

February 2021

Traffic Impact Assessment Benchlands Nkwûkwma Development

Skénkenam Development group, Pemberton, BC

DRAFT REPORT



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1. Introduction

Bethel Land Corporation (Bethel) together with the Lil'wat Nation (Skénkenam Development Group) are planning to develop 267 residential units on the 31.23-hectare parcel in the Benchlands neighbourhood, north of the Village of Pemberton in BC. The land is part of a larger 62-hectare parcel and is referred to as the "Benchlands Nkwûkwma" development. As part of the rezoning approval process, the Village of Pemberton (the Village) requires a traffic impact assessment (TIA) for the project.

Howes Technical Advantage Ltd. (HTA) has been commissioned by Skénkenam Development group undertake the TIA. This study is based on information provided by Skénkenam and the Village as of end of January 2021.

1.1. Context

The Village adopted an Official Community Plan in 2014. The Benchlands Neighbourhood Concept Plan (NCP) was adopted as part of the OCP at that time. A traffic study was undertaken by InterCAD in 2005 and formed part of the Neighbourhood Plan (the InterCAD Report). The OCP Transportation Map is shown in **Appendix A**.

The terms of reference for the TIA have been developed based on the BC Ministry of Transportation and Infrastructure (BC MoTI) standard Terms of Reference. The Village has provided input to and approval of the scope and approach. The main arterial road system through the Village is owned and managed by BC MoTI. BC MoTI has been advised of the planned development and the Village will be liaising directly with BC MoTI for commentary.

The Village provided a copy of a report called Pemberton Crabapple and Downtown Traffic Impact Study, undertaken by ISL Engineering and Land Services, June 2018 (ISL Report). This report reviewed all current and future development proposed until the year 2027.

For this TIA, the proposed development is planned to be built out by 2025. The project location in relation to the Village is shown in **Figure 1**.

1.2. Project Description, Study Area

The proposed development consists of 267 units. The development is planned in two stages - Phase 1 and Phase 2. This is the main focus of this analysis and assessment. The site plan with the phases is illustrated in **Figure 2**.

There is a future phase of the development, Phase 3 with 187 units, with a possible build out timeline of 25 to 30 years in the future. Phase 3 is not included as part of this assessment at this stage.

For this assessment, it has been assumed that Phase 1 and 2 will be built by 2025. This is a more conservative approach for the analysis as it is likely that the units will be built over a longer period of 10 to 15 years.

The breakdown of the units is as follows:

Single family: 71 units (smaller single-family homes)
 Multi-family: 132 units (townhouses and apartments)

Single family + suite: 64 units (medium and large single-family homes)

The study area is shown in **Figure 3**. There are five study area intersections indicated which include:

- Highway 99/Portage Rd.
- Portage Rd./Birch St. (roundabout)
- Birch St./Prospect St.
- Dogwood St./Aster St.
- Eagle Dr./Pemberton Meadows Rd.

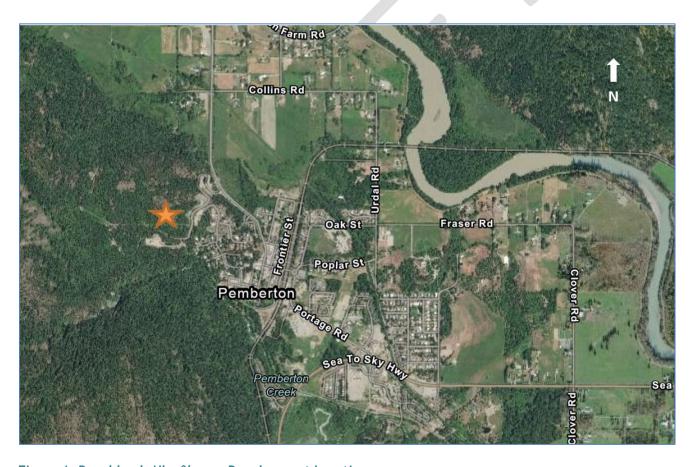


Figure 1: Benchlands Nkwûkwma Development Location



SKENKENAM LANDS PEMBERTON BC

JANUARY 2021 Surveyed + Realigned Streams Single Family Development Areas 8.63 ha | 21.33 ac Strata Townhome Development Areas Apartment Development Areas 0.22 ha | 0.54 ac 24 9% Medium Single Family | 15m **40** 15% **47** 18%

FIGURE 2

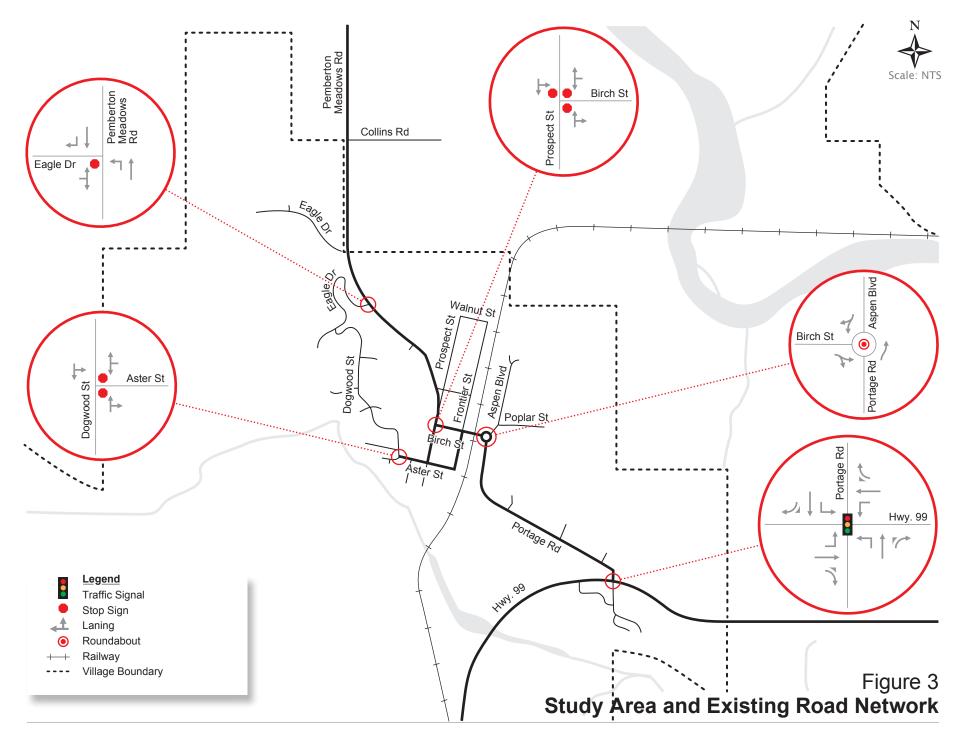
24 9%

92 34%

40 15%

267 100%





1.3. Assumptions

The following assumptions have been made for this report:

- Development: The layout details and future land use were supplied by Ekistics.
- Milestone dates:
 - The proposed Opening Day is 2025.
 - The future projected traffic has been assumed as Opening Day +5 years in 2030.
- Background Traffic: Background traffic assumptions are based on counts undertaken and reference to the ISL Report.
 - Other growth related to future development in the study area was used as represented in the ISL Report. The Village had provided ISL with the future and potential developments to the horizon year 2027. It is assumed the extent of this new development would also apply for the year 2030. In other words, no additional growth is assumed for 2030 beyond that contained in the ISL report
 - It is assumed that there will be little other growth besides these developments in the next 10 years. As such no other background growth will be added to the local Village network.
 - A 2% annual growth rate was applied to the existing through traffic on Highway
 99. This will account for developments east of the Village and general growth in traffic on Highway
 99.

Road network:

- It is assumed that the majority of site traffic will use Eagle Drive (collector road) as it provides the most direct route to and from the development site.
- It is anticipated that some site traffic may use Dogwood St (collector road).
- A future road connection to the north of the site is not contemplated as part of this development.

1.4. Existing Transportation Network

Road System:

The existing road network and traffic control is shown in Figure 3.

There are two existing road accesses to the proposed development. These are Eagle Drive and Dogwood Street. The main access for the development will be Eagle Drive which is a two-lane collector road. As noted previously, this is a more direct route and this route will carry the majority of the traffic which is destined for Highway 99. It is also anticipated that some development traffic will use Dogwood Street.

Therefore, the main roads servicing this project will be the route using Pemberton Meadows Rd, Birch Street and Portage Road connecting to Highway 99. All three of these

roads are collector standard with one lane in each direction. There are some turn lanes at intersections.

A future connection is proposed connecting to Pemberton Meadows Road north of Eagle Drive. This land is not owned by the developer and it is understood that development of these lands together with this access point is unlikely in the short to medium term.

A future connection between Eagle Drive and Walnut Street is shown in the OCP. However, the Village has advised that this link is unlikely to proceed.

The InterCAD report, in 2005, noted that access to the Village Centre relies on Portage Road as the only access from Highway 99. The report recommended the need to establish a secondary route as good transportation planning for the Village. There is ongoing development in and around the Village Centre. Two development areas west and south of the Centre, Harmony Reach and Tiyata, have been rezoned and eliminate the possibility of an additional link to Highway 99 on the east side of Pemberton Creek. Consequently, for the purposes of this traffic study, additional future accesses have not been assumed at this time.

Pedestrian and Cycling:

There are numerous existing mountain bike trail and hiking trails in this area. The proposed development will include linkages to existing trails and provided improved networks to the Village. However, it is anticipated that walking and cycling modes will not provide significant reductions in vehicle trips in the peak hours given the location and topography of the site.

Transit: There are no existing or planned transit routes in the vicinity.



2. Existing Scenario

Traffic counts were undertaken in September 2019, prior to the current COVID-19 pandemic. The five study area intersection locations were counted. These data are summarized in **Figure 4**. The traffic count data are attached in **Appendix B**.

The AM peak hour is from 7:45 to 8:45 AM and the PM peak hour is from 4:30 to 5:30 PM. Based on a review of the September 2019 traffic count volumes at the key intersections, the AM peak hour traffic volumes are 75% of the PM peak hour volumes. The highest volumes are at the intersection of Highway 99 and Portage Road.

A comparison with the 2005 traffic data in the InterCAD report shows both increases and decreases in traffic in the Village area. Traffic volumes on Highway 99 have increased considerably in the last 14 years. The 2018 ISL Report was also reviewed and the recent 2019 traffic count data compared well.

The PM peak hour has the highest traffic volume and is the worst-case scenario. Therefore, the PM peak hour was the only scenario used for the future analysis in this traffic study.

3. Background Traffic

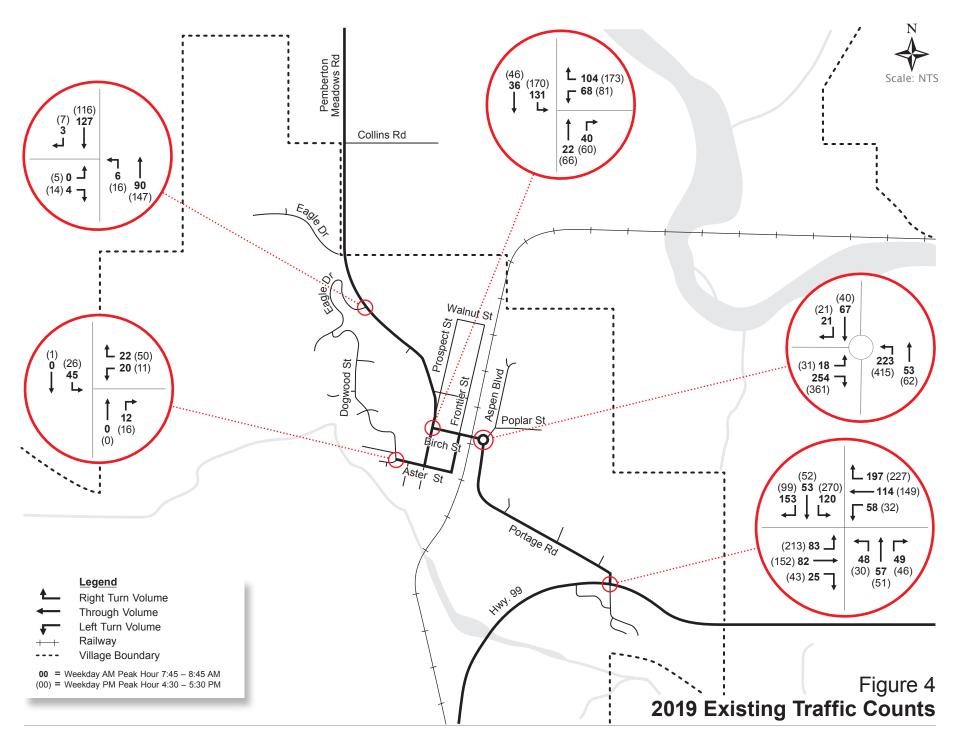
The proposed future development in the study area was used as represented in the ISL Report. The Village had provided ISL with the future and potential developments to the horizon year 2027. It is assumed that this would apply for this assessment to the milestone year of 2030. The total development includes 515 dwelling units (DU) and 16,000 ft² of commercial. This includes 24 future single-family units in the Benchlands Phase 1 development.

The development location and associated trip generation is shown in **Figure 5** (Reference ISL Report, Figure 3.1). The total generated traffic from these developments as applied to the key intersections is shown in **Figure 6** (Reference ISL Report, Figure 3.2).

The total two-way trips from these developments are 249 trips in the AM peak hour and 360 trips in the PM peak hour.

It is assumed that there will be little other growth besides these developments in the next 10 years and therefore no other background growth was added to the local Village network. The only other future growth is the Nkwûkwma development which is captured in the Site Trips.

The Background growth for 2030 was calculated by using the existing traffic counts as a base and adding the future development. A 2% annual growth rate was applied to the existing through traffic on Highway 99 to account for developments east of the Village and general growth on Highway 99. The 2030 Background traffic plus the other development is shown in **Figure 5.**



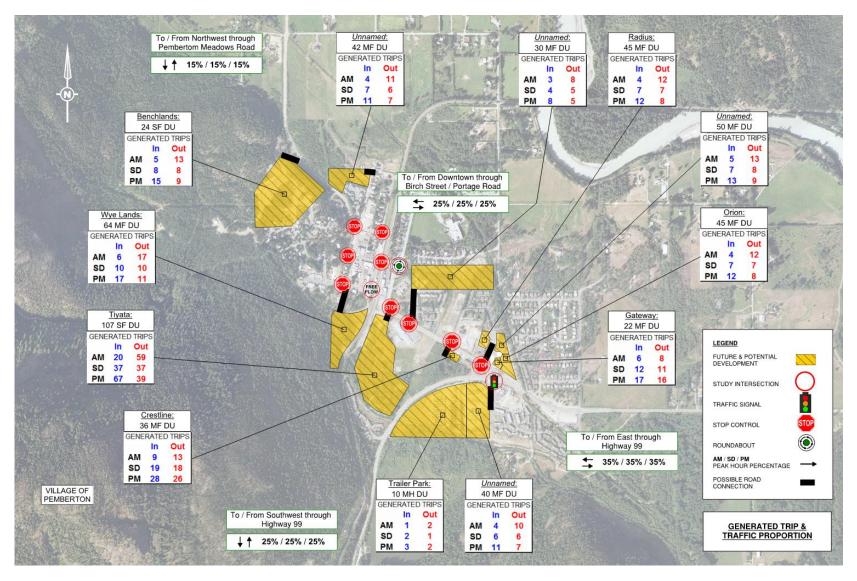
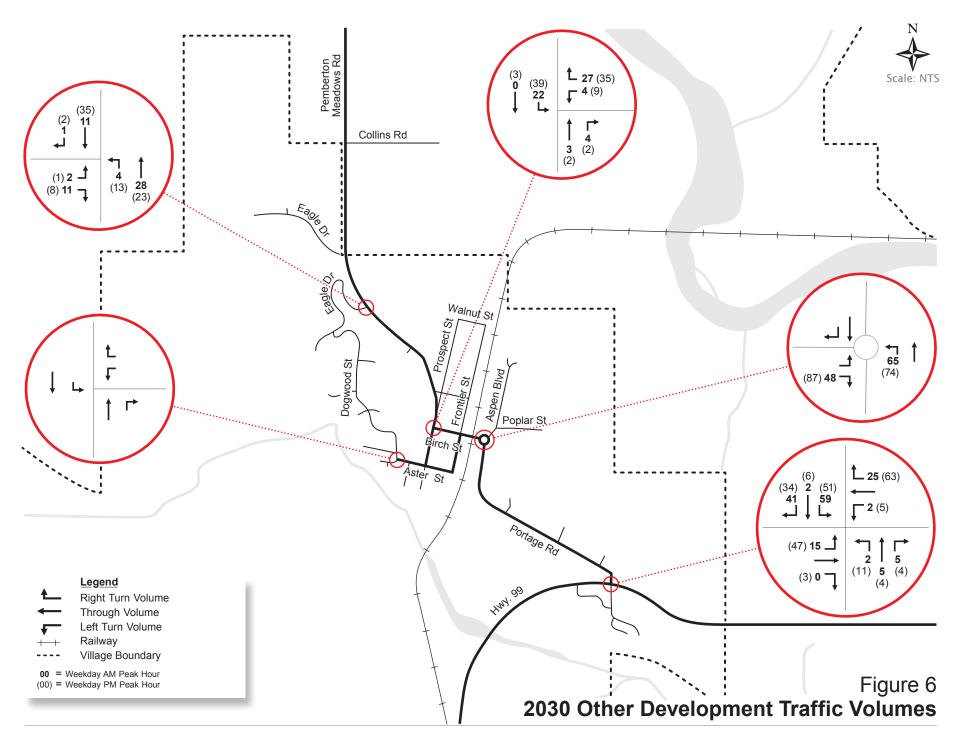
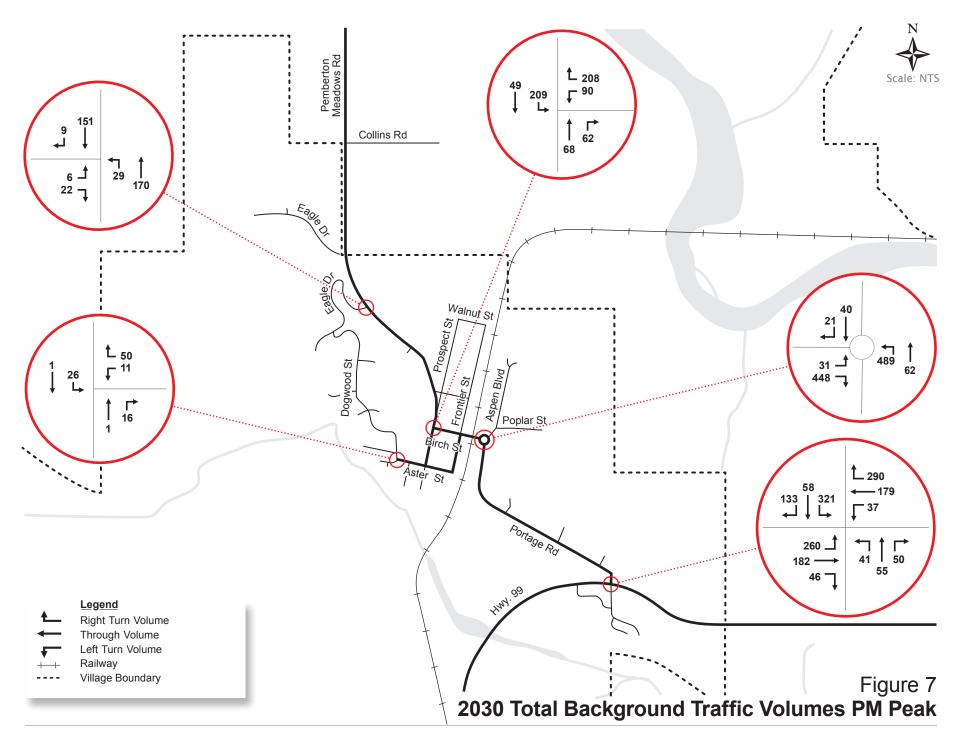


Figure 3.1: Generated Trip and Traffic Proportion







4. Project Traffic

4.1. Trip Generation

This section describes the method used to establish the trip generation rates to be used for estimating the traffic that would to be generated by the development. The types of units are single family units, multi-family units and single-family dwellings with suites.

In the InterCAD study, 2005, the PM peak hour was used for the analyses and trip rates were based on the ITE trip rate manual of the day¹. This is summarized as follows:

- For single family units a rate of 1.02 vehicle trips/unit was used with a directional split of 63% inbound and 37% outbound.
- For multi-family and the suites in single family units, a blended rate was developed based on the premise that a location such as this would have higher trip rates compared to the typical suburban locations for the ITE data. This blended rate of 0.78 veh. trips/unit was the average of the single family rate (1.02) and the multifamily rate (0.56). The same directional split was assumed as per the single family split.

Trip generation rates were reviewed and the latest version (10th Edition) of the Institute of Transportation Engineers (ITE) Trip Generation Manual was referenced. This is shown in **Table 1**.

No reductions have been made for alternative mode use although there may be some residents who will cycle or walk to and from destinations outside the development site. Therefore, the estimate of peak hour motor vehicle trips is likely higher than actual trips and represents a conservative estimate to ensure that any impacts associated with the additional traffic are not underestimated.

Table 1: ITE Trip Rates

			А	M PEAK HO	OUR	PM PEAK HOUR				
DESCRIPTION	ITE REF#	ITE Descrip	ITE Description		RATE IN	RATE IN RATE OUT		RATE IN	RATE OUT	TOTAL RATE
Single family	10th 210	Gen Urban Suburban	Detached		0.19	0.56	0.74	0.62	0.37	0.99
				Directional dist.	25%	75%		63%	37%	
Multifamily Housing (Low Rise)	ultifamily Housing (Low Rise) 10th 220 Gen Urban Suburban 1-2 levels			0.11	0.35	0.46	0.35	0.21	0.56	
				Directional dist.	23%	77%		63%	37%	
Multifamily Housing (Mid Rise)	10th 221	Gen Urban Suburban	3-10 levels		0.09	0.27	0.36	0.27	0.17	0.44
				Directional dist.	26%	74%		61%	39%	
Multifamily Housing (High Rise)	nily Housing (High Rise) 10th 222 Gen Urban Suburban 10 plus levels		10 plus levels		0.07	0.24	0.31	0.22	0.14	0.36
				Directional dist.	24%	76%		61%	39%	

For this development, there are two land use types that can apply - single family (ITE ref # 210) and multifamily low rise (ITE ref # 220), 1-2 levels. The ITE Trip Generation Manual establishes two areas for residential trip rates - general urban/suburban and dense multiuse urban. Both of these areas are typical of a large metropolitan area with dense innercity development and lower density suburbs as opposed to more rural development. Accordingly, because of the project location, the ITE rates have been increased by

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¹Trip Generation Manual, Institute of Transportation Engineers (ITE), 10th Edition

approximately 5 to 10% to reflect the more rural nature of the development (limited potential for non-vehicle trips). Suites in single family homes are assumed to have trip characteristics similar to multi-family units as the occupants are more likely to be renters.

The rates were adjusted as follows:

- Single Family ITE 210 rate increased by 5%
- Multi-family ITE 220 rate increased by 10%
- Single Family with Suite sum of the adjusted Single Family Rate and Multi-family rate

Table 2 summarizes the trip generation rates used for the analysis.

Table 2: Adjusted Trip Generation Rates

				_				
			A	M PEAK H	OUR	F	OUR	
DESCRIPTION	ITE REF#		RATE IN	RATE OUT	TOTAL RATE	RATE IN	RATE OUT	TOTAL RATE
Single family	Adj		0.19	0.58	0.78	0.65	0.38	1.04
		Directional dist.	25%	75%		63%	37%	
Multifamily Housing (Low Rise)	Adj		0.12	0.39	0.51	0.39	0.23	0.62
		Directional dist.	23%	77%		63%	37%	
Single family with Suite	Adj		0.32	0.96	1.28	1.04	0.61	1.66
		Directional dist.	25%	75%		63%	37%	

4.2. Site Traffic

Based on these rates, the resultant project traffic is estimated using the adjusted trip rates and the build out unit numbers. **Table 3** below shows the calculation of the Site traffic per land use.

Table 3: Total project Traffic – AM and PM peak hours

		A	M PEAK HOU	JR	PM PEAK HOUR				
DESCRIPTION	UNITS	TRIPS IN	TRIPS OUT	TRIPS	TRIPS IN	TRIPS OUT	TRIPS		
Single family 71		14	41 55		46	27	7-		
Multifamily Housing (Low Rise)	132	15	51	67	51	30	8		
Single family with Suite	64	21	62	82	67	39	10		
	267	50	154	204	164	97	26		

No trip reductions in the peak hour were considered. The main reasons are that the location and topography of the development are not likely to result in significant use of alternative modes of transportation such as cycling and walking, and future transit service close to the development is not planned.

The total two-way Opening Day project traffic in the AM peak hour is 204 trips and in the PM peak hour is 261 trips.

4.3. Site Traffic Distribution

The trip distribution as noted in the ISL Report was reviewed and is shown in **Table 4** below.

Table 4: ISL Report - Site Trip Distribution

TO and FROM	ISL Report				
TO and FROM	AM	PM			
Village	25%	25%			
Northwest – Pemberton Meadows Rd	15%	15%			
Southwest – Highway 99	25%	25%			
East – Highway 99	35%	35%			

The InterCAD report distributed traffic at the intersection of Highway 99 and Portage Road in proportion to the traffic count.

The 2019 traffic count at Highway 99/Portage was reviewed for the splits east and west. These splits reflect existing traffic movements, but it is anticipated that employment and trips attractions will be located both in the East and the Southwest. This appears to be a consistent trend from the work undertaken in 2005 as well. The 2019 traffic count data reflect the following characteristics:

- Outbound on Portage Road at Highway 99:
 - In the AM, 47% to Southwest and 37% to East
 - In the PM, 24% to Southwest and 64% to East
- Inbound on Portage Road at Highway 99:
 - In the AM, 25% from Southwest and 58% from East
 - In the PM, 43% from Southwest and 46% from East

The recommendation for the Project trip distribution is shown in **Table 5** below with commentary to follow.

Table 5: Project Trip Distribution

	AN	1	PM		
	IN	OUT	IN	OUT	
Village	5%	15%	20%	20%	
Northwest – Pemberton Meadows Rd	5%	5%	5%	5%	
Southwest – Highway 99	25%	45%	35%	25%	
East – Highway 99	65%	35%	40%	50%	

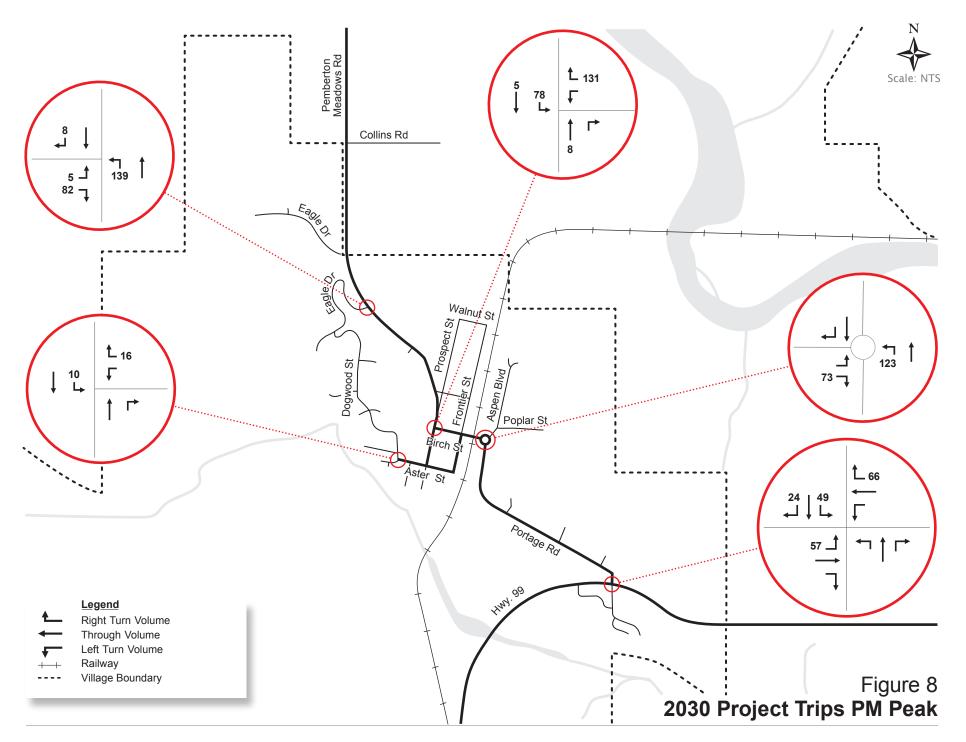
The following discussion provides some commentary on the trip distribution:

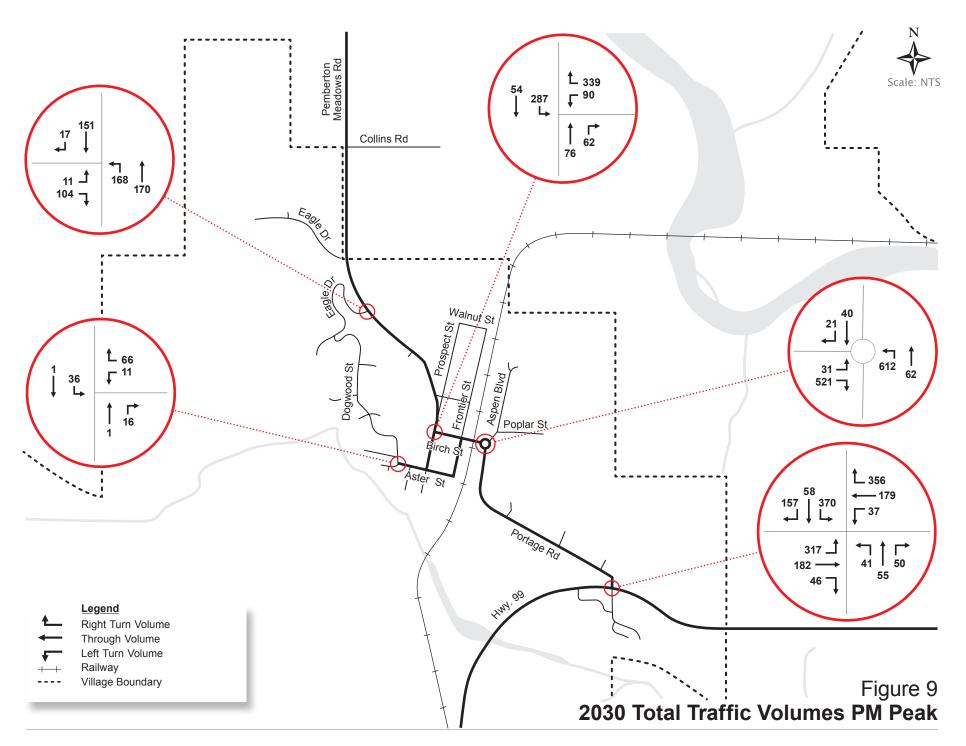
- Northwest there is not much of an attraction for Benchlands residents in the peak hours.
- The majority of the trips generated from and attracted to the site will be distributed south along Eagle Drive onto Pemberton Meadows Road.
- Half of the trips destined to and from the Village will be distributed along Dogwood Street (this equates to 10% of the total trips).
- The majority of trips in the peak hour are to and from employment.
- AM Peak distribution:
 - Inbound: Nominal trips from Village and Northwest; trips from Highway 99 reflect current count splits.
 - Outbound: Nominal trips to Northwest; trips to Village but less than ISL; trips to Highway 99 reflect current count splits.
- PM Peak distribution:
 - Inbound: Nominal trips from Northwest; trips from Village higher than AM peak but less than ISL report; trips from Highway 99 reflect current count splits.
 - Outbound: Nominal trips to Northwest; trips to Village higher than AM peak but less than the ISL report; trips to Highway 99 reflect ratio of current count splits and balanced with other percentages.

The resulting Total Project Trips assigned to the network are shown in Figure 8.

5. Future Traffic Volumes

The total trips for year 2030 were developed by adding the Total Background Trips to the Project Trips for 2030. This is shown in **Figure 9**.





6. Analysis

6.1. **Analysis Assumptions**

The Synchro software² suite was used for the traffic analysis for the existing and the future horizon. This analysis is based on the procedure and methods of the Highway Capacity Manual (HCM) for signalized and unsignalized intersections. SIDRA³ as used to analyze the roundabout.

Operations of roadway facilities are described in terms of Level of Service (LOS). LOS is a qualitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to manoeuvre. Six service levels are defined ranging from LOS A, the best operating conditions, to LOS F, the worst operating conditions. LOS E corresponds to "at or near capacity" operations. When volumes exceed capacity, stop-and-go conditions result and operations are designated LOS F. The delay thresholds and corresponding LOS are presented in Table 6. The calculated 95th percentile queue length has also been reported in terms of length (m) where the average space for a car is approximately 7m.

lable	6:	Level	Ot	Service	Criteria

Level of service	Average delay: Unsignalized intersection	Average delay for Signalized intersection	v / c Ratio			
(LOS)	movements (sec/vehicle)	movements (sec/vehicle)				
Α	0-10	0-10	< 0.60			
В	10-15	10-20	> 0.60 to 0.69			
С	15-25	20-35	> 0.70 to 0.79			
D	25-35	35-55	> 0.80 to 0.89			
E	35-50	55-80	> 0.90 to 0.99			
F	> 50	> 80	> 1.00			

The following assumptions were used for this study:

- PM Peak Hour only (worst case scenario)
- Heavy vehicles 2%
- Grade 0%, except at Eagle Drive
- Speed 50km/h for side streets, 60km/h for Highway 99
- Lane widths 3.6m
- The BC MoTI signal timings were used for Highway 99/Portage St.

² Synchro Software - Version 10

³ Sidra Intersection - Version 7.0

6.2. Analysis Results

The Synchro and SIDRA results are summarized in the tables below. The results shown are the approach leg Level of Service (LoS), the volume-capacity ratio (v/c) and the 95% queue expressed in metres (m). The Synchro output is attached in **Appendix C**.

Existing Traffic - Year 2019

The existing traffic volumes for August 2019 were analyzed with the existing laning, traffic controls and signal timing. The results are shown in **Table 7**.

Table 7: PM Peak Hour - 2019 - Existing Volumes, Existing Laning and Control

Intersection	Movement	LOS	95% Q (m)	v/c
Eagle Dr / Pemb. Meadows Rd	EB L+R	В	3	0.10
T-junction Stop for Eagle Dr	NB L	Α	1	0.01
	NB T			0.12
	SB R			0.01
	SB T			0.09
Aster St / Dogwood St	WB L+R	Α	3	0.08
3-way stop	SB T+L	Α	1	0.02
	NB T+R			0.01
Birch St / Prospect St	WB L+R	В	3	0.44
3-way stop	SB T+L	В	2	0.40
	NB T+R	Α	1	0.21
Birch St / Portage Rd	NB	Α	18	0.37
Roundabout	SB	Α	3	0.08
	EB	Α	16	0.32
Portage Rd / Hwy 99	EB L	В	40	0.58
Signal	EB T	В	24	0.27
	EB R	Α	6	0.09
	WB L	В	8	0.09
	WB T	В	24	0.26
	WB R	Α	12	0.36
	NB L	В	8	0.07
	NB T	В	10	0.09
	NB R	Α	6	0.09
	SB L	С	52	0.67
	SB T	В	11	0.09
	SB R	Α	8	0.18

The network operates well with all movements at LoS C or better.

At the intersection at Highway 99 and Portage, the southbound left turn lane on Portage Rd has a short storage length of 25m. As indicated in **Table 7**, the left turn queue exceeds this storage with an estimated 95th percentile queue length of 52m. The current laning does not reflect existing traffic movements as the southbound left turn volumes are five times higher than the southbound through volumes. Despite this, the intersection operates acceptably as southbound through volume and low northbound conflicting volumes are low.

Total Background Traffic - Year 2030

The total background traffic was analyzed with the existing laning, traffic controls and signal timing. The results are shown in **Table 8**.

Table 8: PM Peak Hour - 2030 - Total Background Traffic

Intersection	Movement	LOS	95% Q (m)	v/c
Eagle Dr / Pemb. Meadows Rd	EB L+R	В	5	0.15
T-junction Stop for Eagle Dr	NB L	Α	1	0.03
	NB T			0.13
	SB R			0.01
	SB T			0.12
Aster St / Dogwood St	WB L+R	Α	3	0.08
3-way stop	SB T+L	Α	1	0.02
	NB T+R			0.01
Birch St / Prospect St	WB L+R	В	2	0.42
3-way stop	SB T+L	В	2	0.40
	NB T+R	Α	1	0.19
Birch St / Portage Rd	NB	Α	23	0.42
Roundabout	SB	Α	4	0.09
	EB	Α	21	0.38
Portage Rd / Hwy 99	EB L	C	51	0.70
Signal	EB T	В	29	0.31
	EB R	A	6	0.09
	WB L	В	8	0.10
	WB T	В	28	0.31
	WB R	Α	13	0.43
	NB L	В	10	0.10
	NB T	В	12	0.09
	NB R	Α	6	0.09
	SB L	С	77	0.76
	SB T	В	12	0.10
	SB R	Α	10	0.23

The future network continues to operate well with additional traffic as all movements operate at LoS C or better.

At Highway 99 and Portage the southbound left turn and eastbound left turn operate at LoS C. As noted previously, the southbound left turn queue extends beyond the turn bay storage length. For the eastbound left turn on Highway 99, the storage length is 70m and the 95 percentile queue length is 51m.

Total Traffic - Year 2030

The total traffic was analyzed with the existing laning, traffic controls and signal timing. The results are shown in **Table 9**.

Table 9: PM Peak Hour - 2030 - Total Traffic

Intersection	Movement	LOS	95% Q (m)	v/c
Eagle Dr / Pemb. Meadows Rd	EB L+R	В	7	0.22
T-junction Stop for Eagle Dr	NB L	Α	5	0.17
	NB T			0.13
	SB R			0.01
	SB T			0.12
Aster St / Dogwood St	WB L+R	Α	3	0.10
3-way stop	SB T+L	Α	1	0.03
	NB T+R			0.01
Birch St / Prospect St	WB L+R	С	5	0.64
3-way stop	SB T+L	С	4	0.58
	NB T+R	В	1	0.23
Birch St / Portage Rd	NB	Α	31	0.51
Roundabout	SB	Α	4	0.09
	EB	Α	27	0.44
Portage Rd / Hwy 99	EB L	С	77	0.81
Signal	EB T	В	29	0.30
	EB R	Α	6	0.08
	WB L	В	8	0.09
	WB T	В	28	0.29
	WB R	Α	14	0.48
	NB L	В	10	0.09
	NB T	В	12	0.09
	NB R	Α	6	0.09
	SB L	D	94	0.84
	SB T	В	12	0.09
	SB R	Α	11	0.25

With the addition of the project traffic, the network continues to operate well with all approaches at LoS C or better, with the exception of the southbound left turn at the intersection of Highway 99 and Portage Road, which operates at LoS D. This is an acceptable level of service, especially for a left turn. The estimated 95 percentile queue length for the southbound turn is 94m which extends beyond the storage length of the left turn lane. For the eastbound left turn, the 95-percentile queue length is estimated as 77m which extends slightly beyond the storage length of the turn bay.

Commentary for total traffic at 2030:

Intersection of Eagle Drive and Pemberton Meadows Road: This intersection operates well in the future with all movements of LoS B or better. Although there is an increase in traffic on Eagle Drive, this additional traffic is well within the capacity of the intersection.

Intersection of Aster Street and Dogwood Street: This intersection has been analyzed as a T-junction. As the volumes are low at this intersection, it operates well in the future with all movements of LoS A, the best possible level of service.

Intersection of Birch Street and Prospect Street: The traffic at this intersection will increase for the northbound right turn and the westbound left turn. Despite the increased traffic, the 3-way stop operates well with all movements at LoS C or better. In the future, there may be some increase in delays due to increased numbers of pedestrians as a result of the improvements made by the Village to improved walkability.

Intersection of Birch Street and Prospect Street: This roundabout operates well in the future with LoS of A for all approaches, the best possible level of service. The railway crossing operation does have an impact on the roundabout. This is an existing circumstance based on the current transportation network.

Intersection of Highway 99 and Portage Road: The signal timing was reviewed to see if there are opportunities to improve the operation. The signal timing setting was last updated in 2016. With the growth in Pemberton, as well as changes in the operation on Highway 99 based on new development to the east of the Village, it is suggested that a signal timing review is undertaken to better balance the traffic delays on all approaches and to minimize queue lengths, particularly for the left turns. In addition, there is also no specific PM peak time of day signal timing plan to account for PM peak traffic volumes.



7. Summary

The background traffic includes all proposed development in the study area as provided by the Village.

Estimates of site traffic are conservative as no reductions have been applied to reflect alternative mode use. The result is that the estimate of peak hour motor vehicle trips is intentionally higher than the actual trips would be, to ensure that any impacts of the additional development are not underestimated.

The PM Peak Hour was analyzed as the worst-case scenario for a regular weekday operation.

The traffic generated from the development will increase traffic volumes on some roads in the Village area but this is within the capacity of the intersections and roadways. The development is not expected to significantly impact the overall operation of the road network in the vicinity on the Village centre.

The five study intersections are estimated to operate below capacity after Opening Day and to year 2030.

The project traffic makes up 10% of the total PM peak hour intersection traffic at Highway 99/Portage Road in 2030.

The intersection of Highway 99/Portage Road does experience some operational impacts based on the current geometry and signal timing plan. There is a high southbound left turn volume combined with a high eastbound left turn volume. This is a background operating condition.

These impacts could likely be mitigated through changes to the signal timing plan of the intersection of Highway 99/ Portage Road to optimize the eastbound and southbound left turn operations.

8. Conclusions and Recommendations

- 1. The traffic generated from the development for Phase 1 and 2 is within the capacity of the intersections and roadways.
- 2. In 2030, the number of trips generated by the development amount to only 10% of the total traffic volume at the intersection of Highway 99 and Portage Road.
- 3. No further mitigation improvements are required on the existing road network, over and above the improvements already included in the development.
- 4. It is recommended that a signal timing review be undertaken for the intersection of Highway 99/Portage Road, to mitigate the eastbound and southbound left turn operational impacts. This could be considered as part of the current Highway 99 corridor review by the Village and BC MoTI.

Appendix A:

Village of Pemberton OCP Transportation Plan





Map N Regional Context Statement

Legend

Regional Context Statement Areas

Village Boundary

Provincial Park

Transportation

__ Highway

— Arterial Road

__Local Road

---- Resource Road -- Proposed Road

— Railway

Hydrography

___Lake/River

Wetland Sand/Gravel Bar

River/Stream - Indefinite

Elevation Contour

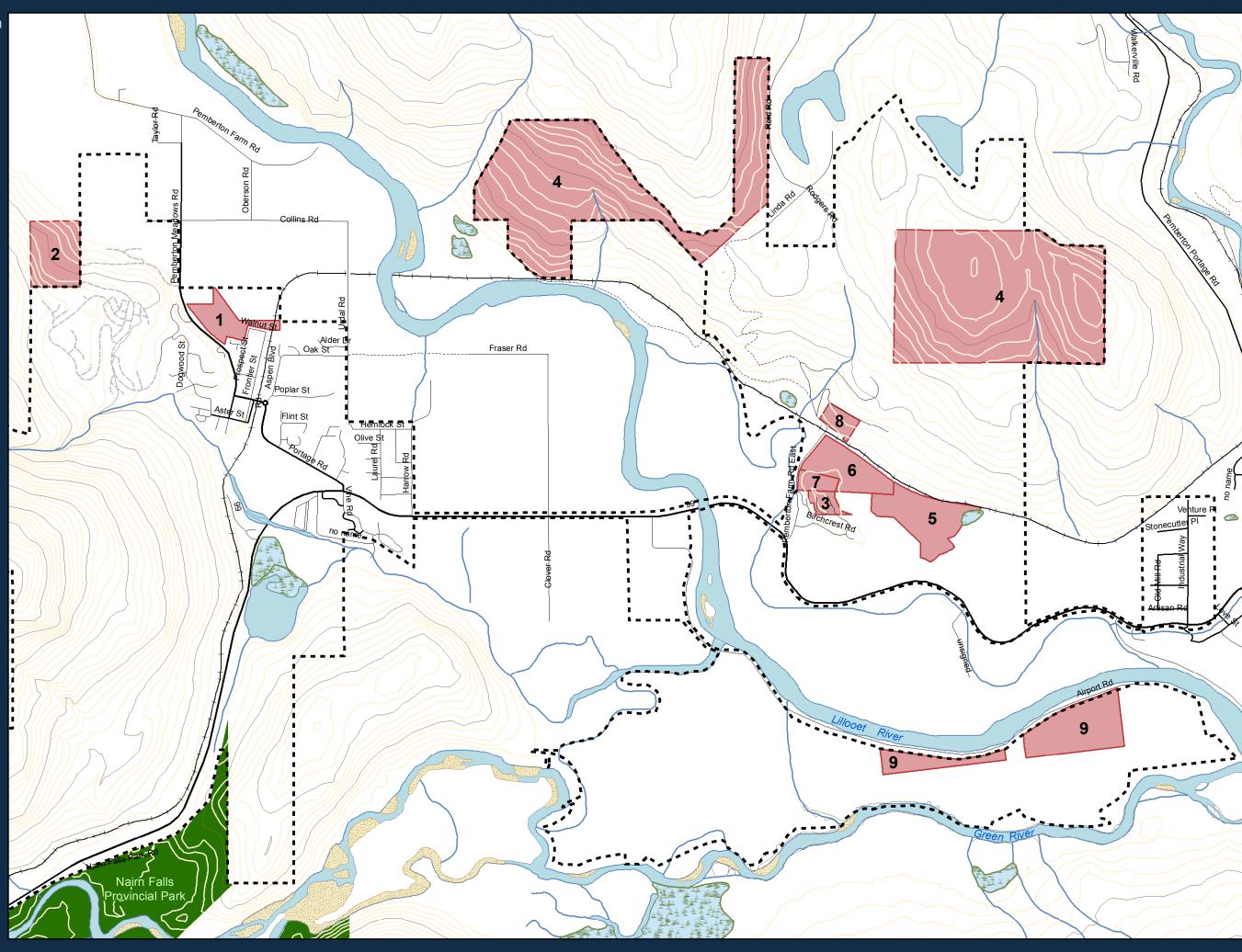
__Index Contour (100m)

Intermediate Contour (20m)



UTM Zone 10 N - NAD83

This map was produced for the Village of Pemberton. December 2014



Appendix B:

Traffic Counts

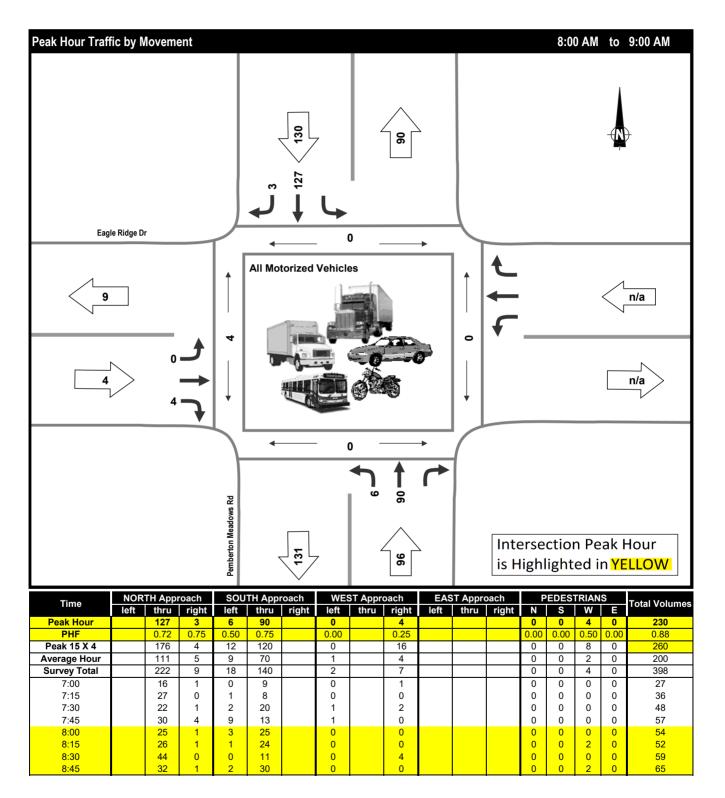




Municipality: Pemberton
Weather: Sunny

Vehicle Class: All Motorized Vehicles

Morning Peak Period



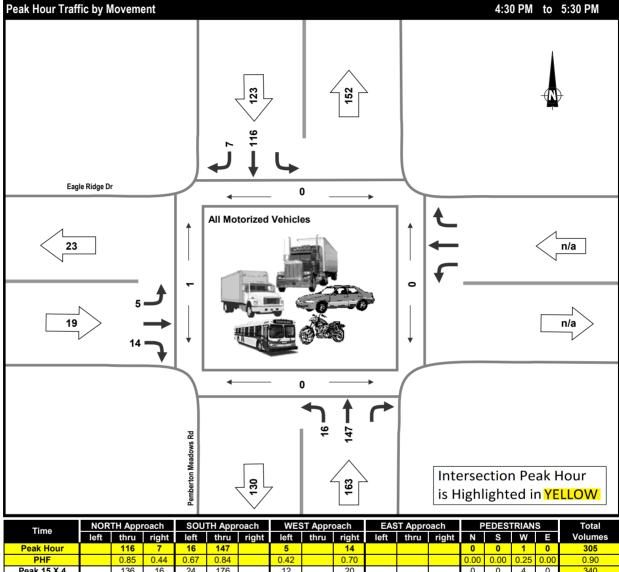


Afternoon Peak Period

Project: #7122: Howes - Whistler TMC's

Municipality: Pemberton

Weather: Sunny
Vehicle Class: All Motorized Vehicles



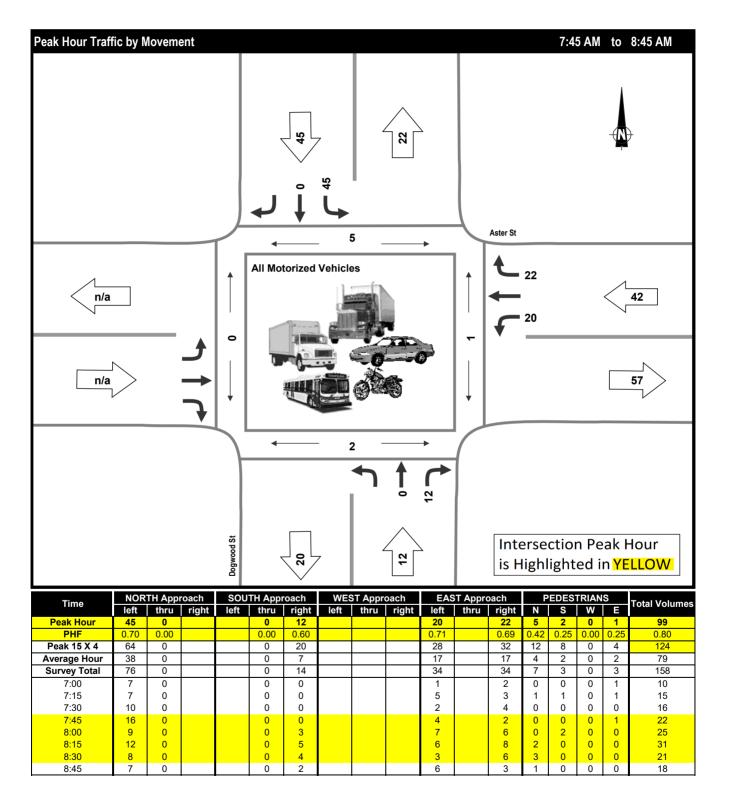
Time	NORTH		roach	SOU	ТН Аррі	roach	WES	ST Appro	oach	EAS	T Appro	oach	Р	EDEST	ΓRIAN	S	Total
Tille	left	thru	right	left	thru	right	left	thru	right	left	thru	right	N	S	W	Е	Volumes
Peak Hour		116	7	16	147		5		14				0	0	1	0	305
PHF		0.85	0.44	0.67	0.84		0.42		0.70				0.00	0.00	0.25	0.00	0.90
Peak 15 X 4		136	16	24	176		12		20				0	0	4	0	340
Average Hour		104	5	12	129		4		12				0	0	3	1	266
Survey Total		311	16	35	387		12		36				0	0	10	3	797
15:00		30	0	2	23		0		7				0	0	1	3	62
15:15		24	0	1	30		1		1				0	0	0	0	57
15:30		29	2	0	19		0		2				0	0	1	0	52
15:45		21	1	4	21		0		2				0	0	1	0	49
16:00		27	1	3	32		3		2				0	0	4	0	68
16:15		26	1	2	35		0		3				0	0	0	0	67
16:30		34	2	2	26		3		5				0	0	0	0	72
16:45		27	4	6	41		2		5				0	0	0	0	85
17:00		27	0	5	44		0		2				0	0	1	0	78
17:15		28	1	3	36		0		2				0	0	0	0	70
17:30		16	2	5	39		2		4				0	0	1	0	68
17:45		22	2	2	41		1		1				0	0	1	0	69



Municipality: Pemberton Weather: Cloudy

Vehicle Class: All Motorized Vehicles

Morning Peak Period

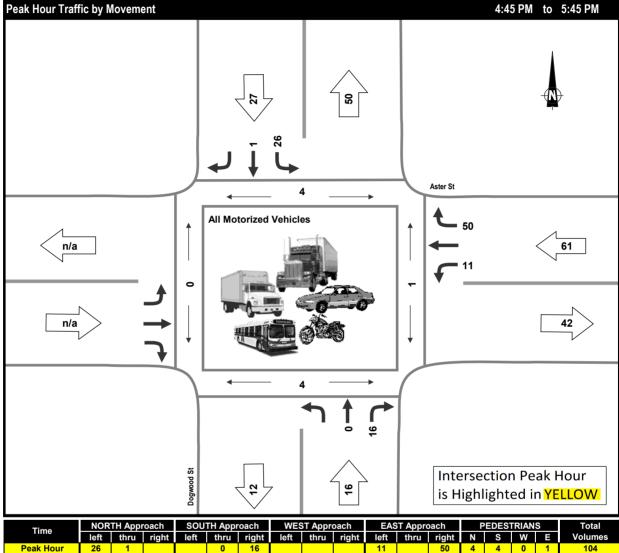




Afternoon Peak Period

Project: #7122: Howes - Whistler TMC's

Municipality: Pemberton
Weather: Cloudy
Vehicle Class: All Motorized Vehicles



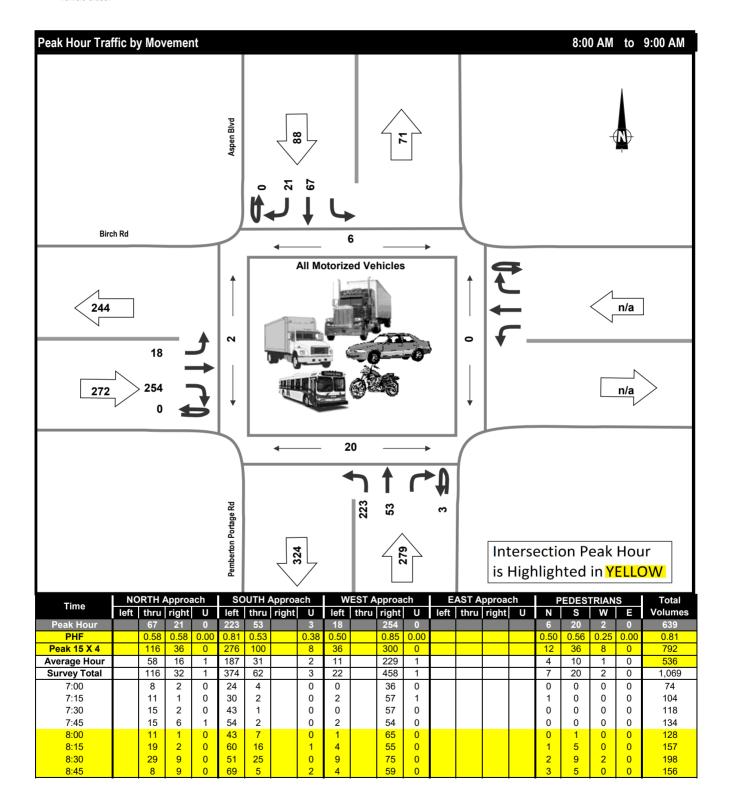
Time	NORTH Approach			SOUTH Approach			WEST Approach			EAST Approach			PEDESTRIANS				Total
	left	thru	right	left	thru	right	left	thru	right	left	thru	right	N	S	W	Е	Volumes
Peak Hour	26	1			0	16				11		50	4	4	0	1	104
PHF	0.46	0.25			0.00	0.50				0.39		0.83	0.33	0.50	0.00	0.25	0.79
Peak 15 X 4	56	4			0	32				28		60	12	8	0	4	132
Average Hour	26	1			1	22				13		31	4	4	0	0	94
Survey Total	79	4			2	65				40		93	11	11	0	1	283
15:00	7	1			0	7				6		12	0	0	0	0	33
15:15	3	0			0	5				4		5	1	0	0	0	17
15:30	7	0			0	5				5		6	0	1	0	0	23
15:45	8	0			0	5				8		5	0	1	0	0	26
16:00	6	0			2	4				0		4	0	2	0	0	16
16:15	5	2			0	8				1		4	0	0	0	0	20
16:30	9	0			0	10				0		3	1	2	0	0	22
16:45	2	1			0	8				1		11	0	0	0	0	23
17:00	14	0			0	3				1		15	3	2	0	0	33
17:15	2	0			0	3				2		11	1	1	0	1	18
17:30	8	0			0	2				7		13	0	1	0	0	30
17:45	8	0			0	5				5		4	5	1	0	0	22



Municipality: Pemberton Weather: Cloudy

Vehicle Class: All Motorized Vehicles

Morning Peak Period

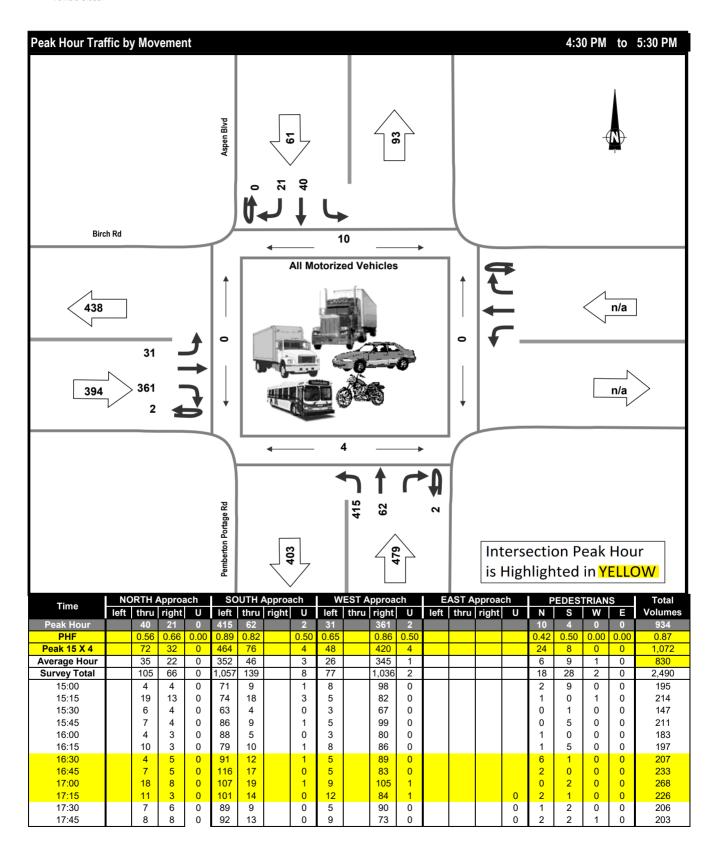




Municipality: Pemberton Weather: Cloudy

Vehicle Class: All Motorized Vehicles

Afternoon Peak Period

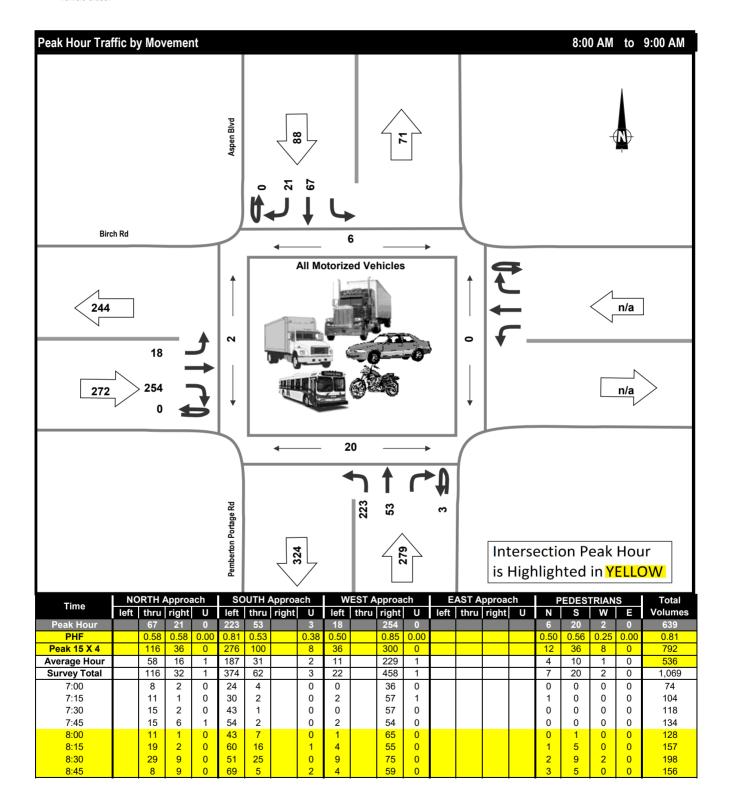




Municipality: Pemberton Weather: Cloudy

Vehicle Class: All Motorized Vehicles

Morning Peak Period



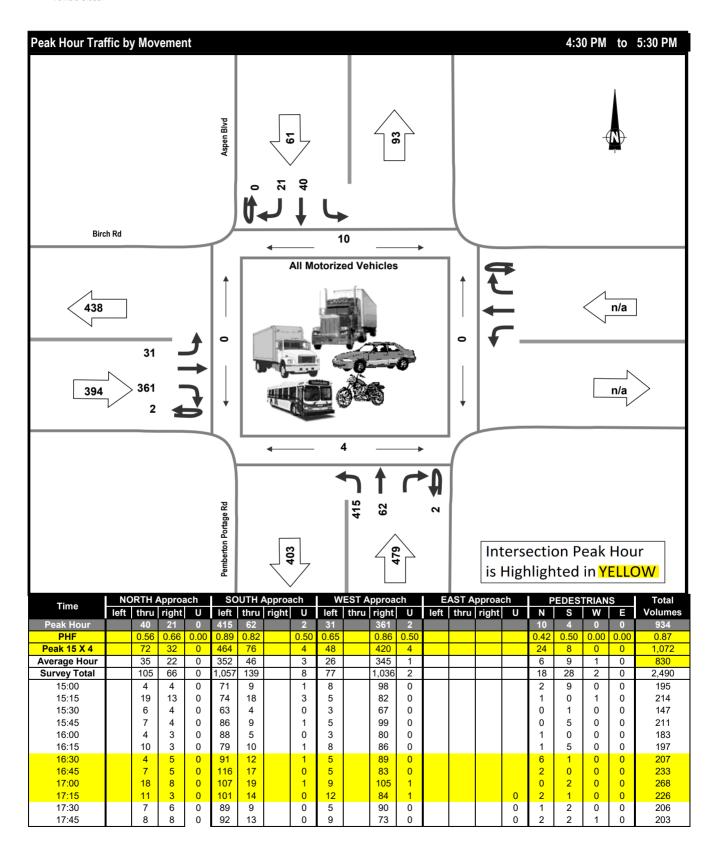


Project: #7122: Howes - Whistler TMC's

Municipality: Pemberton Weather: Cloudy

Vehicle Class: All Motorized Vehicles

Afternoon Peak Period



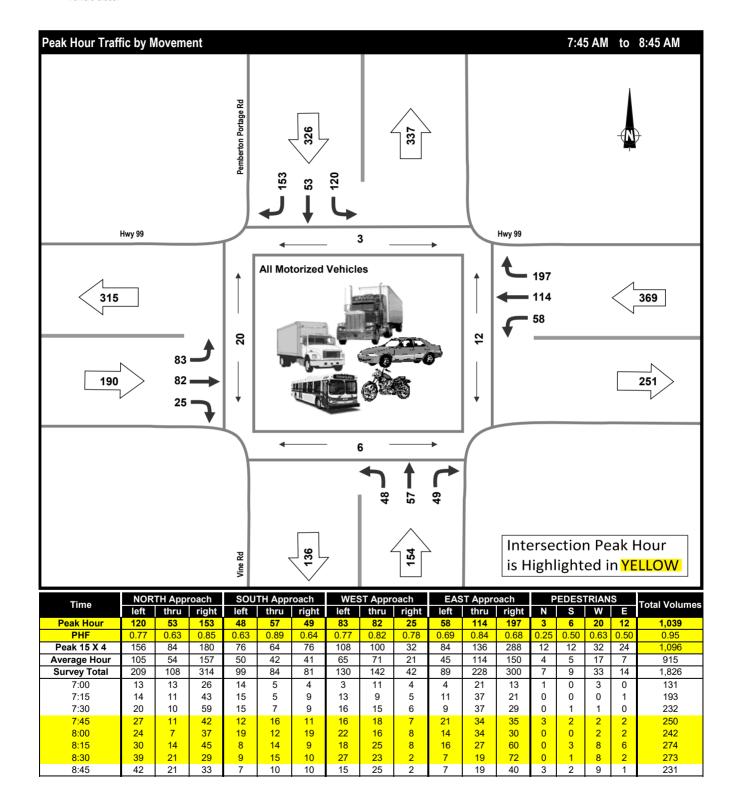


Project: #7122: Howes - Whistler TMC's

Municipality: Pemberton Weather: Cloudy

Vehicle Class: All Motorized Vehicles

Morning Peak Period



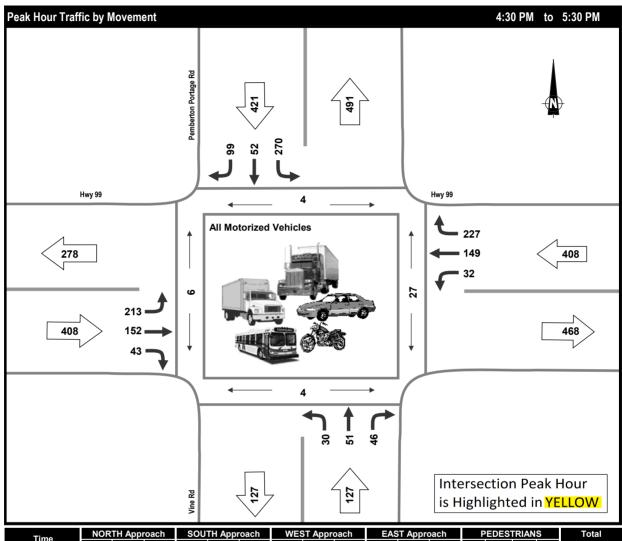


Project: #7122: Howes - Whistler TMC's

Municipality: Pemberton

Weather: Cloudy
Vehicle Class: All Motorized Vehicles

Afternoon Peak Period



Time	NOR	ІН Аррі	roacn	SOU	ІН Аррі	roacn	WES	SI Appr	oacn	EAS	SI Appro	oacn	P	EDES	IRIAN	5	lotal
Time	left	thru	right	left	thru	right	left	thru	right	left	thru	right	N	S	w	Ε	Volumes
Peak Hour	270	52	99	30	51	46	213	152	43	32	149	227	4	4	6	27	1,364
PHF	0.90	0.72	0.75	0.75	0.75	0.82	0.85	0.90	0.90	0.73	0.85	0.95	0.33	0.33	0.75	0.52	0.96
Peak 15 X 4	300	72	132	40	68	56	252	168	48	44	176	240	12	12	8	52	1,420
Average Hour	229	56	97	27	42	43	161	119	36	32	143	197	6	2	10	18	1,182
Survey Total	687	169	290	81	126	129	484	357	107	96	429	592	17	7	30	55	3,547
15:00	52	17	29	10	7	11	21	24	10	11	28	59	3	0	6	2	279
15:15	59	13	33	10	5	6	21	22	8	6	42	44	0	0	3	1	269
15:30	46	17	26	6	7	11	32	17	6	3	30	35	1	1	7	10	236
15:45	67	15	31	4	7	16	39	23	9	10	44	46	0	0	2	0	311
16:00	46	17	18	6	8	9	36	25	7	10	34	45	1	0	0	2	261
16:15	39	20	20	9	12	12	33	24	4	13	33	43	2	0	0	0	262
16:30	54	10	33	10	8	14	58	37	10	6	44	57	0	0	2	8	341
16:45	69	17	21	8	17	10	63	40	10	8	42	50	0	3	2	2	355
17:00	75	18	24	5	15	12	47	33	12	11	30	60	3	1	2	4	342
17:15	72	7	21	7	11	10	45	42	11	7	33	60	1	0	0	13	326
17:30	52	8	21	4	17	9	52	29	5	6	40	41	4	2	4	10	284
17:45	56	10	13	2	12	9	37	41	15	5	29	52	2	0	2	3	281

Appendix C:





	۶	•	4	†	ļ	4
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	W		ሻ	†	†	7
Traffic Volume (veh/h)	5	14	16	147	116	7
Future Volume (Veh/h)	5	14	16	147	116	7
Sign Control	Stop			Free	Free	
Grade	5%			0%	0%	
Peak Hour Factor	0.25	0.25	0.75	0.75	0.75	0.75
Hourly flow rate (vph)	20	56	21	196	155	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	393	155	164			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	393	155	164			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	94	99			
cM capacity (veh/h)	602	891	1414			
				CD 4	CD 2	
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	76	21	196	155	9	
Volume Left	20	21	0	0	0	
Volume Right	56	0	0	0	9	
cSH	791	1414	1700	1700	1700	
Volume to Capacity	0.10	0.01	0.12	0.09	0.01	
Queue Length 95th (m)	2.5	0.4	0.0	0.0	0.0	
Control Delay (s)	10.0	7.6	0.0	0.0	0.0	
Lane LOS	В	A				
Approach Delay (s)	10.0	0.7		0.0		
Approach LOS	В					
Intersection Summary						
Average Delay			2.0			
Intersection Capacity Utiliz	zation		18.6%	IC	U Level c	f Service
Analysis Period (min)			15			

	•	•	†	~	>	ļ
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		ĵ.			र्स
Traffic Volume (veh/h)	11	50	1	16	26	1
Future Volume (Veh/h)	11	50	1	16	26	1
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.74	0.74	0.82	0.82	0.77	0.77
Hourly flow rate (vph)	15	68	1	20	34	1
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	80	11			21	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	80	11			21	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	94			98	
cM capacity (veh/h)	905	1073			1601	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	83	21	35			
Volume Left	03 15	0	34			
	68	20	0			
Volume Right cSH	1038	1700	1601			
Volume to Capacity	0.08	0.01	0.02			
Queue Length 95th (m)	2.1	0.01	0.02			
Control Delay (s)	8.8		7.1			
		0.0				
Lane LOS	A	0.0	A			
Approach Delay (s)	8.8	0.0	7.1			
Approach LOS	Α					
Intersection Summary						
Average Delay			7.0			
Intersection Capacity Utiliz	zation		19.1%	IC	U Level o	of Service
Analysis Period (min)			15			

Intersection						
Intersection Delay, s/veh	11					
Intersection LOS	В					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	¥		f.			4
Traffic Vol, veh/h	81	173	66	60	170	46
Future Vol, veh/h	81	173	66	60	170	46
Peak Hour Factor	0.74	0.74	0.82	0.82	0.77	0.77
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	109	234	80	73	221	60
Number of Lanes	1	0	1	0	0	1
Approach	WB		NB		SB	
Opposing Approach			SB		NB	
Opposing Lanes	0		1		1	
Conflicting Approach Left	NB				WB	
Conflicting Lanes Left	1		0		1	
Conflicting Approach Right	SB		WB		•	
Conflicting Lanes Right	1		1		0	
HCM Control Delay	11.3		9.2		11.5	
HCM LOS	В		Α		В	
Lane		NBLn1	WBLn1	SBLn1		
		NBLn1	WBLn1 32%			
Vol Left, %		0%	32%	SBLn1 79% 21%		
Vol Left, % Vol Thru, %				79% 21%		
Vol Left, % Vol Thru, % Vol Right, %		0% 52% 48%	32% 0% 68%	79% 21% 0%		
Vol Left, % Vol Thru, % Vol Right, % Sign Control		0% 52% 48% Stop	32% 0%	79% 21%		
Vol Left, % Vol Thru, % Vol Right, %		0% 52% 48%	32% 0% 68% Stop	79% 21% 0% Stop		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol		0% 52% 48% Stop 126	32% 0% 68% Stop 254	79% 21% 0% Stop 216		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane		0% 52% 48% Stop 126	32% 0% 68% Stop 254 81	79% 21% 0% Stop 216 170		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol		0% 52% 48% Stop 126 0 66	32% 0% 68% Stop 254 81 0	79% 21% 0% Stop 216 170 46		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate		0% 52% 48% Stop 126 0 66	32% 0% 68% Stop 254 81 0	79% 21% 0% Stop 216 170 46		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol		0% 52% 48% Stop 126 0 66 60	32% 0% 68% Stop 254 81 0 173 343	79% 21% 0% Stop 216 170 46 0 281		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X)		0% 52% 48% Stop 126 0 66 60 154	32% 0% 68% Stop 254 81 0 173 343	79% 21% 0% Stop 216 170 46 0 281		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd)		0% 52% 48% Stop 126 0 66 60 154 1	32% 0% 68% Stop 254 81 0 173 343 1	79% 21% 0% Stop 216 170 46 0 281 1 0.396		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N		0% 52% 48% Stop 126 0 66 60 154 1 0.205 4.814	32% 0% 68% Stop 254 81 0 173 343 1 0.441 4.626	79% 21% 0% Stop 216 170 46 0 281 1 0.396 5.077		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd)		0% 52% 48% Stop 126 0 66 60 154 1 0.205 4.814 Yes	32% 0% 68% Stop 254 81 0 173 343 1 0.441 4.626 Yes	79% 21% 0% Stop 216 170 46 0 281 1 0.396 5.077 Yes		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap		0% 52% 48% Stop 126 0 66 60 154 1 0.205 4.814 Yes 736	32% 0% 68% Stop 254 81 0 173 343 1 0.441 4.626 Yes 772	79% 21% 0% Stop 216 170 46 0 281 1 0.396 5.077 Yes 701		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time		0% 52% 48% Stop 126 0 66 60 154 1 0.205 4.814 Yes 736 2.902	32% 0% 68% Stop 254 81 0 173 343 1 0.441 4.626 Yes 772 2.687	79% 21% 0% Stop 216 170 46 0 281 1 0.396 5.077 Yes 701 3.155		
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		0% 52% 48% Stop 126 0 66 60 154 1 0.205 4.814 Yes 736 2.902 0.209	32% 0% 68% Stop 254 81 0 173 343 1 0.441 4.626 Yes 772 2.687 0.444	79% 21% 0% Stop 216 170 46 0 281 1 0.396 5.077 Yes 701 3.155 0.401		

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	*	7	ሻ	†	7	ሻ		7	ች		7
Traffic Volume (vph)	213	152	43	32	149	227	30	51	46	270	52	99
Future Volume (vph)	213	152	43	32	149	227	30	51	46	270	52	99
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.6	3.6
Storage Length (m)	70.0	0.0	35.0	70.0	0.0	70.0	25.0	0.0	15.0	25.0	0.0	65.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	30.0		•	30.0		·	20.0		•	30.0		·
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	0.850	1.00	1.00	0.850	1.00	1.00	0.850	1.00	1.00	0.850
Flt Protected	0.950		0.000	0.950		0.000	0.950		0.000	0.950		0.000
Satd. Flow (prot)	1593	1676	1425	1593	1676	1425	1593	1676	1425	1575	1676	1425
Flt Permitted	0.654	1010	1 120	0.653	1010	1120	0.720	10.0	1 120	0.721	1010	1 120
Satd. Flow (perm)	1096	1676	1425	1095	1676	1425	1207	1676	1425	1195	1676	1425
Right Turn on Red	1000	1010	Yes	1000	1010	Yes	1201	1010	Yes	1100	1010	Yes
Satd. Flow (RTOR)			47			247			50			108
Link Speed (k/h)		60	71		60	271		50	00		50	100
Link Distance (m)		426.0			251.0			552.0			279.6	
Travel Time (s)		25.6			15.1			39.7			20.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	232	165	47	35	162	247	33	55	50	293	57	108
Shared Lane Traffic (%)	202	100	71	00	102	271			- 00	230	01	100
Lane Group Flow (vph)	232	165	47	35	162	247	33	55	50	293	57	108
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1 01111	4	1 01111	1 01111	8	1 01111	i Viiii	2	1 Oilli	ı Om	6	1 01111
Permitted Phases	4	•	4	8		8	2	_	2	6		6
Detector Phase	4	4	4	8	8	8	2	2	2	6	6	6
Switch Phase		•	•				_	_	_			
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	28.5	28.5	28.5	28.5	28.5	28.5	23.1	23.1	23.1	23.1	23.1	23.1
Total Split (s)	34.0	34.0	34.0	34.0	34.0	34.0	31.0	31.0	31.0	31.0	31.0	31.0
Total Split (%)	52.3%	52.3%	52.3%	52.3%	52.3%	52.3%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%
Maximum Green (s)	28.5	28.5	28.5	28.5	28.5	28.5	25.9	25.9	25.9	25.9	25.9	25.9
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	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 Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.1	5.1	5.1	5.1	5.1	5.1
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	Min	Min	Min	Min	Min	Min
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	16.0	16.0	16.0	16.0	16.0	16.0	12.0	12.0	12.0	12.0	12.0	12.0
Pedestrian Calls (#/hr)	1	1	1	1	1	1	1	1	1	1	1	1
Act Effct Green (s)	15.7	15.7	15.7	15.7	15.7	15.7	15.6	15.6	15.6	15.6	15.6	15.6
Actuated g/C Ratio	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
v/c Ratio	0.58	0.37	0.09	0.09	0.26	0.36	0.07	0.09	0.09	0.67	0.09	0.18
Control Delay	18.5	11.8	4.4	10.7	11.7	3.6	10.6	10.4	4.4	21.1	10.4	3.8
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
	0.0	0.0	5.0	5.0	5.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	18.5	11.8	4.4	10.7	11.7	3.6	10.6	10.4	4.4	21.1	10.4	3.8
LOS	В	В	Α	В	В	Α	В	В	Α	С	В	Α
Approach Delay		14.5			7.1			8.2			15.7	
Approach LOS		В			Α			Α			В	
Queue Length 50th (m)	12.8	7.9	0.0	1.6	7.8	0.0	1.4	2.4	0.0	16.2	2.4	0.0
Queue Length 95th (m)	39.3	24.0	5.1	7.2	23.6	11.5	7.1	10.0	5.5	51.5	10.4	8.0
Internal Link Dist (m)		402.0			227.0			528.0			255.6	
Turn Bay Length (m)	70.0		35.0	70.0		70.0	25.0		15.0	25.0		65.0
Base Capacity (vph)	790	1209	1041	790	1209	1096	791	1099	951	783	1099	971
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	0.29	0.14	0.05	0.04	0.13	0.23	0.04	0.05	0.05	0.37	0.05	0.11

Intersection Summary

Area Type: CBD

Cycle Length: 65

Actuated Cycle Length: 42.7

Natural Cycle: 55

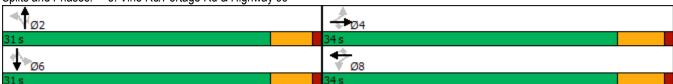
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.67 Intersection Signal Delay: 12.1 Intersection Capacity Utilization 58.5%

Intersection LOS: B
ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 3: Vine Rd/Portage Rd & Highway 99



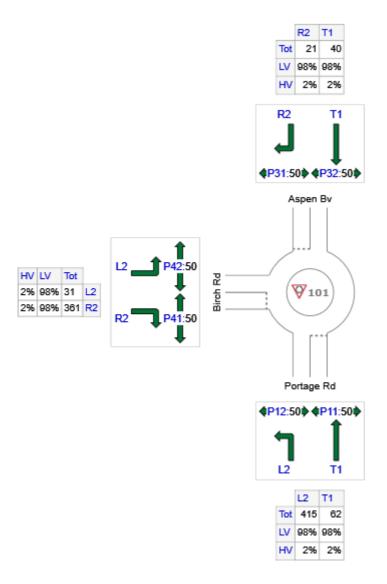
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

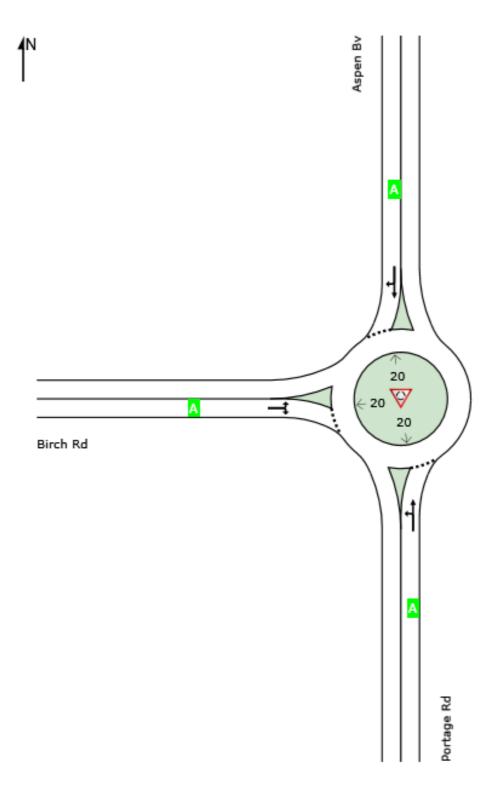
▼ Site: 101 [Pemberton - 2019 Existing (Site Folder: General)]

Pemberton Roundabout Site Category: (None) Roundabout

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Portage Rd	477	467	10
N: Aspen Bv	61	60	1
W: Birch Rd	392	384	8
Total	930	911	19



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

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Organisation: ASSOCIATED ENGINEERING GROUP LTD. | Licence: PLUS / 1PC | Processed: Sunday, February 28, 2021 11:04:11 AM
Project: C:\Users\jacksonb\OneDrive - Associated Engineering Group LTD_Work\Projects\For_Donna\20200210_Pemberton
\SIDRA_Analysis_20210204\Roundabout_Analysis-20210204.sip9

LANE SUMMARY

♥ Site: 101 [Pemberton - 2019 Existing (Site Folder: General)]

Pemberton Roundabout Site Category: (None)

Roundabout

Lane Use	and Pe	rformar	псе										
	DEM FLO [Total veh/h		Cap.	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BA QUE [Veh		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Port		70	V 011/11	• • • • • • • • • • • • • • • • • • • •	70	333			- '''			,,	70
Lane 1 ^d	530	2.0	1442	0.368	100	6.8	LOSA	2.5	17.9	Full	85	0.0	0.0
Approach	530	2.0		0.368		6.8	LOSA	2.5	17.9				
North: Aspe	en Bv												
Lane 1 ^d	68	2.0	849	0.080	100	4.6	LOSA	0.4	2.9	Full	40	0.0	0.0
Approach	68	2.0		0.080		4.6	LOSA	0.4	2.9				
West: Birch	Rd												
Lane 1 ^d	436	2.0	1382	0.315	100	2.3	LOSA	2.2	15.8	Full	35	0.0	0.0
Approach	436	2.0		0.315		2.3	LOSA	2.2	15.8				
Intersectio n	1033	2.0		0.368		4.8	LOSA	2.5	17.9				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS. Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

Approach	Lane FI	ows (v	/eh/h)						
South: Porta	age Rd								
Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c		Prob. SL Ov. %	Ov. Lane No.
Lane 1	461	69	530	2.0	1442	0.368	100	NA	NA
Approach	461	69	530	2.0		0.368			
North: Asper	n Bv								
Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c		Prob. SL Ov. %	Ov. Lane No.
Lane 1	44	23	68	2.0	849	0.080	100	NA	NA
Approach	44	23	68	2.0		0.080			
West: Birch	Rd								
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c		Prob. SL Ov. %	Ov. Lane No.
Lane 1	34	401	436	2.0	1382	0.315	100	NA	NA
Approach	34	401	436	2.0		0.315			
	Total	%HV[Deg.Sat	n (v/c)					

	•	*	4	†	+	4
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	W		ሻ		^	7
Traffic Volume (veh/h)	6	22	29	170	151	9
Future Volume (Veh/h)	6	22	29	170	151	9
Sign Control	Stop			Free	Free	
Grade	5%			0%	0%	
Peak Hour Factor	0.25	0.25	0.75	0.75	0.75	0.75
Hourly flow rate (vph)	24	88	39	227	201	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	506	201	213			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	506	201	213			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	90	97			
cM capacity (veh/h)	510	840	1357			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	112	39	227	201	12	
Volume Left	24	39	0	0	0	
Volume Right	88	0	0	0	12	
cSH	738	1357	1700	1700	1700	
Volume to Capacity	0.15	0.03	0.13	0.12	0.01	
Queue Length 95th (m)	4.3	0.7	0.0	0.0	0.0	
Control Delay (s)	10.8	7.7	0.0	0.0	0.0	
Lane LOS	В	Α				
Approach Delay (s)	10.8	1.1		0.0		
Approach LOS	В					
Intersection Summary						
Average Delay			2.5			
Intersection Capacity Utiliza	tion		25.5%	IC	CU Level	of Service
Analysis Period (min)			15		, , , , , ,	

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Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations	¥		₽			ની	
Traffic Volume (veh/h)	11	50	1	16	26	1	
Future Volume (Veh/h)	11	50	1	16	26	1	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.74	0.74	0.82	0.82	0.77	0.77	
Hourly flow rate (vph)	15	68	1	20	34	1	
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	80	11			21		
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	80	11			21		
tC, single (s)	6.4	6.2			4.1		
tC, 2 stage (s)	•••	V. <u> </u>					
tF (s)	3.5	3.3			2.2		
p0 queue free %	98	94			98		
cM capacity (veh/h)	905	1073			1601		
			CD 4				
Direction, Lane #	WB 1	NB 1	SB 1				
Volume Total	83	21	35				
Volume Left	15	0	34				
Volume Right	68	20	0				
cSH	1038	1700	1601				
Volume to Capacity	0.08	0.01	0.02				
Queue Length 95th (m)	2.1	0.0	0.5				
Control Delay (s)	8.8	0.0	7.1				
Lane LOS	A		_ A				
Approach Delay (s)	8.8	0.0	7.1				
Approach LOS	Α						
Intersection Summary							
Average Delay			7.0				
Intersection Capacity Utiliza	ation		19.1%	IC	U Level o	of Service)
Analysis Period (min)			15				

Intersection						
Intersection Delay, s/veh	10.7					
Intersection LOS	В					
into occion 200						
Mayamant	WDL	WDD	NDT	NDD	CDI	CDT
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations		000	}	CO	000	€ 1
Traffic Vol, veh/h	90	208	68	62	209	49
Future Vol, veh/h Peak Hour Factor	90	208	68	62	209	49
	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2 98		2 74	2	227	53
Mymt Flow		226		67 0		
Number of Lanes	1	0	1	U	0	1
Approach	WB		NB		SB	
Opposing Approach			SB		NB	
Opposing Lanes	0		1		1	
Conflicting Approach Left	NB				WB	
Conflicting Lanes Left	1		0		1	
Conflicting Approach Right	SB		WB			
Conflicting Lanes Right	1		1		0	
HCM Control Delay	10.9		9		11.4	
HCM LOS	В		Α		В	
Lane		NBLn1	WBLn1	SBLn1		
Vol Left, %		0%	30%	81%		
Vol Thru, %		52%	0%	19%		
Vol Right, %		48%	70%	0%		
Sign Control		Stop	Stop	Stop		
Traffic Vol by Lane		130	298	258		
LT Vol		0	90	209		
Through Vol		68	0	49		
RT Vol		62	208	0		
Lane Flow Rate		141	324	280		
Geometry Grp		1	1	1		
		0.188	0.414	0.392		
Degree of Util (X)		0.100				
		4.778	4.599	5.034		
Degree of Util (X) Departure Headway (Hd) Convergence, Y/N		4.778 Yes	4.599 Yes	Yes		
Departure Headway (Hd) Convergence, Y/N Cap		4.778 Yes 743	4.599			
Departure Headway (Hd) Convergence, Y/N Cap Service Time		4.778 Yes 743 2.857	4.599 Yes 777 2.655	Yes 710 3.104		
Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		4.778 Yes 743	4.599 Yes 777 2.655 0.417	Yes 710 3.104 0.394		
Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio HCM Control Delay		4.778 Yes 743 2.857 0.19 9	4.599 Yes 777 2.655 0.417 10.9	Yes 710 3.104 0.394 11.4		
Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		4.778 Yes 743 2.857 0.19	4.599 Yes 777 2.655 0.417	Yes 710 3.104 0.394		

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	*	7	ሻ	†	7	ሻ	1	7	ሻ		7
Traffic Volume (vph)	260	182	46	37	179	290	41	55	50	321	58	133
Future Volume (vph)	260	182	46	37	179	290	41	55	50	321	58	133
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.6	3.6
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	70.0		35.0	70.0		70.0	25.0		15.0	25.0		65.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	30.0			30.0			20.0			30.0		
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
Ped Bike Factor												
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1593	1676	1425	1593	1676	1425	1593	1676	1425	1575	1676	1425
Flt Permitted	0.635	, , ,		0.633		•	0.716		•	0.718		
Satd. Flow (perm)	1065	1676	1425	1061	1676	1425	1200	1676	1425	1190	1676	1425
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			50			315			54			145
Link Speed (k/h)		60			60	0.0		50	•		50	
Link Distance (m)		426.0			251.0			552.0			279.6	
Travel Time (s)		25.6			15.1			39.7			20.1	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												J
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	283	198	50	40	195	315	45	60	54	349	63	145
Shared Lane Traffic (%)	200	100		.0	100	0.10			•	0.10	00	1 10
Lane Group Flow (vph)	283	198	50	40	195	315	45	60	54	349	63	145
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	1 01111	4	. 0	. 0	8	. 0	. 0	2	. 0	. 0	6	
Permitted Phases	4	•	4	8		8	2	_	2	6		6
Detector Phase	4	4	4	8	8	8	2	2	2	6	6	6
Switch Phase	· · · · · · · · · · · · · · · · · · ·	•	•	•	•		_	_	_		J	J
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	28.5	28.5	28.5	28.5	28.5	28.5	23.1	23.1	23.1	23.1	23.1	23.1
Total Split (s)	34.0	34.0	34.0	34.0	34.0	34.0	31.0	31.0	31.0	31.0	31.0	31.0
Total Split (%)	52.3%	52.3%	52.3%	52.3%	52.3%	52.3%	47.7%	47.7%	47.7%	47.7%	47.7%	47.7%
Maximum Green (s)	28.5	28.5	28.5	28.5	28.5	28.5	25.9	25.9	25.9	25.9	25.9	25.9
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	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 Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.1	5.1	5.1	5.1	5.1	5.1
` ,	0.0	ე.ე	5.5	5.5	0.0	5.5	ე. I	J. I	ე. I	5.1	5.1	J. I
Lead/Lag												
Lead-Lag Optimize?	2.0	2 0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Minimum Gap (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	None	None	None	None	None	None	Min	Min	Min	Min	Min	Min
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	16.0	16.0	16.0	16.0	16.0	16.0	12.0	12.0	12.0	12.0	12.0	12.0
Pedestrian Calls (#/hr)	1	1	1	1	1	1	1	1	1	1	1	1
Act Effct Green (s)	18.6	18.6	18.6	18.6	18.6	18.6	19.1	19.1	19.1	19.1	19.1	19.1
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.39
v/c Ratio	0.70	0.31	0.09	0.10	0.31	0.43	0.10	0.09	0.09	0.76	0.10	0.23
Control Delay	24.4	13.0	4.3	11.5	12.9	3.7	11.7	11.3	4.5	26.9	11.4	3.7
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	24.4	13.0	4.3	11.5	12.9	3.7	11.7	11.3	4.5	26.9	11.4	3.7
LOS	С	В	Α	В	В	Α	В	В	Α	С	В	Α
Approach Delay		18.3			7.6			9.1			19.1	
Approach LOS		В			Α			Α			В	
Queue Length 50th (m)	21.1	12.3	0.0	2.3	12.1	0.0	2.4	3.3	0.0	25.7	3.4	0.0
Queue Length 95th (m)	50.8	28.2	5.2	7.9	27.7	12.6	9.3	11.3	5.9	#76.8	11.6	9.5
Internal Link Dist (m)		402.0			227.0			528.0			255.6	
Turn Bay Length (m)	70.0		35.0	70.0		70.0	25.0		15.0	25.0		65.0
Base Capacity (vph)	666	1049	910	664	1049	1009	682	953	834	677	953	873
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	0.42	0.19	0.05	0.06	0.19	0.31	0.07	0.06	0.06	0.52	0.07	0.17

Intersection Summary

Area Type: CBD

Cycle Length: 65

Actuated Cycle Length: 49.1

Natural Cycle: 55

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.76 Intersection Signal Delay: 14.4 Intersection Capacity Utilization 66.3%

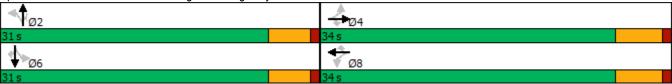
Intersection LOS: B ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 3: Vine Rd/Portage Rd & Highway 99



LANE LEVEL OF SERVICE

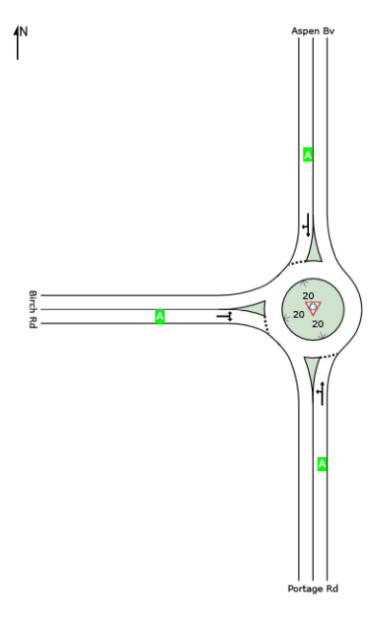
Lane Level of Service

♥ Site: 101 [Pemberton - 2030 Background]

Pemberton Roundabout Roundabout

All Movement Classes

	South	North	West	Intersection
LOS	Α	Α	Α	Α



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

LANE SUMMARY

♥ Site: 101 [Pemberton - 2030 Background]

Pemberton Roundabout Roundabout

Lane Use	and Perfo	ormai	nce										
	Demand F Total veh/h	lows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back o Veh	f Queue Dist m	Lane Config	Lane Length m		Prob. Block. %
South: Port	age Rd												
Lane 1 ^d	612	2.0	1453	0.421	100	6.9	LOSA	3.1	22.2	Full	85	0.0	0.0
Approach	612	2.0		0.421		6.9	LOSA	3.1	22.2				
North: Aspe	en Bv												
Lane 1 ^d	68	2.0	787	0.086	100	5.2	LOSA	0.4	3.2	Full	40	0.0	0.0
Approach	68	2.0		0.086		5.2	LOSA	0.4	3.2				
West: Birch	Rd												
Lane 1 ^d	532	2.0	1396	0.381	100	2.3	LOSA	2.9	21.0	Full	35	0.0	0.0
Approach	532	2.0		0.381		2.3	LOSA	2.9	21.0				
Intersection	1212	2.0		0.421		4.8	LOSA	3.1	22.2				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS. Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SIDRA INTERSECTION 7.0 | Copyright © 2000-2017 Akcelik and Associates Pty Ltd | sidrasolutions.com Organisation: ASSOCIATED ENGINEERING GROUP LTD. | Processed: Monday, February 10, 2020 2:47:45 PM

Project: P:\20192623\00 HTA Projects\PM\02.00 Project Planning\20200210 Pemberton\SIDRA Analysis\Roundabout Analysis.sip7

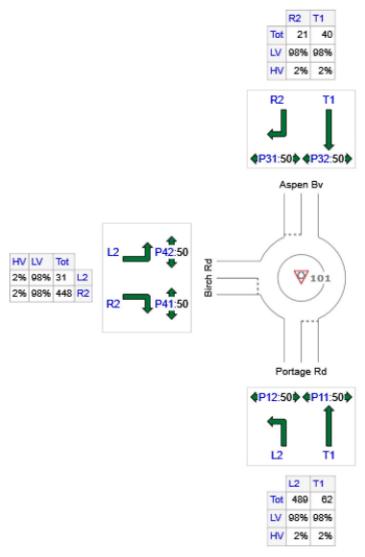
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: 101 [Pemberton - 2030 Background]

Pemberton Roundabout Roundabout

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Portage Rd	551	540	11
N: Aspen Bv	61	60	1
W: Birch Rd	479	469	10
Total	1091	1069	22

	۶	•	4	†	†	1
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	¥		ሻ	↑	↑	7
Traffic Volume (veh/h)	11	104	168	170	151	17
Future Volume (Veh/h)	11	104	168	170	151	17
Sign Control	Stop			Free	Free	
Grade	5%			0%	0%	
Peak Hour Factor	0.75	0.75	0.75	0.75	0.75	0.75
Hourly flow rate (vph)	15	139	224	227	201	23
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	876	201	224			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	876	201	224			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	83	83			
cM capacity (veh/h)	266	840	1345			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
			227		23	
Volume Total	154 15	224 224		201		
Volume Left			0	0	0	
Volume Right	139	0	0	0	23	
cSH	694	1345	1700	1700	1700	
Volume to Capacity	0.22	0.17	0.13	0.12	0.01	
Queue Length 95th (m)	6.8	4.8	0.0	0.0	0.0	
Control Delay (s)	11.7	8.2	0.0	0.0	0.0	
Lane LOS	В	Α		2.0		
Approach Delay (s)	11.7	4.1		0.0		
Approach LOS	В					
Intersection Summary						
Average Delay			4.4			
Intersection Capacity Utiliza	ation		37.0%	IC	CU Level c	of Service
Analysis Period (min)			15			
Analysis Period (min)			15			

	•	•	†	<i>></i>	>	ļ
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		ĵ»			ર્ન
Traffic Volume (veh/h)	11	66	1	16	36	1
Future Volume (Veh/h)	11	66	1	16	36	1
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.74	0.74	0.82	0.82	0.77	0.77
Hourly flow rate (vph)	15	89	1	20	47	1
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	106	11			21	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	106	11			21	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	92			97	
cM capacity (veh/h)	868	1073			1601	
			CD 4			
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	104	21	48			
Volume Left	15	0	47			
Volume Right	89	20	0			
cSH	1038	1700	1601			
Volume to Capacity	0.10	0.01	0.03			
Queue Length 95th (m)	2.7	0.0	0.7			
Control Delay (s)	8.9	0.0	7.2			
Lane LOS	Α		A			
Approach Delay (s)	8.9	0.0	7.2			
Approach LOS	Α					
Intersection Summary						
Average Delay			7.3			
Intersection Capacity Utiliz	zation		20.8%	IC	U Level o	of Service
Analysis Period (min)			15			

Intersection						
Intersection Delay, s/veh	15.3					
Intersection LOS	С					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
	WDL	WDK		NDR	SDL	
Lane Configurations		220	∱	60	287	€
Traffic Vol. veh/h	90 90	339	76 76	62 62	287	54 54
Future Vol, veh/h		339				54
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2
Mymt Flow	98	368	83	67	312	59
Number of Lanes	1	0	1	0	0	1
Approach	WB		NB		SB	
Opposing Approach			SB		NB	
Opposing Lanes	0		1		1	
Conflicting Approach Left	NB				WB	
Conflicting Lanes Left	1		0		1	
Conflicting Approach Right	SB		WB			
Conflicting Lanes Right	1		1		0	
HCM Control Delay	16.4		10.2		15.9	
HCM LOS	С		В		С	
I IOW LOO	U		ט		U	
110W 200	U		Ь		O	
		NBLn1		SBLn1		
Lane		NBLn1	WBLn1	SBLn1 84%		
Lane Vol Left, %		0%	WBLn1 21%	84%		
Lane Vol Left, % Vol Thru, %		0% 55%	WBLn1 21% 0%	84% 16%		
Lane Vol Left, % Vol Thru, % Vol Right, %		0% 55% 45%	WBLn1 21% 0% 79%	84% 16% 0%		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control		0% 55% 45% Stop	WBLn1 21% 0% 79% Stop	84% 16% 0% Stop		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane		0% 55% 45% Stop 138	WBLn1 21% 0% 79% Stop 429	84% 16% 0% Stop 341	0	
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol		0% 55% 45% Stop 138	WBLn1 21% 0% 79% Stop 429 90	84% 16% 0% Stop 341 287		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol		0% 55% 45% Stop 138 0 76	WBLn1 21% 0% 79% Stop 429 90 0	84% 16% 0% Stop 341 287 54		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol		0% 55% 45% Stop 138 0 76	WBLn1 21% 0% 79% Stop 429 90 0 339	84% 16% 0% Stop 341 287 54		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate		0% 55% 45% Stop 138 0 76 62 150	WBLn1 21% 0% 79% Stop 429 90 0 339 466	84% 16% 0% Stop 341 287 54 0		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp		0% 55% 45% Stop 138 0 76 62 150	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1	84% 16% 0% Stop 341 287 54 0 371		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X)		0% 55% 45% Stop 138 0 76 62 150 1	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64	84% 16% 0% Stop 341 287 54 0 371 1		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd)		0% 55% 45% Stop 138 0 76 62 150 1 0.23 5.51	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64 4.939	84% 16% 0% Stop 341 287 54 0 371 1 0.575 5.584		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N		0% 55% 45% Stop 138 0 76 62 150 1 0.23 5.51 Yes	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64 4.939 Yes	84% 16% 0% Stop 341 287 54 0 371 1 0.575 5.584 Yes		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap		0% 55% 45% Stop 138 0 76 62 150 1 0.23 5.51 Yes 650	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64 4.939 Yes 732	84% 16% 0% Stop 341 287 54 0 371 1 0.575 5.584 Yes 645		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time		0% 55% 45% Stop 138 0 76 62 150 1 0.23 5.51 Yes 650 3.558	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64 4.939 Yes 732 2.979	84% 16% 0% Stop 341 287 54 0 371 1 0.575 5.584 Yes 645 3.622		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		0% 55% 45% Stop 138 0 76 62 150 1 0.23 5.51 Yes 650 3.558 0.231	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64 4.939 Yes 732 2.979 0.637	84% 16% 0% Stop 341 287 54 0 371 1 0.575 5.584 Yes 645 3.622 0.575		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio HCM Control Delay		0% 55% 45% Stop 138 0 76 62 150 1 0.23 5.51 Yes 650 3.558 0.231 10.2	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64 4.939 Yes 732 2.979 0.637 16.4	84% 16% 0% Stop 341 287 54 0 371 1 0.575 5.584 Yes 645 3.622 0.575 15.9		
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		0% 55% 45% Stop 138 0 76 62 150 1 0.23 5.51 Yes 650 3.558 0.231	WBLn1 21% 0% 79% Stop 429 90 0 339 466 1 0.64 4.939 Yes 732 2.979 0.637	84% 16% 0% Stop 341 287 54 0 371 1 0.575 5.584 Yes 645 3.622 0.575		

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	†	7	ሻ	†	7	ሻ	†	7	*	†	7
Traffic Volume (vph)	317	182	46	37	179	356	41	55	50	370	58	157
Future Volume (vph)	317	182	46	37	179	356	41	55	50	370	58	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.5	3.6	3.6
Storage Length (m)	70.0	0.0	35.0	70.0	0.0	70.0	25.0	0.0	15.0	25.0	0.0	65.0
Storage Lanes	1		1	1 0.0		1	1		1	1		1
Taper Length (m)	30.0		•	30.0			20.0		•	30.0		•
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	0.850	1.00	1.00	0.850	1.00	1.00	0.850	1.00	1.00	0.850
Flt Protected	0.950		0.000	0.950		0.000	0.950		0.000	0.950		0.000
Satd. Flow (prot)	1593	1676	1425	1593	1676	1425	1593	1676	1425	1575	1676	1425
Flt Permitted	0.635	1070	1720	0.633	1070	1420	0.716	1070	1420	0.718	1070	1420
Satd. Flow (perm)	1065	1676	1425	1061	1676	1425	1200	1676	1425	1190	1676	1425
Right Turn on Red	1003	1070	Yes	1001	1070	Yes	1200	1070	Yes	1130	1070	Yes
Satd. Flow (RTOR)			50			387			54			171
Link Speed (k/h)		60	30		60	301		50	JŦ		50	17.1
Link Distance (m)		426.0			251.0			552.0			279.6	
Travel Time (s)		25.6			15.1			39.7			20.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	345	198	50	40	195	387	45	60	54	402	63	171
Shared Lane Traffic (%)	343	190	50	40	195	301	40	00	54	402	03	17.1
Lane Group Flow (vph)	345	198	50	40	195	387	45	60	54	402	63	171
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)	Leit	3.6	Rigiti	Leit	3.6	Rigiti	Leit	3.6	Rigiti	Leit	3.6	Right
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane		4.0			4.0			4.0			4.0	
Headway Factor	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.16	1.14	1.14
	25	1.14	1.14	25	1.14	1.14	25	1.14	1.14	25	1.14	1.14
Turning Speed (k/h) Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	Pellii	4	reiiii	reiiii	1NA 8	reiiii	Pellii	2	reiiii	Feiiii	6	reiiii
Permitted Phases	4	4	4	8	0	8	2		2	6	U	6
	4	4	4	8	8	8	2	2	2	6	6	6 6
Detector Phase Switch Phase	4	4	4	0	0	0			۷	U	U	U
	10.0	10.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Initial (s)	10.0 28.5	10.0 28.5	10.0 28.5	28.5	10.0	28.5	7.0	7.0 23.1	7.0 23.1	7.0	23.1	7.0
Minimum Split (s)		34.0		34.0	28.5	34.0	23.1		31.0	23.1		23.1
Total Split (s)	34.0		34.0		34.0		31.0	31.0 47.7%		31.0	31.0	31.0
Total Split (%)	52.3%	52.3%	52.3%	52.3%	52.3%	52.3%	47.7%		47.7%	47.7%	47.7%	47.7%
Maximum Green (s)	28.5	28.5	28.5	28.5	28.5	28.5	25.9	25.9	25.9	25.9	25.9	25.9
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	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 Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	5.1	5.1	5.1	5.1	5.1	5.1
Lead/Lag												
Lead-Lag Optimize?										0.0	2.2	0.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	Min	Min	Min	Min	Min	Min

	•	-	•	•	←	•	4	†	~	-	↓	1
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	16.0	16.0	16.0	16.0	16.0	16.0	12.0	12.0	12.0	12.0	12.0	12.0
Pedestrian Calls (#/hr)	1	1	1	1	1	1	1	1	1	1	1	1
Act Effct Green (s)	22.3	22.3	22.3	22.3	22.3	22.3	22.5	22.5	22.5	22.5	22.5	22.5
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.81	0.30	0.08	0.09	0.29	0.48	0.09	0.09	0.09	0.84	0.09	0.25
Control Delay	32.8	13.1	4.1	11.5	13.1	3.8	12.5	12.2	4.6	35.5	12.3	3.7
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	32.8	13.1	4.1	11.5	13.1	3.8	12.5	12.2	4.6	35.5	12.3	3.7
LOS	С	В	Α	В	В	Α	В	В	Α	D	В	Α
Approach Delay		23.8			7.2			9.7			24.6	
Approach LOS		С			Α			Α			С	
Queue Length 50th (m)	34.5	15.2	0.0	2.8	15.0	0.0	3.1	4.2	0.0	40.5	4.4	0.0
Queue Length 95th (m)	#76.4	28.2	5.2	7.9	27.7	13.8	9.3	11.3	5.9	#93.6	11.6	10.3
Internal Link Dist (m)		402.0			227.0			528.0			255.6	
Turn Bay Length (m)	70.0		35.0	70.0		70.0	25.0		15.0	25.0		65.0
Base Capacity (vph)	569	895	784	567	895	942	583	814	720	578	814	779
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	0.61	0.22	0.06	0.07	0.22	0.41	0.08	0.07	0.07	0.70	0.08	0.22

Intersection Summary

Area Type: CBD

Cycle Length: 65

Actuated Cycle Length: 55.9

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.84

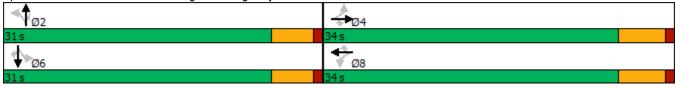
Intersection Signal Delay: 17.8 Intersection LOS: B
Intersection Capacity Utilization 72.8% ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 3: Vine Rd/Portage Rd & Highway 99



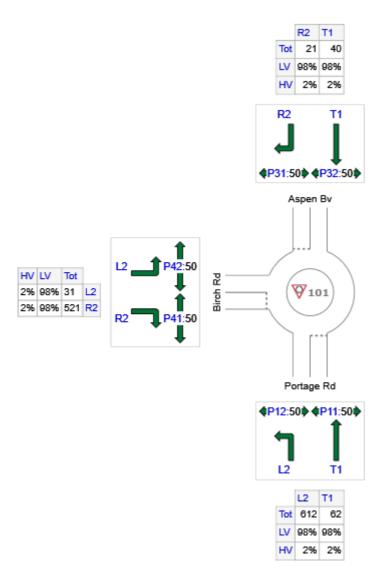
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

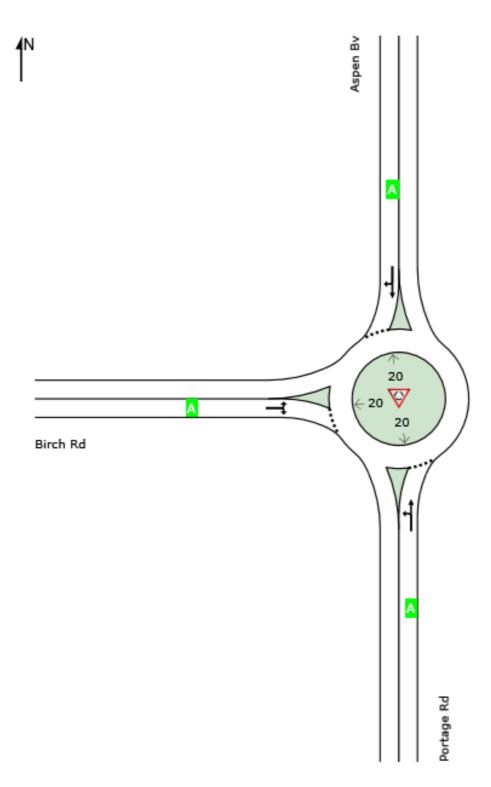
▼ Site: 101 [Pemberton - 2030 Total (Site Folder: General)]

Pemberton Roundabout Site Category: (None) Roundabout

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Portage Rd	674	661	13
N: Aspen Bv	61	60	1
W: Birch Rd	552	541	11
Total	1287	1261	26



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Delay Model: SIDRA Standard (Geometric Delay is included).

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Project: Not Saved

LANE SUMMARY

♥ Site: 101 [Pemberton - 2030 Total (Site Folder: General)]

Pemberton Roundabout Site Category: (None)

Roundabout

Lane Use	and Pe	rformar	nce										
	DEM FLO [Total veh/h		Cap.	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BA QUE [Veh		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Port		70	VO11/11	V/ O	70	300			- '''			70	70
Lane 1 ^d	749	2.0	1471	0.509	100	7.1	LOSA	4.3	30.8	Full	85	0.0	0.0
Approach	749	2.0		0.509		7.1	LOSA	4.3	30.8				
North: Aspe	en Bv												
Lane 1 ^d	68	2.0	700	0.097	100	6.4	LOSA	0.5	3.8	Full	40	0.0	0.0
Approach	68	2.0		0.097		6.4	LOSA	0.5	3.8				
West: Birch	Rd												
Lane 1 ^d	613	2.0	1409	0.435	100	2.3	LOSA	3.7	26.4	Full	35	0.0	0.0
Approach	613	2.0		0.435		2.3	LOSA	3.7	26.4				
Intersectio n	1430	2.0		0.509		5.0	LOSA	4.3	30.8				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS. Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Roundabout Capacity Model: SIDRA Standard.

Delay Model: SIDRA Standard (Geometric Delay is included).

Queue Model: SIDRA Standard.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

Approach		ows (v	/eh/h)						
South: Porta	ige Rd								
Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c		Prob. SL Ov. %	Ov. Lane No.
Lane 1	680	69	749	2.0	1471	0.509	100	NA	NA
Approach	680	69	749	2.0		0.509			
North: Asper	n Bv								
Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c		Prob. SL Ov. %	Ov. Lane No.
Lane 1	44	23	68	2.0	700	0.097	100	NA	NA
Approach	44	23	68	2.0		0.097			
West: Birch	Rd								
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c		Prob. SL Ov. %	Ov. Lane No.
Lane 1	34	579	613	2.0	1409	0.435	100	NA	NA
Approach	34	579	613	2.0		0.435			
Total %HV Deg.Satn (v/c)									