

TRAFFIC IMPACT STUDY PENHORN DEVELOPMENT



PREPARED FOR:
CLAYTON DEVELOPMENTS

JUNE 2020



Project No. 201-04486

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1 INTRODUCTION

Background

Plans are being prepared for a residential development adjacent to the existing Penhorn Plaza site in Dartmouth, Nova Scotia (see Figure 1). Over time Penhorn Plaza has evolved from a large regional shopping center to a smaller-scale retail destination supplemented with a transit terminal. There is currently a significant portion of the Penhorn Plaza site that remains unused and ready for redevelopment.

WSP Canada Inc. has been retained to complete a Traffic Impact Study (TIS) for the proposed residential development concept shown in Figure 2.

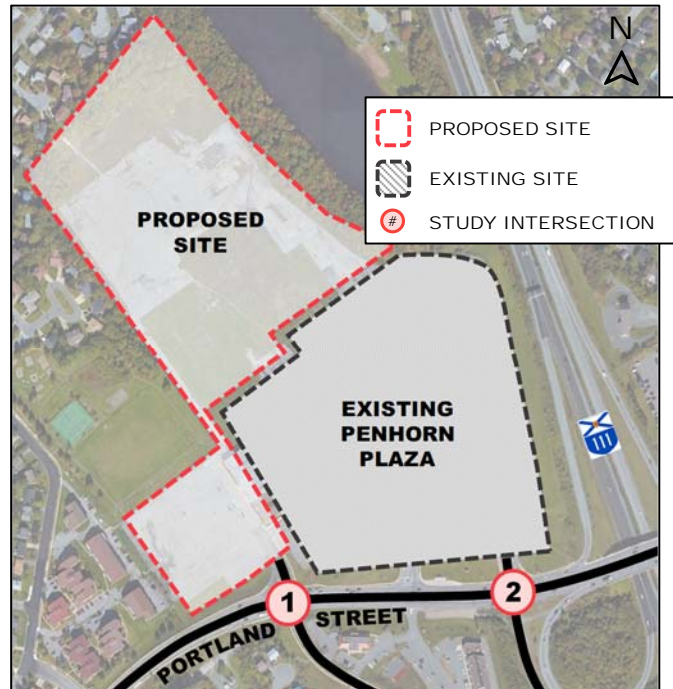


Figure 1 – Study Area

A Traffic Impact Study Usually Considers Four Questions

A TIS usually consists of determining answers for the following questions:

1. **What is the existing transportation situation** adjacent to the study site? How have volumes changed historically?
2. **What transportation changes are expected** at key Study Area locations? How many vehicle and active mode trips are expected to be generated by the proposed development during weekday peak hours? What routes are the trips expected to use to travel within and through the Study Area?
3. **What transportation impacts will occur** on Study Area roads, sidewalks, and intersections?
4. **What transportation improvements are required** to mitigate project impacts on Study Area travel? Are there transportation modifications that should be made to improve the travel experience for all users?

Study Objectives

1. Develop projected 2030 background weekday AM and PM peak hourly volumes for Study Intersection that do not include trips generated by the proposed site.
2. Estimate the number of weekday AM and PM peak hour trips that will be generated by the proposed development.
3. Distribute and assign site generated trips to Study Intersections to project 2030 peak hourly volumes that include site generated trips.
4. Evaluate impacts of site generated traffic on the performance of Study Intersections.
5. Complete warrant analyses, as necessary, for Study Intersections and recommend improvements that may be needed at study intersections to mitigate the impacts of site development.

CONCEPTUAL PLAN

PENHORN REDEVELOPMENT

NOTES:

- CONCEPTUAL LAYOUT ONLY.
- GRADING IS NOT FINALIZED; WALL HEIGHTS AND ELEVATIONS ARE SUBJECT TO CHANGE.
- FINAL GRADING TO BE IN ACCORDANCE WITH HRM ENGINEERING SPECIFICATIONS & WBHL DESIGN GUIDELINES.
- FINAL PLANS TO BE IN ACCORDANCE WITH THE DEVELOPMENT AGREEMENT AND APPLICABLE LAND USE BY-LAW.

DATE

APRIL 15, 2020

SCALE

1:2500



Figure 2 - Site Plan



2 STUDY AREA DESCRIPTIONS

Description of Proposed Development

The proposed residential development is expected to be constructed in the demolished lands north of the existing Penhorn Plaza in Dartmouth, Nova Scotia. The proposed development is expected to be made up of a combination of mid-rise and high-rise apartment buildings, totalling 875 apartment units, as well as 45 single family dwellings. Full occupancy of the development is anticipated by 2030.

Proposed Site Access

It is expected that vehicular access to the proposed site will be provided via the existing signalized intersections (Site Access #1 and Site Access #2) that provide access to Penhorn Plaza (see Figure 3). It is not anticipated that trips generated by the proposed development will access the site through the existing unsignalized intersection due to its inopportune location and traffic control.

Existing Road Descriptions

Portland Street, otherwise known as NS Route 207, is an arterial road that runs east-west approximately 5.7 km between Alderney Drive (Downtown Dartmouth) and Caldwell Road. In the Study Area, Portland Street consists of a changing cross section with alternating turning lanes, divided by a median. There is sidewalk on the both sides of the roadway and parking is prohibited. The posted speed limit is 50 km/h in the Study Area.

Existing Intersection Descriptions

Intersection 1 – Portland Street and Site Access #1/Green Village Lane is a 4-leg signalized intersection with pedestrian crosswalks on the north, south and west legs (see Photo 1). The eastbound and westbound approaches consists of a left-turn lane, a through lane and a shared through/right-turn lane. The northbound approach (Green Village Lane) consists of a through/left-turn lane and a right turn lane. The southbound approach (Site Access #1) consists of a left-turn lane, a through lane and a channelized right turn lane.



Figure 3 – Site Access



Photo 1 – Portland Street and Site Access #1/Green Village Lane

**Existing
Intersection
Descriptions
(Continued)**

Intersection 2 – Portland Street and Site Access #2/NS Highway 111 Southbound Onramp is a 4-leg signalized intersection with pedestrian crosswalks on the north and west legs (see Photo 2). The eastbound approach consists of a left-turn lane, a through lane and a shared through/right-turn lane. The westbound approach consists of a left-turn lane, two (2) through lanes and a shared through/right-turn lane. The southbound approach (Site Access #2) consists of a left-turn lane, a through/left-turn lane and a right-turn lane. The south leg is a southbound onramp for NS Highway 111.



Photo 2 – Portland Street and Site Access #2/NS Highway 111 Southbound Onramp

**Turning
Movement
Counts**

Turning movement counts were obtained from HRM Traffic Management for morning, midday and evening peak periods at the Study Intersections. The turning movement counts for Portland Street at Site Access #1 were collected by HRM on November 22, 2018. The turning movement counts for Portland Street at Site Access #2 were collected by HRM on August 23, 2017. The turning movement counts have been tabulated in Tables A-1 and A-2, Appendix A, with peak hour volumes indicated by shaded areas.

**Background
Traffic**

When the traffic counts were completed the former Sears building was unoccupied, as shown outlined in Figure 4. Since then, the building has been modified to include approximately 32,000 ft² of office space, 5,000 ft² of restaurant and 5,000 ft² of retail establishments.



Figure 4 – Location of Background Development

Annual Growth

The peak hour volumes on Portland Street and the NS Highway 111 onramp have been increased by an annual growth rate of 1.5% to project background traffic volumes. This growth rate was determined based on historical background volume information and is considered typical for this area. The annual growth rate was not applied to turning movements to/from Green Village Lane because no additional growth is expected in this residential neighbourhood (i.e. fully occupied). Similarly, the annual growth rate was not applied to turning movements to/from Penhorn Plaza because the background development was taken into consideration.

**Projected 2020
Traffic
Volumes**

The projected 2020 AM and PM peak hour volumes represent estimates of the current traffic volumes and are shown diagrammatically in Figure A-1, Appendix A.

The proposed site has good accessibility for pedestrians. There are sidewalks on both sides of Portland Street and marked crosswalks at the Study Intersections, therefore, pedestrians can easily access the site from the south. In addition, there are walking trails throughout the Manor Park neighbourhood and near Penhorn Lake and Brownlow Park, which pedestrians may use to access the site from the north.

The Halifax *Integrated Mobility Plan* (IMP) has proposed an all ages and abilities bicycle network throughout the regional centre of Halifax by 2022. An active transportation greenway is planned near to the proposed site (see Figure 5). A trail is currently being constructed around Penhorn Lake that will ultimately connect to these lands to the proposed development and Penhorn Transit Terminal.

The Penhorn Transit Terminal is currently located on Penhorn Plaza site, fronting Portland Street. HRM Transit currently operates Routes 57, 58, 59, 61, 62, 66, 68 and 159 through the Penhorn Transit Terminal (see Figure 7).

The IMP has identified Portland Street as a Transit Priority Corridor (see Figure 7). It is expected that physical or policy-related interventions will be implemented in an effort to reduce the impact of traffic congestion on transit vehicles.



Figure 5 – Active Transportation (IMP, 2017)



Figure 6 – HRM Transit Routes

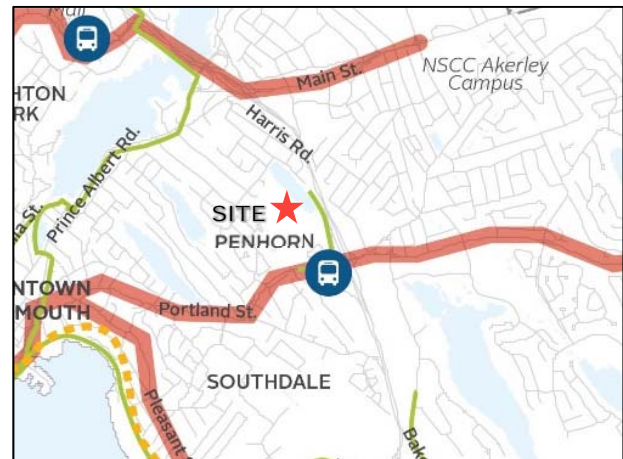


Figure 7 – Transit Priority (IMP, 2017)

3 TRIP GENERATION, DISTRIBUTION, AND ASSIGNMENT

Anticipated Land Use for Proposed Development

The proposed residential development is planned to include a combination of mid-rise (3-10 storeys) and high-rise (more than 10 storeys) apartment buildings as well as single family homes. The site is expected to consist of 427 Mid-Rise Apartment units, 448 High-Rise Apartment units and 45 Single Family Dwellings.

Anticipated Land Use for Background Development

The mixed-use background development is planned to include 32,000 ft² of General Office, 5,000 ft² of High-Turnover (Sit-Down) Restaurant and 5,000 ft² of Specialty Retail.

Estimation of Site Generated Trips (Background Development and Proposed Site)

When using the published rates in *Trip Generation Manual* (Institute of Transportation Engineers), the transportation engineer's objective should be to provide a realistic estimate of the number of trips that will be generated.

Trips generated by Single Family Dwellings (Land Use 210), Mid-Rise Apartment Units (Land Use 221) and High-Rise Apartment Units (Land Use 222) are estimated for the AM and PM peak hours of traffic by the number of units. Trip generated by General Office (Land Use 710), Specialty Retail (Land Use 826) and High-Turnover (Sit-Down) Restaurant (Land Use 932) are estimated for the AM and PM peak hours of traffic by the leasable square footage available.

Trip generation estimates for Single Family Dwellings, Mid-Rise Apartment Units, High-Rise Apartment Units, General Office and High-Turnover (Sit-Down) Restaurant were prepared using published rates from *Trip Generation Manual, 10th Edition* (Institute of Transportation Engineers, Washington, 2017), and estimates for Specialty Retail were prepared using published rates from *Trip Generation Manual, 9th Edition* (Institute of Transportation Engineers, Washington, 2012). Specialty Retail is no longer listed as a potential land usage in the 10th Edition, instead more specific retail descriptions are provided (e.g. supermarket, apparel store, pet supply store, etc.). Detailed breakdowns of the commercial space within the proposed mixed-use development was unavailable, therefore, more general scenarios were explored.

Two types of trips are included in the external trips that will be generated by the background and proposed development:

- **Pass-by trips** are those which are made as 'intervening opportunity' stops to commercial and retail land uses by vehicle trips already passing by the site. Although these trips will be included in the site access volumes to the site, they will not increase the overall traffic volumes on Study Area roads. Diverted link and pass-by rates were determined using *Trip Generation Handbook, 3rd Edition* (Institute of Transportation Engineers, 2017) and local knowledge of the area.
- **Primary trips** for this study include all external site generated trips that are not considered pass-by trips.

Reductions to Trip Generation Estimates

In Halifax approximately 12% of commuting trips were made by transit in 2017 (Page 99, IMP, 2017). The Penhorn Transit Terminal is located on-site (Routes 57, 58, 59, 61, 62, 66, 68 and 159), therefore, the transit-ridership expected to be slightly higher in the Study Area. In addition, there are good pedestrian connections (sidewalks and crosswalks) to the surrounding residential neighbourhoods and adjacent commercial properties.

Reductions to Trip Generation Estimates (Continued)

In addition, it is expected that there will be on-site synergies for trips between the proposed and background developments. These are customers that make one trip to the site and make use of more than one service available.

Halifax has a 60% target for non-auto trips within the Regional Centre by 2031 (Page 40, IMP, 2017). Within the 2030 timeframe, the background and proposed developments are expected to be fully occupied, therefore, a conservative reduction at 30% was used, which accounts for all non-auto trips (transit, cycling and walking trips) and on-site synergies.

**Trip
Generation
Estimates for
Background
Development**

Trip generation estimates for the background development are summarized in Table 1.

During the AM peak hour, it is estimated that background development will generate:

- 43 two-way primary vehicle trips (33 entering and 10 exiting); and,
- 22 two-way pass-by vehicle trips (11 entering and 11 exiting).

During the PM peak hour, it is estimated that that background development will generate:

- 44 two-way primary vehicle trips (16 entering and 28 exiting); and,
- 26 two-way pass-by vehicle trips (13 entering and 13 exiting).

**Trip
Generation
Estimates for
Proposed
Development**

Trip generation estimates for the proposed development are summarized in Table 2. It is estimated that the residential development will generate:

- 179 two-way trips (46 entering and 133 exiting) during the AM peak hour; and,
- 227 two-way trips (140 entering and 87 exiting) during the PM peak hour.

Table 1 – Trip Generation Estimates for the Background Development

Land Use ¹	Units ²	Trip Generation Rates ³				Trip Generation Estimates ⁴			
		AM Peak		PM Peak		AM Peak		PM Peak	
		In	Out	In	Out	In	Out	In	Out
Background Development									
General Office (Land Use 710)	32.0 KGLA	1.00	0.16	0.18	0.97	32	5	6	31
High-Turnover (Sit-Down) Restaurant (Land Use 932)	5.0 KGLA	5.47	4.47	6.06	3.71	27	22	30	19
Specialty Retail ⁵ (Land Use 826) ⁶	5.0 KGLA	0.76	0.60	1.19	1.52	4	3	6	8
Trip Generation Estimate for Bakground Development						63	30	42	58
30% Reduction for Non-Auto Trips ⁷						19	9	13	17
40% Reduction for Commercial Pass-By Trips ⁸						11	11	13	13
Total Primary Trip Estimate for Background Development						33	10	16	28
NOTES:									
1. Land Use Code 710 and 932 is from Trip Generation, 10th Edition, (Institute of Transportation Engineers, Washington, 2017) and Land Use Code 826 is from Trip Generation, 9th Edition, (Institute of Transportation Engineers, Washington, 2012).									
2. 'Gross Leasable Area x 1000 SF' for General Office, High-Turnover (Sit-Down) Restaurant and Specialty Retail.									
3. Trip generation rates are 'vehicles per hour per unit'.									
4. Trips generated are 'vehicles per hour' for AM and PM peak hours.									
5. Retail uses have yet to be identified, therefore, the commercial space was assumed to be Specialty Retail.									
6. The Specialty Retail (ITE Land Use 826) rate for 'Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 PM' has been used. Since there is no published rate for the AM peak hour of adjacent street traffic for this land use, and since AM peak hour trips to specialty retail are generally low, AM trip rates have been assumed to be 50% of the PM rate with reversal of the directional split.									
7. A 30% reduction for non-auto trips has been used to account for transit, cycling and walking trips as well as on-site synergies.									
8. Trip Generation Handbook, 3rd Edition, (Institute of Transportation Engineers, Washington, 2017) indicates an average of 34% pass-by trips for a Variety Store (Land Use 814) during the PM peak hour and there is no published rate for the AM peak hour, therefore, a 35% reduction for Specialty Retail trips was considered for the AM and PM peak hour. It also indicates 43% pass-by trips for High-Turnover (Sit-Down) Restaurant (Land Use 932) during the PM peak hour and there is no published rate for the AM peak hour. A weighted average of the associated pass-by rates was calculated to be 41%, therefore, a 40% reduction in commercial trips was used, which accounts for pass-by trips on Portland Street.									

Table 2 – Trip Generation Estimates for the Proposed Development

Land Use ¹	Units ²	Trip Generation Rates ³				Trip Generation Estimates ⁴			
		AM Peak		PM Peak		AM Peak		PM Peak	
		In	Out	In	Out	In	Out	In	Out
Penhorn Residential Development									
Single Family Housing (Land Use 210)	45 Units	0.19	0.55	0.62	0.37	9	25	28	16
Mid-Rise Apartments (Land Use 221)	427 Units	Equations from Pages 74 and 75 (Residential - Land Uses 200 - 299)				37	105	109	69
High-Rise Apartments (Land Use 222)	433 Units	Equations from Pages 153 and 154 (Residential - Land Uses 200 - 299)				32	102	95	61
Trip Generation Estimate for Proposed Site						78	232	232	146
30% Reduction for Non-Auto Trips ⁵						23	70	70	44
Total Primary Trip Estimate for Proposed Site						55	162	162	102
NOTES:									
1. Trip generation rates and equations are from Trip Generation, 10th Edition, (Institute of Transportation Engineers, Washington, 2017).									
2. 'Number of Residential Units' for Single Family Housing and Mid-Rise and High-Rise Apartment Buildings.									
3. Trip generation rates are 'vehicles per hour per unit'.									
4. Trips generated are 'vehicles per hour' for AM and PM peak hours.									
5. A 30% reduction for non-auto trips has been used to account for transit, cycling and walking trips as well as on-site synergies.									

**Trip
Distribution
and
Assignment**

External trips generated by the proposed development were assigned to the roadway network based on review of past studies and WSP's local knowledge of the area considering major trip origins and destinations in the region.

North	45%	(Burnside, Dartmouth Crossing, Bayers Lake, Bedford, Airport)
East	15%	(Adjacent Shopping Centers, Cole Harbour)
South	10%	(Woodside Industrial Park, Woodside Ferry Terminal, Shearwater)
West	30%	(Downtown Dartmouth, Downtown Halifax, Alderney Ferry Terminal)

Pass-by trips generated by the proposed development were assigned to the roadway based on the turning movement counts available.

It is estimated that of the vehicular traffic generated to/from the north, east and south, 80% will enter/exit the site using Site Access #1 and 20% will enter/exit the site using Site Access #2. It is estimated that trips to/from the west will use Site Access #1. In addition, it is estimated that all trips generated by the background development will enter/exit the site using Site Access #1 due to the location of the background development site. The configuration of the proposed site discourages vehicular traffic from traversing through the Penhorn Plaza site to/from the existing unsignalized driveway. It is not expected that new trips generated by the developments will access the site via the existing unsignalized driveway.

**Projected
2030
Background
Traffic
Volumes**

The projected 2030 AM and PM peak hour background volumes are shown diagrammatically in Figure A-2, Appendix A. It should be noted that the volumes have been rounded to the nearest multiple of 5.

**Projected
2030 Traffic
Volumes with
Site
Generated
Trips**

Trips generated by the proposed site (Figure A-3, Appendix A) have been added to the 2030 traffic volumes with the background developments (Figure A-2, Appendix A) to provide projected 2030 AM and PM peak hourly volumes that include site generated trips. The 2030 traffic volumes with the site generated trips are illustrated diagrammatically in Figure A-4, Appendix A.



4 INTERSECTION OPERATIONAL ANALYSIS

Intersection Capacity Analysis

Intersection capacity analysis was completed to estimate how the Study Intersections are currently performing and how they may be expected to operate in the future without and with site generated trips.

Synchro 10.0 software was used to evaluate the performance of the Study Intersections for the following scenarios:

- A. Existing 2020 AM and PM peak hour volumes (with background development);
- B. Projected 2030 AM and PM peak hour volumes without site development; and,
- C. Projected 2030 AM and PM peak hour volumes with site development.

Detailed results of the analyses are included in Appendix B.

Intersection Capacity Analysis Results

Intersection 1 – Portland Street and Site Access #1/Green Village Lane (Table 3) – The existing intersection is expected to operate within available capacity during the AM and PM peak hours. Without site development, the intersection is expected to continue operating at a satisfactory performance during the peak hours. With site development, a surplus of residual capacity is expected and minimal changes to seconds of delay per vehicle are projected. This intersection is expected to operate within HRM guidelines with development of the proposed site.

Intersection 2 – Portland Street and Site Access #2/NS Highway 111 Southbound Onramp (Table 4) – The existing intersection is expected to operate within available capacity during the morning and evening peak periods. Without site development, the intersection is expected to continue operating at an acceptable performance during the peak hours. With site development, a surplus of residual capacity is expected and negligible changes to seconds of delay per vehicle are projected. This intersection is expected to operate within HRM guidelines with development of the proposed site.



Table 3 – Intersection Capacity Analysis for Portland Street at Site Access #1/Green Village Lane

LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement									Overall Intersection
	Portland Street				Green Village Lane		Site Access #1			
	EB-L	EB-TR	WB-L	WB-TR	NB-LT	NB-R	SB-L	SB-T	SB-R	Delay
2020 AM Peak Hour with Existing Conditions (Page B-1)										
Delay	6.3	5.3	2.2	5.9	41.8	1.2	38.6	0.0	0.1	6.2
v/c	0.08	0.22	0.10	0.33	0.21	0.13	0.09	0.00	0.03	
Queue	5.9	29.8	5.0	47.7	12.7	0.0	7.0	0.0	0.0	
2020 PM Peak Hour with Existing Conditions (Page B-3)										
Delay	6.6	6.6	2.6	6.2	42.8	0.9	39.2	0.0	0.2	7.0
v/c	0.05	0.37	0.15	0.32	0.26	0.10	0.13	0.00	0.05	
Queue	4.6	59.6	5.3	49.1	14.6	0.0	8.9	0.0	0.0	
2030 AM Peak Hour without Proposed Site (Page B-5)										
Delay	6.6	5.4	2.2	6.3	41.8	1.2	38.6	0.0	0.1	6.4
v/c	0.09	0.25	0.11	0.38	0.21	0.13	0.09	0.00	0.03	
Queue	6.1	34.5	5.0	56.7	12.7	0.0	7.0	0.0	0.0	
2030 PM Peak Hour without Proposed Site (Page B-7)										
Delay	6.7	7.0	2.8	6.5	42.8	0.9	38.2	0.0	0.2	7.3
v/c	0.06	0.42	0.17	0.36	0.26	0.10	0.13	0.00	0.05	
Queue	4.7	70.7	5.3	57.6	14.6	0.0	8.9	0.0	0.0	
2030 AM Peak Hour with Proposed Site (Page B-9)										
Delay	11.6	8.9	4.2	10.4	33.5	0.6	47.4	0.0	0.4	11.6
v/c	0.17	0.28	0.12	0.44	0.14	0.09	0.58	0.00	0.11	
Queue	12.2	46.1	8.0	79.2	11.3	0.0	33.8	0.0	0.0	
2030 PM Peak Hour with Proposed Site (Page B-11)										
Delay	11.8	9.7	4.1	9.3	37.0	0.7	46.1	0.0	0.3	10.6
v/c	0.25	0.46	0.18	0.44	0.20	0.08	0.48	0.00	0.10	
Queue	16.8	82.0	7.0	75.8	13.7	0.0	26.4	0.0	0.0	



Table 4 – Intersection Capacity Analysis for Portland Street at Site Access #2/NS Highway 111 Southbound Onramp

LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement							Overall Intersection
	Portland Street				Site Access #2			Delay
	EB-L	EB-TR	WB-L	WB-TR	SB-L	SB-T	SB-R	
2020 AM Peak Hour with Existing Conditions (Page B-2)								
Delay	2.8	5.5	14.3	4.8	43.8	43.7	0.4	9.0
v/c	0.05	0.25	0.57	0.25	0.40	0.40	0.05	
Queue	2.8	38.0	80.4	32.0	25.6	26.1	0.0	
2020 PM Peak Hour with Existing Conditions (Page B-4)								
Delay	3.0	7.2	12.3	5.7	44.2	43.7	0.9	9.5
v/c	0.08	0.36	0.40	0.24	0.43	0.42	0.11	
Queue	4.1	56.3	33.7	30.6	28.1	28.0	0.0	
2030 AM Peak Hour without Proposed Site (Page B-6)								
Delay	2.9	5.7	24.5	5.1	43.8	43.7	0.4	10.5
v/c	0.06	0.30	0.75	0.28	0.40	0.40	0.05	
Queue	2.8	46.0	117.6	38.2	25.6	26.1	0.0	
2030 PM Peak Hour without Proposed Site (Page B-8)								
Delay	3.1	7.9	21.2	6.1	44.2	43.7	0.9	10.2
v/c	0.09	0.43	0.58	0.28	0.43	0.42	0.11	
Queue	4.1	72.9	61.1	37.3	28.1	28.0	0.0	
2030 AM Peak Hour with Proposed Site (Page B-10)								
Delay	3.1	6.3	36.5	5.5	44.4	44.1	0.3	12.6
v/c	0.06	0.34	0.85	0.30	0.45	0.44	0.04	
Queue	3.0	55.0	127.3	41.3	29.1	29.1	0.0	
2030 PM Peak Hour with Proposed Site (Page B-12)								
Delay	3.4	8.4	26.1	6.5	44.5	44.2	0.8	10.9
v/c	0.10	0.46	0.64	0.32	0.46	0.45	0.11	
Queue	4.2	80.1	65.6	43.6	29.8	30.2	0.0	

5 SUMMARY AND CONCLUSIONS

5.1 SUMMARY

- | | |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description of the Proposed Development | 1. Plans are being prepared for a residential development adjacent to the existing Penhorn Plaza site in Dartmouth, Nova Scotia. The proposed development is expected to consist of 427 Mid-Rise Apartment units, 448 High-Rise Apartment units and 45 Single Family Dwellings. Full occupancy of this development is anticipated by 2030. |
| Description of the Background Development | 2. A background development was taken into consideration in order to project background traffic volumes resulting from redevelopment of the former Sears building. This mixed-use background development includes 32,000 ft ² of General Office, 5,000 ft ² of High-Turnover (Sit-Down) Restaurant and 5,000 ft ² of Specialty Retail when fully occupied. |
| Proposed Site Access | 3. It is expected that vehicular access to the proposed site will be provided via the existing signalized intersections that currently provide access to Penhorn Plaza. |
| Estimation of Site Generated Trips | 4. Trip generation estimates were prepared using rates published in <i>Trip Generation, 10th Edition</i> (Institute of Transportation Engineers, Washington, 2017) as well as <i>Trip Generation Manual, 9th Edition</i> (Institute of Transportation Engineers, Washington, 2012).

It is estimated that the site will generate: <ul style="list-style-type: none"> • 179 two-way trips (46 entering and 133 exiting) during the AM peak hour; and, • 227 two-way trips (140 entering and 87 exiting) during the PM peak hour. |
| Trip Distribution and Assignment | 5. External trips generated by the proposed development were assigned to the roadway network based on review of past studies and WSP's local knowledge of the area considering major trip origins and destinations in the region. Trips were distributed to the north (45%), east (15%), south (10%) and west (30%). |
| Summary – Intersection Capacity Analysis | 6. Intersection 1 – Portland Street and Site Access #1/Green Village Lane – This intersection is expected to operate within HRM acceptable limits in 2030 with site development.

Intersection 2 – Portland Street and Site Access #2/NS Highway 111 Southbound Onramp – This intersection is expected to operate within HRM acceptable limits in 2030 with site development. |

5.2 CONCLUSIONS

- | | |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Impacts to Vehicular Traffic | 7. Since the access intersections for this redevelopment site have been constructed to accommodate traffic volumes for a large regional shopping center, there remains residual capacity on the driveway approaches. With added trips generated by the proposed development, the access intersections are projected to operate within HRM guidelines at full occupancy. |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

APPENDIX

A

TRAFFIC VOLUME DATA



<div>Table A-1</div> <div>Portland Street</div> <div>@</div> <div>Green Village Lane/Site Access #1</div> <div></div> <div>Dartmouth, NS</div> <div>Thursday, November 22, 2018</div>				<div><div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div></div> 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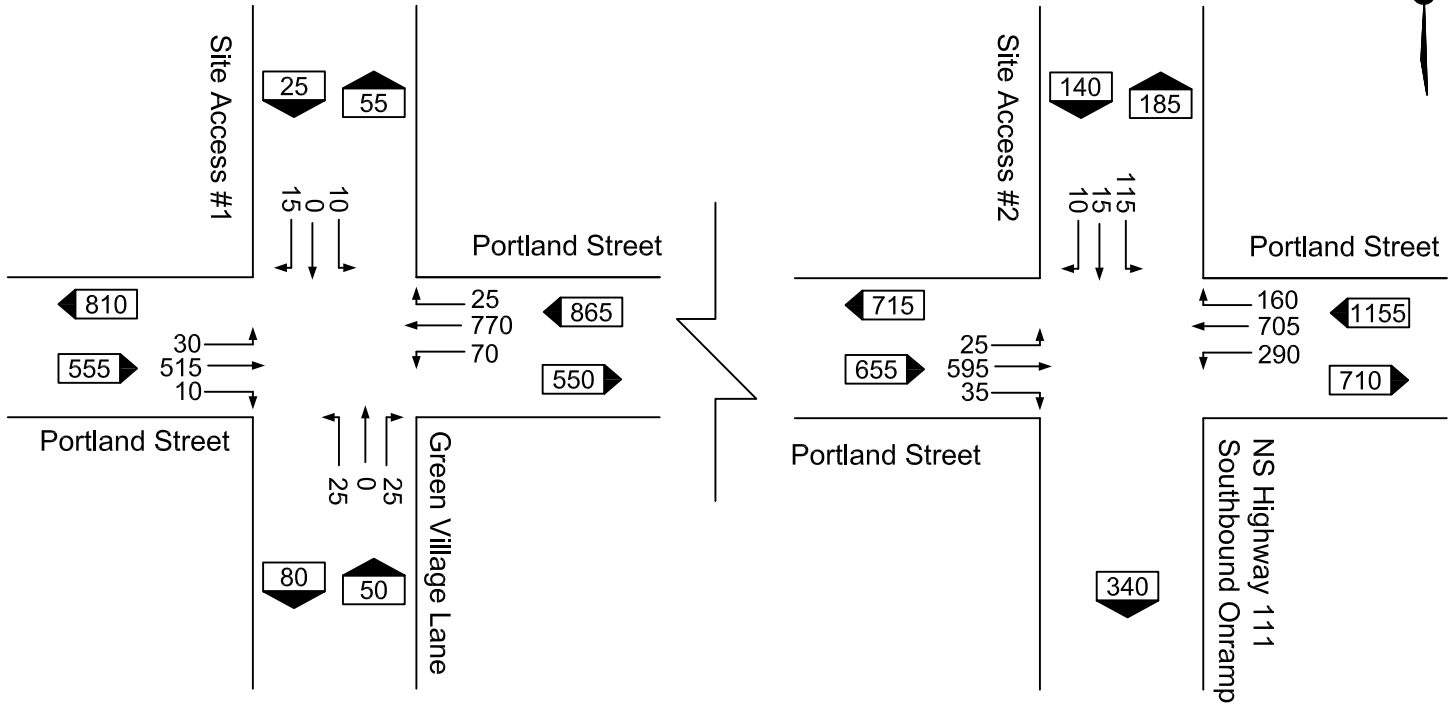
* Count not completed by WSP

<div>Table A-2</div> <div>Portland Street @ Site Access #2/ NS Highway 111 SB Onramp</div> <div>Dartmouth, NS Wednesday, August 23, 2017</div>												<div><div><div>Site Access #2</div><div>I H G</div><div><div><div>J</div><div>K</div><div>L</div></div><div>Portland Street</div></div><div><div><div>Ped 3</div><div>Ped 4</div><div>Ped 2</div><div>Ped 1</div></div><div>Portland Street</div><div>NS Highway 111 SB Onramp</div></div><div><div>Portland Street</div><div>F E D</div></div></div></div>											
AM Peak Period Volume Data																							
Time		Portland Street Westbound Approach			Site Access #2 Southbound Approach			Portland Street Eastbound Approach			Total Vehicles												
		D	E	F	G	H	I	J	K	L													
07:00	07:15	62	153	20	13	10	2	3	118	7	388												
07:15	07:30	76	167	31	21	11	1	6	133	11	457												
07:30	07:45	83	191	34	15	7	1	5	141	8	485												
07:45	08:00	78	188	36	40	5	0	5	147	10	509												
08:00	08:15	77	168	45	36	2	3	8	157	11	507												
08:15	08:30	60	166	44	24	1	6	7	161	6	475												
08:30	08:45	59	171	37	26	2	3	8	159	8	473												
08:45	09:00	64	188	33	23	4	2	5	166	8	493												
AM Peak Hour		298	713	159	115	15	10	25	606	35	1976												
07:00	08:00	299	699	121	89	33	4	19	539	36	1839												
08:00	09:00	260	693	159	109	9	14	28	643	33	1948												
		Ped 2			Ped 3			Ped 4			Total Peds												
07:00	08:00	0			7			0			7												
08:00	09:00	0			9			0			9												
Midday Peak Period Volume Data																							
Time		Portland Street Westbound Approach			Site Access #2 Southbound Approach			Portland Street Eastbound Approach			Total Vehicles												
		D	E	F	G	H	I	J	K	L													
11:00	11:15	25	163	44	38	7	3	11	198	21	510												
11:15	11:30	32	140	43	38	4	2	9	171	14	453												
11:30	11:45	34	138	43	40	8	4	9	182	19	477												
11:45	12:00	32	162	47	33	5	2	12	184	18	495												
12:00	12:15	34	148	25	41	7	3	9	193	22	482												
12:15	12:30	41	154	31	48	6	2	9	196	20	507												
12:30	12:45	30	147	37	39	9	1	11	199	26	499												
12:45	13:00	27	259	38	32	5	3	8	197	21	590												
Midday Peak Hour		132	708	131	160	27	9	37	785	89	2078												
11:00	12:00	123	603	177	149	24	11	41	735	72	1935												
12:00	13:00	132	708	131	160	27	9	37	785	89	2078												
		Ped 2			Ped 3			Ped 4			Total Peds												
11:00	12:00	0			7			0			7												
12:00	13:00	0			9			0			9												
PM Peak Period Volume Data																							
Time		Portland Street Westbound Approach			Site Access #2 Southbound Approach			Portland Street Eastbound Approach			Total Vehicles												
		D	E	F	G	H	I	J	K	L													
16:00	16:15	17	154	51	35	2	1	5	223	11	499												
16:15	16:30	50	162	26	25	5	5	8	219	12	512												
16:30	16:45	41	176	29	33	6	5	10	204	13	517												
16:45	17:00	31	183	45	31	10	8	9	211	11	539												
17:00	17:15	28	174	43	24	8	5	13	216	9	520												
17:15	17:30	22	169	35	27	6	4	9	207	8	487												
17:30	17:45	26	158	27	29	11	3	9	201	10	474												
17:45	18:00	18	157	25	21	7	3	6	194	8	439												
PM Peak Hour		150	695	143	113	29	23	40	850	45	2088												
16:00	17:00	139	675	151	124	23	19	32	857	47	2067												
17:00	18:00	94	658	130	101	32	15	37	818	35	1920												
		Ped 2			Ped 3			Ped 4			Total Peds												
16:00	17:00	0			10			0			10												
17:00	18:00	0			11			0			11												

* Count not completed by WSP

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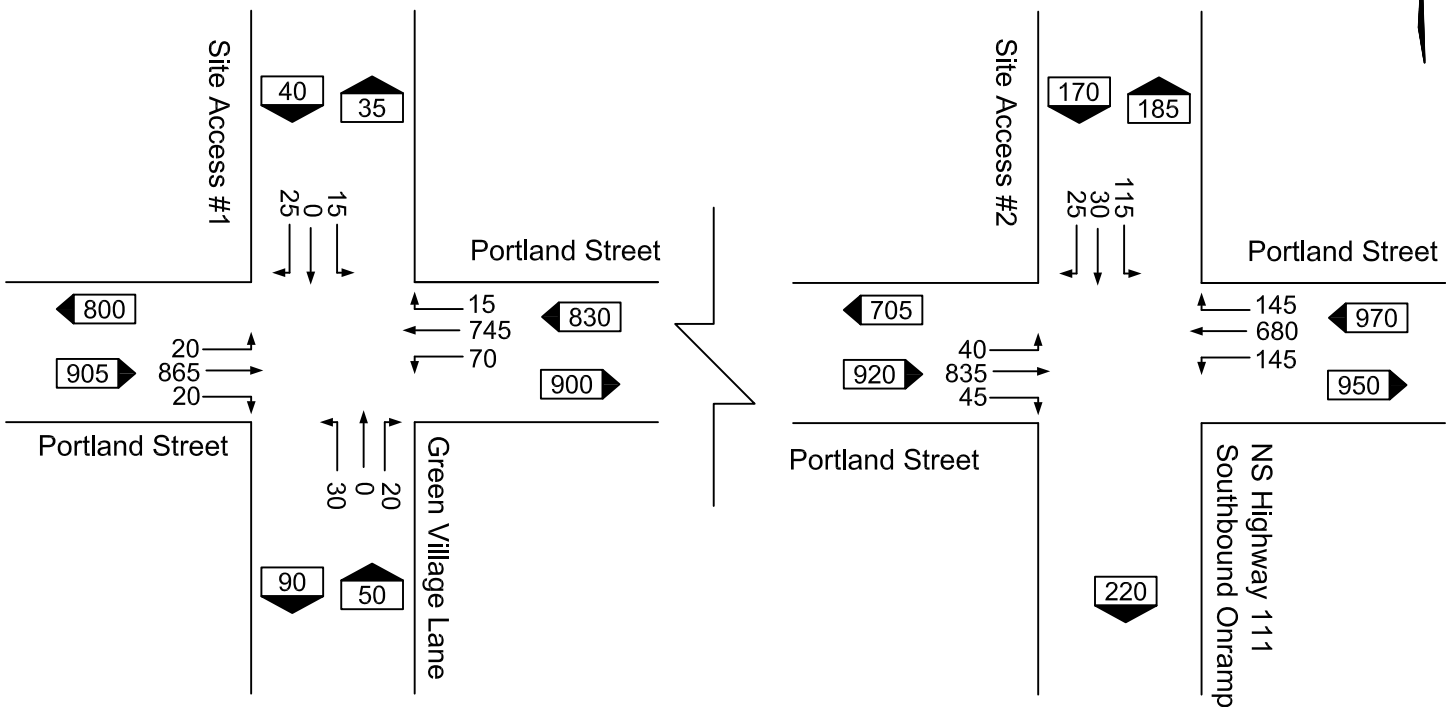
AM Peak Hour



NOT TO SCALE

B

PM Peak Hour



NOT TO SCALE



Traffic Impact Study - Proposed Penhorn Development
Dartmouth, Nova Scotia

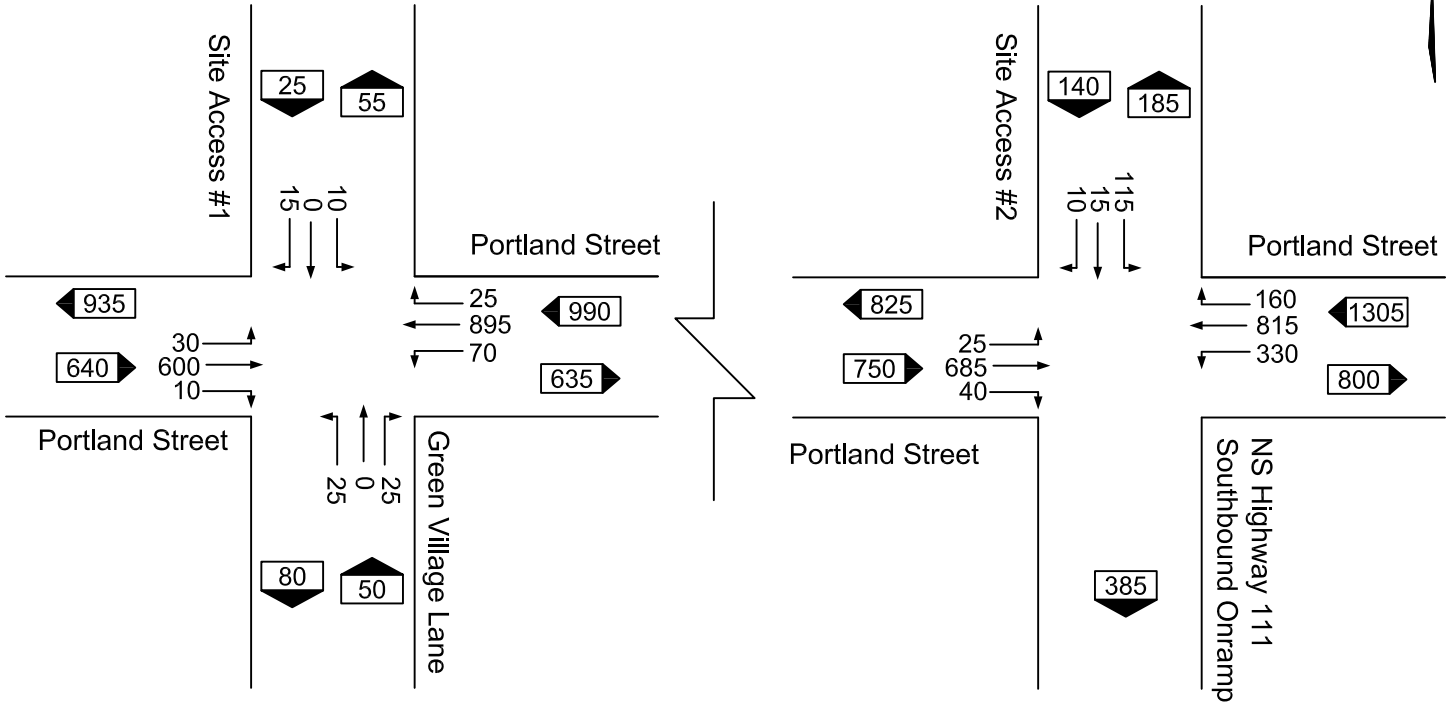
2020 Weekday AM and PM Peak Hour
Without Site Development

Figure A-1

June 2020

A

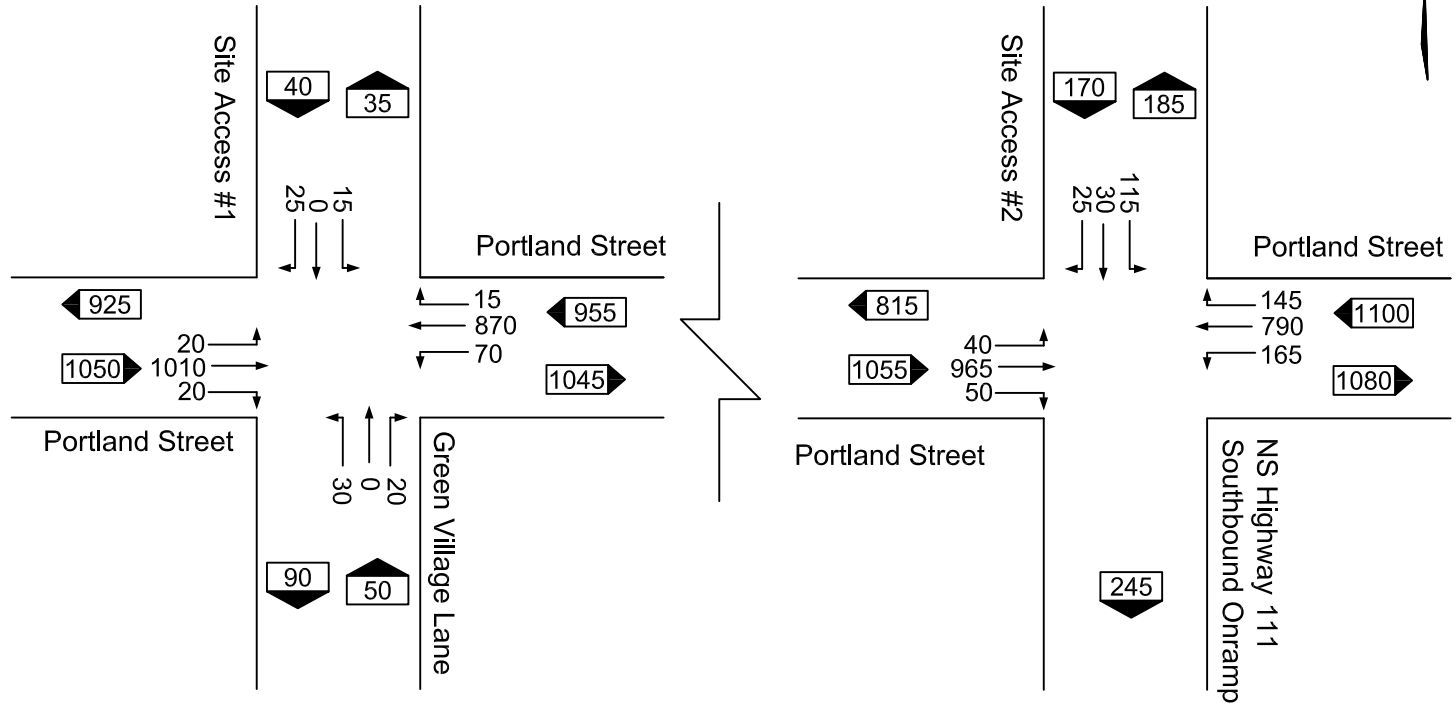
AM Peak Hour



NOT TO SCALE

B

PM Peak Hour



NOT TO SCALE



Traffic Impact Study - Proposed Penhorn Development
Dartmouth, Nova Scotia

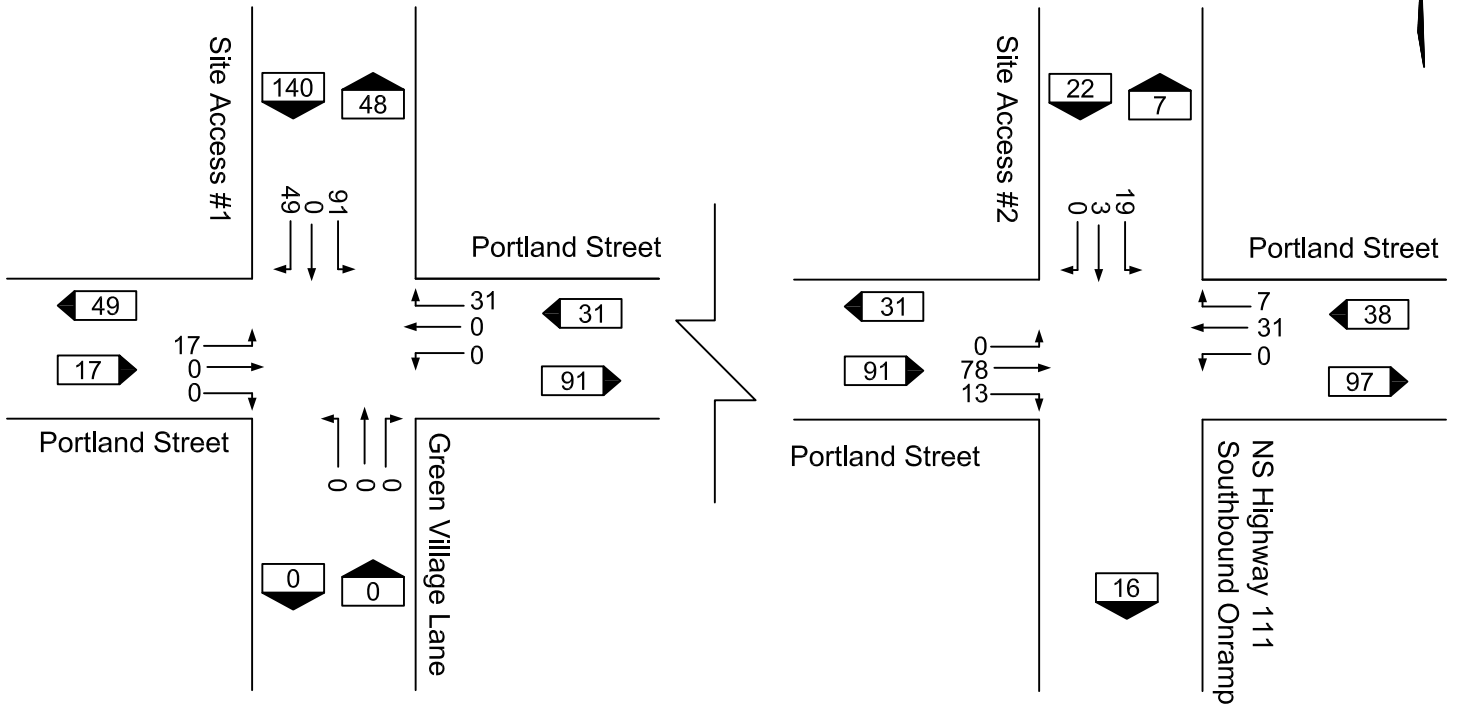
2030 Weekday AM and PM Peak Hour
Without Site Development

Figure A-2

June 2020

A

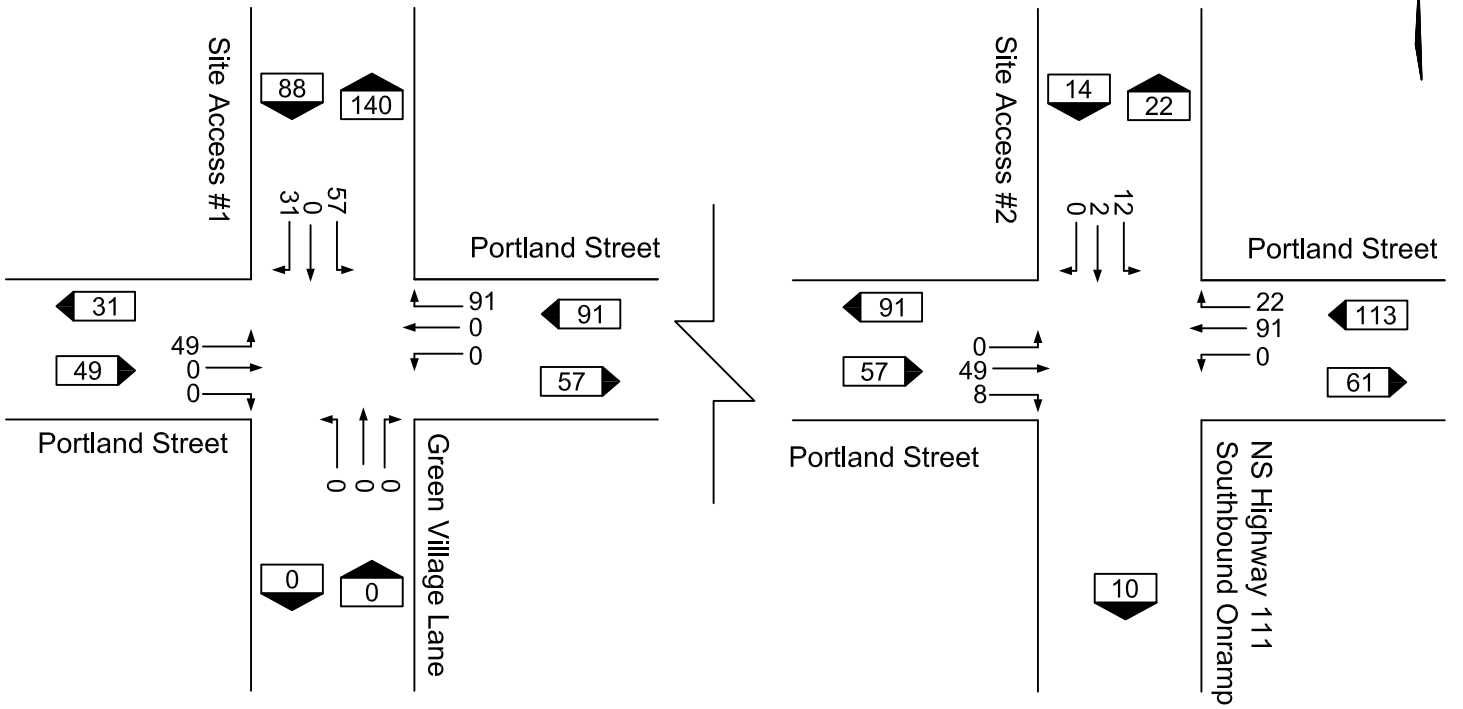
AM Peak Hour



NOT TO SCALE

B

PM Peak Hour



NOT TO SCALE



Traffic Impact Study - Proposed Penhorn Development
Dartmouth, Nova Scotia

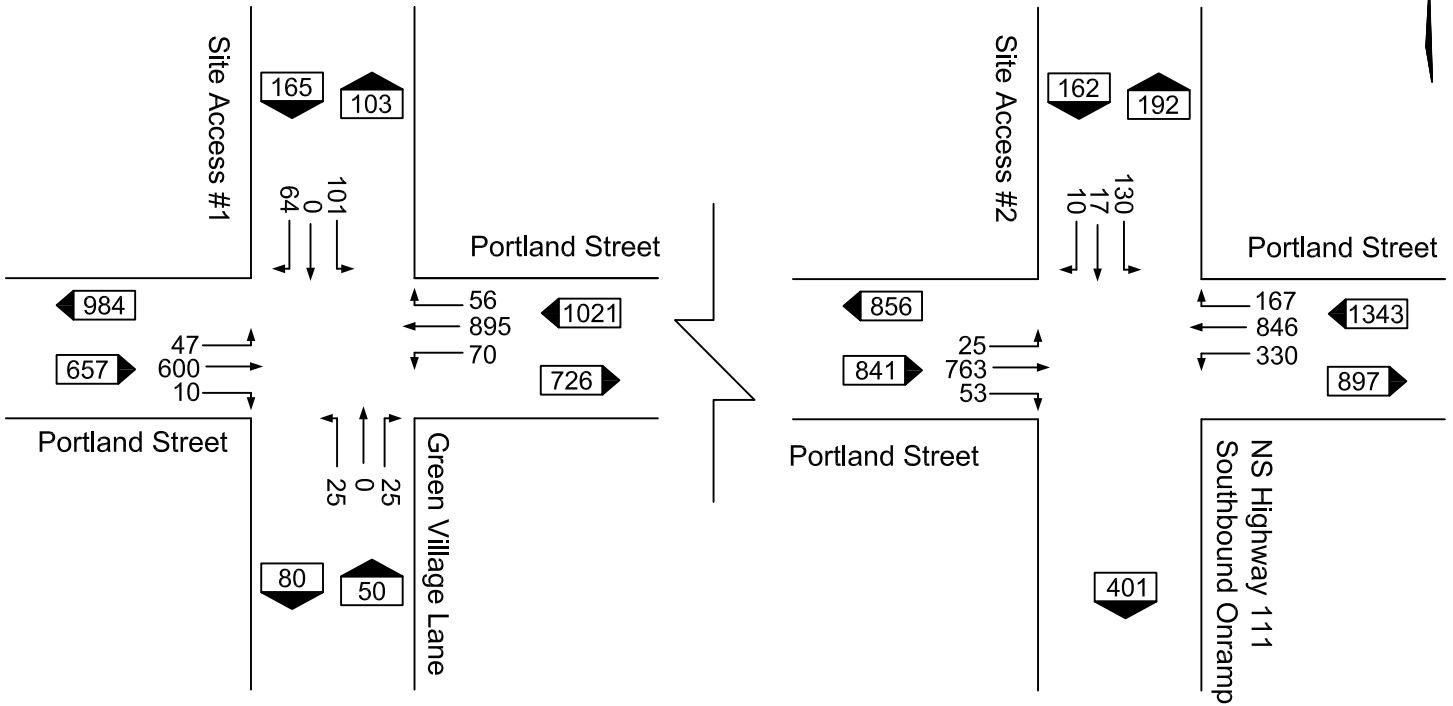
Site Generated Trips Estimate

Figure A-3

June 2020

A

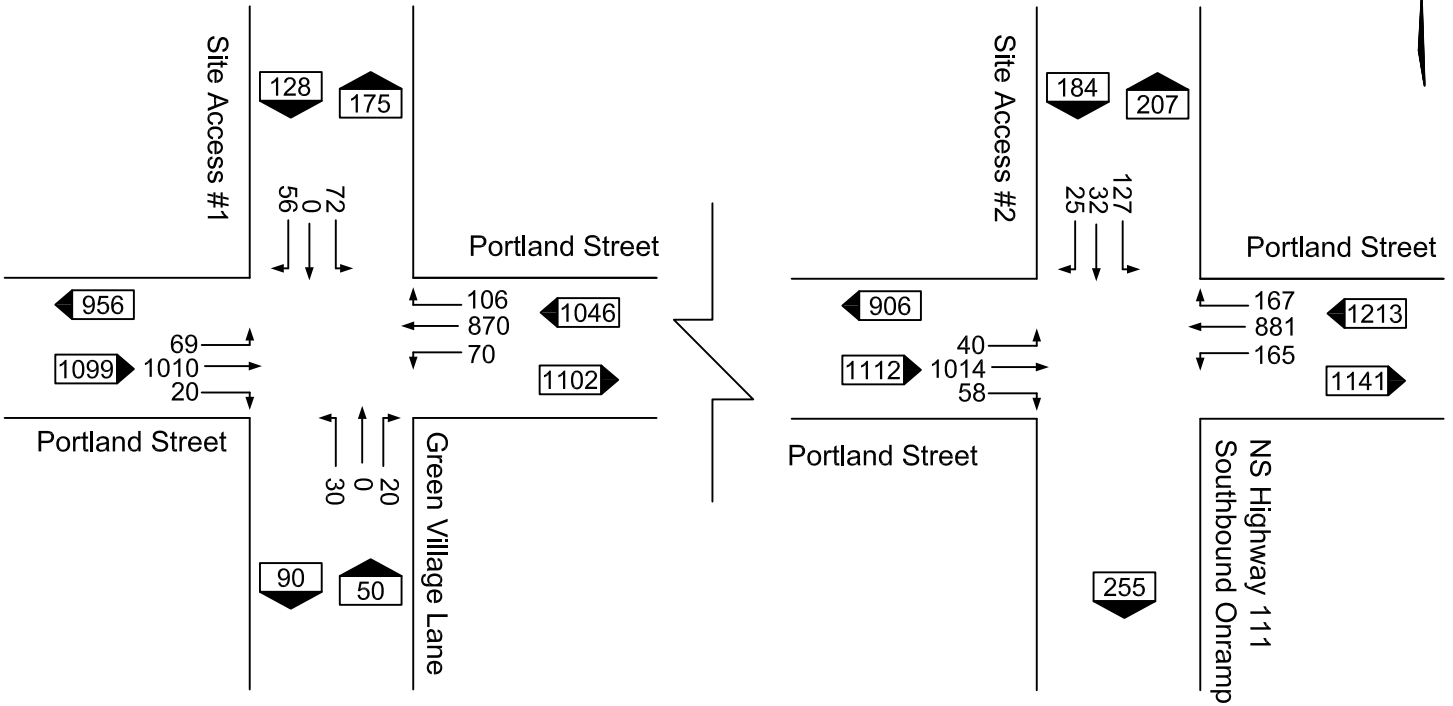
AM Peak Hour



NOT TO SCALE

B

PM Peak Hour



NOT TO SCALE



Traffic Impact Study - Proposed Penhorn Development
Dartmouth, Nova Scotia

2030 Weekday AM and PM Peak Hour
With Site Development

Figure A-4

June 2020

APPENDIX






















B

INTERSECTION PERFORMANCE ANALYSIS



Penhorn Development Traffic Impact Study
1: Green Village Lane/Site Access #1 & Portland Street

Page B-1
Existing Conditions (2020) - AM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	515	10	70	770	25	25	0	25	10	0	15
Future Volume (vph)	30	515	10	70	770	25	25	0	25	10	0	15
Satd. Flow (prot)	1770	3529	0	1770	3522	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.309			0.429				0.800		0.800		
Satd. Flow (perm)	576	3529	0	799	3522	0	0	1490	1583	1490	1863	1583
Satd. Flow (RTOR)		2			4				85			476
Lane Group Flow (vph)	33	590	0	76	873	0	0	27	27	11	0	16
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases		2		1	6			4			5	
Permitted Phases	2			6			4		4	5		5
Total Split (s)	35.0	35.0		25.0	35.0		30.0	30.0	30.0	30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	67.8	67.8		74.2	67.8			7.8	7.8	7.8		7.8
Actuated g/C Ratio	0.75	0.75		0.82	0.75			0.09	0.09	0.09		0.09
v/c Ratio	0.08	0.22		0.10	0.33			0.21	0.13	0.09		0.03
Control Delay	6.3	5.3		2.2	5.9			41.8	1.2	38.6		0.1
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	6.3	5.3		2.2	5.9			41.8	1.2	38.6		0.1
LOS	A	A		A	A			D	A	D		A
Approach Delay		5.3			5.6			21.5			15.8	
Approach LOS		A			A			C			B	
Queue Length 50th (m)	1.9	19.8		2.0	32.5			4.7	0.0	1.9		0.0
Queue Length 95th (m)	5.9	29.8		5.0	47.7			12.7	0.0	7.0		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	433	2657		913	2652			397	484	397		771
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	0.08	0.22		0.08	0.33			0.07	0.06	0.03		0.02

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.33

Intersection Signal Delay: 6.2

Intersection Capacity Utilization 51.0%

Analysis Period (min) 15

Intersection LOS: A

ICU Level of Service A




















Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



Penhorn Development Traffic Impact Study

2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Page B-2
Existing Conditions (2020) - AM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	595	35	290	705	160	0	0	0	115	15	10
Future Volume (vph)	25	595	35	290	705	160	0	0	0	115	15	10
Satd. Flow (prot)	1770	3511	0	1770	4943	0	0	0	0	1681	1704	1583
Flt Permitted	0.293			0.393						0.950	0.963	
Satd. Flow (perm)	546	3511	0	732	4943	0	0	0	0	1681	1704	1583
Satd. Flow (RTOR)		9			82							85
Lane Group Flow (vph)	27	671	0	315	932	0	0	0	0	70	71	11
Turn Type	pm+pt	NA		Perm	NA					Split	NA	Prot
Protected Phases	5	2			6					4	4	4
Permitted Phases	2			6								
Total Split (s)	15.0	50.0		50.0	50.0					25.0	25.0	25.0
Total Lost Time (s)	4.0	6.0		6.0	6.0					6.0	6.0	6.0
Act Effect Green (s)	71.6	68.0		68.0	68.0					9.4	9.4	9.4
Actuated g/C Ratio	0.80	0.76		0.76	0.76					0.10	0.10	0.10
v/c Ratio	0.05	0.25		0.57	0.25					0.40	0.40	0.05
Control Delay	2.8	5.5		14.3	4.8					43.8	43.7	0.4
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	2.8	5.5		14.3	4.8					43.8	43.7	0.4
LOS	A	A		B	A					D	D	A
Approach Delay		5.4			7.2						40.6	
Approach LOS		A			A						D	
Queue Length 50th (m)	0.8	14.4		18.7	12.6					12.8	12.9	0.0
Queue Length 95th (m)	2.8	38.0		#80.4	32.0					25.6	26.1	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	593	2654		553	3754					354	359	401
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.05	0.25		0.57	0.25					0.20	0.20	0.03

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.57

Intersection Signal Delay: 9.0

Intersection LOS: A

Intersection Capacity Utilization 54.5%

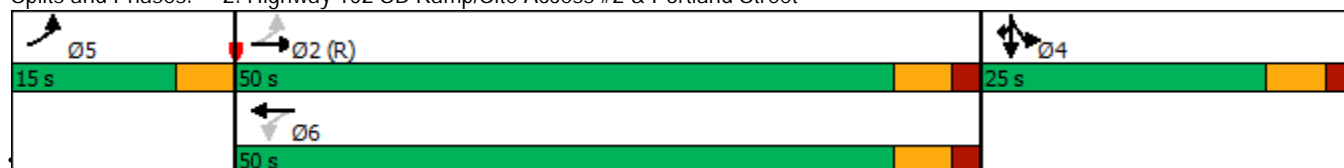
ICU Level of Service A

Analysis Period (min) 15

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






















Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



Penhorn Development Traffic Impact Study
1: Green Village Lane/Site Access #1 & Portland Street

Page B-3
Existing Conditions (2020) - PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	865	20	70	745	15	30	0	20	15	0	25
Future Volume (vph)	20	865	20	70	745	15	30	0	20	15	0	25
Satd. Flow (prot)	1770	3529	0	1770	3529	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.316			0.268				0.757		0.755		
Satd. Flow (perm)	589	3529	0	499	3529	0	0	1410	1583	1406	1863	1583
Satd. Flow (RTOR)		3			2				85			477
Lane Group Flow (vph)	22	983	0	76	853	0	0	33	22	16	0	27
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases		2		1	6			4			5	
Permitted Phases	2			6			4		4	5		5
Total Split (s)	35.0	35.0		25.0	35.0		30.0	30.0	30.0	30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	67.2	67.2		73.9	67.2			8.1	8.1	8.1		8.1
Actuated g/C Ratio	0.75	0.75		0.82	0.75			0.09	0.09	0.09		0.09
v/c Ratio	0.05	0.37		0.15	0.32			0.26	0.10	0.13		0.05
Control Delay	6.6	6.6		2.6	6.2			42.8	0.9	39.2		0.2
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	6.6	6.6		2.6	6.2			42.8	0.9	39.2		0.2
LOS	A	A		A	A			D	A	D		A
Approach Delay		6.6			5.9			26.1			14.7	
Approach LOS		A			A			C			B	
Queue Length 50th (m)	1.3	38.9		2.1	32.1			5.8	0.0	2.8		0.0
Queue Length 95th (m)	4.6	59.6		5.3	49.1			14.6	0.0	8.9		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	439	2635		723	2634			376	484	374		771
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	0.05	0.37		0.11	0.32			0.09	0.05	0.04		0.04

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.37

Intersection Signal Delay: 7.0

Intersection Capacity Utilization 52.0%

Analysis Period (min) 15

Intersection LOS: A




















ICU Level of Service A

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



Penhorn Development Traffic Impact Study
2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Page B-4
Existing Conditions (2020) - PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	835	45	145	680	145	0	0	0	115	30	25
Future Volume (vph)	40	835	45	145	680	145	0	0	0	115	30	25
Satd. Flow (prot)	1770	3511	0	1770	4948	0	0	0	0	1681	1720	1583
Flt Permitted	0.312			0.291						0.950	0.972	
Satd. Flow (perm)	581	3511	0	542	4948	0	0	0	0	1681	1720	1583
Satd. Flow (RTOR)		9			76							85
Lane Group Flow (vph)	43	910	0	158	874	0	0	0	0	79	79	27
Turn Type	pm+pt	NA		Perm	NA					Split	NA	Prot
Protected Phases	5	2			6					4	4	4
Permitted Phases	2			6								
Total Split (s)	15.0	50.0		50.0	50.0					25.0	25.0	25.0
Total Lost Time (s)	4.0	6.0		6.0	6.0					6.0	6.0	6.0
Act Effect Green (s)	70.4	65.4		65.4	65.4					9.8	9.8	9.8
Actuated g/C Ratio	0.78	0.73		0.73	0.73					0.11	0.11	0.11
v/c Ratio	0.08	0.36		0.40	0.24					0.43	0.42	0.11
Control Delay	3.0	7.2		12.3	5.7					44.2	43.7	0.9
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	3.0	7.2		12.3	5.7					44.2	43.7	0.9
LOS	A	A		B	A					D	D	A
Approach Delay		7.0			6.7						37.7	
Approach LOS		A			A						D	
Queue Length 50th (m)	1.4	37.7		13.2	20.6					14.4	14.4	0.0
Queue Length 95th (m)	4.1	56.3		33.7	30.6					28.1	28.0	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	615	2553		393	3616					354	363	401
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.07	0.36		0.40	0.24					0.22	0.22	0.07

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.43

Intersection Signal Delay: 9.5

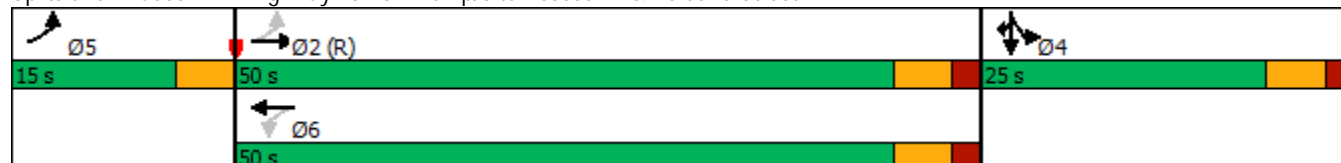
Intersection LOS: A

Intersection Capacity Utilization 53.4%

ICU Level of Service A






















Analysis Period (min) 15

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



1: Green Village Lane/Site Access #1 & Portland Street

Future Background without Site (2030) - AM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	600	10	70	895	25	25	0	25	10	0	15
Future Volume (vph)	30	600	10	70	895	25	25	0	25	10	0	15
Satd. Flow (prot)	1770	3532	0	1770	3525	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.264			0.397				0.800		0.800		
Satd. Flow (perm)	492	3532	0	740	3525	0	0	1490	1583	1490	1863	1583
Satd. Flow (RTOR)		2			3				85			468
Lane Group Flow (vph)	33	663	0	76	1000	0	0	27	27	11	0	16
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases		2		1	6			4			5	
Permitted Phases	2			6			4		4	5		5
Total Split (s)	35.0	35.0		25.0	35.0		30.0	30.0	30.0	30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	67.8	67.8		74.2	67.8			7.8	7.8	7.8		7.8
Actuated g/C Ratio	0.75	0.75		0.82	0.75			0.09	0.09	0.09		0.09
v/c Ratio	0.09	0.25		0.11	0.38			0.21	0.13	0.09		0.03
Control Delay	6.6	5.4		2.2	6.3			41.8	1.2	38.6		0.1
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	6.6	5.4		2.2	6.3			41.8	1.2	38.6		0.1
LOS	A	A		A	A			D	A	D		A
Approach Delay		5.5			6.0			21.5			15.8	
Approach LOS		A			A			C			B	
Queue Length 50th (m)	1.9	22.9		2.0	39.2			4.7	0.0	1.9		0.0
Queue Length 95th (m)	6.1	34.5		5.0	56.7			12.7	0.0	7.0		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	370	2659		876	2654			397	484	397		765
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	0.09	0.25		0.09	0.38			0.07	0.06	0.03		0.02

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.38

Intersection Signal Delay: 6.4

Intersection Capacity Utilization 54.4%

Analysis Period (min) 15




















Intersection LOS: A

ICU Level of Service A

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



2: Highway 102 SB Ramp/Site Access #2 & Portland Street Future Background without Site (2030) - AM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	685	40	330	815	160	0	0	0	115	15	10
Future Volume (vph)	25	685	40	330	815	160	0	0	0	115	15	10
Satd. Flow (prot)	1770	3511	0	1770	4958	0	0	0	0	1681	1704	1583
Flt Permitted	0.252			0.342						0.950	0.963	
Satd. Flow (perm)	469	3511	0	637	4958	0	0	0	0	1681	1704	1583
Satd. Flow (RTOR)		9			64							85
Lane Group Flow (vph)	27	788	0	359	1060	0	0	0	0	70	71	11
Turn Type	pm+pt	NA		Perm	NA					Split	NA	Prot
Protected Phases	5	2			6					4	4	4
Permitted Phases	2			6								
Total Split (s)	15.0	50.0		50.0	50.0					25.0	25.0	25.0
Total Lost Time (s)	4.0	6.0		6.0	6.0					6.0	6.0	6.0
Act Effect Green (s)	71.6	68.0		68.0	68.0					9.4	9.4	9.4
Actuated g/C Ratio	0.80	0.76		0.76	0.76					0.10	0.10	0.10
v/c Ratio	0.06	0.30		0.75	0.28					0.40	0.40	0.05
Control Delay	2.9	5.7		24.5	5.1					43.8	43.7	0.4
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	2.9	5.7		24.5	5.1					43.8	43.7	0.4
LOS	A	A		C	A					D	D	A
Approach Delay		5.7			10.0						40.6	
Approach LOS		A			B						D	
Queue Length 50th (m)	0.8	17.7		27.7	15.2					12.8	12.9	0.0
Queue Length 95th (m)	2.8	46.0		#117.6	38.2					25.6	26.1	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	540	2654		481	3761					354	359	401
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.05	0.30		0.75	0.28					0.20	0.20	0.03

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.75

Intersection Signal Delay: 10.5

Intersection LOS: B

Intersection Capacity Utilization 59.3%

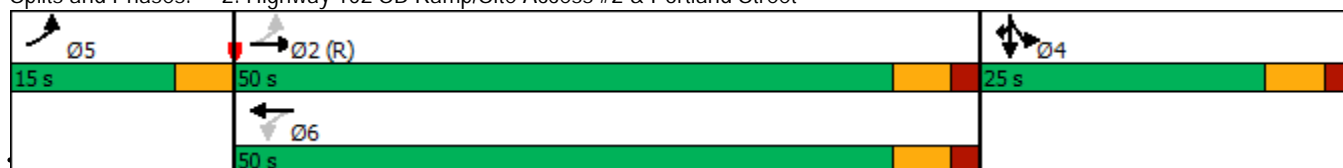
ICU Level of Service B

Analysis Period (min) 15

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






















Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



1: Green Village Lane/Site Access #1 & Portland Street

Future Background without Site (2030) - PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	1010	20	70	870	15	30	0	20	15	0	25
Future Volume (vph)	20	1010	20	70	870	15	30	0	20	15	0	25
Satd. Flow (prot)	1770	3529	0	1770	3532	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.276			0.225				0.757		0.755		
Satd. Flow (perm)	514	3529	0	419	3532	0	0	1410	1583	1406	1863	1583
Satd. Flow (RTOR)		2			2				85			470
Lane Group Flow (vph)	22	1120	0	76	962	0	0	33	22	16	0	27
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases		2		1	6			4			5	
Permitted Phases	2			6			4		4	5		5
Total Split (s)	35.0	35.0		25.0	35.0		30.0	30.0	30.0	30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	67.2	67.2		73.9	67.2			8.1	8.1	8.1		8.1
Actuated g/C Ratio	0.75	0.75		0.82	0.75			0.09	0.09	0.09		0.09
v/c Ratio	0.06	0.42		0.17	0.36			0.26	0.10	0.13		0.05
Control Delay	6.7	7.0		2.8	6.5			42.8	0.9	39.2		0.2
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	6.7	7.0		2.8	6.5			42.8	0.9	39.2		0.2
LOS	A	A		A	A			D	A	D		A
Approach Delay		7.0			6.2			26.1			14.7	
Approach LOS		A			A			C			B	
Queue Length 50th (m)	1.3	46.8		2.1	37.7			5.8	0.0	2.8		0.0
Queue Length 95th (m)	4.7	70.7		5.3	57.6			14.6	0.0	8.9		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	383	2636		674	2638			376	484	374		766
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	0.06	0.42		0.11	0.36			0.09	0.05	0.04		0.04

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.42

Intersection Signal Delay: 7.3





Intersection Capacity Utilization 56.1%

Analysis Period (min) 15




















Intersection LOS: A

ICU Level of Service B

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street

		
Ø1	Ø2 (R)	Ø4
25 s	35 s	30 s
		
	Ø6	Ø5
	35 s	30 s

2: Highway 102 SB Ramp/Site Access #2 & Portland Street Future Background without Site (2030) - PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	965	50	165	790	145	0	0	0	115	30	25
Future Volume (vph)	40	965	50	165	790	145	0	0	0	115	30	25
Satd. Flow (prot)	1770	3514	0	1770	4968	0	0	0	0	1681	1720	1583
Flt Permitted	0.263			0.227						0.950	0.972	
Satd. Flow (perm)	490	3514	0	423	4968	0	0	0	0	1681	1720	1583
Satd. Flow (RTOR)		8			58							85
Lane Group Flow (vph)	43	1103	0	179	1017	0	0	0	0	79	79	27
Turn Type	pm+pt	NA		Perm	NA					Split	NA	Prot
Protected Phases	5	2			6					4	4	4
Permitted Phases	2			6								
Total Split (s)	15.0	50.0		50.0	50.0					25.0	25.0	25.0
Total Lost Time (s)	4.0	6.0		6.0	6.0					6.0	6.0	6.0
Act Effect Green (s)	70.4	65.4		65.4	65.4					9.8	9.8	9.8
Actuated g/C Ratio	0.78	0.73		0.73	0.73					0.11	0.11	0.11
v/c Ratio	0.09	0.43		0.58	0.28					0.43	0.42	0.11
Control Delay	3.1	7.9		21.2	6.1					44.2	43.7	0.9
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	3.1	7.9		21.2	6.1					44.2	43.7	0.9
LOS	A	A		C	A					D	D	A
Approach Delay		7.7			8.4						37.7	
Approach LOS		A			A						D	
Queue Length 50th (m)	1.4	49.6		18.4	25.8					14.4	14.4	0.0
Queue Length 95th (m)	4.1	72.9		#61.1	37.3					28.1	28.0	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	552	2555		307	3625					354	363	401
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.08	0.43		0.58	0.28					0.22	0.22	0.07

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.58

Intersection Signal Delay: 10.2

Intersection LOS: B

Intersection Capacity Utilization 58.2%

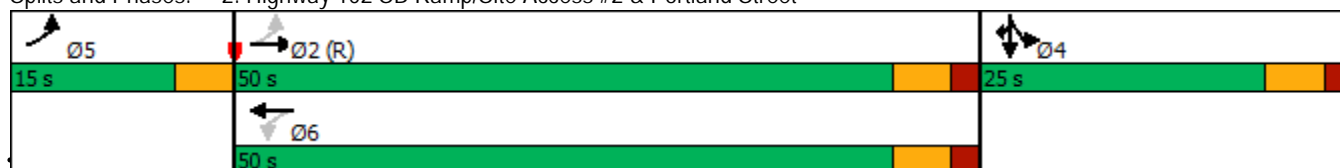
ICU Level of Service B

Analysis Period (min) 15

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






















Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



Penhorn Development Traffic Impact Study
1: Green Village Lane/Site Access #1 & Portland Street

Page B-9
Future Background with Site (2030) - AM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	600	10	70	895	56	25	0	25	101	0	64
Future Volume (vph)	47	600	10	70	895	56	25	0	25	101	0	64
Satd. Flow (prot)	1770	3532	0	1770	3507	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.237			0.386				0.757		0.740		
Satd. Flow (perm)	441	3532	0	719	3507	0	0	1410	1583	1378	1863	1583
Satd. Flow (RTOR)		2			7				85			468
Lane Group Flow (vph)	51	663	0	76	1034	0	0	27	27	110	0	70
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases		2		1	6			4			5	
Permitted Phases	2			6			4		4	5		5
Total Split (s)	35.0	35.0		25.0	35.0		30.0	30.0	30.0	30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	60.3	60.3		66.9	60.3			12.5	12.5	12.5		12.5
Actuated g/C Ratio	0.67	0.67		0.74	0.67			0.14	0.14	0.14		0.14
v/c Ratio	0.17	0.28		0.12	0.44			0.14	0.09	0.58		0.11
Control Delay	11.6	8.9		4.2	10.4			33.5	0.6	47.4		0.4
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	11.6	8.9		4.2	10.4			33.5	0.6	47.4		0.4
LOS	B	A		A	B			C	A	D		A
Approach Delay		9.1			10.0			17.1			29.1	
Approach LOS		A			B			B			C	
Queue Length 50th (m)	3.8	28.0		2.9	50.2			4.4	0.0	19.0		0.0
Queue Length 95th (m)	12.2	46.1		8.0	79.2			11.3	0.0	33.8		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	295	2368		805	2353			376	484	367		765
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	0.17	0.28		0.09	0.44			0.07	0.06	0.30		0.09

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.58

Intersection Signal Delay: 11.6

Intersection Capacity Utilization 59.6%

Analysis Period (min) 15

Intersection LOS: B




















ICU Level of Service B

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Future Background with Site (2030) - AM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	763	53	330	846	167	0	0	0	134	18	10
Future Volume (vph)	25	763	53	330	846	167	0	0	0	134	18	10
Satd. Flow (prot)	1770	3504	0	1770	4958	0	0	0	0	1681	1704	1583
Flt Permitted	0.239			0.302						0.950	0.963	
Satd. Flow (perm)	445	3504	0	563	4958	0	0	0	0	1681	1704	1583
Satd. Flow (RTOR)		11			64							85
Lane Group Flow (vph)	27	887	0	359	1102	0	0	0	0	83	83	11
Turn Type	pm+pt	NA		Perm	NA					Split	NA	Prot
Protected Phases	5	2			6					4	4	4
Permitted Phases	2			6								
Total Split (s)	15.0	50.0		50.0	50.0					25.0	25.0	25.0
Total Lost Time (s)	4.0	6.0		6.0	6.0					6.0	6.0	6.0
Act Effect Green (s)	71.0	67.4		67.4	67.4					10.0	10.0	10.0
Actuated g/C Ratio	0.79	0.75		0.75	0.75					0.11	0.11	0.11
v/c Ratio	0.06	0.34		0.85	0.30					0.45	0.44	0.04
Control Delay	3.1	6.3		36.5	5.5					44.4	44.1	0.3
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	3.1	6.3		36.5	5.5					44.4	44.1	0.3
LOS	A	A		D	A					D	D	A
Approach Delay		6.2			13.1						41.5	
Approach LOS		A			B						D	
Queue Length 50th (m)	0.8	21.5		34.8	16.9					15.1	15.1	0.0
Queue Length 95th (m)	3.0	55.0		#127.3	41.3					29.1	29.1	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	521	2627		421	3730					354	359	401
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.05	0.34		0.85	0.30					0.23	0.23	0.03

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.85

Intersection Signal Delay: 12.6

Intersection LOS: B

Intersection Capacity Utilization 61.9%

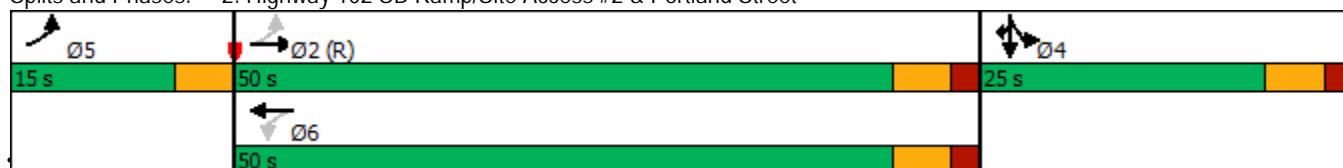
ICU Level of Service B

Analysis Period (min) 15

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






















Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



Penhorn Development Traffic Impact Study
1: Green Village Lane/Site Access #1 & Portland Street

Page B-11
Future Background with Site (2030) - PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	69	1010	20	70	870	106	30	0	20	72	0	56
Future Volume (vph)	69	1010	20	70	870	106	30	0	20	72	0	56
Satd. Flow (prot)	1770	3529	0	1770	3483	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.233			0.215				0.757		0.736		
Satd. Flow (perm)	434	3529	0	400	3483	0	0	1410	1583	1371	1863	1583
Satd. Flow (RTOR)		2			15				85			470
Lane Group Flow (vph)	75	1120	0	76	1061	0	0	33	22	78	0	61
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases		2		1	6			4			5	
Permitted Phases	2			6			4		4	5		5
Total Split (s)	35.0	35.0		25.0	35.0		30.0	30.0	30.0	30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	62.1	62.1		68.7	62.1			10.7	10.7	10.7		10.7
Actuated g/C Ratio	0.69	0.69		0.76	0.69			0.12	0.12	0.12		0.12
v/c Ratio	0.25	0.46		0.18	0.44			0.20	0.08	0.48		0.10
Control Delay	11.8	9.7		4.1	9.3			37.0	0.7	46.1		0.3
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	11.8	9.7		4.1	9.3			37.0	0.7	46.1		0.3
LOS	B	A		A	A			D	A	D		A
Approach Delay		9.8			9.0			22.5			26.0	
Approach LOS		A			A			C			C	
Queue Length 50th (m)	5.6	52.6		2.6	48.2			5.5	0.0	13.5		0.0
Queue Length 95th (m)	16.8	82.0		7.0	75.8			13.7	0.0	26.4		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	299	2434		639	2406			376	484	365		766
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	0.25	0.46		0.12	0.44			0.09	0.05	0.21		0.08

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.48

Intersection Signal Delay: 10.6

Intersection Capacity Utilization 58.9%

Analysis Period (min) 15

Intersection LOS: B




















ICU Level of Service B

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Future Background with Site (2030) - PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	1014	58	165	881	167	0	0	0	127	32	25
Future Volume (vph)	40	1014	58	165	881	167	0	0	0	127	32	25
Satd. Flow (prot)	1770	3511	0	1770	4963	0	0	0	0	1681	1718	1583
Flt Permitted	0.226			0.208						0.950	0.971	
Satd. Flow (perm)	421	3511	0	387	4963	0	0	0	0	1681	1718	1583
Satd. Flow (RTOR)		9			60							85
Lane Group Flow (vph)	43	1165	0	179	1140	0	0	0	0	86	87	27
Turn Type	pm+pt	NA		Perm	NA					Split	NA	Prot
Protected Phases	5	2			6					4	4	4
Permitted Phases	2			6								
Total Split (s)	15.0	50.0		50.0	50.0					25.0	25.0	25.0
Total Lost Time (s)	4.0	6.0		6.0	6.0					6.0	6.0	6.0
Act Effect Green (s)	70.1	65.1		65.1	65.1					10.1	10.1	10.1
Actuated g/C Ratio	0.78	0.72		0.72	0.72					0.11	0.11	0.11
v/c Ratio	0.10	0.46		0.64	0.32					0.46	0.45	0.11
Control Delay	3.4	8.4		26.1	6.5					44.5	44.2	0.8
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	3.4	8.4		26.1	6.5					44.5	44.2	0.8
LOS	A	A		C	A					D	D	A
Approach Delay		8.2			9.1						38.5	
Approach LOS		A			A						D	
Queue Length 50th (m)	1.4	54.3		20.0	30.2					15.6	15.8	0.0
Queue Length 95th (m)	4.2	80.1		#65.6	43.6					29.8	30.2	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	503	2541		279	3605					354	362	401
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.09	0.46		0.64	0.32					0.24	0.24	0.07

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.64

Intersection Signal Delay: 10.9

Intersection LOS: B

Intersection Capacity Utilization 59.8%

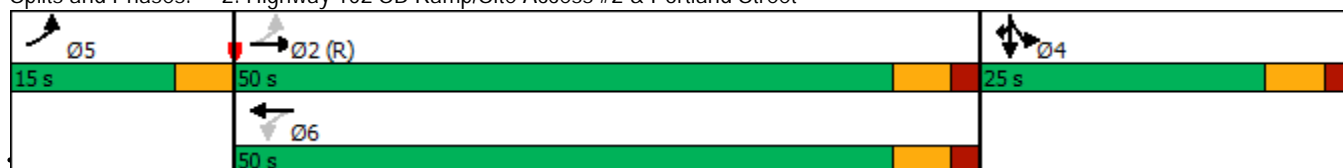
ICU Level of Service B

Analysis Period (min) 15

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

Queue shown is maximum after two cycles.

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



MEMO

TO: Stephanie Mah, MES Planning, MCIP, LPP – Clayton Developments Limited
FROM: Greg O'Brien, P.Eng. – WSP Canada Inc.
SUBJECT: Addendum to Penhorn Traffic Impact Study (June 2020)
DATE: December 4, 2020

WSP has completed an addendum to the *Penhorn Traffic Impact Study* (WSP, June 2020) (June 2020 TIS) to consider impact to study intersections that would result from redevelopment of the existing commercial portion of the site. Figure 1 shows the two areas of the Penhorn site including the existing developed commercial portion in the southeast near Portland Street, and the added development in the north and west of the site that was considered in the Traffic Impact Study.

In the Traffic Impact Study the existing development on the commercial portion of the site was considered in the background traffic already using the street network. This Addendum reviews the traffic impact on study intersections that would result from increased density on this portion of the site. The increased density is expected to include a mix of more commercial development and added residential units.



Figure 1 – Study Area

TRAFFIC VOLUME DATA

All traffic volume data used in this Addendum has been extracted from the June 2020 TIS, Appendix A. The base volumes for this Addendum are the 2030 traffic volumes with the background developments from the TIS (*June 2020 TIS, Figure A-4, Appendix A*).

TRIP GENERATION, DISTRIBUTION & ASSIGNMENT

When using the published rates in *Trip Generation Manual, 10th Edition* (Institute of Transportation Engineers, Washington, 2017), the transportation engineer's objective should be to provide a realistic estimate of the number of trips that will be generated.

A concept for the redevelopment of the commercial portion of the site is shown in Figure 2. It is expected that if the existing Penhorn Plaza Site is redeveloped in the future, it could include an increase of 20% to the current commercial area and an additional 511 Multi-Family Apartment units. For the purposes of this Addendum, a combination of Mid-Rise and High-Rise Apartments were considered. Generated trips for Mid-Rise Apartments (Land Use 221) and High-Rise Apartments (Land Use 222) are estimated for the AM and PM peak hours of traffic by the number of units. The potential redevelopment is estimated to include approximately 435 Mid-Rise and 76 High-Rise Apartment units.

- The existing Penhorn Plaza Site generates 20% more vehicle trips than originally considered in the June 2020 TIS; and,
- Potential future redevelopment of the existing Penhorn Plaza Site is expected to result in an additional 511 multi-family apartment units.



Figure 2 - Concept Plan

Trip generation estimates for addition of residential units to the existing Penhorn Plaza Site are summarized in Table 1. It was estimated that the redevelopment will generate an additional:

- 125 two-way trips (32 entering and 93 exiting) during the AM peak hour; and,
- 150 two-way trips (92 entering and 58 exiting) during the PM peak hour.

Table 1 – Trip Generation Estimate for Potential Future Redevelopment of Penhorn Plaza

Land Use ¹	Units ²	Trip Generation Rates ³				Trip Generation Estimates ⁴			
		AM Peak		PM Peak		AM Peak		PM Peak	
		In	Out	In	Out	In	Out	In	Out
Potential Future Penhorn Plaza Redevelopment									
Mid-Rise Apartments (Land Use 221)	435 Units	Equations from Pages 74 and 75 (Residential - Land Uses 200 - 299)				38	107	111	70
High-Rise Apartments (Land Use 222)	76 Units	Equations from Pages 153 and 154 (Residential - Land Uses 200 - 299)				8	26	21	13
Trip Generation Estimate for Proposed Site						46	133	132	83
30% Reduction for Non-Auto Trips ⁵						14	40	40	25
Total Primary Trip Estimate for Proposed Site						32	93	92	58
NOTES:									
1. Trip generation rates and equations are from Trip Generation, 10th Edition, (Institute of Transportation Engineers, Washington, 2017).									
2. 'Number of Residential Units' for Mid-Rise and High-Rise Apartment Buildings.									
3. Trip generation rates are 'vehicles per hour per unit'.									
4. Trips generated are 'vehicles per hour' for AM and PM peak hours.									
5. A 30% reduction for non-auto trips has been used to account for transit, cycling and walking trips as well as on-site synergies.									

Trip generation for the expanded commercial activity on the site has been estimated by increasing the background volumes currently turning into and out of the site (*June 2020 TIS Figure A-1, Appendix A*,) by 20%.

The Addendum trip generation estimates were assigned to the roadway network based on the trip distribution in the June 2020 TIS, however, the trip assignment was modified slightly. Since this portion of the development is closer to Access #2, it is estimated that 70% of the traffic generated to/from the north, east and south will use Site Access #2. The AM and PM peak hour Addendum trip generation estimates are shown diagrammatically in Figure A-1, Appendix A.

The Addendum trip generation estimates (Figure A-1, Appendix A) have been added to the 2030 traffic volumes with the background developments from the June 2020 TIS (*June 2020 TIS, Figure A-4, Appendix A*) to provide projected 2030 AM and PM peak hourly volumes that include the Addendum generated trips. The 2030 traffic volumes with the Addendum generated trips are illustrated diagrammatically in Figure A-2, Appendix A.

OPERATIONAL ANALYSIS

Intersection capacity analysis was completed to estimate how the Study Intersections are expected to operate in the future with the additional Addendum trip generation estimates.

Synchro 10.0 software was used to evaluate the performance of the Study Intersections for the following scenarios:

- Projected 2030 AM and PM peak hour volumes with proposed Penhorn Site Development (*June 2020 TIS, Figure A-4, Appendix A*); and,
- Projected 2030 AM and PM peak hour volumes with increased density on the existing commercial portion of the site (Figure A-2, Appendix A).

Detailed results of the analyses are included in Appendix B.

Intersection 1 – Portland Street and Site Access #1/Green Village Lane (Table 2) – With Addendum trips expected to be generated, analysis indicates minimal changes to delay residual capacity remains. This intersection is expected to operate within HRM guidelines with development of the proposed site.

Intersection 2 – Portland Street and Site Access #2/NS Highway 111 Southbound Onramp (Table 3) – With Addendum trips expected to be generated, analysis indicates minimal changes to delay residual capacity remains. This intersection is expected to operate within HRM guidelines with development of the proposed site.

Table 2 – Intersection Capacity Analysis for Portland Street and Site Access #1/Green Village Lane

LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement									Overall Intersection
	Portland Street				Green Village Lane		Site Access #1			
	EB-L	EB-TR	WB-L	WB-TR	NB-LT	NB-R	SB-L	SB-T	SB-R	Delay
2030 AM Peak Hour with Site Development - Figure A-4, Appendix A, June 2020 TIS (Page B-1)										
Delay	4.5	8.9	4.2	10.1	37.3	0.7	53.6	0.0	0.6	11.7
v/c	0.13	0.29	0.13	0.45	0.14	0.10	0.61	0.00	0.14	
Queue	6.1	47.3	8.4	79.8	12.2	0.0	38.5	0.0	0.0	
2030 PM Peak Hour with Site Development - Figure A-4, Appendix A, June 2020 TIS (Page B-3)										
Delay	3.9	9.2	3.9	8.4	41.8	0.8	52.5	0.0	0.6	10.0
v/c	0.17	0.45	0.18	0.42	0.21	0.09	0.51	0.00	0.13	
Queue	7.0	84.6	7.1	75.1	14.9	1.0	29.0	0.0	0.0	
2030 AM Peak Hour with Addendum Trips (Page B-5)										
Delay	6.5	11.5	5.9	13.4	32.2	0.4	53.3	0.0	0.8	15.1
v/c	0.18	0.31	0.14	0.50	0.11	0.08	0.71	0.00	0.19	
Queue	9.5	55.4	10.4	97.9	11.2	0.0	53.3	0.0	0.0	
2030 PM Peak Hour with Addendum Trips (Page B-7)										
Delay	5.9	11.2	5.0	11.8	37.7	0.6	53.6	0.0	0.8	12.8
v/c	0.29	0.49	0.20	0.51	0.17	0.08	0.62	0.00	0.17	
Queue	11.5	92.6	8.5	93.4	14.1	0.0	39.0	0.0	0.0	

Table 3 – Intersection Capacity Analysis for Portland Street and Site Access #2/Highway 111 SB Ramps

LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95 th %ile Queue (m) by Intersection Movement							Overall Intersection
	Portland Street				Site Access #2			
	EB-L	EB-TR	WB-L	WB-TR	SB-L	SB-T	SB-R	Delay
2030 AM Peak Hour with Site Development - Figure A-4, Appendix A, June 2020 TIS (Page B-2)								
Delay	14.6	14.3	7.6	3.0	50.3	50.2	0.4	10.7
v/c	0.10	0.43	0.59	0.27	0.46	0.46	0.05	
Queue	8.7	84.2	31.6	25.9	30.8	31.0	0.0	
2030 PM Peak Hour with Site Development - Figure A-4, Appendix A, June 2020 TIS (Page B-4)								
Delay	11.7	12.5	6.2	3.5	50.5	50.1	0.9	10.6
v/c	0.16	0.53	0.44	0.30	0.48	0.48	0.11	
Queue	11.1	102.3	14.2	28.0	32.8	33.0	0.0	
2030 AM Peak Hour with Addendum Trips (Page B-6)								
Delay	17.6	17.3	10.4	3.9	51.1	51.3	9.1	13.5
v/c	0.14	0.49	0.63	0.31	0.56	0.57	0.26	
Queue	11.6	96.3	42.4	31.3	41.2	41.8	9.9	
2030 PM Peak Hour with Addendum Trips (Page B-8)								
Delay	13.8	13.5	7.0	3.9	51.4	50.8	9.5	11.7
v/c	0.21	0.55	0.46	0.33	0.54	0.54	0.27	
Queue	14.3	111.7	15.3	33.1	38.3	38.4	10.1	

SUMMARY

1. An addendum to the *June 2020 TIS* was completed in order to consider potential redevelopment of the existing Penhorn Plaza Commercial Site.
2. For the residential portion of the site, trip generation estimates were prepared using rates published in *Trip Generation, 10th Edition* (Institute of Transportation Engineers, Washington 2017). The commercial portion of the redevelopment is expected to increase current volume entering and exiting the site by 20%.

It is estimated that redevelopment of the existing Penhorn Plaza Commercial Portion of the site will generate an additional:

- 206 two-way trips (80 entering and 126 exiting) during the AM peak hour; and,
 - 236 two-way trips (136 entering and 100 exiting) during the PM peak hour.
3. The Study Intersections are expected to operate within HRM acceptable limits in 2030 with overall site buildout and redevelopment of the existing Penhorn Plaza Commercial portion of the site.

CONCLUSION

4. Since the access intersections for this redevelopment site have been constructed to accommodate traffic volumes for a large regional shopping center, there remains residual capacity on the driveway approaches. With added trips generated by the proposed development, the access intersections are projected to operate within HRM guidelines at full build-out of the site and redevelopment of the commercial portion of the site.

If you have any questions or comments, please contact me by email at greg.obrien@wsp.com or by telephone at 902-444-8347.

Sincerely,

Original Signed

Atlantic Practice Manager
Traffic Engineering and Transportation Planning
WSP Canada Inc.

Original Signed

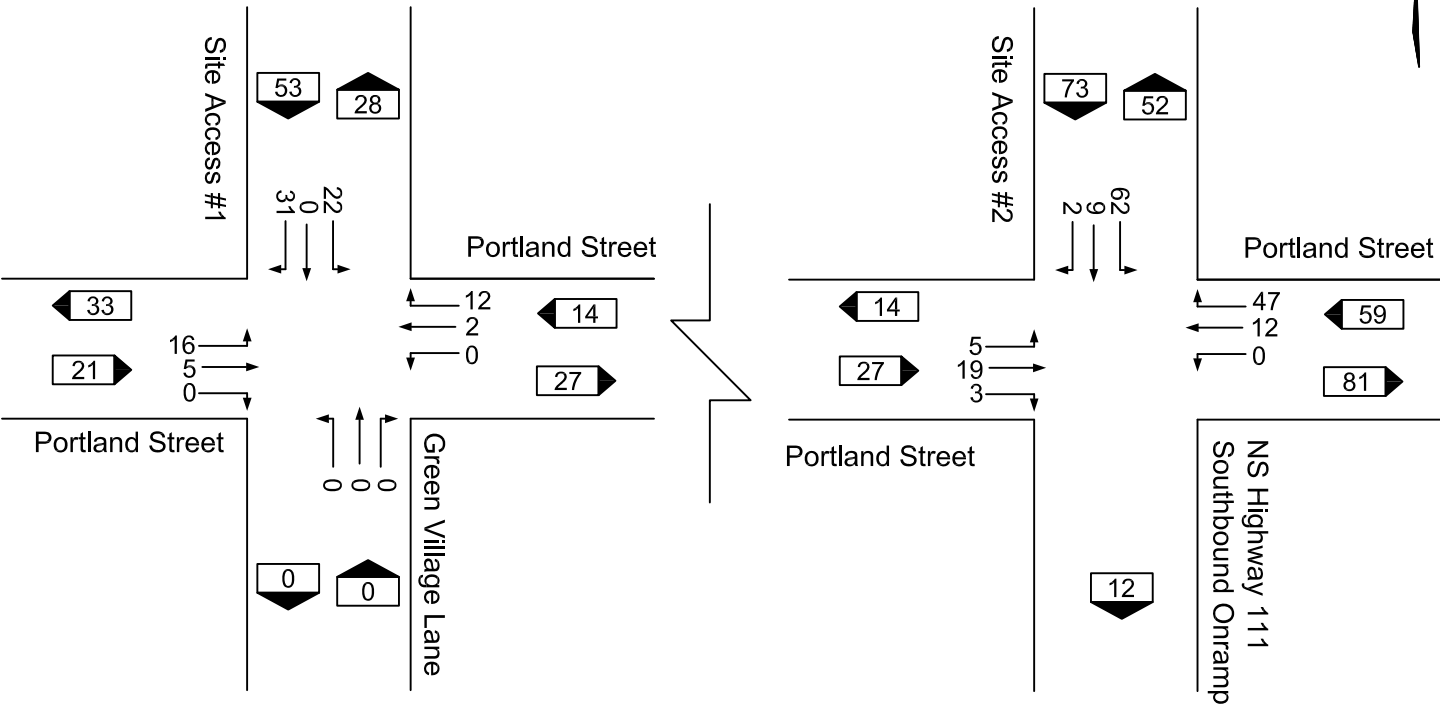




APPENDIX A

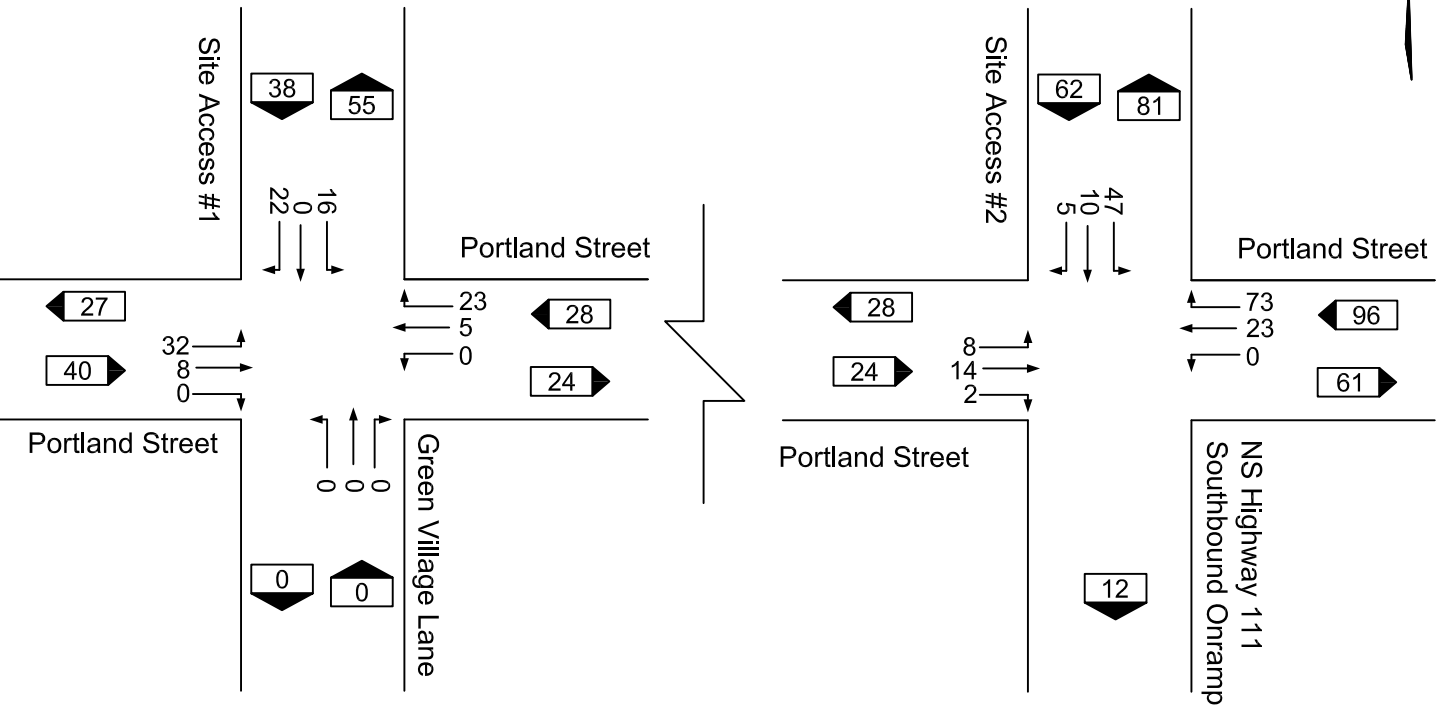
TRAFFIC VOLUME DATA

A
AM Peak Hour



NOT TO SCALE

B
PM Peak Hour

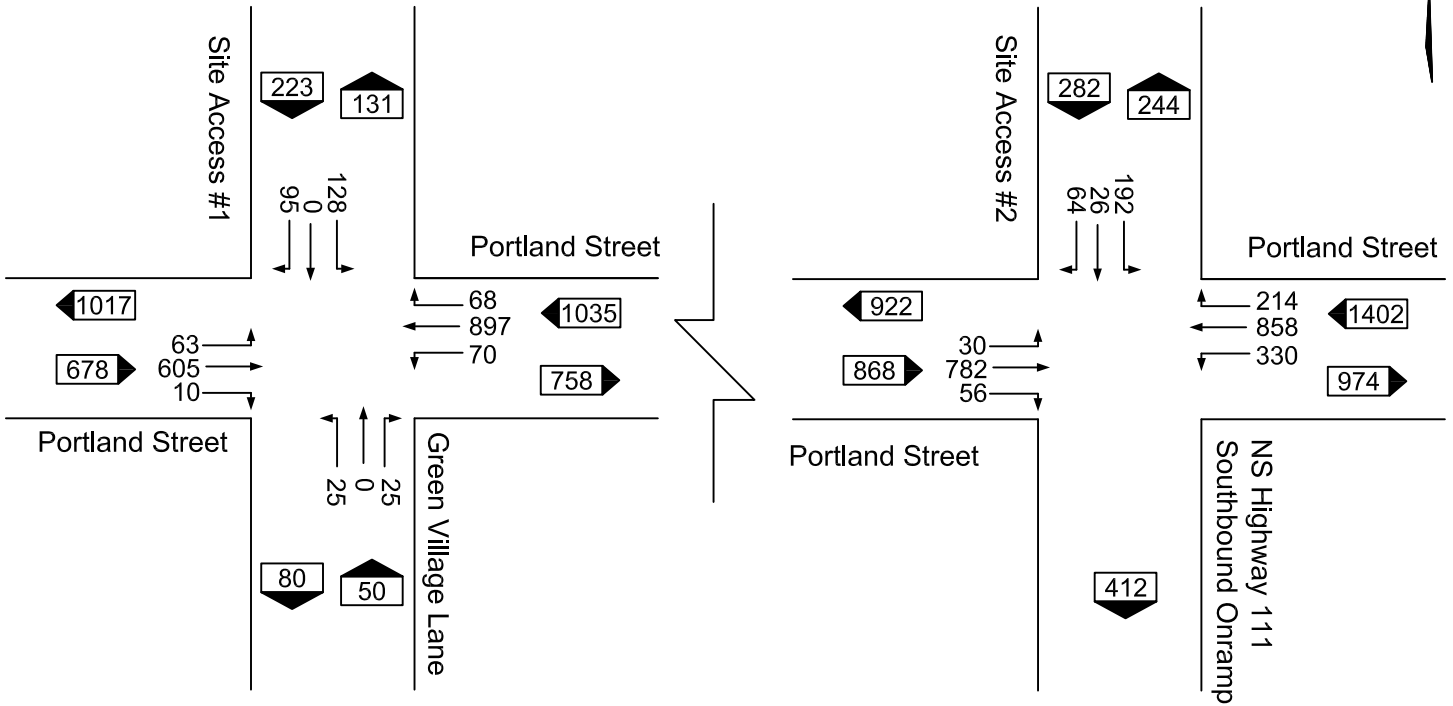


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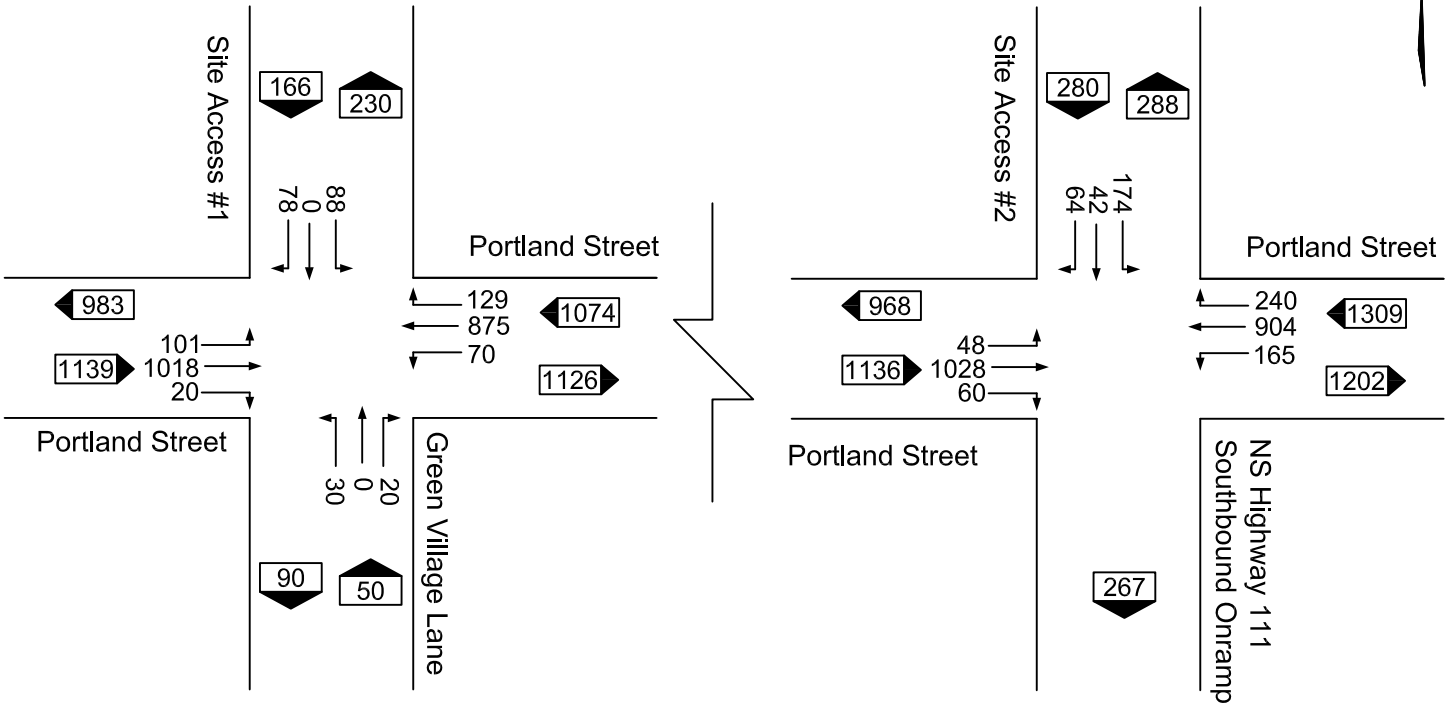
A

AM Peak Hour



B

PM Peak Hour



Traffic Impact Study Addendum - Proposed Penhorn Development
Dartmouth, Nova Scotia

2030 Weekday AM and PM Peak Hour
With Addendum Generated Trips

Figure A-2

December 2020
























APPENDIX B

INTERSECTION PERFORMANCE ANALYSIS

Penhorn Development Addendum
1: Green Village Lane/Site Access #1 & Portland Street

Page B-1
June 2020 TIS Figure A-4

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	600	10	70	895	56	25	0	25	106	0	64
Future Volume (vph)	47	600	10	70	895	56	25	0	25	106	0	64
Satd. Flow (prot)	1770	3532	0	1770	3507	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.240			0.380				0.757		0.740		
Satd. Flow (perm)	447	3532	0	708	3507	0	0	1410	1583	1378	1863	1583
Satd. Flow (RTOR)		2			8				76			311
Lane Group Flow (vph)	51	663	0	76	1034	0	0	27	27	115	0	70
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8		8	4		4
Total Split (s)	18.0	47.0		18.0	47.0		35.0	35.0	35.0	35.0	35.0	35.0
Total Lost Time (s)	4.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effct Green (s)	72.5	65.3		73.8	65.9			13.7	13.7	13.7		13.7
Actuated g/C Ratio	0.72	0.65		0.74	0.66			0.14	0.14	0.14		0.14
v/c Ratio	0.13	0.29		0.13	0.45			0.14	0.10	0.61		0.14
Control Delay	4.5	8.9		4.2	10.1			37.3	0.7	53.6		0.6
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	4.5	8.9		4.2	10.1			37.3	0.7	53.6		0.6
LOS	A	A		A	B			D	A	D		A
Approach Delay		8.6			9.7			19.0			33.6	
Approach LOS		A			A			B			C	
Queue Length 50th (m)	2.1	29.2		3.1	50.7			4.9	0.0	22.4		0.0
Queue Length 95th (m)	6.1	47.3		8.4	79.8			12.2	0.0	38.5		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	526	2306		688	2315			408	513	399		679
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	0.10	0.29		0.11	0.45			0.07	0.05	0.29		0.10

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.61

Intersection Signal Delay: 11.7

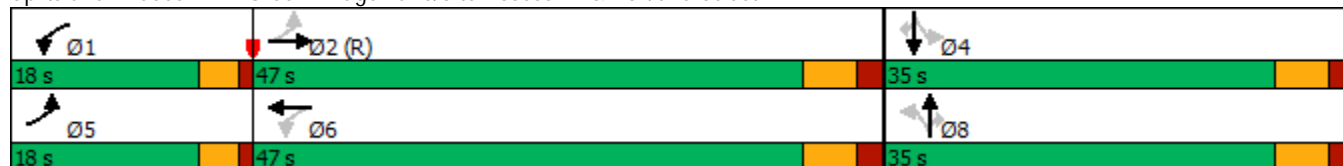
Intersection Capacity Utilization 56.6%

Analysis Period (min) 15

Intersection LOS: B




















ICU Level of Service B

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



Penhorn Development Addendum
2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Page B-2
June 2020 TIS Figure A-4

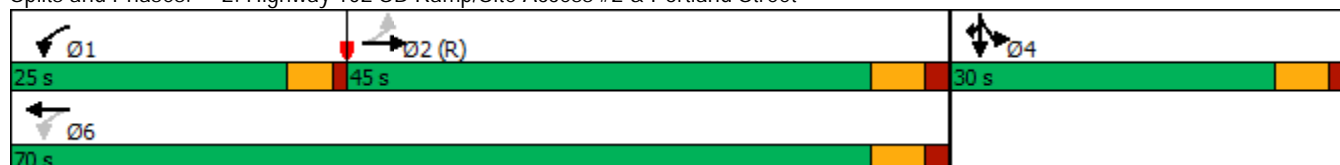
												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	763	53	330	846	167	0	0	0	130	17	10
Future Volume (vph)	25	763	53	330	846	167	0	0	0	130	17	10
Satd. Flow (prot)	1770	3504	0	1770	4958	0	0	0	0	1681	1704	1583
Flt Permitted	0.247			0.251						0.950	0.963	
Satd. Flow (perm)	460	3504	0	468	4958	0	0	0	0	1681	1704	1583
Satd. Flow (RTOR)		8			82							82
Lane Group Flow (vph)	27	887	0	359	1102	0	0	0	0	79	80	11
Turn Type	Perm	NA		pm+pt	NA					Split	NA	Prot
Protected Phases		2		1	6					4	4	4
Permitted Phases	2			6								
Total Split (s)	45.0	45.0		25.0	70.0					30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.5	6.0					6.0	6.0	6.0
Act Effect Green (s)	58.4	58.4		81.9	81.6					10.2	10.2	10.2
Actuated g/C Ratio	0.58	0.58		0.82	0.82					0.10	0.10	0.10
v/c Ratio	0.10	0.43		0.59	0.27					0.46	0.46	0.05
Control Delay	14.6	14.3		7.6	3.0					50.3	50.2	0.4
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	14.6	14.3		7.6	3.0					50.3	50.2	0.4
LOS	B	B		A	A					D	D	A
Approach Delay		14.4			4.1						47.0	
Approach LOS		B			A						D	
Queue Length 50th (m)	2.5	52.9		14.6	16.8					16.3	16.5	0.0
Queue Length 95th (m)	8.7	84.2		31.6	25.9					30.8	31.0	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	268	2048		656	4060					403	408	442
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.10	0.43		0.55	0.27					0.20	0.20	0.02

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.59
 Intersection Signal Delay: 10.7
 Intersection Capacity Utilization 60.6%
 Analysis Period (min) 15






















Intersection LOS: B
 ICU Level of Service B

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



Penhorn Development Addendum
1: Green Village Lane/Site Access #1 & Portland Street

Page B-3
June 2020 TIS Figure A-4

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	69	1010	20	70	870	106	30	0	20	72	0	56
Future Volume (vph)	69	1010	20	70	870	106	30	0	20	72	0	56
Satd. Flow (prot)	1770	3529	0	1770	3483	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.241			0.216				0.757		0.736		
Satd. Flow (perm)	449	3529	0	402	3483	0	0	1410	1583	1371	1863	1583
Satd. Flow (RTOR)		2			16				76			314
Lane Group Flow (vph)	75	1120	0	76	1061	0	0	33	22	78	0	61
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8		8	4		4
Total Split (s)	18.0	47.0		18.0	47.0		35.0	35.0	35.0	35.0	35.0	35.0
Total Lost Time (s)	4.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	77.5	71.3		78.9	72.0			11.2	11.2	11.2		11.2
Actuated g/C Ratio	0.78	0.71		0.79	0.72			0.11	0.11	0.11		0.11
v/c Ratio	0.17	0.45		0.18	0.42			0.21	0.09	0.51		0.13
Control Delay	3.9	9.2		3.9	8.4			41.8	0.8	52.5		0.6
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	3.9	9.2		3.9	8.4			41.8	0.8	52.5		0.6
LOS	A	A		A	A			D	A	D		A
Approach Delay		8.8			8.1			25.4			29.7	
Approach LOS		A			A			C			C	
Queue Length 50th (m)	2.6	53.5		2.7	48.1			6.3	0.0	15.3		0.0
Queue Length 95th (m)	7.0	84.6		7.1	75.1			14.9	0.0	29.0		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	550	2515		518	2511			408	513	397		682
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	0.14	0.45		0.15	0.42			0.08	0.04	0.20		0.09

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.51

Intersection Signal Delay: 10.0

Intersection Capacity Utilization 58.4%

Analysis Period (min) 15

Intersection LOS: B




















ICU Level of Service B

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



Penhorn Development Addendum
2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Page B-4
June 2020 TIS Figure A-4

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	1014	58	165	881	167	0	0	0	127	32	25
Future Volume (vph)	40	1014	58	165	881	167	0	0	0	127	32	25
Satd. Flow (prot)	1770	3511	0	1770	4963	0	0	0	0	1681	1718	1583
Flt Permitted	0.237			0.178						0.950	0.971	
Satd. Flow (perm)	441	3511	0	332	4963	0	0	0	0	1681	1718	1583
Satd. Flow (RTOR)		7			77							82
Lane Group Flow (vph)	43	1165	0	179	1140	0	0	0	0	86	87	27
Turn Type	Perm	NA		pm+pt	NA					Split	NA	Prot
Protected Phases		2		1	6					4	4	4
Permitted Phases	2			6								
Total Split (s)	45.0	45.0		25.0	70.0					30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.5	6.0					6.0	6.0	6.0
Act Effect Green (s)	62.5	62.5		78.9	77.4					10.6	10.6	10.6
Actuated g/C Ratio	0.62	0.62		0.79	0.77					0.11	0.11	0.11
v/c Ratio	0.16	0.53		0.44	0.30					0.48	0.48	0.11
Control Delay	11.7	12.5		6.2	3.5					50.5	50.1	0.9
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	11.7	12.5		6.2	3.5					50.5	50.1	0.9
LOS	B	B		A	A					D	D	A
Approach Delay		12.5			3.8						43.6	
Approach LOS		B			A						D	
Queue Length 50th (m)	3.3	63.4		6.6	18.2					17.6	17.8	0.0
Queue Length 95th (m)	11.1	102.3		14.2	28.0					32.8	33.0	0.0
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	275	2197		556	3857					403	412	442
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.16	0.53		0.32	0.30					0.21	0.21	0.06

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.53

Intersection Signal Delay: 10.6

Intersection LOS: B

Intersection Capacity Utilization 58.6%

ICU Level of Service B






















Analysis Period (min) 15

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



Penhorn Development Addendum
1: Green Village Lane/Site Access #1 & Portland Street

Page B-5
2030 AM Peak with Addendum Trips

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	63	600	10	70	895	81	25	0	25	164	0	95
Future Volume (vph)	63	600	10	70	895	81	25	0	25	164	0	95
Satd. Flow (prot)	1770	3532	0	1770	3497	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.218			0.373				0.757		0.740		
Satd. Flow (perm)	406	3532	0	695	3497	0	0	1410	1583	1378	1863	1583
Satd. Flow (RTOR)		2			11				76			311
Lane Group Flow (vph)	68	663	0	76	1061	0	0	27	27	178	0	103
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8		8	4		4
Total Split (s)	18.0	47.0		18.0	47.0		35.0	35.0	35.0	35.0	35.0	35.0
Total Lost Time (s)	4.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	68.3	60.6		69.0	61.0			18.2	18.2	18.2		18.2
Actuated g/C Ratio	0.68	0.61		0.69	0.61			0.18	0.18	0.18		0.18
v/c Ratio	0.18	0.31		0.14	0.50			0.11	0.08	0.71		0.19
Control Delay	6.5	11.5		5.9	13.4			32.2	0.4	53.3		0.8
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	6.5	11.5		5.9	13.4			32.2	0.4	53.3		0.8
LOS	A	B		A	B			C	A	D		A
Approach Delay		11.0			12.9			16.3			34.0	
Approach LOS		B			B			B			C	
Queue Length 50th (m)	3.5	33.4		3.9	61.2			4.6	0.0	34.5		0.0
Queue Length 95th (m)	9.5	55.4		10.4	97.9			11.2	0.0	53.3		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	482	2141		649	2136			408	513	399		679
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	0.14	0.31		0.12	0.50			0.07	0.05	0.45		0.15

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.71

Intersection Signal Delay: 15.1

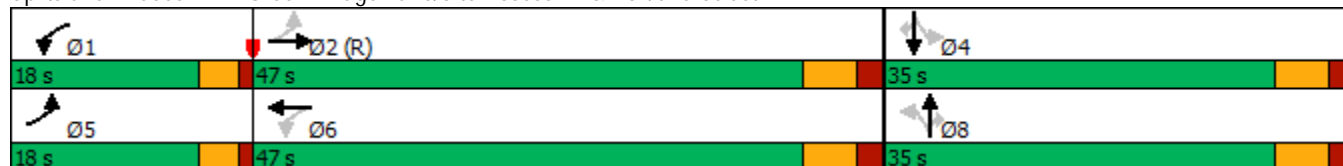
Intersection LOS: B

Intersection Capacity Utilization 60.6%

ICU Level of Service B




















Analysis Period (min) 15

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



Penhorn Development Addendum
2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Page B-6
2030 AM Peak with Addendum Trips

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	786	57	330	859	213	0	0	0	192	26	64
Future Volume (vph)	30	786	57	330	859	213	0	0	0	192	26	64
Satd. Flow (prot)	1770	3504	0	1770	4933	0	0	0	0	1681	1704	1583
Flt Permitted	0.231			0.228						0.950	0.963	
Satd. Flow (perm)	430	3504	0	425	4933	0	0	0	0	1681	1704	1583
Satd. Flow (RTOR)		9			119							82
Lane Group Flow (vph)	33	916	0	359	1166	0	0	0	0	117	120	70
Turn Type	Perm	NA		pm+pt	NA					Split	NA	Prot
Protected Phases		2		1	6					4	4	4
Permitted Phases	2			6								
Total Split (s)	45.0	45.0		25.0	70.0					30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.5	6.0					6.0	6.0	6.0
Act Effect Green (s)	53.3	53.3		77.1	75.6					12.4	12.4	12.4
Actuated g/C Ratio	0.53	0.53		0.77	0.76					0.12	0.12	0.12
v/c Ratio	0.14	0.49		0.63	0.31					0.56	0.57	0.26
Control Delay	17.6	17.3		10.4	3.9					51.1	51.3	9.1
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	17.6	17.3		10.4	3.9					51.1	51.3	9.1
LOS	B	B		B	A					D	D	A
Approach Delay		17.3			5.5						41.6	
Approach LOS		B			A						D	
Queue Length 50th (m)	3.2	58.6		17.0	19.8					24.0	24.6	0.0
Queue Length 95th (m)	11.6	96.3		42.4	31.3					41.2	41.8	9.9
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	229	1871		614	3760					403	408	442
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.14	0.49		0.58	0.31					0.29	0.29	0.16

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.63

Intersection Signal Delay: 13.5

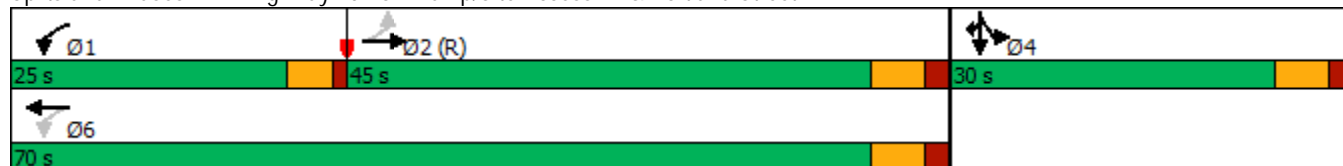
Intersection LOS: B

Intersection Capacity Utilization 61.6%

ICU Level of Service B






















Analysis Period (min) 15

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street



Penhorn Development Addendum
1: Green Village Lane/Site Access #1 & Portland Street

Page B-7
2030 PM Peak with Addendum Trips

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	101	1010	20	70	870	160	30	0	20	108	0	78
Future Volume (vph)	101	1010	20	70	870	160	30	0	20	108	0	78
Satd. Flow (prot)	1770	3529	0	1770	3458	0	0	1770	1583	1770	1863	1583
Flt Permitted	0.201			0.213				0.757		0.736		
Satd. Flow (perm)	374	3529	0	397	3458	0	0	1410	1583	1371	1863	1583
Satd. Flow (RTOR)		2			26				76			314
Lane Group Flow (vph)	110	1120	0	76	1120	0	0	33	22	117	0	85
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA	Perm	Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases	2			6			8		8	4		4
Total Split (s)	18.0	47.0		18.0	47.0		35.0	35.0	35.0	35.0	35.0	35.0
Total Lost Time (s)	4.0	6.0		4.0	6.0			6.0	6.0	6.0	6.0	6.0
Act Effect Green (s)	73.0	65.0		72.3	62.9			13.9	13.9	13.9		13.9
Actuated g/C Ratio	0.73	0.65		0.72	0.63			0.14	0.14	0.14		0.14
v/c Ratio	0.29	0.49		0.20	0.51			0.17	0.08	0.62		0.17
Control Delay	5.9	11.2		5.0	11.8			37.7	0.6	53.6		0.8
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0	0.0		0.0
Total Delay	5.9	11.2		5.0	11.8			37.7	0.6	53.6		0.8
LOS	A	B		A	B			D	A	D		A
Approach Delay		10.7			11.3			22.9			31.4	
Approach LOS		B			B			C			C	
Queue Length 50th (m)	4.7	59.2		3.2	58.2			6.0	0.0	22.8		0.0
Queue Length 95th (m)	11.5	92.6		8.5	93.4			14.1	0.0	39.0		0.0
Internal Link Dist (m)		186.0			98.3			168.8			141.4	
Turn Bay Length (m)	35.0			50.0					35.0	20.0		
Base Capacity (vph)	480	2293		494	2185			408	513	397		682
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	0.23	0.49		0.15	0.51			0.08	0.04	0.29		0.12

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.62

Intersection Signal Delay: 12.8

Intersection Capacity Utilization 60.7%

Analysis Period (min) 15

Intersection LOS: B




















ICU Level of Service B

Splits and Phases: 1: Green Village Lane/Site Access #1 & Portland Street



Penhorn Development Addendum
2: Highway 102 SB Ramp/Site Access #2 & Portland Street

Page B-8
2030 PM Peak with Addendum Trips

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	1042	63	165	932	209	0	0	0	157	39	64
Future Volume (vph)	48	1042	63	165	932	209	0	0	0	157	39	64
Satd. Flow (prot)	1770	3511	0	1770	4948	0	0	0	0	1681	1718	1583
Flt Permitted	0.213			0.166						0.950	0.971	
Satd. Flow (perm)	397	3511	0	309	4948	0	0	0	0	1681	1718	1583
Satd. Flow (RTOR)		7			100							82
Lane Group Flow (vph)	52	1201	0	179	1240	0	0	0	0	106	107	70
Turn Type	Perm	NA		pm+pt	NA					Split	NA	Prot
Protected Phases		2		1	6					4	4	4
Permitted Phases	2			6								
Total Split (s)	45.0	45.0		25.0	70.0					30.0	30.0	30.0
Total Lost Time (s)	6.0	6.0		4.5	6.0					6.0	6.0	6.0
Act Effect Green (s)	61.6	61.6		77.9	76.4					11.6	11.6	11.6
Actuated g/C Ratio	0.62	0.62		0.78	0.76					0.12	0.12	0.12
v/c Ratio	0.21	0.55		0.46	0.33					0.54	0.54	0.27
Control Delay	13.8	13.5		7.0	3.9					51.4	50.8	9.5
Queue Delay	0.0	0.0		0.0	0.0					0.0	0.0	0.0
Total Delay	13.8	13.5		7.0	3.9					51.4	50.8	9.5
LOS	B	B		A	A					D	D	A
Approach Delay		13.5			4.3						40.8	
Approach LOS		B			A						D	
Queue Length 50th (m)	4.3	68.3		7.1	21.3					21.7	22.0	0.0
Queue Length 95th (m)	14.3	111.7		15.3	33.1					38.3	38.4	10.1
Internal Link Dist (m)		93.0			221.7			87.6			105.5	
Turn Bay Length (m)	75.0			30.0						70.0		70.0
Base Capacity (vph)	244	2166		540	3802					403	412	442
Starvation Cap Reductn	0	0		0	0					0	0	0
Spillback Cap Reductn	0	0		0	0					0	0	0
Storage Cap Reductn	0	0		0	0					0	0	0
Reduced v/c Ratio	0.21	0.55		0.33	0.33					0.26	0.26	0.16

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.55

Intersection Signal Delay: 11.7

Intersection LOS: B

Intersection Capacity Utilization 59.5%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 2: Highway 102 SB Ramp/Site Access #2 & Portland Street

