	7.9
Level of Service	B	B	B	B	B	B	A	B	A	A	A	A
Approach Delay (s)		13.6			16.0			12.5			9.1	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	48.5	Sum of lost time (s)	14.3
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	69	451	20	57	355	172	68	886	119	90	276	38
v/c Ratio	0.23	0.73	0.04	0.29	0.59	0.30	0.16	0.62	0.16	0.50	0.21	0.06
Control Delay	14.2	23.3	7.0	16.8	18.3	9.8	11.1	14.2	3.0	24.3	10.4	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.2	23.3	7.0	16.8	18.3	9.8	11.1	14.2	3.0	24.3	10.4	3.9
Queue Length 50th (m)	3.9	31.2	0.3	3.3	23.1	6.5	3.4	29.2	0.0	5.3	7.4	0.0
Queue Length 95th (m)	10.7	#63.0	3.1	10.1	41.9	16.3	9.3	43.4	6.1	#19.9	13.1	3.5
Internal Link Dist (m)		1346.7			1342.5			2950.1			204.9	
Turn Bay Length (m)	30.0		14.0	30.0		28.0	40.0		21.0	35.0		28.0
Base Capacity (vph)	320	653	590	210	640	604	417	1431	739	181	1316	673
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.69	0.03	0.27	0.55	0.28	0.16	0.62	0.16	0.50	0.21	0.06

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	69	451	20	57	355	172	68	886	119	90	276	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5	3.5	3.7	3.5
Total Lost time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.2	6.2	5.2	6.2	6.2	5.2
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1716	1883	1581	1526	1847	1551	1684	3544	1581	1668	3259	1536
Flt Permitted	0.51	1.00	1.00	0.38	1.00	1.00	0.58	1.00	1.00	0.26	1.00	1.00
Satd. Flow (perm)	923	1883	1581	605	1847	1551	1032	3544	1581	448	3259	1536
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	69	451	20	57	355	172	68	886	119	90	276	38
RTOR Reduction (vph)	0	0	10	0	0	35	0	0	69	0	0	22
Lane Group Flow (vph)	69	451	10	57	355	137	68	886	50	90	276	16
Heavy Vehicles (%)	4%	2%	1%	17%	4%	3%	6%	3%	1%	7%	12%	4%
Turn Type	Perm		Perm	Perm		Perm	Perm		Perm	Perm		Perm
Protected Phases		2			2			1			1	
Permitted Phases	2		2	2		2	1		1	1		1
Actuated Green, G (s)	16.1	16.1	16.1	16.1	16.1	16.1	19.8	19.8	19.8	19.8	19.8	19.8
Effective Green, g (s)	16.1	16.1	17.1	16.1	16.1	17.1	19.8	19.8	20.8	19.8	19.8	20.8
Actuated g/C Ratio	0.33	0.33	0.35	0.33	0.33	0.35	0.40	0.40	0.42	0.40	0.40	0.42
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Grp Cap (vph)	303	617	551	198	606	540	416	1429	670	181	1314	651
v/s Ratio Prot		c0.24			0.19			c0.25			0.08	
v/s Ratio Perm	0.07		0.01	0.09		0.09	0.07		0.03	0.20		0.01
v/c Ratio	0.23	0.73	0.02	0.29	0.59	0.25	0.16	0.62	0.08	0.50	0.21	0.02
Uniform Delay, d1	12.0	14.6	10.5	12.2	13.7	11.4	9.4	11.7	8.4	10.9	9.6	8.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.8	5.4	0.0	1.7	2.2	0.5	0.4	1.2	0.1	4.4	0.2	0.0
Delay (s)	12.8	20.0	10.5	13.9	16.0	12.0	9.7	12.8	8.5	15.4	9.7	8.3
Level of Service	B	B	B	B	B	B	A	B	A	B	A	A
Approach Delay (s)		18.7			14.6			12.2			10.8	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	49.1	Sum of lost time (s)	13.2
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Appendix P

ARCADY Roundabout Analysis 2031 Traffic Volumes

Airport Road at Old School / Healey Road 2031

Multi Lane Roundabout 2 lane N,S Approaches
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	8.00	20.00	25.00	49.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	8.00	20.00	25.00	49.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual 2 lane - 2031							
Healey Road	0.20	?	4.18	0.17	A	14.73	B	0% [Old School Road]
Airport Road North	5.74	20.00	15.07	0.86	C			
Old School Road	2.39	8.00	33.53	0.72	D			
Airport Road South	0.25	?	3.30	0.20	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual 2 lane - 2031							
Healey Road	23.98	63.00	146.40	1.05	F	38.41	E	-10% [Healey Road]
Airport Road North	0.47	1.00	3.74	0.32	A			
Old School Road	0.19	?	4.80	0.16	A			
Airport Road South	2.50	4.00	7.65	0.72	A			

Airport Road at Old School / Healey Road 2031

Multi Lane Roundabout 2 Lane N,S Approaches with Healey Road RT Bypass
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	4.25	8.00	20.00	25.00	49.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	8.00	20.00	25.00	49.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual with Healey Bypass 2 lane - 2031							
Healey Road	0.15	?	4.03	0.13	A	14.72	B	0% [Old School Road]
Airport Road North	5.74	20.00	15.07	0.86	C			
Old School Road	2.39	8.00	33.53	0.72	D			
Airport Road South	0.25	?	3.30	0.20	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual with Healey Bypass 2 lane - 2031							
Healey Road	2.26	6.00	22.27	0.70	C	10.04	B	6% [Healey Road]
Airport Road North	0.48	1.00	3.80	0.32	A			
Old School Road	0.19	?	4.81	0.16	A			
Airport Road South	2.50	4.00	7.65	0.72	A			

Airport Road at Old School / Healey Road 2031

Multi Lane Roundabout 2 Lane N, S, E approaches
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	8.00	20.00	25.00	49.00	20.00	
Airport Road North	4.25	8.00	20.00	25.00	49.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	8.00	20.00	25.00	49.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S/E Dual 2 lane - 2031							
Healey Road	0.09	?	2.40	0.08	A	14.59	B	0% [Old School Road]
Airport Road North	5.74	20.00	15.07	0.86	C			
Old School Road	2.39	8.00	33.53	0.72	D			
Airport Road South	0.25	?	3.30	0.20	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	DC N/S/E Dual 2 lane - 2031							
Healey Road	0.61	1.00	5.87	0.38	A	6.29	A	30% [Airport Road South]
Airport Road North	0.48	1.00	3.80	0.32	A			
Old School Road	0.19	?	4.81	0.16	A			
Airport Road South	2.50	4.00	7.65	0.72	A			

Airport Road at Old School / Healey Road 2031

Multi Lane Roundabout 2 lane N, S, approaches Healey Road RT Bypass
4 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road North	7.50	8.00	10.00	25.00	49.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	7.50	8.00	10.00	25.00	49.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual with Bypass 4 lane - 2031							
Healey Road	0.15	?	4.03	0.13	A	8.79	A	0% [Old School Road]
Airport Road North	2.43	4.00	6.20	0.71	A			
Old School Road	2.42	8.00	33.85	0.72	D			
Airport Road South	0.20	?	2.60	0.16	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S Dual with Bypass 4 lane - 2031							
Healey Road	2.27	6.00	22.27	0.70	C	8.20	A	6% [Healey Road]
Airport Road North	0.36	?	2.87	0.27	A			
Old School Road	0.19	?	4.81	0.16	A			
Airport Road South	1.45	1.00	4.41	0.59	A			

Airport Road at Old School / Healey Road

Multi Lane Roundabout 2 lane N, S, E approaches
4 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
Healey Road	4.25	8.00	20.00	25.00	49.00	20.00	
Airport Road North	7.50	8.00	10.00	25.00	49.00	20.00	
Old School Road	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	7.50	8.00	10.00	25.00	49.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	N/S/E Dual 4 lane - 2031							
Healey Road	0.09	?	2.40	0.08	A	8.66	A	0% [Old School Road]
Airport Road North	2.43	4.00	6.20	0.71	A			
Old School Road	2.42	8.00	33.84	0.72	D			
Airport Road South	0.20	?	2.60	0.16	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	DC N/S/E Dual 4 lane - 2031							
Healey Road	0.61	1.00	5.87	0.38	A	4.45	A	41% [Healey Road]
Airport Road North	0.36	?	2.87	0.27	A			
Old School Road	0.19	?	4.81	0.16	A			
Airport Road South	1.45	1.00	4.41	0.59	A			

Airport Road at King Street 2031

Multilane Roundabout -2 lanes N, S and E Approaches
2 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
King Street East	4.25	8.00	20.00	25.00	48.00	20.00	
Airport Road North	4.25	8.00	20.00	25.00	48.00	20.00	
King Street West	4.25	4.25	0.00	25.00	55.00	20.00	
Airport Road South	4.25	8.00	20.00	25.00	48.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Dual lane East, North, South approaches - 2031							
King Street East	0.80	1.00	3.94	0.44	A	31.43	D	-8% [King Street West]
Airport Road North	9.13	35.00	31.07	0.92	D			
King Street West	10.58	40.00	91.10	0.97	F			
Airport Road South	0.20	?	3.29	0.17	A			

	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Dual lane East, North, South approaches - 2031							
King Street East	2.37	4.00	13.64	0.71	B	34.53	D	-5% [Airport Road South]
Airport Road North	0.53	1.00	4.30	0.35	A			
King Street West	1.96	3.00	12.08	0.67	B			
Airport Road South	21.43	79.00	66.30	0.99	F			

Airport Road at King Street 2031

2 Lane Roundabout All Approaches
4 Lane Cross Section

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
King Street East	4.25	8.00	20.00	25.00	49.00	20.00	
Airport Road North	7.50	8.00	10.00	25.00	49.00	20.00	
King Street West	4.25	8.00	20.00	25.00	49.00	20.00	
Airport Road South	7.50	8.00	10.00	25.00	49.00	20.00	

	AM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	Dual lane West, East, North, South approaches - 4 lane - 2031							
King Street East	0.80	1.00	3.93	0.44	A	6.96	A	19% [Airport Road North]
Airport Road North	2.78	5.00	9.02	0.74	A			
King Street West	1.03	2.00	8.62	0.51	A			
Airport Road South	0.16	?	2.59	0.14	A			

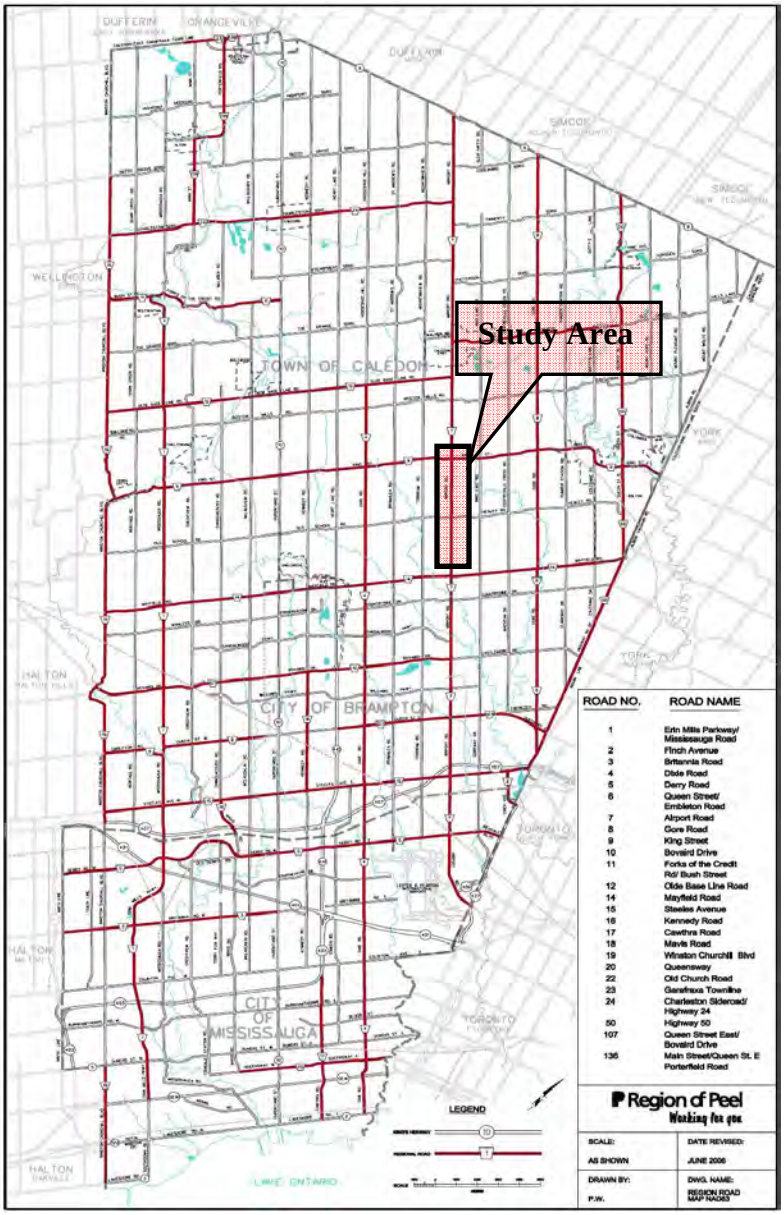
	PM							
	Queue (Veh)	95% Queue (Veh)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Network Residual Capacity
	DC Dual lane West, East, North, South approaches - 4 lane - 2031							
King Street East	2.47	6.00	14.22	0.72	B	9.67	A	11% [King Street East]
Airport Road North	0.39	?	3.19	0.28	A			
King Street West	0.69	1.00	4.20	0.41	A			
Airport Road South	3.91	11.00	12.25	0.80	B			

REGION OF PEEL

ROAD SAFETY AUDIT

AIRPORT ROAD EA

1KM NORTH OF MAYFIELD ROAD TO 0.6KM NORTH OF KING STREET



February 2013

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APPENDICES

Appendix A – Collision History

AIRPORT ROAD FROM STREET 'A' TO KING STREET
ROAD SAFETY AUDIT

This report documents a Road Safety Review of Airport Road (Regional Road 7) 1.0km north of Mayfield Road (Regional Road 14) from Street 'A' to 0.6km north of King Street (Regional Road 9).

1. BACKGROUND

The Region of Peel has initiated a Class 'C' Environmental Assessment (EA) Project # 12-4380 for Airport Road and is investigating roadway widening from two lanes (one lane per direction) to four lanes (two lanes per direction) in order to address the operational deficiencies and the need for additional north-south capacity in the area. A safety review was conducted as part of the EA process and details the findings of our investigation.

The purpose of this audit was to examine the facility's safety performance and to identify engineering related factors and opportunities for improvement and recommend potential mitigative solutions.

It is acknowledged that safety is one of many considerations that the Region of Peel needs to balance in undertaking any EA project, including, but not necessarily limited to; cost, environmental protection, traffic management, and community impacts. This report is focused on safety, with the anticipation that in general, the safety enhancements identified will be considered for inclusion in the planning process.

2. STUDY AREA

The study area consists of the zone on Airport Road, 1.0km north of Mayfield Road to 0.6km north of King Street, approximately 5.75kms. For the purpose of this audit, the intersection of Street 'A' that is to the south of the southern limit of the study area has been included to provide a definite boundary to the study area **(Figure 1).**

Airport Road is a two-lane (single lane per direction), hard-surfaced, rural roadway serving an arterial function in the northeast quadrant under the jurisdiction of the Region of Peel in the Town of Caledon. For the purposes of this report, Airport Road will be described as running in a north-south direction.

Figure 1: Study Area
(Source: Google Maps)

Airport Road has a posted speed limit of 80km/h from Street 'A' to 610m south of King Street, and 60km/h from 610m south of King Street to 305m north of King

Street. Airport Road from 305m north of King Street to the project limits has a posted speed limit of 80 km/h.

There are two signalized intersections in the study zone: Street 'A' and King Street; and two stop controlled offset intersections: Healey Road and Old School Road.

The pavement width is nominally 7.2 metres, with gravel shoulders for Airport Road. Land use adjacent to the study zone is presently predominantly rural agricultural, low density commercial and low-density rural residential. The intersection of Street 'A' which is to the south of the southern limit of the study area and has been included to provide a defined boundary to the study zone. . There are four intersections along this stretch of the study area:

- **Street 'A'** – It is a signalized "T" intersection to the east of Airport Road. It is a private access road. (**Figure 2**)
- **Healey Road** – It is a two lane rural roadway under the jurisdiction of the Town of Caledon. It is a stop controlled, offset "T" intersection to the east of Airport Road with a posted speed limit of 80km/h (**Figure 3**).
- **Old School Road** – It is a two lane rural roadway under the jurisdiction of the Town of Caledon. It is a stop controlled, offset "T" intersection to the west of Airport Road with a speed limit of 80km/h (**Figure 3**).
- **King Street –** It is a two lane East/West arterial roadway under the jurisdiction of the Region of Peel. It is a signalized intersection with a posted speed limit of 70km/h through the intersection of Airport Road (**Figure 4**).

Figure 2: Airport Road at Street "A"
(Source: Google Earth)

Figure 3: Offset intersections of Healey Road and Old School Road
(Source: Google Earth)

Figure 4: Airport Road at King Street
(Source: Google Earth)

3. METHODOLOGY

3.1. COLLISION HISTORY

The first step in the process consisted of conducting an in-office review. A collision analysis of the most recent five years (2006-2010) of collision data was undertaken. This preliminary review was undertaken for the following reasons:

1. To identify the dominant collision type and collision frequency in the zone in the past five years.
2. To acquire documented evidence of collision data in order to identify causal patterns that may indicate underlying issues.
3. To calculate the collision rates for the zone.
4. To conduct a safety review with mitigative countermeasures for possible inclusion in the EA.

The results identified 43 reportable collisions occurring in the study zone on Airport Road from Street ‘A’ to 0.6km north of King Street over the five-year (2006-2010) review period. A summary of reported collisions is presented in **Table 1** and a summary of collisions per year is presented as a bar graph in **Exhibit 1**.

Location	Fatal	Non Fatal Injury	PDO	Total	Collision Type
Airport Road at Street 'A'	0	0	0	0	No Reported Collisions
Airport Road between Street 'A' and Healey Road	0	2	9	11	SMV other (11)
Airport Road at Healey Road	0	0	2	2	Rear End (1) Turning Movement (1)
Airport Road between Healey Road and Old School Road	0	0	0	0	No Reported Collisions
Airport Road at Old School Road	0	0	0	0	No Reported Collisions
Airport Road between Old School Road and King Street	0	1	11	12	Rear End (3) Sideswipe (2) SMV other (7)
Airport Road at King Street	0	4	10	14	Angle (4) Rear End (6) Sideswipe (2) SMV other (1) Turning Movement (1)
Airport Road up to 0.6 km north of King Street	0	0	4	4	Rear End (1) SMV other (2) Other (1)
Total	**0**	**7**	**36**	**43**	

Table 1: Summary of Reported Collisions along Airport Road (2006-2010)

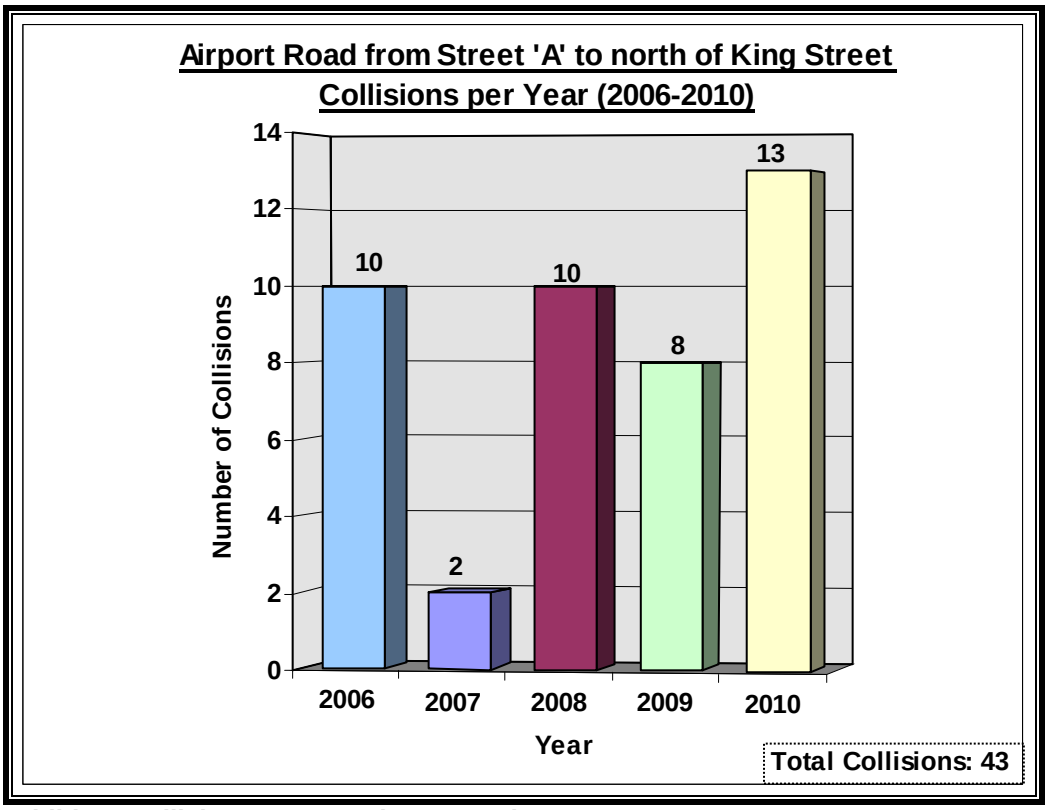

Exhibit 1: Collisions per Year (2006-2010)

The 'Single Motor Vehicle (SMV) other' type of collision was the dominant type of collision with 48.8% followed by 'Rear End', which consisted of 25.6% of collisions and 11.6% of 'Right Angle' type of collisions (**Exhibit 2**). SMV – other typically involves a loss of control and/or run off road vehicle type of collision.

It should be noted that the Ontario Provincial Police (OPP) uses the terms 'Turning Movement' and 'Angle' interchangeably when reporting a collision. There were about 83.7% of 'Property Damage Only' type of collisions which were the majority of the collisions in this zone (**Exhibit 3**). There were no fatal collisions in this zone in the study period. Further, 72.1% of the collisions occurred under clear environmental conditions (**Exhibit 4**) and 58.1% with favourable road conditions (**Exhibit 5**).

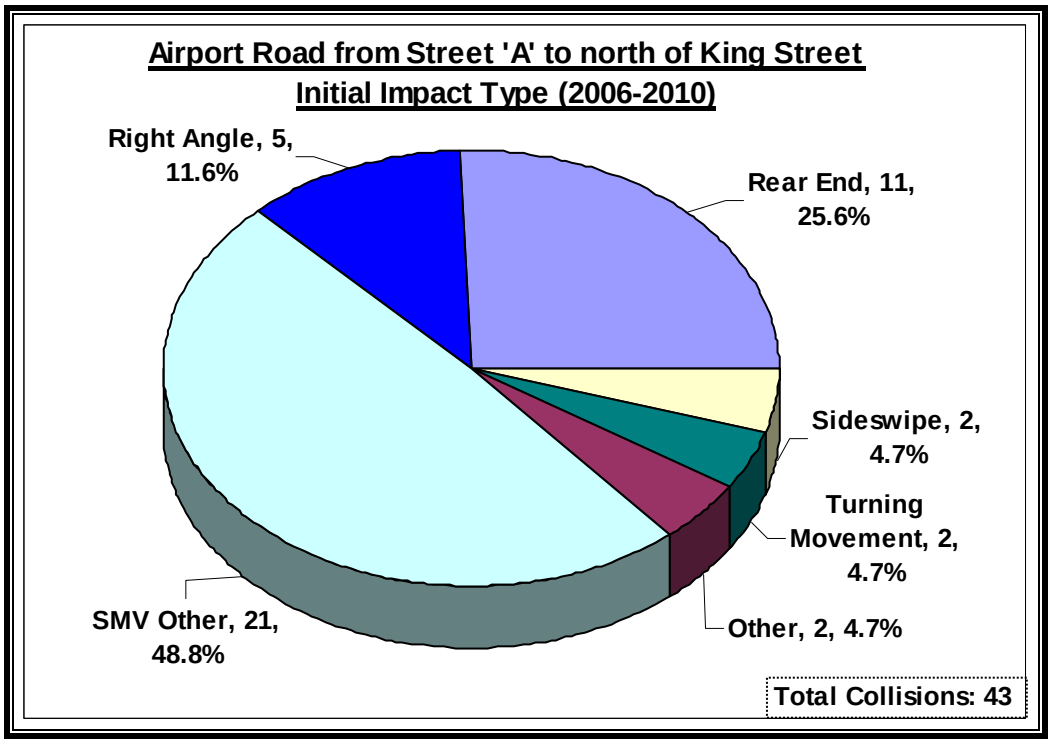

Exhibit 2: Collisions by Initial Impact Type (2006-2010)

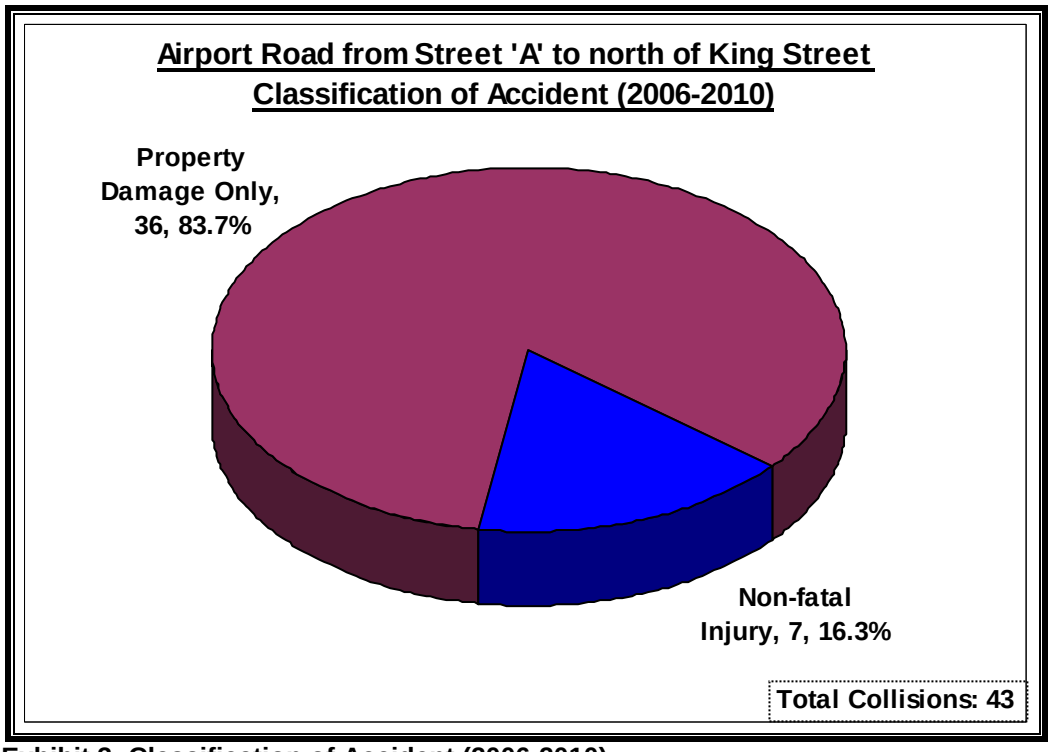

Exhibit 3: Classification of Accident (2006-2010)

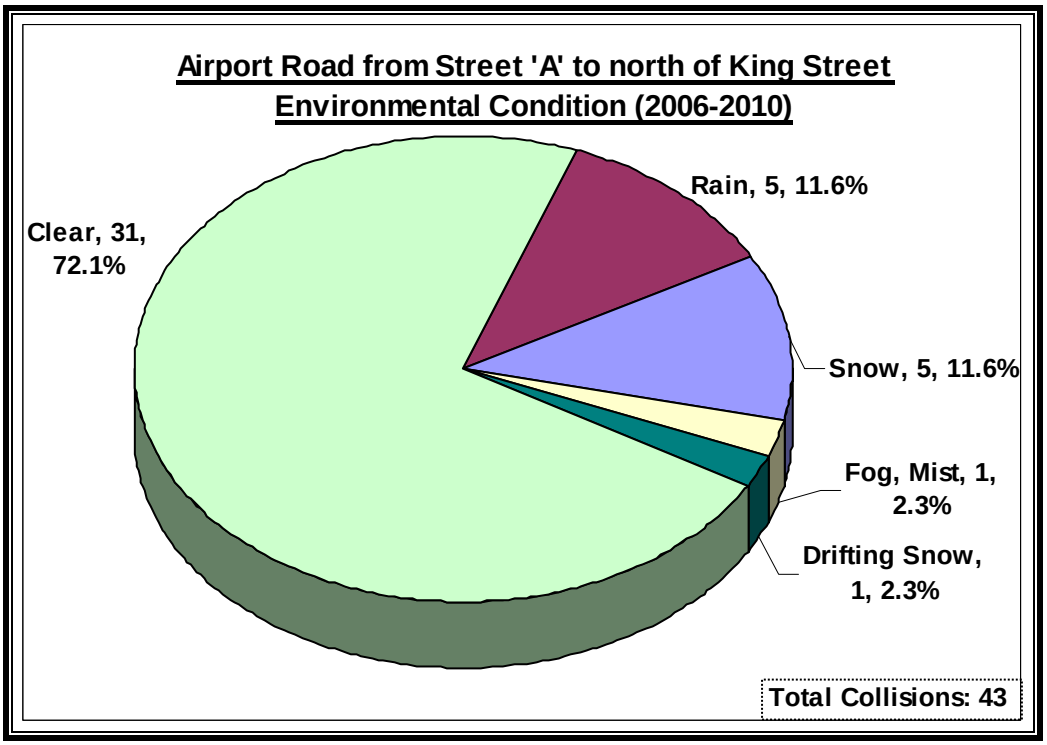

Exhibit 4: Collisions by Environmental Condition (2006-2010)

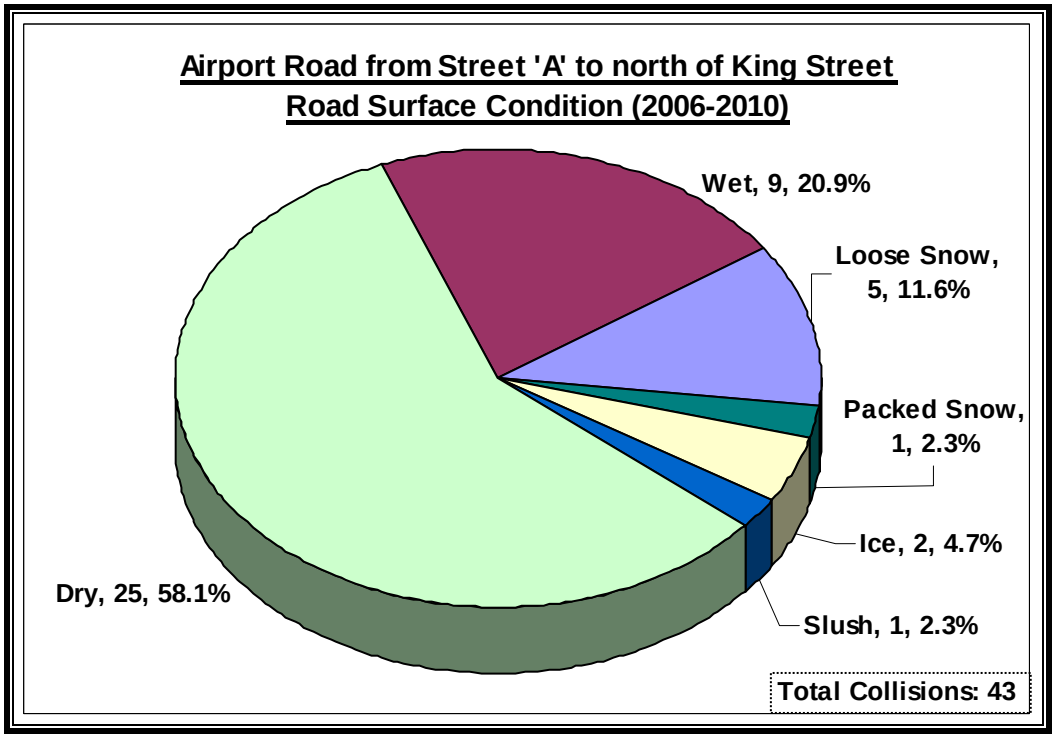

Exhibit 5: Collisions by Road Surface Condition (2006-2010)

It should be noted that there was a high percentage of 'SMV Other' type of collisions on Airport Road between Street 'A' and Healey Road. The number of 'SMV Other' (Run-off-road) type of collision on this road section is 100% of which 54.6% were snow related **(Exhibit 6**). On Airport Road between Old School Road and King Street 50% of the total reported collisions were due to unfavourable road conditions (**Exhibit 7**).

The number of 'SMV-Other' type of collisions were considerably higher than the Regional average of 5% based on the 2007-2009 data.

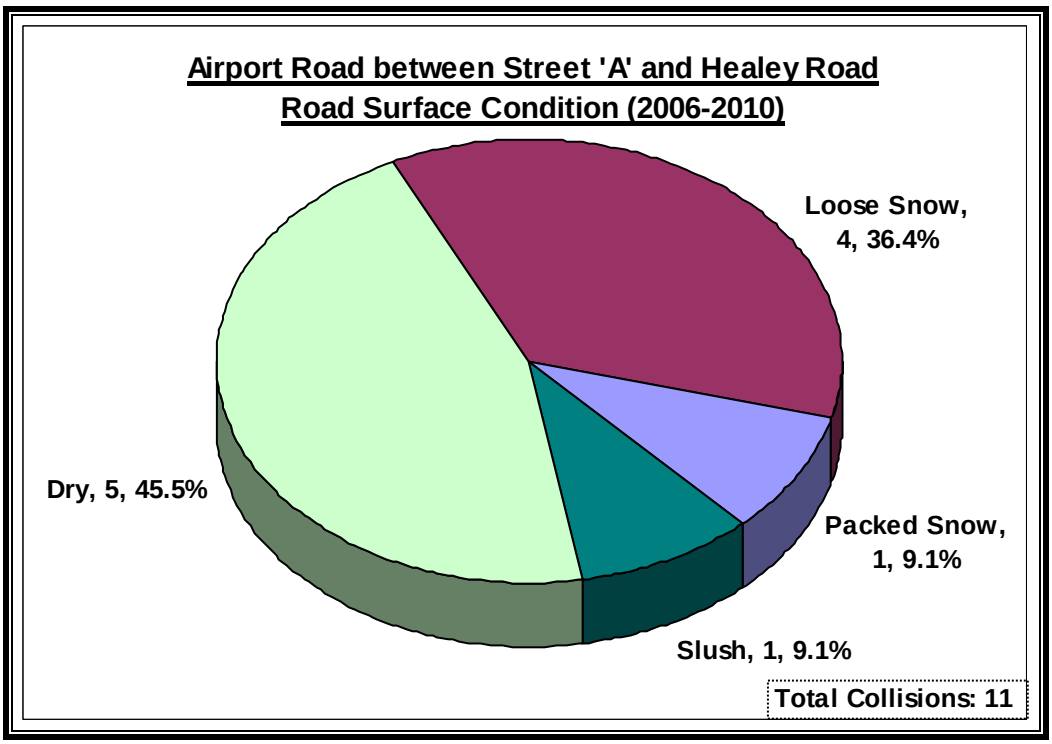

Exhibit 6: Collisions by Road Surface Condition (2006-2010) between Healey Road and Street 'A'

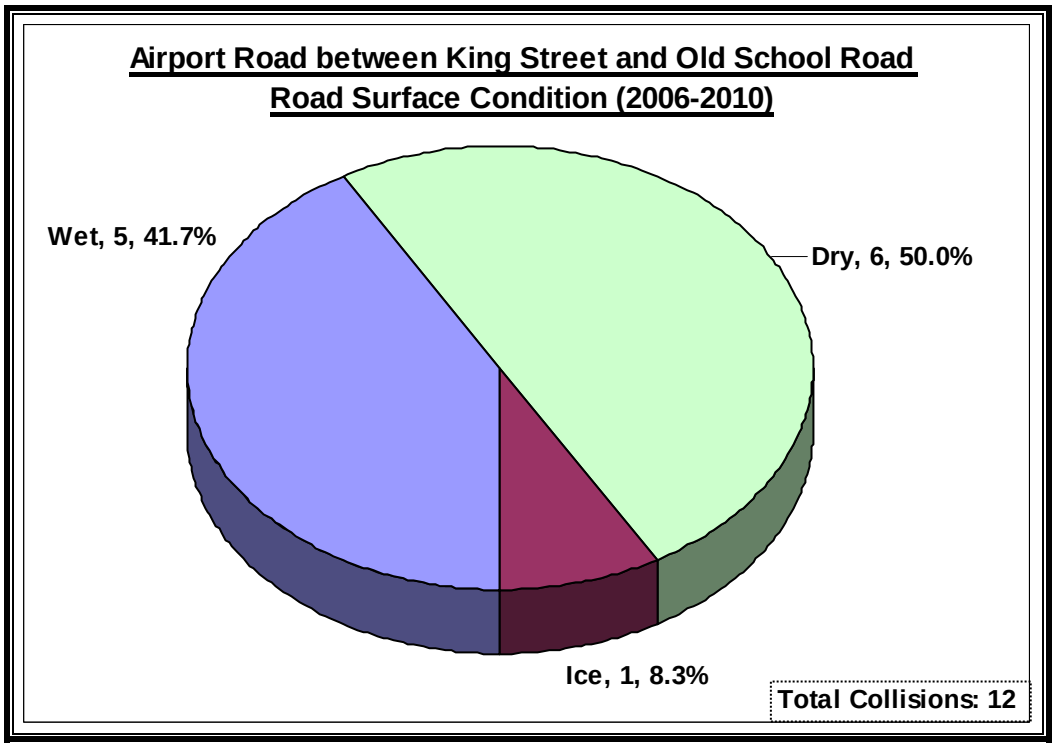

Exhibit 7: Collisions by Road Surface Condition (2006-2010) between King Street and Old School Road

The land use adjacent to this road section is rural farms. During the winter months, mitigative measures to address the amount of blowing and drifting snow from the open fields on either side of the roadway is already being undertaken with the placement of snow fencing. However, loss of control and Run-off-road type of collisions are still occurring as indicated from the historical collision records. As such, staff will further enhance the snow fencing in the area and provide Shoulder Rumble Strips to further improve safety in the area.

The average collision rate in the zone for the previous five years (2006-2010) is 0.22 (based on 1 million vehicles entering). A comparative analysis was conducted for Airport Road with other Regional Roads in the area with similar geometrics, traffic and environmental characteristics, and the results indicated that the average collision rate on Airport Road is similar to like facilities in the area. Detailed collision history has been provided in **Appendix 'A'**.

Historically speaking, our records do not indicate a significant increase in the number of collisions occurring in the zone. Our monitoring of collision activity in

this zone will continue as part of the scoping and monitoring process of safety programs.

3.2. NETWORK SCREENING AND RANKING

The network screening and ranking process establishes a priority system to rank the intersections and midblock road segments based on their Potential for Safety Index (PSI). In other words, this system ranks different locations according to where the safety of road users could potentially see the greatest increase.

The Empirical Bayes (EB) method is used to estimate the long-term safety performance of each location. The long-term safety performance of each location is compared with its peers (i.e. other locations with similar geometric, traffic, and environment characteristics). If the safety performance of the subject location is worse than the average safety of its peers, i.e. average predicted number of collisions obtained from Safety Performance Functions (SPF), then the subject location has a potential for safety improvement.

The PSI is calculated as the difference between the expected number of collisions and the predicted number of collisions. It is then calculated for severe and for property damage only (PDO) type collisions. The PSI for the severe collisions is also adjusted as a function of the societal cost of collisions for fatal and injury collisions. Intersections and Midblock road segments are then independently ranked from the highest to the lowest.

Presently there are 587 intersections and 777 road sections in the Region of Peel ranked based on their PSI. The PSI ranking of the intersections and the road segments in the study zone are provided in **Table 2**. None of the intersections and road sections in the zone are among the top 100 locations in the PSI ranking.

LOCATION	PSI Ranking*
Airport Road at Street 'A'	584
Airport Road between Healey Road and Street 'A'	416
Airport Road at Healey Road	493
Airport Road between Healey Road and Old School Road	264
Airport Road at Old School Road	555
Airport Road between King Street and Old School Road	191
Airport Road at King Street	252

Table 2: Potential for Safety Index (PSI) Ranking
*As per the "2009 Networking Screening Report"

3.3. SPEED DATA

Speed data from Automatic Traffic Recorder's (ATR) at two locations was analyzed to determine the operating characteristics of the vehicles, as they pertain to speed, in the area. These locations are:

1. 0.1km north of Old School Road
2. 2.1km north of Mayfield Road

The Mean speed and the 85th percentile speed were calculated from the results of the speed data. Mean speed is the average speed of all the vehicles and 85th percentile is the speed at or below which 85% of motorists feel is a safe and comfortable operating speed.

The posted Speed limit in the zone is 80 km/h for Airport Road 0.1km north of Old School Road. Recorded northbound and southbound speed data returned the following (**Table 3 – Table 5**):

Northbound Direction	2007	2008	2009	2010	2011
85th Percentile	80	113	99	109	89
Mean Speed (Average)	68	65	86	92	78

Table 3: Northbound direction - 0.1 Km N of Old School Road

Southbound Direction	2007	2008	2009	2010	2011
85th Percentile	81	85	98	96	106
Mean Speed (Average)	69	78	85	83	93

Table 4: Southbound direction - 0.1 Km N of Old School Road

Northbound / Southbound Direction	2007	2008	2009	2010	2011
85th Percentile	81	99	99	104	100
Mean Speed (Average)	68	71	86	87	86

Table 5: Northbound /Southbound direction - 0.1 Km N of Old School Road

The posted speed limit in the zone is 80 km/h for Airport Road 2.1km north of Mayfield Road where the second ATR was installed. Recorded northbound and southbound speed data returned the following (**Table 6 –Table 8**):

Northbound Direction	2007	2008	2009	2010	2011
85th Percentile	80	98	89	97	89
Mean Speed (Average)	57	80	79	86	76

Table 6: Northbound direction - 2.1km north of Mayfield Road

Southbound Direction	2007	2008	2009	2010	2011
85th Percentile	80	95	98	98	91
Mean Speed (Average)	60	82	86	88	79

Table 7: Southbound direction - 2.1km north of Mayfield Road

Northbound / Southbound Direction	2007	2008	2009	2010	2011
85th Percentile	80	96	95	98	90
Mean Speed (Average)	58	81	83	87	78

Table 8: Northbound/ Southbound direction - 2.1km north of Mayfield Road

The results indicate that speeding infractions are occurring in the area and are not to be unexpected as the zone is primarily rural in nature. Although the Region of Peel does not condone speeding, it is unlikely that sporadic enforcement will have any long term effect on driver behaviour unless the enforcement is maintained on a frequent and sustained basis.

4. SITE INVESTIGATION

The second phase of the investigation consisted of a site visit on January 5, 2012. Although there was no significant increase in the number or severity of collisions identified in our preliminary collision history review; staff have taken a proactive approach to safety by conducting on-site reviews to determine what elements could be enhanced in this zone.

The site investigation consisted of a positive guidance review and conformance check to determine what role information deficiencies and violation of driver

expectations may have played in contributing to crash potential. The site investigations consisted of:

- Review of the geometric elements including lane configuration
- Signing review
- Identification of potential hazards
- Illumination
- Pavement markings/ pavement condition

4.1. POTENTIAL SAFETY ENHANCEMENTS

There were potential safety enhancements identified in the study zone during the review that can be implemented to improve the overall safety of the zone. The enhancements on Airport Road as well as on the municipal roads intersecting it have been identified. The safety enhancements identified on municipal roads are under the jurisdiction of the Town of Caledon. Every intersection has a luminaire unless stated otherwise.

Identified potential safety enhancements are as follows:

a. Advance ‘street name’ sign is recommended on Healey Road approaching Airport Road in the westbound direction (**Figure 5**).

Figure 5: Advance Street Name Sign required on westbound Healey Road

b. Advance 'street name' sign is recommended on Old School Road approaching Airport Road in the eastbound direction (**Figure 6**).

Figure 6: Advance Street Name Sign required on eastbound Old School Road

c. Street Name sign on Airport Road at Old School Road is damaged and needs to be replaced (**Figure 7**).

Figure 7: Damaged Street Name Sign Airport Road at Old School Road

d. Ladder crosswalks and Pedestrian Countdown signal heads should be provided at the intersection of Airport Road at King Street for the safety of the vulnerable road users (**Figure 8**). It has to be noted that pedestrian cross buttons have been provided at this intersection.

Figure 8: Crosswalk required at Airport Road at King Street

e. A luminaire is provided at the offset intersections of Old School Road and Healey Road (**Figure 9**) on Airport Road. However, the location should be reviewed and upgraded to the new current ANSI Roadway Lighting RP-8-00 standards at the time of reconstruction of the intersection. This is to increase the visibility of the roadway and its immediate environment, thereby permitting the drivers to manoeuvre efficiently and safely.

Figure 9: Luminaire at Old School Road and Healey Road on Airport Road

f. For the road section on Airport Road between Street ‘A’ and Healey Road ‘SMV Other’ (Run-off-road) was the only type of collision that occurred. Speeding and weather were noted to be the leading causes for these collisions. Countermeasures were explored to mitigate the situation; one of which was installing raised reflective markers on the centerline as well as on the lane markings within the zone.

g. Missing guide wire should be replaced with guiderail with reflectors on the support post on the west side of Airport Road between Street ‘A’ and Healey Road for the safety of vehicles that might run off road (**Figure 10**).

Figure 10: Replace marker post wire between Street 'A' and Healey Road

5. CONCLUSIONS

This report identifies some safety improvements in the study area and contains recommendations that should be implemented to further enhance the safety and conspicuousity of the intersections and road segments in the study area.

As part of this EA, constructing a roundabout at the offset intersection of Airport Road with Healey Road and Old School Road is being considered to improve the traffic flow and reduce the potential of collision of left turning vehicles. Meanwhile, signalization of the said offset intersection is warranted based on volumes and, as a result, temporary signals are recommended as an interim measure. Roundabout or permanent signals will be considered as a long-term solution. Detailed review of both the options will be part of the Traffic report.

Further, this review incorporates recommended signage enhancements that may be beyond the jurisdiction of the Regional Municipality of Peel. It is recommended that the Town of Caledon be contacted regarding any signage that is under their jurisdiction.

6. RECOMMENDATIONS

There were potential safety enhancements identified in the study zone during the safety audit, which can be implemented to improve the overall safety of the zone. Identified recommendations are as follows:

Signage (Town of Caledon Jurisdiction):

1. Install advance “street name” sign on Healey Road approaching Airport Road in the westbound direction.
2. Install advance “street name” sign on Old School Road approaching Airport Road in the eastbound direction.

Pavement Marking:

3. Install ladder crosswalk at the intersection of Airport Road at King Street to increase the safety and conspicuity of the intersection.

Illumination:

4. Lighting through the study area on Airport Road be reviewed and upgraded to the new current ANSI Roadway Lighting RP-8-00 standards, at the time of reconstruction.

Others

5. Install pedestrian countdown signal heads at the intersection of Airport Road at King Street to increase the safety of the pedestrians and conspicuity of the intersection.

Geometrics

6. Marker posts wire should be upgraded to guiderail with reflectors on the support posts on the west side of Airport Road between Street ‘A’ and Healey Road

Pilot:

7. Install new yellow raised reflective markers in the centre line as well as white raised reflective markers on the lane markings on Airport Road between Street ‘A’ and King Street to enhance the visibility of the roadway during low light and poor environmental conditions.

8. For the road section on Airport Road between Street ‘A’ and Healey Road, some of the countermeasures to mitigate the Run-off-road type of collisions are:
   I. **Shoulder Rumble Strip:** the installation of shoulder rumble strip can be used to warn drivers by creating vibration and noise when driven over. As per *Highway Safety Manual 2010* “The vibratory effect of the Rumble Strip can be felt in snowy and icy conditions and may act as a guide to drivers in inclement weather”.

      This countermeasure does have some impact to the movement of some cyclists. As such, designed breaks in the Shoulder Rumble Strip will be provided as per input from the Region’s Active Transportation Group (**Figure 11**).

Figure 11: Shoulder Rumble Strip
(Source - FHWA)

II. **Snow Fence**: Enhancing the snow fence that is installed during the winter months will further address blowing snow from the open fields on either side of the roadway. Additionally, the Region of Peel's 'Living Snow Fence Program' will be considered. Living snow fences are tree and shrub windbreaks strategically planted in critical locations to assist in minimizing the hazards caused by drifting snow. The trees and shrubs are planted a minimum of 30 meters from the travelled portion of the roadway (**Figure 12**). If the landowners on this stretch of the roadway are willing to participate in this program, it may be incorporated as a mitigative measure to prevent the snow from blowing onto the roadway hence, improving road safety.

A new install technique for standard snow fence can be piloted by installing the snow fence slightly above the ground to get higher yield of snow and prevent majority of it from blowing onto the roadway. Consideration should also be made for double snow fencing if standard snow fencing is used as a mitigative measure.

Figure 12: Examples of a Snow Fence

9. This entire zone would be a good pilot area for "Safety Edge". Safety edge is a process where the edge of the paved roadway is finished at a 30º angle (**Figure 13**). This roadway treatment can assist in the reduction of (SMV

other) Run-off-road type collisions by eliminating pavement drop off and assisting in recovery. The drop off unfinished asphalt lip creates a significant amount of tire scrub that can cause a driver to over compensate when attempting to return to the paved surface if the vehicle has driven off the pavement.

Figure 13: Safety Edge
(Source - FHWA)

REFERENCES:

Highway Safety Manual 1st Edition 2010

Ontario Traffic Manual

Federal Highway Administration

Detailed Collision History of Airport Road between Street 'A' and 0.6km North of King Street

MIDBLOCK ID: 966 **DESCRIPTION:** AIRPORT ROAD BETWEEN HEALEY ROAD & STREET "A"

Accident ID	Date & Time	Light	Environment Condition 1	Road 1 Surface Condition	Initial Impact Type	Classification of Accident	Apparent Driver 1 Action	Apparent Driver 2 Action	Initial Direction of Travel 1	Initial Direction of Travel 2	Vehicle 1 Manoeuver	Vehicle 2 Manoeuver	Sequence of Events 1	Sequence of Events 2
60000201	04-Feb-06 7:55 PM	Snow	Dark	Loose snow	SMV - Other	P.D. only	Lost control	Other	North	Other	Skidding/sliding	Other	Going ahead	Other
60000267	25-Feb-06 7:11 AM	Clear	Daylight	Loose snow	SMV - Other	P.D. only	Speed too fast for condition	Other	South	Other	Skidding/sliding	Other	Going ahead	Other
00060648	17-Jun-06 3:45 AM	Clear	Dark	Dry	SMV - Other	P.D. only	Lost control	Other	North	Other	Skidding/sliding	Other	Going ahead	Other
06000996	02-Oct-06 4:25 AM	Clear	Dawn	Dry	SMV - Other	P.D. only	Lost control	Other	South	Other	Other	Other	Unknown	Other
08020017	08-Mar-08 2:00 PM	Snow	Daylight	Packed snow	SMV - Other	P.D. only	Speed too fast for condition	Other	South	Other	Skidding/sliding	Other	Going ahead	Other
08020638	04-Aug-08 4:50 AM	Clear	Dark	Dry	SMV - Other	Non-fatal injury	Improper passing	Other	South	Other	Ditch	Other	Overtaking	Other
09000287	22-Feb-09 4:00 PM	Drifting snow	Daylight	Loose snow	SMV - Other	P.D. only	Lost control	Other	South	Other	Pole (sign, parking meter)	Other	Going ahead	Other
09000937	15-Aug-09 11:45 AM	Clear	Daylight	Dry	SMV - Other	Non-fatal injury	Lost control	Other	North	Other	Skidding/sliding	Other	Going ahead	Other
10000158	10-Feb-10 12:15 AM	Snow	Dark	Loose snow	SMV - Other	P.D. only	Lost control	Other	South	Other	Ran off road	Other	Going ahead	Other
10000541	19-May-10 7:30 PM	Clear	Daylight	Dry	SMV - Other	P.D. only	Lost control	Other	North	Other	Other	Ditch	Going ahead	Other
10001278	13-Dec-10 2:05 PM	Clear	Daylight	Slush	SMV - Other	P.D. only	Speed too fast for condition	Other	North	Other	Skidding/sliding	Rollover	Going ahead	Other

LOCATION TOTAL COLLISIONS: 11

INTERSECTION ID: INT_1228 **DESCRIPTION:** AIRPORT ROAD @ HEALEY ROAD

Accident ID	Date & Time	Light	Environment Condition 1	Road 1 Surface Condition	Initial Impact Type	Classification of Accident	Apparent Driver 1 Action	Apparent Driver 2 Action	Initial Direction of Travel 1	Initial Direction of Travel 2	Vehicle 1 Manoeuver	Vehicle 2 Manoeuver	Sequence of Events 1	Sequence of Events 2
08020523	10-Aug-08 3:05 PM	Rain	Daylight	Wet	Rear end	P.D. only	Improper passing	Driving properly	South	South	Other motor vehicle	Other	Going ahead	Turning left
10000979	08-Oct-10 9:50 AM	Clear	Daylight	Dry	Turning movement	P.D. only	Improper turn	Driving properly	West	North	Other motor vehicle	Other motor vehicle	Turning left	Going ahead

LOCATION TOTAL COLLISIONS: 2

MIDBLOCK ID: 358 **DESCRIPTION:** AIRPORT ROAD BETWEEN KING STREET & OLD SCHOOL ROAD

Accident ID	Date & Time	Light	Environment Condition 1	Road 1 Surface Condition	Initial Impact Type	Classification of Accident	Apparent Driver 1 Action	Apparent Driver 2 Action	Initial Direction of Travel 1	Initial Direction of Travel 2	Vehicle 1 Manoeuver	Vehicle 2 Manoeuver	Sequence of Events 1	Sequence of Events 2
06000212	14-Feb-06 7:50 PM	Clear	Dark	Wet	SMV - Other	P.D. only	Other	Other	North	Other	Ran off road	Other	Going ahead	Other
06000363	23-Mar-06 1:20 AM	Clear	Dark	Dry	SMV - Other	P.D. only	Driving properly	Other	South	Other	Animal - domestic	Other	Going ahead	Other
64000046	06-Apr-06 10:50 AM	Clear	Daylight	Dry	SMV - Other	P.D. only	Lost control	Other	South	Other	Ran off road	Other	Going ahead	Other
60000554	19-May-06 2:00 PM	Clear	Daylight	Dry	SMV - Other	P.D. only	Lost control	Other	South	Other	Ran off road	Other	Slowing or stopping	Other
07001268	19-Nov-07 5:55 PM	Rain	Dark	Wet	SMV - Other	P.D. only	Other	Other	North	Other	Other	Other	Turning right	Other
08000189	08-Feb-08 4:05 PM	Clear	Daylight	Dry	Rear end	P.D. only	Following too close	Driving properly	North	North	Other motor vehicle	Other motor vehicle	Going ahead	Stopped
08021817	04-Nov-08 6:20 AM	Fog, mist, smoke, dust	Dark	Wet	Sideswipe	P.D. only	Driving properly	Failed to yield right-of-way	South	South	Other motor vehicle	Other motor vehicle	Going ahead	Making "U" turn
09000979	28-Aug-09 8:45 AM	Rain	Daylight	Wet	Rear end	P.D. only	Following too close	Driving properly	South	South	Other motor vehicle	Other motor vehicle	Slowing or stopping	Turning left
09001429	18-Dec-09 12:30 PM	Clear	Daylight	Wet	Sideswipe	P.D. only	Other	Improper turn	North	North	Other motor vehicle	Other motor vehicle	Going ahead	Turning right
10000062	23-Dec-09 9:35 PM	Clear	Dark	Ice	SMV - Other	P.D. only	Speed too fast for condition	Other	North	Other	Ran off road	Other	Going ahead	Other
10000353	30-Mar-10 4:00 PM	Clear	Daylight	Dry	Rear end	Non-fatal injury	Following too close	Driving properly	North	North	Other motor vehicle	Other motor vehicle	Going ahead	Stopped
10001166	20-Nov-10 8:40 PM	Clear	Dark	Dry	SMV - Other	P.D. only	Improper turn	Other	North	Other	Ditch	Other motor vehicle	Turning left	Other

LOCATION TOTAL COLLISIONS: 12

INTERSECTION ID: INT_1170 **DESCRIPTION: AIRPORT ROAD @ KING STREET**

Accident ID	Date & Time	Light	Environment Condition 1	Road 1 Surface Condition	Initial Impact Type	Classification of Accident	Apparent Driver 1 Action	Apparent Driver 2 Action	Initial Direction of Travel 1	Initial Direction of Travel 2	Vehicle 1 Manoeuver	Vehicle 2 Manoeuver	Sequence of Events 1	Sequence of Events 2
06000348	16-Mar-06 3:53 PM	Clear	Daylight	Dry	Sideswipe	P.D. only	Improper passing	Driving properly	East	East	Other motor vehicle	Other motor vehicle	Overtaking	Turning left
06000718	01-Jul-06 12:45 PM	Clear	Daylight	Dry	Rear end	P.D. only	Speed too fast for condition	Driving properly	North	North	Other motor vehicle	Other motor vehicle	Going ahead	Stopped
07000939	10-Aug-07 3:10 PM	Clear	Daylight	Dry	Rear end	P.D. only	Other	Driving properly	South	South	Other motor vehicle	Other motor vehicle	Going ahead	Stopped
08000177	01-Feb-08 2:00 PM	Clear	Daylight	Dry	Rear end	P.D. only	Driving properly	Driving properly	South	South	Other motor vehicle	Other	Slowing or stopping	Stopped
08020555	03-Aug-08 9:05 PM	Clear	Dusk	Dry	Sideswipe	Non-fatal injury	Failed to yield right-of-way	Driving properly	South	South	Other motor vehicle	Other motor vehicle	Turning right	Going ahead
08020727	30-Aug-08 12:10 AM	Clear	Dark	Dry	Angle (t-bone)	Non-fatal injury	Driving properly	Disobeyed traffic control	North	East	Other motor vehicle	Other motor vehicle	Going ahead	Going ahead
08020647	19-Sep-08 10:51 AM	Clear	Daylight	Dry	Angle (t-bone)	P.D. only	Disobeyed traffic control	Driving properly	North	West	Other motor vehicle	Other motor vehicle	Going ahead	Going ahead
08021140	25-Dec-08 11:32 AM	Clear	Daylight	Dry	Angle (t-bone)	P.D. only	Driving properly	Failed to yield right-of-way	West	South	Other motor vehicle	Other motor vehicle	Going ahead	Going ahead
09000342	22-Feb-09 4:50 PM	Clear	Daylight	Dry	Rear end	P.D. only	Other	Driving properly	West	West	Other motor vehicle	Other motor vehicle	Reversing	Stopped
09000483	24-Mar-09 12:25 PM	Clear	Daylight	Dry	Angle (t-bone)	Non-fatal injury	Disobeyed traffic control	Driving properly	South	West	Other motor vehicle	Other motor vehicle	Going ahead	Going ahead
09001144	22-Jun-09 7:55 AM	Clear	Daylight	Dry	Rear end	P.D. only	Following too close	Other	South	South	Other motor vehicle	Other motor vehicle	Going ahead	Stopped
10000123	26-Jan-10 4:50 PM	Clear	Daylight	Dry	Turning movement	P.D. only	Failed to yield right-of-way	Driving properly	East	North	Other motor vehicle	Other	Turning left	Going ahead
10000504	27-May-10 5:23 PM	Rain	Daylight	Wet	Rear end	P.D. only	Following too close	Driving properly	West	West	Other motor vehicle	Other	Going ahead	Stopped
10000968	13-Oct-10 5:54 PM	Rain	Daylight	Wet	SMV - Other	Non-fatal injury	Speed too fast for condition	Other	West	Other	Ran off road	Other	Going ahead	Other

LOCATION TOTAL COLLISIONS: 14

MIDBLOCK ID: 301 **DESCRIPTION: AIRPORT ROAD UPTO 0.6KM NORTH OF KING STREET**

Accident ID	Date & Time	Light	Environment Condition 1	Road 1 Surface Condition	Initial Impact Type	Classification of Accident	Apparent Driver 1 Action	Apparent Driver 2 Action	Initial Direction of Travel 1	Initial Direction of Travel 2	Vehicle 1 Manoeuver	Vehicle 2 Manoeuver	Sequence of Events 1	Sequence of Events 2
60000790	23-Jul-06 2:41 AM	Clear	Dark	Dry	SMV - Other	P.D. only	Lost control	Other	North	Other	Rollover	Other	Going ahead	Other
07028694	15-Feb-07 5:00 PM	Clear	Dawn	Wet	Other	P.D. only	Driving properly	Driving properly	North	South	Other	Other	Going ahead	Going ahead
07001348	29-Nov-07 4:00 PM	Snow	Dawn	Ice	Rear end	P.D. only	Following too close	Driving properly	South	South	Other motor vehicle	Other motor vehicle	Slowing or stopping	Stopped
10000245	25-Feb-10 10:52 PM	Snow	Dark	Loose snow	SMV - Other	P.D. only	Lost control	Other	South	Other	Skidding/sliding	Other	Going ahead	Other

LOCATION TOTAL COLLISIONS: 4

GRAND TOTAL FOR THE ZONE: 43