PORT WALLACE CAPITAL COST CONTRIBUTION ANALYSIS BASELINE STUDY

Final Report

CBCL LIMITED
Consulting Engineers

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UPLAND

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Executive Summary

The Port Wallace Study area is comprised of approximately 285 hectares and is located to the north and south of Highway 107 at the Montague Road intersection. The site is largely undeveloped, and plans are in place to construct over 3,700 residential units as well as some commercial, industrial and institutional development. The area was previously identified under the Regional Municipal Planning Strategy (RMPS, 2006) to be serviced with water, wastewater, and stormwater systems. There are a number of land owners involved in the development of this site who have presented proposed development layout and phasing plans for their lands. The developers are Port Wallace Holdings Limited, Conrad, Unia, and Whebby.

This capital cost contribution analysis establishes long-term infrastructure requirements necessary to service the development of Port Wallace. The infrastructure considered in this study includes transportation, wastewater, stormwater, potable and fire suppression water systems, and suggests how the community can fulfill a role within the regional context. The primary purpose of this study is to develop a basis for Halifax Regional Municipality (HRM) Regional Council and Halifax Water (HW) to assess and validate costs and risks associated with infrastructure requirements necessary to service the Port Wallace site growth area.

To facilitate the development of Port Wallace, this study identified the following required infrastructure upgrades:

Transportation:
Upgrades to existing intersections are required on Montague Road, Waverley Road, Caledonia Road and Main Street/Forest Hills Extension. These upgrades can be constructed successively at a rate which parallels buildout of the Port Wallace area.

Estimated cost borne by HRM: $16,000,000
Estimated cost borne by the developers: $5,100,000

Wastewater:
The existing municipal wastewater system does not have any additional capacity and cannot support any additional development. The existing pump station at 390 Waverley Road should be upgraded/replaced, and a new forcemain constructed to tie into the North Dartmouth Trunk Sewer which runs parallel to Highway 118. The sanitary system needs to be upgraded prior to any development in Port Wallace.

Estimated cost born by HRM/HW: $4,000,000.
Estimated cost born by the developers: $9,400,000.

Stormwater:
No stormwater elements have been identified which are considered to warrant capital cost contribution or shared developer cost.

Potable Water and Fire Suppression:
To service Port Wallace, some internal upsizing is required and has been identified in the water section of the report. The pipe upsizing should be constructed in conjunction with road construction.

Estimated cost born by the developers: $2,000,000.

Transportation

CBCL Limited completed an assessment of the existing and future road network as it relates to the Port Wallace development. The existing road network and intersections were examined under current operating conditions (2017), 50% buildout (2031) and full buildout (2047). A background growth rate of 1% was applied between 2017 and 2031, with a background growth rate of 0.75% being applied from 2031 and beyond. A number of potential road network layouts were established based on various potential road configurations within the study area, connections to the existing road network and future road upgrades outside the study area. AM and PM analysis were completed for these layouts. Both 10% and 20% non–auto mode shares were subsequently assessed for each of the road network layouts.

The 2017 models indicate that the majority of existing modeled intersections currently provide a satisfactory level of service, with the exception of Main Street/Forest Hills Extension signalised intersection which HRM is aware of. The 2031 models identified key intersections which have a poor operational performance. The 2047 model shows a further decrease in the level of service at the key intersections.

This development represents a substantial increase in trip generation for the immediate area. To facilitate the Port Wallace development, it is recommended that the intersections identified with poor levels of service be upgraded, and the potential to reduce trip generation be pursued to the greatest extent possible. Further modeling and preliminary engineering design would be required to determine the extent of intersection upgrades required to achieve an acceptable level of service at the 2031 and 2047 horizons; however, for the purposes of this report possible suitable upgrades have been established based on engineering judgement. A preliminary summary of recommended intersection upgrades based on percentage of overall buildout is given within the body of this report, in section 2.11.

Transit services are seen as the primary method of reducing trip generation and should be implemented in the initial stages of the development. We believe that non-auto modes in particular, transit and active transportation, should be widely supported and encouraged for the Port Wallace development given the level of trips generated during the buildout period.

Wastewater

Wastewater from the study area will be discharged to the existing municipal sewer system on Waverley Road. Flow is directed towards Dartmouth center via a series of gravity sewers and pump stations. This study assessed the wastewater system from Montague Road to the pump station at civic 200 Waverley Road.

There are portions of the gravity system which have limited capacity and will require upgrades due to this development. There is currently no available additional capacity at the 390 Waverley Road pumping station or at the 200 Waverley Road pumping station. Port Wallace Holdings Limited (PWHL) has forwarded a proposal to temporarily increase the capacity of the pump station at 390 Waverley Road which would increase flow to the 200 Waverley Road pump station which has no available capacity.

The pumping station at 390 Waverley Road should be upgraded/replaced and a force main should be rerouted west, across the Shubenacadie Canal to the North Dartmouth Trunk Sewer on the west side of Highway 118. The North Dartmouth Trunk Sewer has capacity for the Port Wallace development.

Planned capital works for capacity upgrades should be reviewed in the event of modifications to the development areas and characteristics.

Stormwater

There are a number of pipes and/or drainage courses which enter the study area from lands upstream. It is the responsibility of each land owner to manage the stormwater on their property. If the mechanism for stormwater conveyance is altered the developer is responsible to insure that pre and post flows are maintained. For example if stormwater currently flows over land or in a ditch and the developer requests to change to a hard pipe sewer system some form of detention facility would likely be required to offset the reduced time of concentration.

The Port Wallace study area is within the Lake Charles watershed. Lake Charles is a headwater lake which flows in two directions with a number of significant water bodies downstream. The proposed Port Wallace development area contains several small watercourses, marshes, swamps and bogs as well as a major watercourse, Barry's Run, which discharges to a fen wetland.

Areas of environmental contamination and cultural significance have been identified within Port Wallace. It is vital that potential contamination is fully investigated and appropriate action taken for the protection of public health and safety. One of the areas of environmental and cultural significance is the aforementioned Barry's Run. It has been proposed to utilize Barry's Run as a stormwater management mechanism. For environmental, ecological and cultural reasons, Barry's Run should not be considered for stormwater management for the Port Wallace development. Other areas of potential concern are discussed in detail in the main body of the report.

Stormwater management is required to maintain peak pre-development runoff rates for the 1 in 2, 5, 10, 25, 50 and 100-year storm events to meet Halifax Water and Nova Scotia Environment requirements. Within HRM, and throughout Atlantic Canada, these requirements have traditionally been achieved by constructing centralised stormwater management facilities such as large detention ponds, which are ultimately owned by the stormwater management utility.

Centralized stormwater management infrastructure based solely on rate control represents a simplified ownership, maintenance and liability model, however they do not mimic the natural environment, can often increase the risk of downstream flooding and degrade water quality. Throughout North America and Europe the goals of stormwater management have been adjusted to account for this. Quantity and quality control are more prevalent in much of today's stormwater management guidelines and are becoming a more central requirement in stormwater management in many municipalities.

Source control is generally considered the most favourable way to achieve this. Traditional stormwater systems collect rainwater where it falls and directs runoff downstream through pipes, roadways, ditches, creeks, etc. Source control is the process of infiltrating rain water where it falls, much like the undeveloped, natural environment. Water which does not infiltrate is then routed downstream through pipes, roadways, ditches, creeks, etc. Source control reduces the total amount of water in the municipal storm system, reduces risk of flooding, improves water quality, promotes ground water recharge and offers many more benefits.

Previous reports completed by others have recommended that source control be implemented within the Port Wallace study area and the landowners have demonstrated their intent to implement source control by proposing Low Impact Development (LID) measures. LIDs include; rain gardens, bio swales, infiltration trenches, permeable pavement, infiltration galleries, absorbent landscape, etc. LIDs are ideally installed on public as well as private property. Due to the current Nova Scotia Environment and Halifax Water mandate for stormwater management, the developers may have some difficulty pursuing the LID approach on private property however, Halifax Regional Municipality Council passed a motion on March 4, 2014 pertaining to stormwater management which noted that the design of Port Wallace should include stormwater management facilities on private property.

It is recommended that this motion be built upon by HRM to facilitate the implementation of source control techniques on both public and private lands. This practice is becoming common across Canada. Not following this approach will likely lead to increased flooding risk, degraded water quality, and thereby not meet the project requirements.

Potable & Fire Suppression Water

This study is intended to establish the minimum water and fire flow service requirements necessary to achieve the Halifax Water design guidelines within the Port Wallace Development. The addition of Port Wallace to the water system will increase water demands and an analysis of the existing infrastructure has been carried out to understand the impacts of the additional demand.

For the purposes of the study, Halifax Water provided a copy of the water model understood to be representative of the system to 2017. WaterCAD V8i (SELECTSeries 6) was used to model current conditions, future background growth and the addition of Port Wallace. Meetings between Halifax Water and CBCL were held to develop an understanding of current system operation. The outcome from the meetings helped to establish the design constraints for evaluating the impact of future growth within the Port Wallace study area and background growth to the existing system.

The system should be capable of achieving the desired fire flow for the given land use while maintaining a minimum of 22 psi throughout the system. A 400 mm waterline along Avenue du Portage Extension and to the Conrad Lands is recommended to provide service to the full study area. Areas within the study area where 300mm watermains are recommended have been identified in the main body of the report.

Crossing the Shubenacadie Park and Highway 118

This development will very likely require a new forcemain to run from an upgraded pump station at 390 Waverley Road to the North Dartmouth Trunk Sewer. This forcemain would cross through Shubie Park, including the Shubenacadie canal, and cross Highway 118. This is an environmentally and culturally sensitive area with significant construction constraints. The lands are owned by the Department of Natural Resources (DNR) and Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR). As such, the sanitary servicing concept recommended in this report is subject to DNR and NSTIR approval. The Shubenacadie canal commission are also a significant stakeholder.

Future regional growth will require a transmission watermain to make a similar crossing. Other utilities have also have expressed an interest in a crossing including gas, power and communications. It would likely be financially and environmentally beneficial to complete these crossings concurrently. This potential for a common utility corridor should be incrementally investigated with all utilities. Cost contribution discussions should be held in parallel with the design development.

This study will identify order of magnitude costing for the crossing as it relates to Port Wallace developments. A number of potential crossing mechanisms have been discussed including tunneling and pipe/pedestrian bridges. Subsequent to this study it is recommended that a crossing design be agreed upon with all interested stakeholders which would subsequently be submitted to the DNR, the canal commission and NSTIR for review.

The critical path for the development of Port Wallace is the sanitary service. Crossing the canal and Highway 118 will take significant coordination, design and approval effort. It is recommended this process begin as soon as possible.

Costs

This report identifies infrastructure upgrades required to service the Port Wallace Study area and future growth within HRM. The benefactors for each upgrade have been recognised and costs should be apportioned between benefactors. It is suggested to allocate costs related to transportation upgrades based on trip generation and that sanitary and water upgrades are allocated based on gross development area. The costs for internal site development and connections to existing infrastructure at a property owner's boundary should be borne by the individual developer. Internal upsizing required to service the full study area should be shared between each developer based on trips generated or contribution area as outlined above. Following this report a more detailed design and cost estimate should be completed to establish capitol cost contribution charges.

Chapter 1 Introduction

1.1 Background

The Port Wallace Secondary Planning Study Area was identified as one of six areas under the Regional Municipal Planning Strategy (RMPS, 2006) to be serviced with water, wastewater, and stormwater systems. Prior to servicing, an evaluation of cost to provide municipal services and transportation links to the study area was required. A Watershed Study was also required.

On March 4, 2014, following the completion of the aforementioned studies – the Cost of Servicing Study, (COS, CBCL Limited., 2009); and the Shubenacadie Lakes Subwatershed Study – Final Report, (SWS, AECOM, 2013), respectively – Regional Council passed a motion to proceed with the Port Wallace Secondary Planning Process.

Subsequently, a Land Suitability Analysis (LSA) was completed by WSP in 2016 (WSP LSA, 2016) to determine areas of environmental and cultural importance based on physical attributes inherent to the study area. This process included an assessment and mapping of natural systems and critical areas, the purpose of which was to identify, map and assess natural environmental features, cultural landscape features, and engineered structures critical to maintain natural ecological functions.

This master infrastructure study represents the next stage in the secondary planning process by conducting a detailed assessment of the regional and local infrastructure required to support the proposed development. The intent of this study is to establish the long term infrastructure requirements necessary to service this proposed growth area. The infrastructure to be considered in this study includes water, wastewater, and stormwater and transportation systems. The primary purpose of this study is to develop a basis for HRM Regional Council and Halifax Water (HW) to assess and validate costs and risks associated with infrastructure requirements necessary to service this proposed growth area. The general location of the study area is shown in Figure 1: General Location of Study Area and Key Intersections.

1.2 Report Structure

This is a broad report covering a range of disciplines and includes an introduction with five main chapters. Each chapter discusses a particular infrastructure system as follows:

1. Introduction;
2. Transportation;
3. Wastewater;
4. Stormwater; and
5. Potable water and fire suppression.

It is anticipated that most readers of this report will be interested in the chapter which discusses their particular area of expertise rather than reviewing the report as a whole. To accommodate a discipline based review each chapter has been written as a standalone section which can be reviewed independently of the other chapters.

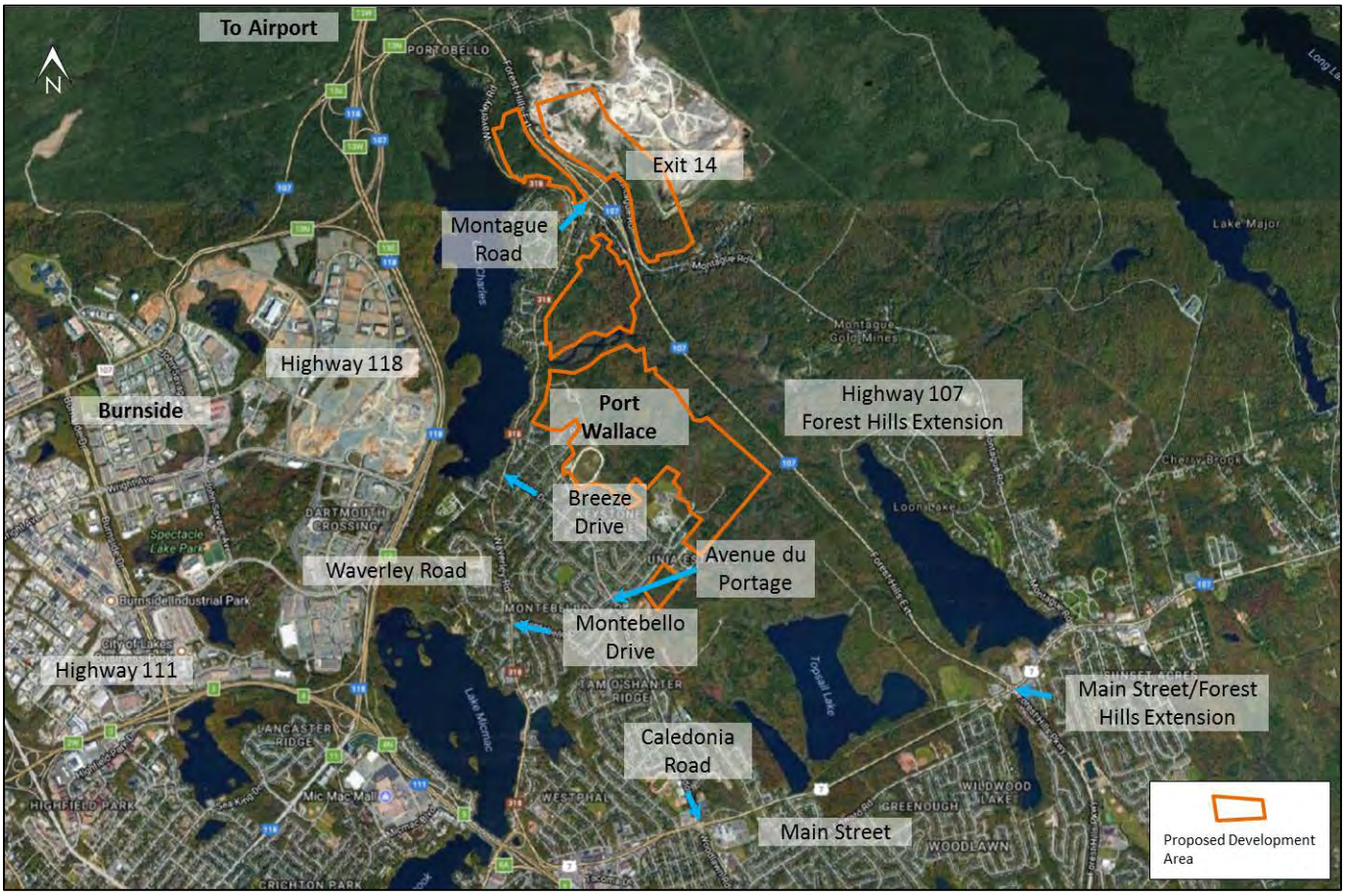


Figure 1: General Location of Study Area and Key Intersections

1.3 Land Ownership and Stakeholder Engagement

Error! Reference source not found. outlines the current property owners as well as the study area. The land owners engaged as part of this study were:

→ Conrad Brothers;
→ Port Wallace Holdings Limited;
→ Frank/Eric Whebby; and
→ Unia.

Three meetings were held with the stakeholders and/or their representatives. During our first meeting, each stakeholder provided their development plans, outlined their work to date and discussed their phasing intent. A follow-up meeting was conducted for stakeholders to offer their input to this study. At a third meeting, CBCL provided initial feedback on the preliminary findings of the report.

The southern portion of the Unia lands, PID 41254822, has poor development potential due to an environmental encumbrance. The land owner has requested that this portion of land be removed from the study area they have indicated as they intend to develop this portion of land in accordance with its existing zoning. There are no known issues with this proposal at this time. For the purposes of this report, these lands have been kept within the study area, however, they can be removed from consideration at a later stage if deemed appropriate by HRM.

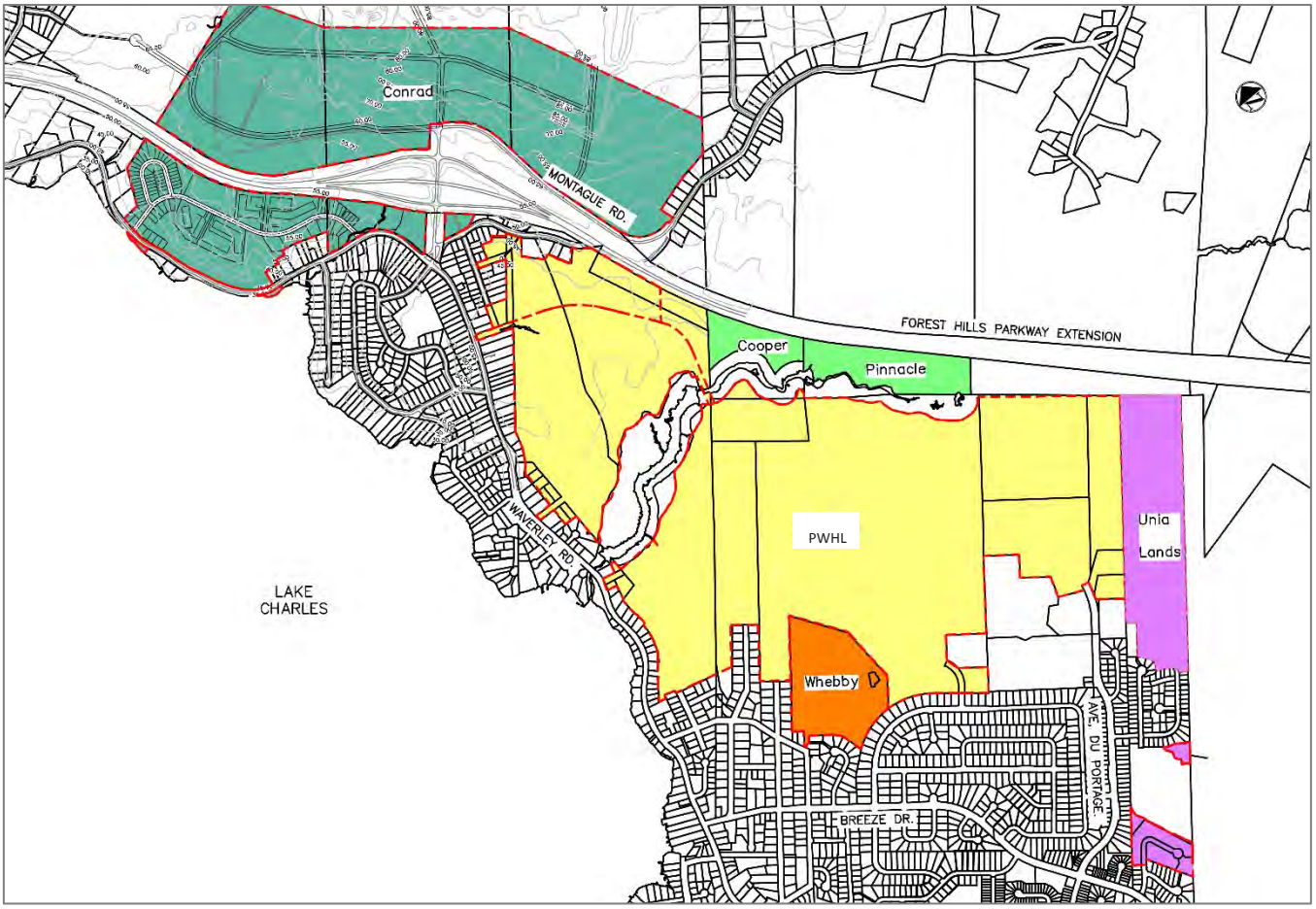


Figure 2: Land Owners

There were two land owners within the study area who could not be contacted by HRM PID 41365180. The property owner is noted on property online as George Anthony Cooper of Dartmouth, and PID 41025321 is owned by Pinnacle Properties. These properties were shown to have significant constraints to development in the land suitability assessment, which indicates there may be very limited financial benefit to be gained from development of these parcels and therefore, at present, future development of these properties is considered unlikely. Through the course of this development, the land owners should be contacted to confirm they do not intend to develop these parcels in the future, or the development layout be configured to offer access to these lots. Alternatively, HRM may decide that the constraints on the lands are such that they would not permit the area to be developed, and they may implement a non-development zone on those lots.

1.4 Population Projections and Project Buildout

Development of Port Wallace will be a joint effort from a number of developers and public agencies. Each developer has presented their proposed development layout, phasing plans and buildout timeline. The development layouts and phases integrate well to create an overall area plan which demonstrates a homogenous style and pattern. The developers have submitted a cumulative unit count of 3,744 residential units. Commercial, institutional and industrial development is also proposed.

Port Wallace Holdings Limited and Conrad Developments have expressed the strongest desire to begin development in the near future; Unia and Whebby have indicated they intend to commence development further down the road. A holistic review of the buildout timelines put forward by each developer shows a buildout overlap between developments. This overlap identifies a potential overall buildout scenario of over 300 units per year. This could equate to a full project buildout timeline as short as 12 years. This is considered very aggressive for Port Wallace.

This study does not aim to agree or disagree with the development timelines presented by any developer, but to review the development as a whole in terms of risk to HRM and Halifax Water. Project buildout timeline has been a significant issue for HRM and Halifax Water in the past where they have made capital investments in infrastructure to support large developments. In some cases, the rate of buildout, which was initially presented by the developers, was not achieved by all landowners. This delayed the generation of the tax revenue required by HRM and Halifax Water to recoup the initial capital investment, meaning that HRM and Halifax Water would be financing this infrastructure over longer than expected time frames at a higher cost to them.

A full buildout timeline for the study area of 30 years has been estimated. This equates to an average of 125 new residential units per year. While 125 units per year represents a significant portion of the annual average HRM new building permit applications and a substantial construction effort, it is considered to represent an acceptable timeline for the development, based on the information provided by the developers and overall growth in HRM.

In the infrastructure sections in this report, we have outlined upgrades based on buildout rate where possible. For example, road intersection upgrades are triggered at 10, 30, 50 & 70% buildout. This is in an effort to promote a distributed rate of capital cost investment for HRM, Halifax Water and the developers. Should development proceed at a faster rate and full development be achieved in say 12 years, the upgrades will still be constructed as required. Should development proceed at a slower rate full buildout may be achieved in say 60 years, the capital costs would be deferred in line with the rate of development. Populations and occupancy rates are taken from HRM and Halifax Water design guidelines. These are considered to be accurate representations of current and future occupancy rates. Potential occupancy rates outside the existing guidelines were not considered herein as they would represent a significant deviation from the established acceptable standard of practice in this jurisdiction and would require significant, detailed study and analysis to offer appropriate justification. Population and population equivalents for each sub area within Port Wallace are given in Table 1, with the sub areas being shown in Figure 3.

Table 1: Population Equivalents

Port Wallace Area	Population Equivalent
PW 1	1,147
PW 2	4,163
PW 3	1,477
PW 4	1,047
PW 5	2,096
PW 6	1,513
PW 7	633
PW 8	1,247
PW 9	906
PW 10	586
PW 11	106
Total:	14,921

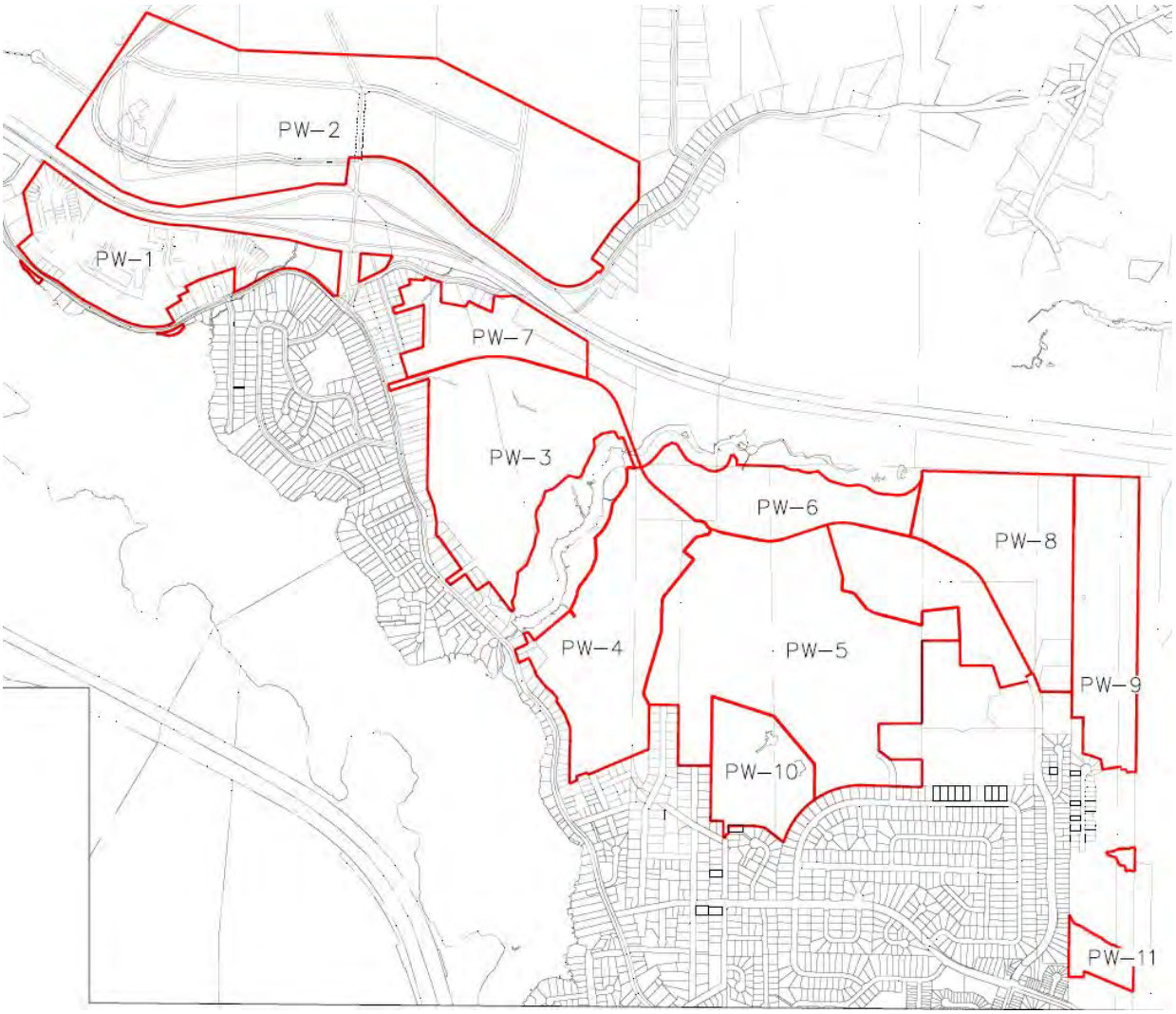


Figure 3: Port Wallace Sub Areas

Chapter 2 Transportation

2.1 Transportation Objectives

CBCL Limited completed an assessment of the existing and future road network as it relates to the Port Wallace study area. There are a number of potential road network layouts proposed by the developers within Port Wallace, with each layout representing a different potential road connection to the existing network. CBCL reviewed each of the proposed layouts considering the existing road network as well as assessing a number of potential future offsite upgrades. Each scenario was assessed under varying background growth conditions and with varying non-auto mode share.

Analysis of possible development layouts with different access options and potential future offsite infrastructure upgrades was completed. Varying levels of background growth and percentages of non-auto mode share (transit, walking, bicycling, taxi, rideshare, etc.) were adopted, to determine the level of service, queues and delays at major intersections within the study area.

This section provides an overview of the trip generation and suggested transportation infrastructure improvements associated with the Port Wallace study area. There are a number of landowners affected including Port Wallace Holdings Limited, Conrad Brothers Ltd, J&W Whebby Enterprises and Unia Estates. It is understood that the site could be available for development as soon as 2018. WSP has completed a review and analysis of the Port Wallace Holdings Limited proposals on behalf of Port Wallace Holdings Limited. HRM has also undertaken a comprehensive analysis of the baseline conditions within the area, as well as the proposed development and its impact on the surrounding road network using the VISUM model. CBCL completed a number of tasks as part of the infrastructure study, including:

- → Review of previously completed reports;
- → Review, assess, validate and modify the VISUM model outputs;
- → Conduct peak hour turning movement counts at key intersections;
- → Modify modelled trip distribution;
- → Assignment and mode choice assumptions;
- → Validate delays at key intersections; and
- → Conduct intersection modelling analysis using Synchro.

2.2 Site Description

The Port Wallace study area is currently largely undeveloped lands and owned by various developers. A portion of the land, owned by Conrad Brothers, is currently in operation as a quarry with trucks accessing Highway 107 (Forest Hills Extension) at Exit 14, Montague Road on the east side of the highway. There is also a secondary access on the west via local residential streets. It is understood that quarry vehicles do not typically utilise this access. We understand that operations at this site are expected to continue in the future, but also that these operations are seasonally dependent. The quarry vehicles mainly access the Forest Hills Extension to travel north and south away from the quarry. The site is bordered by Highway 107 Forest Hills Extension to the east, and Waverley Road to the west. The Port Wallace Study Area is bisected by Highway 107, which is accessible from Exit 14 at Montague Road.

Access to Highway 107 Exit 14 is currently along Waverley Road and Montague Road to the north of the site. Access to Main Street is currently via Avenue du Portage and Caledonia Road. The general location of the study area and existing access points are previously shown in Figure 1.

2.3 Initial Review

CBCL Limited reviewed background information provided from a number of sources, we also reviewed analysis undertaken by WSP and HRM, on behalf of various developers. The review included consideration of the anticipated numbers of residents or number of residential units as part of the development, a comparison of traffic count data obtained during different months and over different years, the estimated trip generation, distribution and non-auto mode share, and also the proposed access points, both existing and new.

2.3.1 Port Wallace Pre-Design Baseline Study (HRM 2014)

The HRM Baseline Report included an analysis of pre-designed baseline conditions for transportation services and forms an essential part of the secondary planning process undertaken by HRM. In this report, there were two main tasks: to determine the capacity constraints in the road, active transportation, and transit network systems; and to identify critical infrastructure deficiencies.

The key points to be noted from the study include:

- → The southern section of Waverley Road/Braemar Drive is at capacity and the signals at Montebello Road are also near capacity;
- → The remaining roads and intersections have spare capacity to accommodate new development;
- → Main constraints to active transportation in the area are street layout, grades, and the lack of infrastructure; and
- → The transit system in the area is underutilized. Transit accounts for 7.5% of commuting trips. The contributing factors are population density, street layout, lack of active transportation connections, and limited service to areas other than the Regional Centre.

2.3.2 Port Wallace Development Access Review (WSP May 2017)

This analysis was undertaken by WSP on behalf of Port Wallace Holdings Limited, and included a total number of 3,189 residential units (single family and multi-unit buildings) for the development. The Access Review considered a number of options for access from the development including:

- → All traffic loading on to Waverley Road;
- → Traffic being split between Waverley Road and a one-way only intersection on the Highway 107 Forest Hills Extension; and
- → Traffic split between Waverley Road and a new full intersection on the Highway 107 Forest Hills Extension.

The Access Review also included a bridge across Barry's Run between the two parts of Port Wallace Holdings Limited's proposed development.

The inclusion of a bridge to connect both parts of the development would allow for a continuous spine road through the development, and would also allow for a more efficient transit service.

In terms of phasing, WSP assumed a 10 year buildout timeline for full buildout of the Port Wallace Holdings Limited development. They also assumed that traffic from the development would be heading towards Waverley Road to the north and south, but would also use a right-in/right-out connection from the Highway 107 Forest Hills Extension to the Port Wallace development. In terms of typical build rates by developers, constructing 3,189 residential units in 10 years appears to be very ambitious given the number of anticipated trips generated by the development and current limitations on the road infrastructure.

WSP assumed a 20% non-auto mode choice, which is higher than HRM's assumption. If we are taking the long-term view of the proposed development, then a 20% share should be encouraged to help to reduce and to mitigate the number of peak hour trips generated by the Port Wallace development.

The key points to be noted from the study include:

→ It did not include the Conrad Residential and Industrial Lands;

→ Improvements are required for the Montague Road corridor, and intersection upgrades are required at the Waverley/Montebello, Waverley/Breeze, Caledonia/Montebello intersections; and

→ Planning should continue to preserve a road reserve for a future connection to the Forest Hills Extension.

2.3.1 Port Wallace Travel Demand Modelling Report (HRM 2017)

The information included in the Baseline Report was used as the basis for the work undertaken to create the Travel Demand Modelling Report. An estimate of 3,500 residential units were included as part of the development. The analysis considered that full buildout of the development would be in 2031 which coincides with the regional plan travel demand model developed by HRM. The baseline VISUM model looked at the wider study area as well as a sub-area model using PM peak hour travel demand. The model looked at five key intersections within the sub-area which surround the Port Wallace development and would be most directly affected by the generated trips. Background traffic growth was considered and compared with WSP's baseline traffic volumes as shown later in this section. In terms of trip generation, the VISUM model includes a 10% non-auto mode choice, half of the 20% assumed by WSP.

The key points to be noted from the study include:

→ The critical peak hour period is the PM peak hour;

→ At full buildout, the proposed development will generate 2,900 PM peak hour external trips;

→ The forecast demand with and without development will exceed the capacity of Forest Hills Extension, from Montague Road to Highway 118;

→ The forecast demand for Braemar Drive, just south of Montebello, is 1,100 vehicles per hour (vph) in the peak hour direction.

2.3.2 Summary

The Port Wallace Pre-Design baseline Study, Travel Demand Modelling Report, and the Access Review studies are consistent in their approach. Based on the analysis undertaken by CBCL, which is outlined in Section 2.9 below, CBCL generally agrees with the results of the HRM and WSP studies.

2.4 Access

2.4.1 Existing Access

There are two undeveloped portions of the study area, a portion of lands to the west of Montague Road, south of the highway owned by Conrad and the remainder of the study area to the east of Montague Road/Waverley Road. The Conrad lands front on Waverley Road. The lands to the east front on Waverley Road and have a number of dead end roads which will be used for future site access, these include Avenue du Portage, Rosecroft Drive, Lethbridge Avenue, Belvedere Drive and Lynwood Drive.

There are three existing Halifax Transit bus services, routes 10, 54 and 55 that serve the area surrounding Port Wallace. Routes 10 and 54 travel into the residential areas close to Avenue du Portage, and route 55 travels along Waverley Road.

There are also multiple active transportation trails in the area that encourage active transportation with connections to Waverley Road and Main Street, as well as an existing bicycle lane along Waverley Road/Braemar Drive.

2.4.2 Access Routes - Option Review

Proposed access to the site in the future will still include Waverley Road and Main Street/Caledonia Road. Waverley Road provides access both north to Exit 14 on Highway 107 towards Burnside Industrial Park, and to the Airport, and south towards Main Street, downtown Dartmouth and Halifax, as well as the Eastern Shore. These will continue to be the main access routes during the initial phase of the development as residential areas are constructed. The direct access point into Port Wallace will be via a continuation of Avenue du Portage which would become a spine road through the development. Routes to and from the site were determined in terms of route direction, trips were generated going North, South, East and West. There are a number of route options being discussed at the moment to accommodate the anticipated level of new traffic coming from the development. The route options are described in the following text and are shown in corresponding figures.

2.4.3 Option 1 (Baseline)

Option 1 is shown in Figure 4: Access Option 1 below. New traffic to access Waverley Road at the existing Montebello Drive and Breeze Drive intersections, plus via seven new access points A, B, C, D, E, F and G; Access to Main Street is via the Forest Hills Extension and Caledonia Road intersections. Access to Forest Hills Extension is via the Montague Road interchange. Option 1 includes a bridge connection across Barry's Run.

- → Access A - New intersection with Waverley Road via a vacant lot and an extension of Lynwood Drive (Primary access point);
- → Access B – New intersection with Waverley Road opposite Applewood Lane (Secondary access point); and
- → Access C – New Intersection with Waverley Road opposite Meadow Walk (Secondary access point);
- → Access D – New Intersection with Waverley Road for the Conrad Residential lands. (Location to be determined);
- → Access E – New Intersection with Waverley Road for the Conrad Residential lands. (Location to be determined);
- → Access F – New Intersection with Cono Drive for the Conrad Industrial lands. (Location to be determined); and
- → Access G – New Intersection with Montague Road for the Conrad Industrial lands. (Location to be determined).

Figure 4: Access Option 1

2.4.4 Option 1A

This option consists of Option 1 plus construction of right-in/right-out access from the Forest Hills Extension to the proposed Port Wallace development.

The above details are shown in Figure 5: Access Option 1A.

Figure 5: Access Option 1A

2.4.5 Option 2

This option consists of Option 1 plus construction of a full access (possibly a roundabout) on the Forest Hills Extension to the proposed development. Option 2 does not include a bridge connection across Barry's Run.

The above details are shown in Figure 6: Access Option 2.

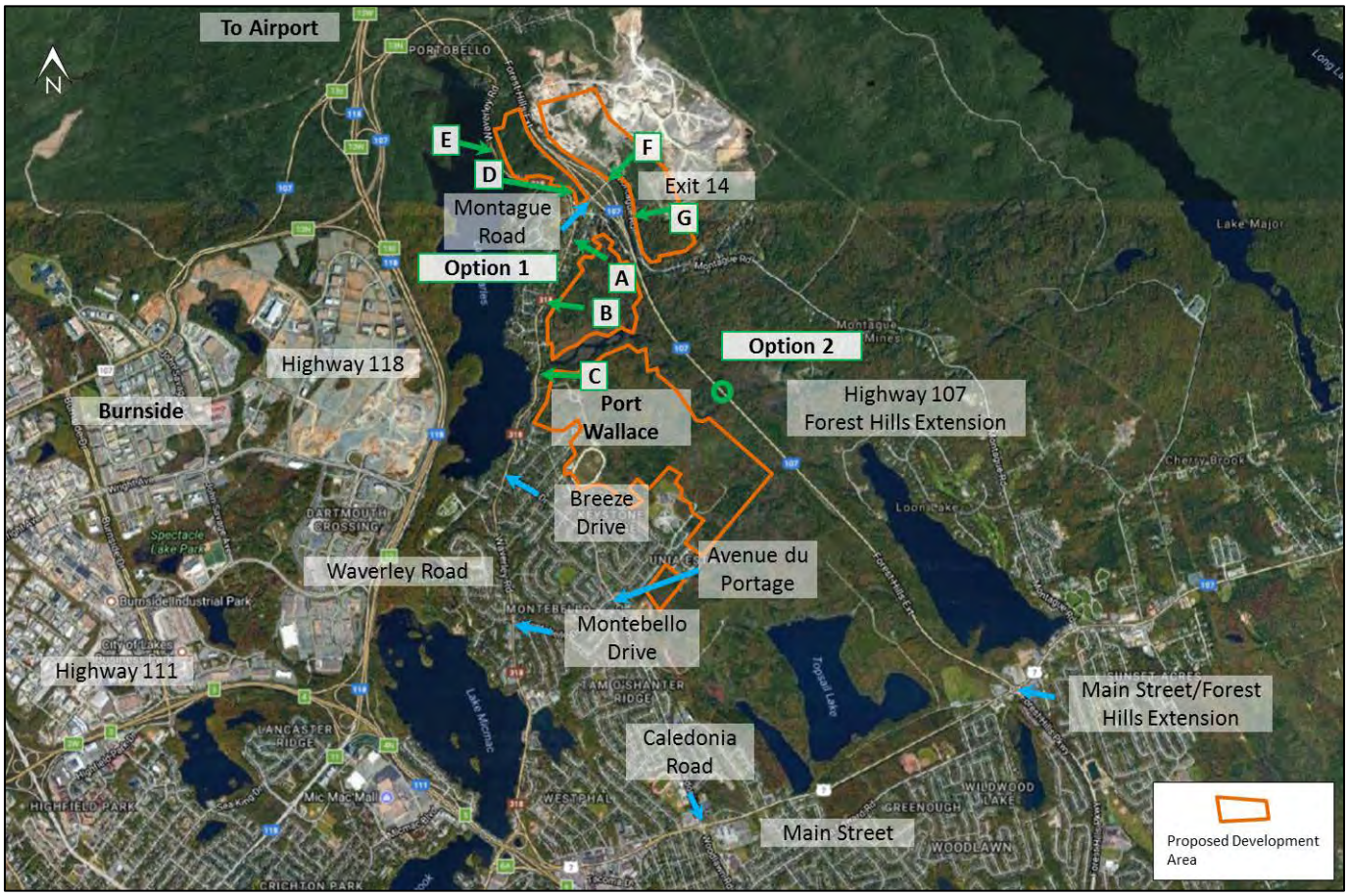


Figure 6: Access Option 2

2.5 Baseline Traffic Volume and Background Growth

2.5.1 CBCL Limited Data Collection

To provide an updated baseline, and to allow us to make a comparison with previous analysis, CBCL Limited undertook traffic turning movement counts over three days in May 2017. The traffic counts were undertaken to establish a new baseline and to provide confirmation of the VISUM modelling and analysis already undertaken by HRM. The counts were made on either Tuesday, May 9; Wednesday, May 10; or Thursday, May 11, 2017 at the following intersections:

→ Waverley Road/Montague Road;
→ Waverley Road/Montebello Drive;
→ Waverley Road/Breeze Drive;
→ Breeze Drive/Montebello Drive/Caledonia Road;
→ Main Street/Caledonia Road/Woodlawn Road;
→ Main Street/Forest Hills Extension/Forest Hills Parkway; and
→ Highway 107/Montague Road ramp terminals.

The hours of data collection included peak hours from 7:00 am to 9:00 am and 4:00 pm to 6:00 pm during the weekdays mentioned above. Traffic counts were conducted for one day at each intersection. The traffic counts were conducted using "Miovision" video traffic data collection technology and were undertaken over as short a time period as possible to minimize the risk of daily or weekly variations. To provide sufficient information by vehicle type, the following classifications were adopted:

→ Passenger vehicles;
→ Medium trucks;
→ Heavy trucks and buses;
→ Pedestrians; and
→ Cyclists.

From the May 2017 traffic counts, we have established the turning movements at key intersections within the study area, creating a baseline traffic conditions. The results of the turning movement counts have been used as the basis of the Synchro modelling work being undertaken.

2.5.2 Trip Patterns

The traffic count data indicates that the distribution of trips to and from the study area show a similar pattern of outbound and inbound trips. For example, traffic volumes using the northbound ramp at the Montague Road interchange during the AM peak hour are similar to the traffic volumes using the southbound ramp during the PM peak hour. This would indicate that commuters are using the same routes during both the morning and evening rush hour periods.

A comparison of the intersection traffic count data obtained by HRM and CBCL Limited shows that although HRM's data were collected between 2009 and 2013 (generally May, September, October), accounting for growth and allowing for variations due to the recording days/times of the year they are very similar to the data collected by CBCL in May 2017. However, CBCL's counts are a little higher as would be expected given 4 to 8 years' worth of background growth within the area. The comparison would also appear to indicate that traffic patterns and volumes have changed very little over an eight year period due to the existing residential neighbourhoods being well established.

2.5.3 Background Growth

We compared the 2031 traffic volumes generated by HRM VISUM, WSP and CBCL without any future development, only background growth, for the key intersections within the study area. Background growth was assumed to be 1% per year for the period from 2017 to 2031. Background growth beyond 2031 was assumed to be 0.75% per year. The results of the comparison show that, including the reported rounding differences, all three sources of data are generally within 200 vehicles plus or minus of each other. Some larger differences appear at various locations within the study area road network, generally CBCL's values are greater than either HRM or WSP's values. This is due to our methodology of adopting a "worst case scenario" for background traffic growth and applying a 1% increase to 2031 across the board. A lower background growth rate would make the corresponding differences smaller. All three sources of data are within reasonable limits accounting for various time periods and rounding differences.

2.5.4 Forest Hills Extension

While comparing the VISUM model with our own 2031 baseline analysis, it became apparent that traffic using the Forest Hills Extension in the northbound direction was much higher in VISUM than in CBCL's analyses.

Through investigating individual turning movements and zone to zone volumes, the volume of traffic coming from the Porter's Lake direction to the Forest Hills Extension northbound showed an increase of over 400 vehicles which were attributed to an unrelated proposed development in the Porter's Lake area. In the VISUM model, these ~400 vehicles are using the Exit 14 northbound ramp to bypass Highway 107 to avoid the congestion on Highway 107, which would not likely occur in reality. Therefore, to represent the worst case scenario, these ~400 vehicles were reallocated from the ramp to the Highway 107 in the Synchro analysis. By removing these ~ 400 trips from the ramp and adding them back on to the main Forest Hills Extension, the traffic volumes at the ramp from the VISUM model and CBCL's analysis on this section were more comparable.

2.6 Trip Generation and Mode Choice

2.6.1 Number of Residential Units, Commercial, and Industrial Areas

Based on the information provided by the land owners, the estimated number of residential units anticipated for the Port Wallace development is 3,744. The analysis also includes 184 acres of light industrial and 152,000 square feet of commercial area. While it is anticipated that the Port Wallace development may have institutional land uses, these land uses typically do not generate or attract trips from outside of the immediate surrounding area.

2.6.2 Trip Generation

The trip generation analysis undertaken by CBCL has been based on standard trip rates from the Institute of Transportation Engineers (ITE) Trip Generation Handbook (9th edition). Note that a comparison of the ITE trip generation rates adopted by CBCL indicates that they are similar to the rates and land use codes used by HRM and WSP in their analysis. At full buildout, the Port Wallace development is expected to generate 3,400 trips during the AM peak hour, and 4,200 trips during the PM peak hour.

2.6.3 Trip Reductions

An estimated buildout timeline of 30 years has been assumed for this development. As we are considering long term future planning for trip generation, there are a number of significant possibilities relating to transportation that we must include in our analysis. For the purposes of this analysis, we have examined AM and PM peak hours as they generally have more trips than any other time of the day.

Trip generation considerations included:

- → The number of jobs within Burnside Industrial Park and at the Halifax International Airport are likely to increase given the level of expansion being proposed at both locations;
- → Based on the rate of advances in vehicle technology, autonomous vehicles are potentially going to be on our roads within the 30 year buildout. Autonomous vehicles have the potential to reduce car ownership as they may provide an on-demand transportation service without the need for private ownership. It is anticipated that this would operate in a similar way to a taxi service, so trips will be made to a specific destination. This could also reduce the requirement for parking space provision currently accommodated in new developments;
- → We also anticipate that a small percentage of people living within the site will also work at some of the shops and schools proposed as part of the multi-use development. These trips are classed as internal trips, and would not impact the surrounding existing road connections during peak hours;

→ We also considered trips by active transportation (AT) instead of by private vehicle. The proposed development includes AT trails, with connections to existing AT facilities around the site for walking and bicycling;
→ There are also opportunities to reduce the number of private vehicle trips by people choosing to use transit services to and from the site. The existing transit services routes 10, 54 and 55 that travel close to the Port Wallace development could potentially be altered to include a loop through the new development, or perhaps a new transit service could be offered based on sufficient demand. One way of helping to reduce private-and particularly single occupancy vehicle trips, would be to encourage the introduction of sustainable, reliable transit services to Burnside Industrial Park and Halifax International Airport. If demand was sufficient, perhaps consideration of a transit hub within the development could also be considered; and
→ We anticipate that some of the residents of the proposed development will be retired. The anticipation is that most residents will be families, and therefore are more likely to be making vehicle trips during the peak hours. However, another shift in traditional working and travel patterns could be that more people will be working from home in the future, or indeed able to work flexible hours to avoid travelling in peak hour traffic.

Assumed trip reduction rates were chosen based on the likelihood of trips not being made during peak hours. The reductions adopted are the same for both AM and PM peak hours due to this being a high level analysis.

Trip reduction rates include non-auto mode share (transit and AT trips) and internal trips. Residential trips were reduced by 27%. Commercial trips were reduced by 75% to account for site synergies. Industrial trips were not reduced.

From a comparison of the HRM and WSP reports, HRM's Port Wallace Master Plan Area Travel Demand Modelling Report (2017) used 10% reduction for non-auto mode choice, and 75% reduction for neighborhood shopping and on site synergies. WSP's Access Review on Proposed Residential Development - Port Wallace (2014) used 20% reduction for non-auto mode choice and 75% reduction for neighborhood shopping and on site synergies.

At full buildout, the Port Wallace development is expected to generate 2,450 net external vehicle trips during the AM peak hour, and 3,050 net external vehicle trips during the PM peak hour.

Based on our analysis, we found that after the trip reductions and non-auto mode choice factors were applied, the adjusted external trips are similar to the HRM and WSP estimates of adjusted trip generation.

2.7 Trip Distribution

We have assumed that there will be five main access routes to the residential developments via the existing access on Avenue du Portage, and Waverley Road. This will be the case until the sites are more developed. Avenue du Portage should be extended through the site as a primary/spine road in the future. The existing access routes are as follows:
→ From Waverley Road via Breeze Drive;
→ From Waverley Road via Montebello Road; and
→ From Main Street via Caledonia Road.

Access to the Conrad residential lands would be directly from Waverley Road at two new access points. Access to the Conrad industrial lands would be from two new access points with Montague Road, and one at the Cono Drive/Montague Road intersection. Access to the Whebby and Unia lands will be via adjacent existing development or through the study area.

2.7.1 Initial Review

In terms of residential trip distribution assumptions, HRM initially adopted the trip distribution percentages from the 2031 PM peak VISUM Regional Travel Demand Model. These percentages were then compared to the trip distribution percentages shown in WSP's Access Review which are as follows:

→ North - 10%;
→ East - 5%;
→ South - 35%; and
→ West - 50%.

Following this, the Origin Destination (OD) tables were adjusted by HRM and the final residential trip distribution assumptions adopted in the VISUM model are as follows:

→ North - 7%;
→ East - 5%;
→ South - 30%; and
→ West - 58%.

2.7.2 Recommended

Each of these general directions of distribution was allocated a percentage of trips to and from the site at 50% (2031) and full buildout (2047). Note that the trip distribution percentages were based on a combination of CBCL's own estimation and the trip distribution percentages used by HRM and WSP, and are as follows:

→ North - 7%;
→ East - 6%;
→ South - 38%; and
→ West - 49%.

Development traffic has been assigned to the available routes based on the CBCL trip assignment assumptions which differed depending on the route option being analysed.

Considering future roadway connections, it is proposed that there be five new access points (A, B, C, D, and E) from the proposed developments on to Waverley Road, as described in section 2.4 above. Other options for access include the construction of a right-in/right-out access only on to the Forest Hills Extension, or a full access on the Forest Hills Extension which we have modelled as a roundabout for the purposes of this study.

2.8 Analysis Assumptions and Constrains

Several assumptions have been incorporated into the concept plan and have been adopted for the transportation analysis. These assumptions and constraints are as follows:

→ Background growth rates applied to our baseline 2017 traffic volumes were 1% per year to 2031, and 0.75% per year from 2031 to 2047;

→ Development is anticipated to commence in 2018. We have assumed a 30 year buildout for this study area, therefore the buildout year is assumed to be 2048. For the purposes of this analysis, a full buildout year of 2047 has been used to accommodate existing models and data. For the purposes of this assessment, it is anticipated that there will be a negligible change in traffic patterns between 2047 and 2048;
→ 2031 is the limit of HRM's VISUM model;
→ We have assumed 50% of the total development area is to be constructed by 2031;
→ An estimate of trip distribution from the entire development at full buildout (2047) has been made using existing and future access points;
→ The residential area would include approximately 3,744 units, split between single-family detached housing, apartments and condos/townhouses;
→ Significant traffic (including private vehicle trips, walking, cycling, transit trips) will be generated by a development of this size and the types of land use anticipated;
→ Assumptions have been made to reduce the number of private vehicle trips from the entire development during peak hours. This is based on percentages of people making internal trips, working from home, using active transportation or transit, amongst other modes or travel patterns;
→ Active transportation, and transit services and use needs form a large part of travel to and from the site, including connections to existing active transportation facilities;
→ Non-auto mode choice was assumed at 10%;
→ Waverley Road is the most likely point of access to the site to/from the Highways 107 and 111, Main Street, and downtown Dartmouth and Halifax, at least initially;
→ The Forest Hills Extension (Highway 107) offers a potential future connection point as the site is developed; and
→ Forest Hills Extension (Highway 107) will be widened by 2031.

2.9 Baseline and Scenario Results

In discussion with HRM, several scenarios were developed for modelling in Synchro based on the access options discussed above, in conjunction with the two horizon years (2031 and 2047), 50% and 100% buildout, and modelled for both AM and PM peak hours. Each modelled intersection was examined in terms of level of service (LoS), and queues and delays, which are the key indicators for intersection analysis.

In summary, the majority of the intersections examined do not have any operational issues under existing 2017 AM and PM peak hour conditions, with the exception of the Main Street/Forest Hills Extension signalized intersection which HRM are aware of. Looking at 2031 AM peak hour conditions and a 50% buildout of Port Wallace, the following intersections show signs of poor operational performance including lower level of service, longer queues and delays for vehicles passing through the intersections:
→ Highway 107 ramp northbound;
→ Waverley Road/Montague Road;
→ Waverley Road/Option 1 Access A; and
→ Breeze Drive/Avenue du Portage/Caledonia Road.

As for the 2031 PM conditions, more intersections display poor operational performance, namely;
→ Highway 107 ramp southbound;
→ Waverley Road/Montague Road;
→ Waverley Road/Option 1 Access A;
→ Waverley Road/Option 1 Access B;

→ Waverley Road/Option 1 Access C;
→ Waverley Road/Montebello Road; and
→ Breeze Drive/Avenue du Portage/Caledonia Road.

Note that our Level of Service (LoS) analyses for 2031 agree with HRM and WSP's recommendation on upgrading Montebello Road at Waverley Road with an additional northbound right turn lane.

Figure 7: Intersections Displaying Poor Operational Performance During the 2031 Peak Hour illustrates

Figure 7: Intersections Displaying Poor Operational Performance During the 2031 Peak Hour

intersections displaying poor performance during the 2031 peak hour.

Although the proposed access points A, B and C show poor level of service at 2031, we assume that the developer will be implementing mitigation measures so that they operate satisfactorily.

Similarly by 2047, using a 0.75% background growth rate beyond 2031, plus the inclusion of a 10% non-auto mode choice, the following intersections show poor level of service during the AM peak hour in addition to the intersections mentioned above for 2031 AM peak hour:

→ Main Street/Caledonia Road;
→ Waverley Road/Access Road B; and
→ Waverley Road/Access Road C.

The following intersections also show poor level of service during the 2047 PM peak hour in addition to the intersections mentioned above for 2031 PM peak hour:

→ Main Street/Caledonia Road; and

→ Highway 107 Exit 14 ramp northbound.

Figure 8: Intersections Displaying Poor Operational Performance During the 2047 Peak Hour illustrates intersections displaying poor performance during the 2047 peak hour.

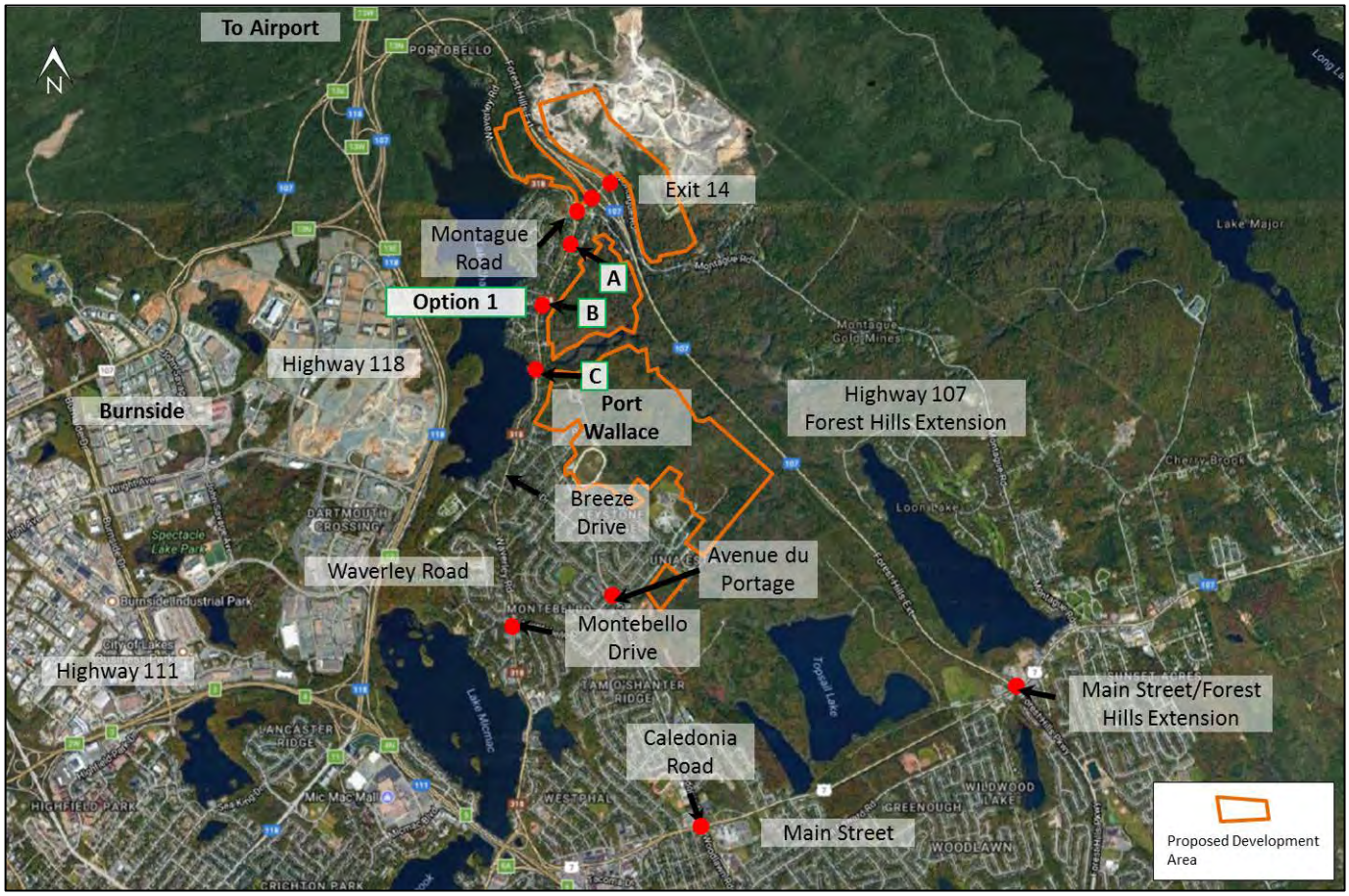


Figure 8: Intersections Displaying Poor Operational Performance During the 2047 Peak Hour

We note that Waverley Road/Braemar Drive south of Montebello, a two-lane arterial road, currently carries approximately 930 vehicles per hour (vph) in the peak direction during the peak period. This is expected to increase to 1,250 vph by 2031 at 50% buildout. For comparison, sections of St Margaret's Bay Road, another two-lane arterial road, currently carry traffic volumes exceeding 1,200 vph in the peak direction during the peak hour. This would suggest that Waverley Road/Braemar Drive could carry similar traffic volumes without the need to widen the roadway before 2031.

Including future Port Wallace development, traffic heading to and from Highway 107 at Exit 14 will use up any spare capacity on the Montague Road overpass which is currently two lanes wide, one lane in each direction. Improvements at each ramp terminal intersection may mitigate the need to widen the structure. Further detailed analysis of future traffic volumes and queue lengths will be required to confirm this.

2.10 Sensitivity Analysis

HRM requested that we run a few sensitivity tests using the VISUM model to examine the impacts of additional scenarios on the surrounding road network.

2.10.1 New Connection to Forest Hills Extension

Firstly, we compared Option 1 and Option 1A. Option 1A offers a right in/right out access from Highway 107. The analysis showed that there is no appreciable difference in overall LOS at the surrounding intersections between Option 1 and Option 1A. However, the results of the analysis did show that the 95th percentile queue length, V/C ratio, and average delay in seconds by intersection approaches improve slightly with Option 1A compared to Option 1.

Therefore, there would appear to be little difference in the impact at the intersections by including a right in/right out access to the Forest Hills Extension.

Similarly, Option 2 (Option 1 plus full access on to the Forest Hills Extension) improves the 95th percentile queue length, V/C ratio, and average delay in seconds by intersection approaches at the Caledonia/Montebello intersection. However, there is no appreciable difference in overall LOS in between Option 1 and Option 2.

Therefore, Option 2 does not eliminate the need to upgrade the Caledonia/Montebello intersection.

2.10.2 Non-Auto Mode Choice

Secondly, we examined the effect of using a 20% non-auto mode choice mode choice in 2047 for full buildout of the development. In reviewing the non-auto mode share percentages used in HRM and WSP's analysis, the VISUM model, which used a 10% value, was adjusted to include a 20% value.

The results of this analysis showed that conditions at both northbound and southbound ramps on the Highway 107 Forest Hills Extension improved such that there was no operational issue at these locations during the AM peak period. However, during the PM peak period, conditions at all intersection location were the same as with the 10% non-auto mode choice.

There was very little difference in overall traffic volumes based on the two values, therefore, there would appear to be little benefit in the impact to the surrounding intersections from a 20% non-auto mode choice. However, we believe that non-auto modes, in particular, transit and active transportation should be widely supported and encouraged for the Port Wallace development given the level of trips generated during the buildout period.

2.10.3 Forest Hills Extension Twinning

Lastly, we examined the impact of twinning the Highway 107 Forest Hills Extension from Exit 14 to the interchange with Highway 118. Using the VISUM model, we examined the forecast travel demand on this section of highway with and without the Port Wallace development. Currently, peak hour traffic volumes in the peak direction are estimated at 1,400 to 1,600 vehicles per hour (vph). This is at or near the capacity of this two-lane highway section. Without the Port Wallace development, 2031 peak hour travel demand on this section is expected to exceed 1,900 vph in the peak direction. With the Port Wallace development, peak hour travel demand is expected to exceed 2,300 vph in the peak direction.

Using the VISUM model and adjusting the links which represent this section of highway, we changed the link type from one lane in each direction to two lanes in each direction which simulates a twinned highway. From the analysis, it was found that 170 additional vehicles are heading to the north via the new twinned highway during the AM peak period. Moreover, there is an extra 40 vehicles using the twinned highway to come south during the AM peak period. Similarly, during the PM peak period, there are additional 255 vehicles coming to the south via the twinned highway. The results of this analysis show that there is a significant difference in the volumes of directional traffic, specifically traffic heading to the north and south via the Highway 107 ramps. The twinned highway attracts significantly more vehicles than the existing two lane highway. In addition, should an intersection on the Forest Hills Extension from the Port Wallace development be constructed and the highway twinned from this intersection, this would alleviate traffic issues at the Waverley Road and Exit 14 ramp terminals.

While the Port Wallace development will add traffic to the section of Highway 107, from the Exit 14 interchange to the interchange with Highway 118, improvements to this section of highway will be needed with or without the development.

2.11 Infrastructure Plan

The surrounding road network has been assessed under a number of different scenarios. Each potential development layout or infrastructure configuration will generate a different trip distribution. This affects the level of service at each intersection and therefore the potential required infrastructure upgrades. Detailed analysis will be required at the time of preliminary/detailed design to determine the appropriate upgrade for each intersection.

For the purpose of the costing discussion given herein, we have compared two scenarios: 2031 without Port Wallace vs 2031 with Port Wallace, as most of the upgrades are triggered by 2031, with the remaining being required before 2047. Both scenarios show intersections with poor levels of service. Preliminary estimated upgrade timelines have been developed for this study and are provided below.

As indicated above, the way the development will connect to existing infrastructure is undefined at this point. For the purposes of this study we have reviewed Infrastructure configuration Option 1 at full buildout. Intersections have been reviewed to determine the trigger point where level of service is no longer acceptable based on the anticipated increased traffic volumes. This trigger point was established on an individual basis for each intersection based on the total number of vehicles, the total wait time and an overall level of service for all turning movements within the intersection. The cost of the transportation upgrades is shown in Table 2 below.

The recommended infrastructure improvements shown above are described in more detail in the section below, and have been grouped by specific geographic corridors**.** Figure 9: Infrastructure Improvement Corridor shows the infrastructure improvement corridors recommended to be upgraded based on our analysis.

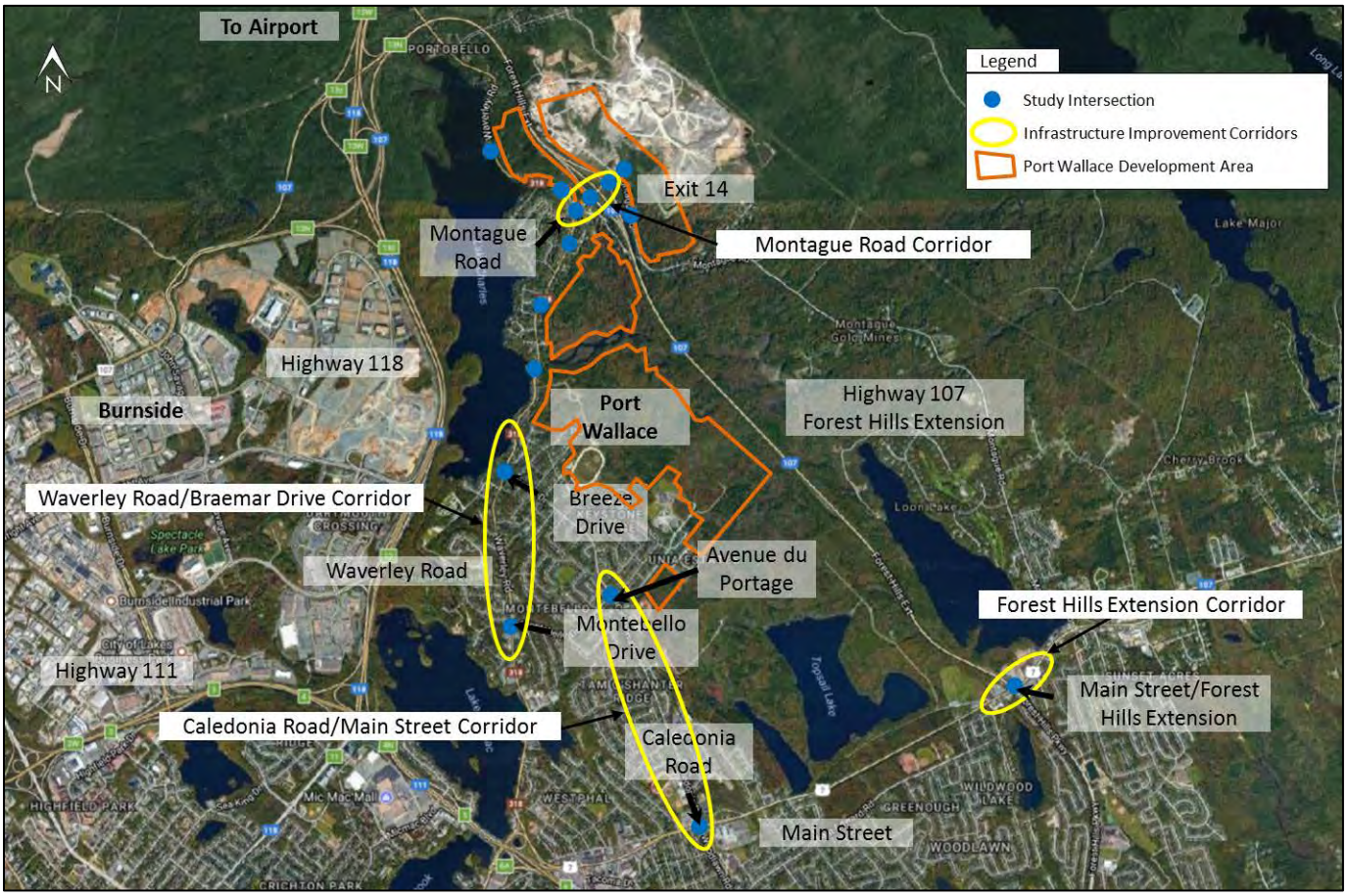


Figure 9: Infrastructure Improvement Corridor

2.11.1 Montague Road Corridor

Looking at the analysis completed and at some of the individual intersections and upgrades required based on Option 1, and for a 50% buildout at 2031, the following points should be noted:

→ Montague Road and Ramp Terminal (South) – The Highway 107 Exit 14 south ramp terminal will also require a roundabout to accommodate development traffic coming from Port Wallace heading towards the highway.

This roundabout would need to be 50 metre diameter with a single circulating lane and a southbound right turn lane to remove this movement from the traffic passing through the roundabout, in particular the left turn movement.

Trigger Point: 10% buildout (400 residential units)

→ Montague / Charles Keating / Waverley – The existing Montague Road / Waverley Road stop controlled intersection will require a single lane roundabout, while maintaining the right turn slip lane from Montague Road.

Trigger Point: Construction of the Montague/Ramp Terminal South Roundabout.

→ Montague Road and Ramp Terminal (North) – The Highway 107 Exit 14 north ramp terminal will require a roundabout to accommodate development traffic coming from Port Wallace heading towards the highway.

This roundabout would need to be 50 metre diameter with a single circulating lane. In addition, this intersection should also include a westbound right turn slip lane on the approach to the roundabout to remove this movement from the through traffic. An eastbound through traffic bypass lane could also be included to remove the conflict between through traffic and left turn traffic.

Trigger Point: Development of the Conrad Industrial Lands and/or 30% residential development (1100 residential units).

→ Montague Road at Cono Drive (Access F) – Improvements to this intersection will be needed to accommodate the development of the Conrad Industrial lands. This plan assumes that a single lane roundabout will be required, however given its proximity to the Montague Road/Ramp Terminal North intersection, a single five-leg roundabout may be required. Further analysis will be required. Access G/Montague Road – additional access from Conrad Industrial Lands.

Trigger Point: Development of the Conrad Industrial Lands or construction of the Montague/Ramp Terminal North roundabout.

→ Montague Road Overpass – Including future Port Wallace development, traffic heading to and from Highway 107 at Exit 14 will use up any spare capacity on the Montague Road overpass which is currently two lanes wide, one lane in each direction. Based on the inclusion of a roundabout at each ramp terminal, and through providing bypass and slip lanes, any peak hour queuing across the bridge should be accommodated within the existing cross section of one lane in each direction. This would mitigate the need to widen the structure at this time, however further more detailed analysis of future traffic volumes and queue lengths would be required to determine if the structure would need to be widened at a later date.

Trigger Point: TBD.

2.11.2 Waverley Road/Braemar Drive Corridor

→ Access A / Waverley – Assume two lane westbound approach as Access A. Install a southbound left turning lane on Waverley Road. Install traffic signals.

Trigger Point: 0% buildout. Southbound left turn lane on Waverley Road and traffic signal civil works will be needed when Access Road A is constructed. It is assumed that Access Road A will be one of the first roads constructed. Traffic signals (electrical) will be constructed by the local developer when signals are warranted.

→ Access B / Applewood Lane and Waverley Road – Install a southbound left turning lane on Waverley Road. Traffic signals if required will be the responsibility of the local developer.

Trigger Point: TBD by the local developer.

→ Access C / Meadow Walk & Waverley – Install a southbound left turning lane on Waverley Road. Traffic signals if required will be the responsibility of the local developer.

Trigger Point: TBD by the local developer.

→ Access D / Waverley Road – Install a northbound left turning lane on Waverley Road. Traffic signals if required will be the responsibility of the local developer.

Trigger Point: TBD by the local developer.

→ Access E / Waverley Road – Install a northbound left turning lane on Waverley Road. Traffic signals if required will be the responsibility of the local developer.

Trigger Point: TBD by the local developer.

→ Breeze / Waverley – Install additional westbound lane on Breeze Drive, and install traffic signals.

Trigger Point: 70% buildout (2,600 residential units).

→ Montebello / Waverley – Install northbound right turn lane on Waverley Road.

Trigger Point: 50% buildout (1,900 residential units).

2.11.3 Breeze Drive/Caledonia Road Corridor

→ Montebello / Avenue du Portage / Caledonia / Breeze – Install traffic signals.

Trigger Point: 10% buildout (400 residential units) and/or the extension of Avenue du Portage (Access A) to Waverley Road.

2.11.4 Forest Hills Extension

→ Forest Hills Extension Twinning – The requirement for twinning of Highway 107 from Exit 14 to Highway 118 at Burnside will need to be monitored as time goes by. This upgrade would need to be instigated in conjunction with NSTIR. This study assumes that twinning will occur by 2031.

Trigger Point: TBD

→ New connection to Forest Hills Extension – Option 1A considers a right in / right turn out connection on Highway 107. Option 2 considers a full access to Highway 107 (Roundabout or Interchange). While a new connection to Highway 107 would improve operations on Waverley Road and the Montague Road interchange, it has not been costed as part of this Infrastructure Plan.

Trigger Point: Not Considered.

2.11.5 Main Street

→ Main / Caledonia / Woodlawn – Traffic signal optimization.

Trigger Point: 70% buildout (2600 residential units).

→ Main / Forest Hills – This intersection is at or near capacity during the peak hour. Upgrades to this intersection will be required if the Cherrybrook Bypass is not constructed. For the purposes of this study, it is assumed that this intersection would be converted to a multi-lane roundabout.

Trigger Point: TBD.

2.11.6 Cost Estimates, Timing, and Cost Sharing

Class D cost estimates are presented in Table 2 and include a 45% contingency, and 12% engineering fees. The cost estimates are in 2017 dollars and do not include land acquisition. For upgrades where the trigger point has not been determined, the timing of these projects for cost estimating purposes were established as noted below.

For upgrades that will be funded 100% by the local developer Access points A, B, C, D, E, and G, these projects have not been included in Table 2. Access point F (Cono Drive) has been included in Table 2 as it would be a cost shared project between HRM and local developer. The Forest Hills Extension twinning project has not been included since it will be needed with or without the Port Wallace development.

Improvements to the Main at Forest Hills Extension were assumed to occur at 50% buildout for costing purposes. Looking at the Main Street/Forest Hills Extension intersection, HRM is aware that there is a significant volume of traffic using this intersection even before the Port Wallace development goes ahead. Our analysis shows that less than 5% of the total trips (including residential, industrial, commercial and institutional) generated by the development would use the Main Street/Forest Hills Extension intersection. This in turn represents a smaller percentage of the cost sharing by the local developers at this location.

Many of these existing intersections are currently at a satisfactory level of service, and therefore have additional available capacity. The capacity of a few intersections is exceeded over the timeline of this development due to increased road use, triggering upgrade requirements. Increased road use originates from a combination of the Port Wallace development and background growth. Cost sharing has been allocated based on HRM Capital Cost Contribution policy with background growth included as an HRM responsibility.

Should Port Wallace not proceed, some existing intersections within the study area are shown to require upgrades over the next 30 years based on background growth alone. These intersections are: Montague Rd / Ramp Terminal (South), Main / Forest Hills, and Montebello / Avenue du Portage / Caledonia / Breeze. It is anticipated that the costs for upgrading these intersections would be shared between the developers and HRM.

Cost sharing has been typically allocated based on the % share of total traffic approaching (or exiting) an intersection. When using the model (as opposed to a manual trip distribution and assignment) to estimate cost sharing, there is induced traffic. This is traffic that shifts from one facility to another when road system capacity is changed. Spare capacity is equally allocated to background and site generated traffic.

The HRM CCC policy states that: *"… In cases where existing traffic has been shifted from an existing facility, thereby releasing capacity for use by traffic generation in the charge area, no direct benefit will be attributed to the Municipality…"*

To factor this in, % traffic share has been allocated by comparing the 2031 PM Peak model run without Port Wallace to the 2031 PM peak model run with Port Wallace. The 2031 model with and without Port Wallace includes background growth.

The model results are given below in Table 2**.**

Table 2: Cost Sharing Between Developers and HRM

Project	Cost ($M)	Baseline Volume Without Development	Baseline Volume With Development	Volume Difference	Developer Share	Developer Share (Rounding Adjustment)	Developer Cost ($M)	HRM Cost ($M)
Cono Drive (Access F)	2.40	830	1,500	670	44.7%	45%	1.1	1.3
Ramp Terminal (North)	2.40	1,000	1,750	750	42.9%	45%	1.1	1.3
Ramp Terminal (South)	2.40	1,500	2,300	800	34.8%	35%	0.8	1.6
Charles Keating	2.40	1,200	2,000	800	40.0%	40%	1.0	1.4
Waverley at Breeze	0.70	650	1,300	650	50.0%	50%	0.4	0.4
Waverley at Montebello	0.35	1,300	1,900	600	31.6%	30%	0.1	0.2
Main at Forest Hills	10.00	4,250	4,700	450	9.6%	5%	0.5	9.5
Main at Caledonia	0.00	3,250	4,300	1050	24.4%	25%	0.0	0.0
Caledonia at Avenue du Portage	0.40	700	1,300	600	46.2%	45%	0.2	0.2
Total Cost (with Main at Forest Hills)	**21.05**						**5.1**	**16.0**
Total Cost (without Forest Hills)	**11.05**						**4.6**	**6.5**
Total Developer Share (with Main at Forest Hills)	**24%**							
Total Developer Share (without Main at Forest Hills)	**42%**							

Chapter 3 Wastewater

3.1 Introduction

3.1.1 Objectives

This analysis has the objective of evaluating the existing sanitary system capacity downstream of the planned Port Wallace Development, and identifies potential upgrades in order to service this development's wastewater flows. The existing sewer system and planned Port Wallace development are shown in Figure 10: Existing Sanitary Sewershed in Relation to Proposed Development Area. Letters A and B Denote the Start and End of the Profile in Figure 11.

The limiting sections of the existing sanitary system have been identified by comparing the available capacity of the existing system with the projected flows of the proposed development. If, for a given phase of development, the projected flows exceed the available capacity, updates are required prior to that phase of development. Upgrades of the downstream system have been designed to meet the ultimate service requirements of the development at full buildout.

This chapter presents calculations of future design flows and an assessment of existing system capacity. The results show, for each section, at which phase of development upgrades will need to be completed.

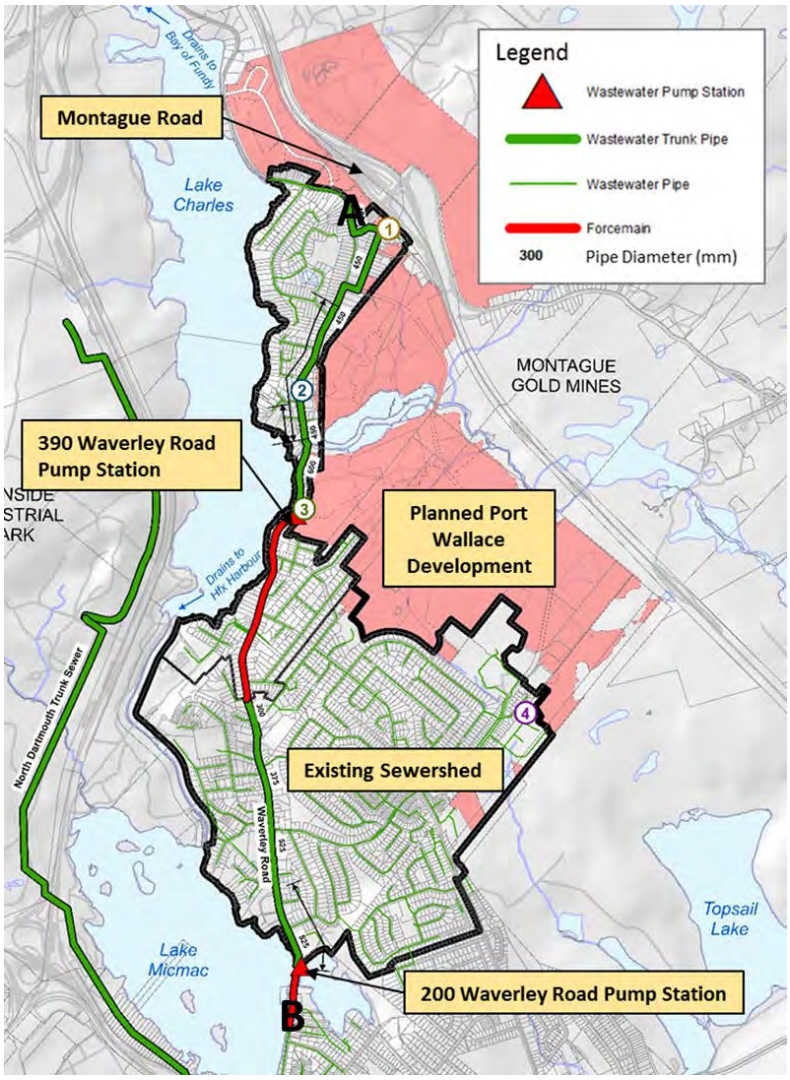


Figure 10: Existing Sanitary Sewershed in Relation to Proposed Development Area. Letters A and B Denote the Start and End of the Profile in Figure 11

3.1.2 Existing System

The existing gravity system is depicted in plan view in Figure 10: Existing Sanitary Sewershed in Relation to Proposed Development Area. Letters A and B Denote the Start and End of the Profile in Figure 11 and in profile in Figure 11: Profile of Existing Sanitary Sewer System. The existing sewer originates at the intersection of Montague Road and Waverley Road and continues south along Waverley Road to a pumping station (PS) at 390 Waverley Road. Flow is then pumped further south on Waverley Road into another gravity sewer system. This gravity system discharges to the pumping station at 200 Waverley Road, which pumps to the Dartmouth Trunk Sewer. The topography in the area explains the need for two pumping stations in the area. A complete gravity system could only be constructed with excavations in the order of 20m of depth.

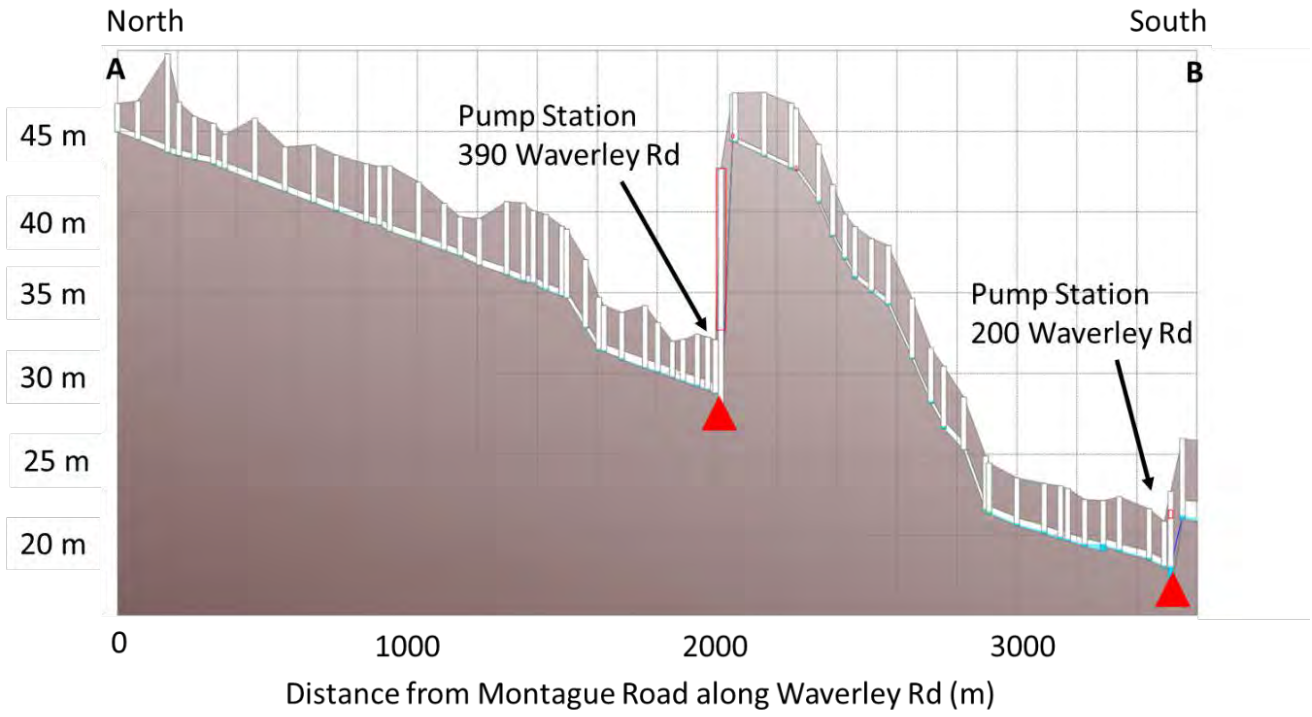


Figure 11: Profile of Existing Sanitary Sewer System

The gravity system upstream of the 390 Waverley Road PS is comprised of concrete pipes with diameters in the order of 400mm to 600mm (according to the Halifax Water GIS). Downstream, between the 390 Waverley Road PS and the 200 Waverley Road PS, the gravity system has similar slopes, but is comprised of smaller diameter pipes, that range from 375mm to 525mm. This section of gravity sewer therefore has a lower overall capacity compared to the gravity system upstream of the 390 Waverley Road PS.

3.1.3 Proposed Changes

The proposed Port Wallace development area is shown in Figure 10: Existing Sanitary Sewershed in Relation to Proposed Development Area. Letters A and B Denote the Start and End of the Profile in Figure 11**.** The proposed area is composed of varied land ownership and land uses (as shown in Figures 1, 2 and 3 respectively in previous chapters). The new wastewater system will connect to the existing wastewater system at distinct connections points. Four connection points have been identified based on: (1) pre-development grading (i.e., LIDAR flow paths), (2) the conceptual layout of the proposed development (provided by the developers), and (3) spatial arrangement of existing parcels.

Therefore, the location of the connection points are subject to change:

→ Connection Point 1 is at the intersection of Wilcot Lane and Lynwood Drive;

→ Connection Points 2 and 3 are along Waverley Road, at Applewood Lane and at the 390 Waverley Road Pump Station respectively; and

→ The fourth connection point, at Stanfield Avenue, is off of the main trunk sewer, at the fringe of the existing sewer system.

The connection points and associated contribution areas are shown in Figure 12: Connection Points Where the Proposed Wastewater System will Connect into the Existing System, and Associated Contribution Areas.

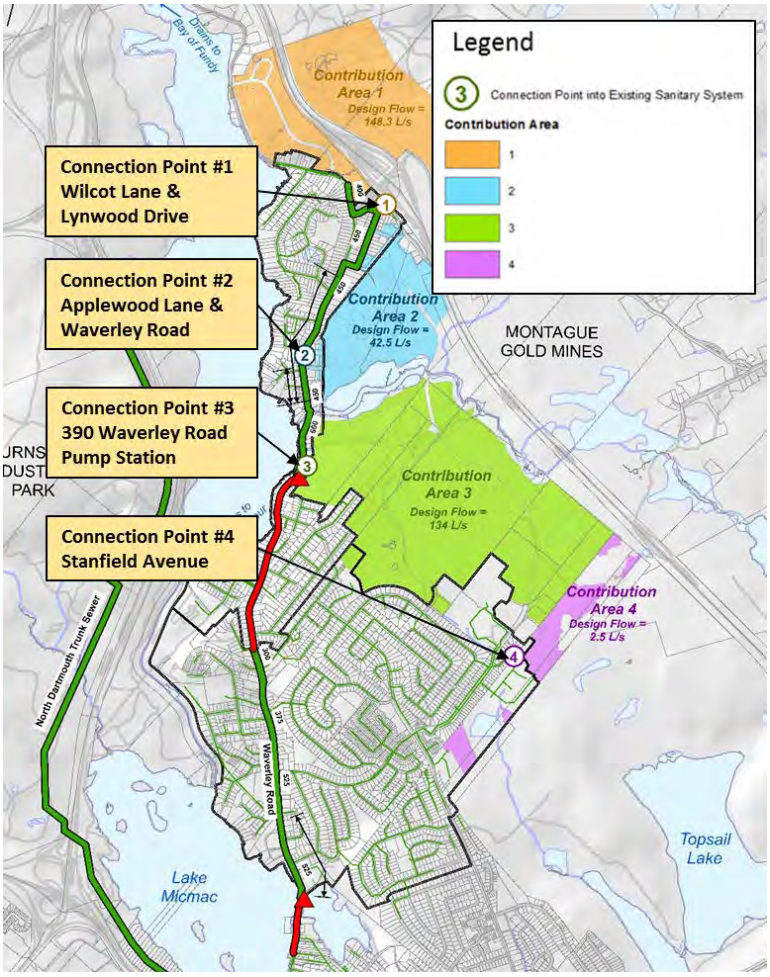


Figure 12: Connection Points Where the Proposed Wastewater System will Connect into the Existing System, and Associated Contribution Areas

3.1.4 Previous Studies

Several studies have previously been completed and contribute to the understanding of the existing sanitary system:

→ The Dartmouth Cove Wastewater Management Study (CBCL Limited, 2007) analysed possible routing paths for the future wastewater flows from the Port Wallace development, recommending the option of routing the flows to the North Dartmouth Trunk Sewer;

→ The Halifax Water Cost of Servicing Plan (CBCL Limited, 2009) noted that the 390 Waverley Road Pump Station will need to be upgraded to receive wastewater flows from the Port Wallace development;
→ The Regional Wastewater Functional Plan (CBCL Limited, 2012) provided a capacity analysis of the North Dartmouth Trunk Sewer (NDTS) and its downstream system. The impacts of future flows from the Port Wallace development to the NDTS was also evaluated, and confirmed the NDTS had adequate capacity to handle flow from this development; and
→ A drawdown test of the 390 Waverley Road Pump Station was carried out by DesignPoint on January 29, 2015.

3.1.5 Scope

The following analyses were included as part of the wastewater component of this study:
→ Capacity analyses of the 390 Waverley Road Pump Station, the 200 Waverley Road Pump Station and their respective upstream wastewater systems were completed to assess future partial development conditions for Port Wallace. These analyses were not previously carried out as part of the Regional Wastewater Functional Plan (CBCL Limited, 2012); this was confirmed by CBCL Limited and Halifax Water during the May 31, 2017 meeting;
→ A wastewater capacity analysis of the North Dartmouth Trunk Sewer with respect to the Port Wallace development was not completed, because this analysis was done as part of the Regional Wastewater Functional Plan (CBCL Limited, 2012); this was confirmed by CBCL Limited and Halifax Water during the May 31, 2017 meeting; and
→ Since the intent of this masterplan is to establish long term infrastructure requirements, detailed design of the sanitary system was not included.

3.2 Methodology

3.2.1 Specifications

The sanitary system analysis presented here follows the most up-to-date version of the Halifax Water Design Specification for water, wastewater & Stormwater systems 2017. In addition to this, all assumptions for non-residential properties (industrial and commercial) were based on the Atlantic Canada Wastewater Guidelines Manual (Environment Canada, 2006).

3.2.2 Approach

The following steps were undertaken as part of this analysis:
1. Calculation of design flows into the existing sanitary system based on the existing sewershed areas and land uses (Section 4.2.3);
2. Calculation of design flows for the proposed Port Wallace development into each of the four connection points (Section 4.2.3);
3. Drawdown analysis for the 200 Waverley Road Pump Station (Section 4.2.4);
4. Hydraulic modelling of the existing sanitary system (pipes and pump stations) (Section 4.2.5);
5. Calculation of the remaining capacity of the existing system based on the existing flows (Section 4.2.6); and
6. Comparison of the remaining capacity of the existing system with the future development design flows (Section 4.2.7).

3.2.3 Design Flow Calculations

Design flows were calculated for both for the proposed Port Wallace development and for the existing sanitary system using the equations in the specifications described above.

→ For the existing system, flows were calculated based on the types and numbers of establishments within the existing sewershed;

→ For the proposed development, flows were calculated to the four connections points detailed above. The proposed development areas and number and type of units for the proposed development were based on information provided by the developers; and

→ It is noted that these design flows were calculated based on the equations in the specifications described above, and therefore not calibrated based on flow gauges.

The following assumptions were made based on the specifications described above. Assumed flow allowances, operational periods and peaking factors for various types of establishments are presented in Table 3.

→ Safety Factor 1.25;

→ I/I Allowance: 0.28 L/ha/s;

→ Single Unit Dwelling: 3.35 people/unit;

→ Townhouse: 3.35 people/unit; and

→ Multi-Unit Dwelling: 2.25 people/unit.

Table 3: Flow Allowance Assumptions for Various Types of Establishments

Type of Establishment	Daily Flow Allowance	Operational Period	Peaking Factor
Light Industrial/Commercial Area	35,000 L/ha	12 hours	1.0
Residential	300 L/person/day	24 hours	(Harmon)
School	105 L/person/day	8 hours	1.5
Restaurant	225 L/seat/day + 100 L/employee/day	16 hours	2.0
Carwash	340 L/car/day	16 hours	4.0
Gas Station	20 L/car/day	24 hours	4.0
Industrial/Commercial Building	45 L/person/day	12 hours	2.0

3.2.4 Pump Station Drawdown Analyses

A drawdown test of the 390 Waverley Road Pump Station had previously been carried out by DesignPoint on January 29, 2015. To close the information gap on the capacity of the 200 Waverley Road Pump Station, CBCL Limited and Halifax Water completed a drawdown test at that location on June 19, 2017.

3.2.5 Hydraulic Modelling

The EPA-SWMM5 modelling engine was used in combination with the PCSWMM interface to assess the capacity of the existing sanitary system. The hydraulic model uses the characteristics of the existing sanitary system's pipes (e.g., sizes, slopes, material, spatial arrangement) and pump stations (e.g., information from drawdown analyses) to assess how much flow the system is able to transmit downstream.

3.2.6 Remaining Capacity of Existing System

Next, the hydraulic model was used to evaluate the remaining capacity of the existing system.

→ Firstly, the existing flows calculated above were inputted into the model to identify whether sections of the existing system are currently under capacity; and

→ Secondly, flows were incrementally increased to determine the maximum amount of flow that can be added in addition to the existing flow until a pipe is full. This is called the "remaining capacity" or "flow thresholds", because flow above this threshold requires an upgrade to the existing system.

3.2.7 Required Upgrades to Service Proposed Design Flow

Once the above results were obtained, the flow capacity thresholds were compared with the calculated future design flows. Some parts of the system were found to already have the capacity to absorb the future development flows (see Results and Recommendations below). For the locations that did not have sufficient capacity, the percentage of development (or "phase" of development) at which the upgrade would be necessary was calculated.

> *For example, if the flow capacity threshold downstream of a connection point is 50 L/s and the future development design flow at that connection point is expected to be 100 L/s, the upgrade will be necessary by the time 50% of development occurs.*

3.3 Results and Recommendations

Results are presented in the following order: the design flow calculations are reported first, followed by the results of the capacity analysis and associated recommended upgrades.

3.3.1 Future Development Design Flows

The calculated design flows for Contributions Areas 1-4 of the proposed Port Wallace development are presented in the "Total Design Flow" column of Table 4. The largest flows are expected from Connection Points 1 and 3, with only minor flows at Connection Point 4.

Table 4: Estimated Wastewater Design Flows for Port Wallace

Connection Point #	Connection Point Location	Development Type	Development Area	Design Flow [HW Formula] (L/s)	Total Design Flow (L/s)	Cumulative Design Flow (L/s)	Remaining Capacity (L/s)	Percentage of Development (%)
1	Wilcot Lane & Lynwood Drive	Residential	PW-2 (Conrad)	28.7	148.3	148.3	111.0	75
		Light Industrial	PW-1 (Conrad)	119.6				
2	Applewood Lane & Waverley Road	Residential	PW-3 (Port Wallace Holdings Limited)	39.4	42.5	190.8	173.0	91
			PW-7 (Port Wallace Holdings Limited)					
		Institutional	PW-3 (Port Wallace Holdings Limited)	3.1				
3	390 Waverley Road PS	Residential	PW-4 (Port Wallace Holdings Limited)	125.2	134.0	324.8	N/A	>100
			PW-5 (Port Wallace Holdings Limited)					
			PW-6 (Port Wallace Holdings Limited)					
			PW-8 (Port Wallace Holdings Limited)					
			PW-9 (Port Wallace Holdings Limited)					
			PW-10 (Unia)					
		Commercial	PW-5 (Port Wallace Holdings Limited)	8.8				
			PW-6 (Port Wallace Holdings Limited)					
			PW-8 (Port Wallace Holdings Limited)					
4	Stanfield Avenue	Residential	PW-11 (Unia)	2.5	2.5	2.5	N/A	>100

3.3.2 Remaining Capacity of Existing System and Rcommended Upgrades

Recommendations are as follows (explained in more detail below):

1. Upgrade 390 Waverley Road Pump Station;
2. Upgrade Wastewater Pipes at 75% Development of Area 1; and
3. Revise Analysis Upon Changes to Planned Development.

1. Upgrade of 390 Waverley Road Pump Station

The key limiting component of the existing sanitary sewer system was found to be the 390 Waverley Road Pump Station. Based on a drawdown test (DesignPoint, January 29, 2015), the firm capacity of the 390 Waverley Road Pump Station is 37.0 l/s. Given that flows from the existing sewershed were calculated at 47.8 l/s (using the current HW design formula), this means that this Pump Station's current capacity is below its design capacity and that there is no available capacity for the proposed development. Figure 13: Proposed Rerouting of Flow from 390 Waverley Road Pump Station to North Dartmouth Trunk Sewer shows the comparison of upstream flows and pumping station capacities. This information therefore indicates that an upgrade to the 390 Waverley Road pumping station would be required to service any upstream future development. This upgrade should occur before development in the Port Wallace area is undertaken.

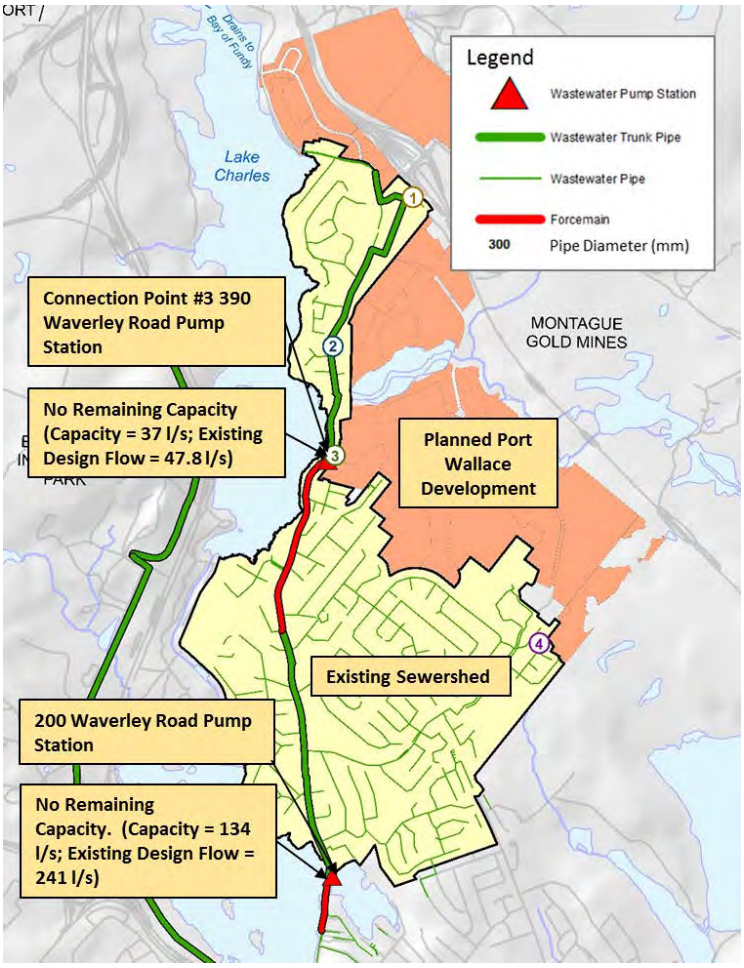


Figure 13: Proposed Rerouting of Flow from 390 Waverley Road Pump Station to North Dartmouth Trunk Sewer

2. Upgrade Wastewater Sewer Pipes at 75% Development of Area 1

If wastewater flows from Contribution Area 1 are directed to the wastewater system upstream of Connection Point 1 and exceed 111 L/s, upgrades to the wastewater system would be required. This upgrade is shown as Phase 2 in Table 5 (also see Figure 14: Proposed Options for Rerouting of Flow from 390 Waverley Road Pump Station).

Table 5: Summary of Required Upgrades to the Existing Sanitary System

PHASE #	PHASE 1	PHASE 2
Connection Point	3	1
Contribution Area(s)	All	1
Developers	Conrad, Port Wallace Holdings Limited, Unia	Conrad
Remaining Capacity (L/s)	0	111
Total Design Flow (L/s)	324.8	148
Percentage of Contribution Area Development at Which Threshold is Reached	0%	75%
Capital Works	1) Replace 390 Waverley Road Pumping Station 2) New forcemain from Pumping Station to North Dartmouth Trunk Sewer. This includes: • New trench under Jaybe Drive and Ethel Court; • Crossing under; Shubenacadie Canal; and • Crossing under Highway 118.	Pipe Upgrade - 350m of 450mm pipe Upstream of Wilcot Lane Note: Only needed if connection is made upstream of Wilcot Lane.

3. Revise Analyses upon Changes to Planned Development

Although it was found that, other than the necessary upgrades mentioned above, the remaining sanitary system has adequate capacity to meet the service demands of the existing area, thresholds at which the capacity of the existing system would be surpassed were still identified throughout the sewer. It was found that several locations would be at or near capacity with full development. For example, sections near capacity at full development include portions of the gravity system between Highway 107 and the 390 Waverley Road Pump Station. Therefore, it is recommended that the flows be reassessed if there are future changes and refinements to the proposed development.

3.3.3 Options for Rerouting Flow from 390 Waverley Road Pump Station

It was shown in the previous section that both the 390 Waverley Road and 200 Waverley Road Pump Stations are under capacity according to the current design standards. Upgrading the 390 Waverley Road Pump Station will increase the amount of flow that has to be carried by the downstream system. It is therefore important to evaluate the available options to convey the increased flows through the downstream system. Figure 14: Proposed Options for Rerouting of Flow from 390 Waverley Road Pump Station shows three potential options that have been investigated:

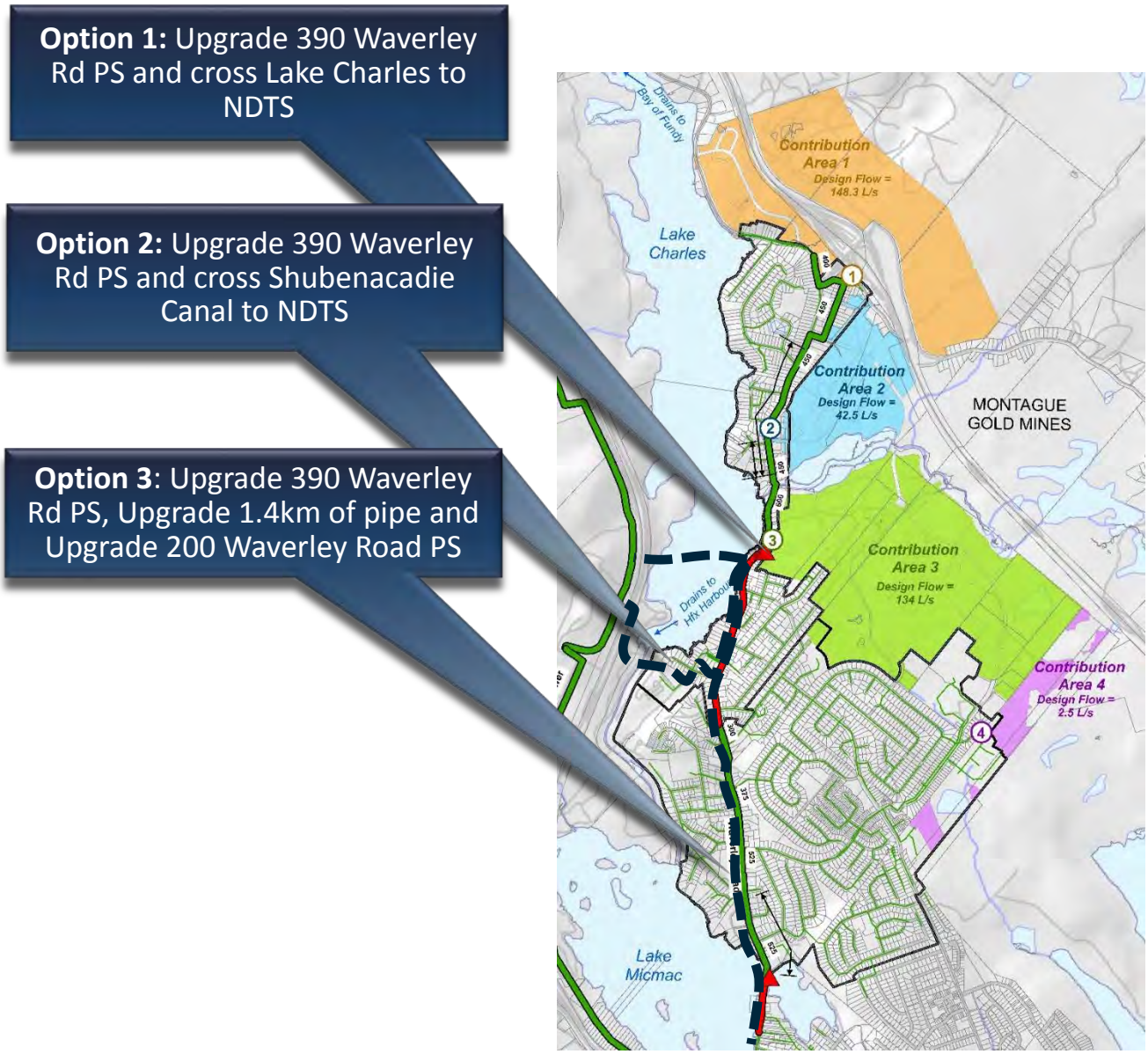


Figure 14: Proposed Options for Rerouting of Flow from 390 Waverley Road Pump Station

1. **Reroute Flow from 390 Waverley Road Pump Station to North Dartmouth Trunk Sewer by Crossing Lake Charles**

This is an option that had been investigated in the Dartmouth Cove Wastewater Management Study (CBCL, 2007) and was promoted as having potentially lower costs than crossing under the Shubenacadie Canal. Halifax Water investigated this option, and made the decision in September 2016 that it was not feasible from an access and maintenance perspective. This option was therefore not pursued further.

2. Reroute Flow from 390 Waverley Road Pump Station to North Dartmouth Trunk Sewer

The capacity analysis revealed that the 200 Waverley Road Pump Station is also under capacity and that several sections of wastewater pipes upstream of the 200 Waverley Road Pump Station are very close to capacity. The capacity analysis was based on published flow calculations in the Halifax Water Design Specification for water, wastewater and stormwater systems 2017 which include a 1.25 safety factor. It is recommended that the 390 Waverley Road Pump Station forcemain be rerouted to the NDTS west, across the Shubie Canal to the North Dartmouth Trunk Sewer on Highway 118.

Redirection of the flow will mean that the 200 Waverley Road Pump Station will not receive flows from proposed Contribution Areas 1-3. Furthermore, the area to be rerouted to the North Dartmouth Trunk Sewer represents 30.2% of the existing sewershed (hatched in Figure 15: Proposed Rerouting of Flow from 390 Waverley Road Pump Station to North Dartmouth Trunk Sewer), which means that approximately 30% of the flows to the 200 Waverley Road Pump Station will be relieved. This decrease in flows will largely offset the additional flow from Contribution Area 4, which will connect at Stanfield Avenue (downstream from the Pump Station at 390 Waverley Road) and will flow to the 200 Waverley Road Pump Station.

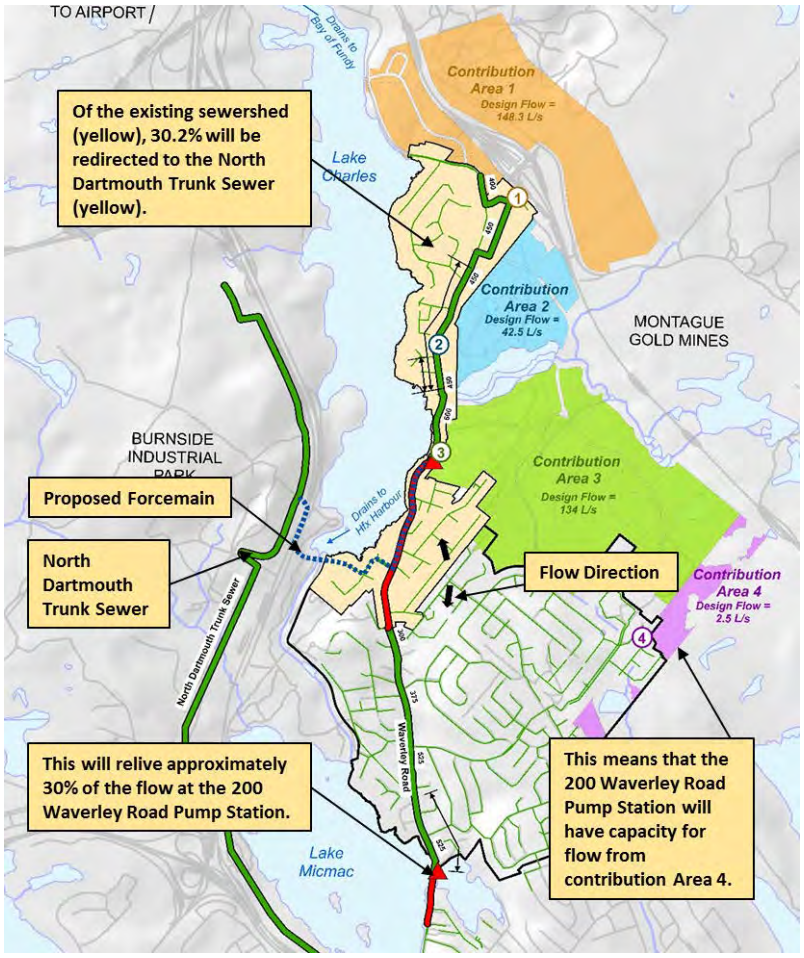


Figure 15: Proposed Rerouting of Flow from 390 Waverley Road Pump Station to North Dartmouth Trunk Sewer

Previous studies have proposed this diversion (e.g. Dartmouth Cove Wastewater Management Study, CBCL Limited, 2007) and have verified that the North Dartmouth Trunk Sewer has capacity to receive wastewater flows from the proposed Port Wallace development (Regional Wastewater Functional Plan, CBCL Limited, 2012).

The upgrade and rerouting of the 390 Waverley Road Pump Station are shown as Phase 1 in Table 5. The table shows that there is 0 l/s remaining capacity and that the upgrade must be completed prior to any development in the Port Wallace Contribution Areas.

3. Upgrade 390 Waverley Rd PS, Upgrade 1.4km of pipe and Upgrade 200 Waverley Road PS

This third option is also potentially feasible and needed to be investigated. Its benefits are that the construction will be simpler and only require an upgrade to existing components, as opposed to acquiring new easements through land owned by the Province and conducting delicate construction work under a river and through a highway. Permitting will be made simpler as well.

The significant drawback of this option is that it involves a very large amount of upgrade work: in addition to upgrading the 390 Waverley Road pumping station (and associated forcemain), the gravity pipe will need to be replaced along 1.4km Waverley Road, and the 200 Waverley Road pumping station (and associated forcemain) will need to be upgraded as well. This is a significantly larger amount of work and its costs far exceed that of option 2.

3.4 Wastewater System Upgrade Cost Sharing Mechanisim

When considering the cost of upgrades, it would be fair to assume that the portion of cost carried by each developer should be equivalent to the gross catchment area that each developer contributes to the system

Another consideration for cost sharing is that the proposed forcemain will cross the Shubenacadie Canal, since a canal crossing may also be required for water, gas and other utilities. The potential for a cost sharing mechanism between these projects should be explored as dates and timelines for each become solidified.

The development of Port Wallace will increase demand on the sanitary system. This will therefore increase operational costs such as pumping demands at lift stations. It is anticipated that these costs will be borne by Halifax Water.

Chapter 4 Stormwater

No stormwater elements have been identified which are considered to warrant capital cost contribution or shared developer cost.

There are several pipes and/or drainage courses which enter the study area from lands upstream. It is the responsibility of each land owner to manage the stormwater on their property. If the mechanism for stormwater conveyance is altered, the developer is responsible to ensure that pre and post development flows are maintained. For example, if stormwater currently flows overland or in a ditch and the developer requests a change to a hard pipe sewer system, some form of stormwater control system would likely be required to offset the reduced time of concentration.

The proposed Port Wallace development area is located within the Lake Charles watershed on the east side of the lake as shown in Figure 16. All stormwater runoff from the proposed development area is currently discharged into Lake Charles, while a portion of the development area first drains into a major watercourse referred to as Barry's Run. Since Lake Charles is a headwater lake that flows in two directions, impacts to water quality or quantity in the lake from the proposed development would be distributed to several other lakes already experiencing the effects of urbanization, and would cascade downstream in a cumulative manner. This is of concern since Fletcher's Lake is a source of drinking water in HRM, and the Shubenacadie River is the source of drinking water to Enfield (Municipality of East Hants), with many individual users drawing their drinking water directly from the river. It is emphasized that the historic gold mining operations and other past uses of the area have resulted in contamination of the soil. Further information can be obtained in the references noted below, as well as the technical appendix to this document. Following the recommendations for stormwater management will be critical to prevent further impacts.

Flooding risks are also a clear concern of a very sensitive nature in the Shubenacadie River system through the Municipality of East Hants, as well as through downtown Dartmouth and the Sullivan's Pond area residents. Protecting Lake Charles and the downstream lakes is further emphasized by the cultural significance and recreational use of the lakes. According to the Shubenacadie Lakes Subwatershed Study (AECOM, 2012), additional water quality objectives should therefore be implemented for the Port Wallace development, including a "no net export of phosphorous" objective. Thus, stormwater management for the Port Wallace development is critical and will require a specific plan to address those issues.

Additional references:

Land Suitability Analysis - Port Wallace Secondary Planning Study Area, WSP, February 23, 2016

Version 4.0Historical gold mining, Montague area, Halifax County, Nova Scotia. P. K. Smith & T. A. Goodwin.

N. S. Department of Natural Resources Open File Map 2009-1, Sheet 28, 200

(http://novascotiagold.ca/theme/exploitation_de_lor-mining/montague-eng.php)

Abandoned escape shaft on the Skerry Mine, Montague Gold District

http://www.novascotia.ca/nse/contaminatedsites/docs/goldminetailingpics.pdf

[1] Nova Scotia Department of Environment, "Historic Gold Mine Tailings".

Accessed Sept 07, 2017. <https://novascotia.ca/nse/contaminatedsites/docs/faq-goldminetailings.pdf.>

Parker, S., McNabb, D, Hartling, P., O'Rielly, G., Skilliter, D. "Consequences of Historical Mining." Virtual Museum of Canada.

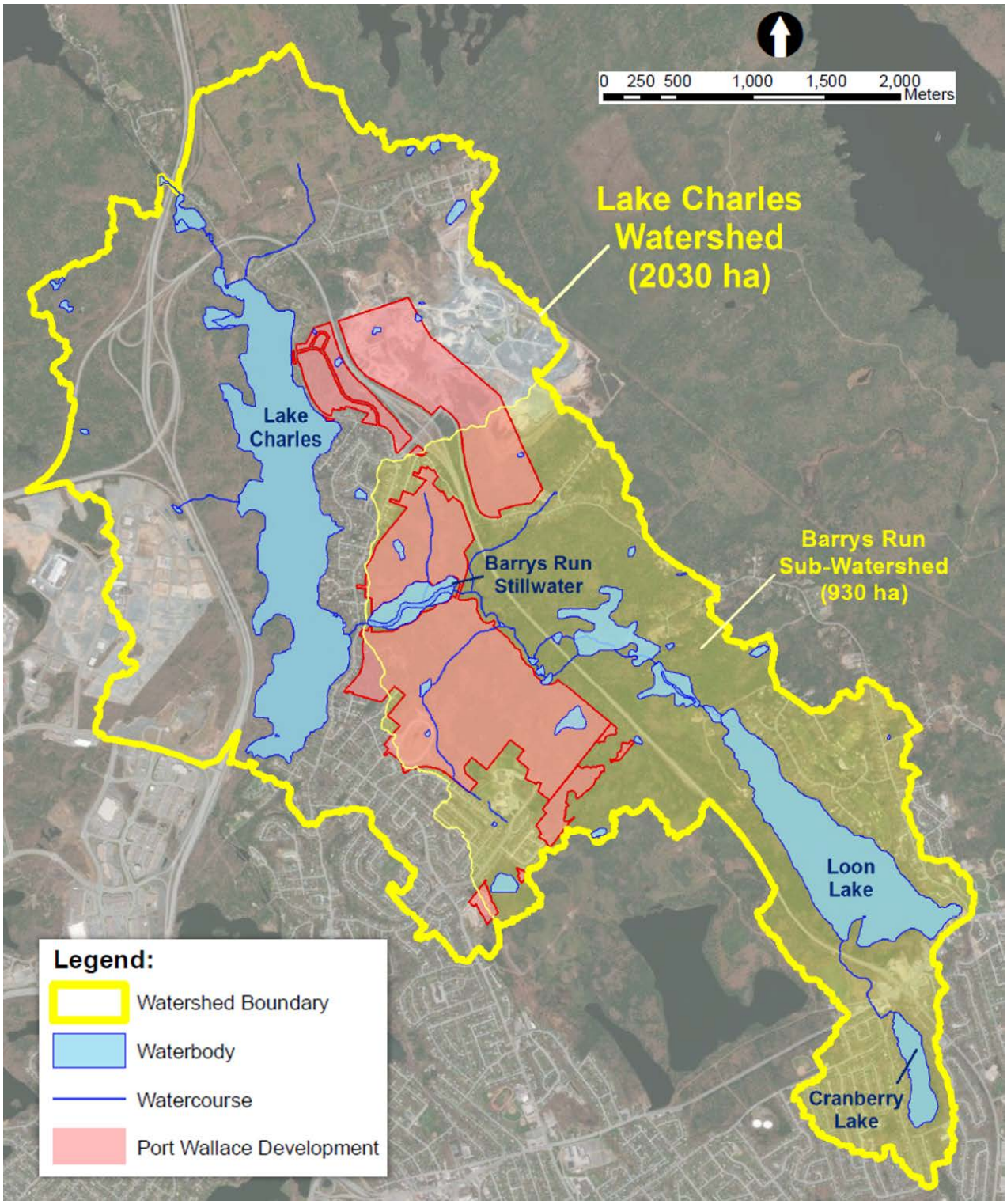


Figure 16: Lake Charles and Barry's Run Watershed Delineation

The use of LID for the Port Wallace development instead of conventional retention ponds will allow for stormwater to infiltrate with a similar amount to pre-development conditions, which will help maintain existing runoff volumes, as well as peak flows, and protect the water quality of the runoff discharged to Lake Charles.

While Halifax Water currently requires all new development to maintain pre-development peak flow rates for stormwater runoff, there are no existing requirements for controlling runoff volumes, which can also increase lake levels (and therefore in this case increase peak flows downstream), erosion risks and resuspension of sediment (that may include contamination) if they are not maintained. Meeting the Halifax Water requirements in this system will therefore entail runoff volume control, which is not provided by detention ponds. Suitable potential stormwater management approaches may include runoff source control practices that aim to mimic the natural hydrology of the watershed, providing water quality treatment and infiltration. This approach to stormwater management is commonly referred to in Canada and the USA as Low Impact Development (LID), Stormwater Best Management Practices (BMPs) or using Green Infrastructure (GI), and are infiltration-based. The use of LID techniques for the Port Wallace development will allow a similar amount of stormwater to infiltrate as during pre-development conditions, which will help maintain existing runoff volumes, peak flows, and protect the water quality of the runoff discharged to Lake Charles.

The proposed Port Wallace development area contains several small watercourses, marshes, swamps and bogs, as well as a major watercourse that discharges to a fen wetland. The major watercourse is referred to as Barry's Run, and the fen wetland is referred to as Barry's Run Stillwater or Summit Reservoir. This reservoir is potentially contaminated due to historic gold mining operations and is also a component of the Shubenacadie Canal System National Historical Civil Engineering Site. Any impacts to the current hydrology, water quality and structure of the reservoir should therefore be avoided due to the risk of contamination as well as its cultural significance. Preservation of the Barry's Run Stillwater can be achieved using LID practices in the upstream development drainage area that achieve the effect of mimicking the natural pre-development hydrology of the watershed.

4.1 Barry's Run Stillwater

According to the Land Suitability Assessment: Port Wallace Secondary Planning Study Area (WSP, 2017), one of the major natural corridors and cultural assets within the proposed Port Wallace development area is the Barry's Run Stillwater or Summit Reservoir. Barry's Run was identified by the Land Suitability Assessment as containing contaminated soils that originate from historic gold mining that are hazardous to human health. The Land Suitability Assessment also states that development in the Barry's Run Stillwater site is "totally constrained" from a cultural assets standpoint due to it being a National Historic Civil Engineering Site, whereas the dam area of the reservoir is expected to become a Registered Archaeological Site by Special Places upon submission of Maritime Archaeological Resource Inventory forms. Furthermore, the Land Suitability Assessment recommends for Barry's Run to be a central open space that provides active and passive recreational activities for the community, and local residents have identified Barry's Run as a significant cultural landmark that possesses intrinsic cultural beauty and value. The Shubenacadie Canal Commission has also expressed concern for the preservation of the dam, and an archaeological assessment carried out by CRM Group in 2014 recommended that no ground disturbance occur within a 10 m buffer of the dam extension.

The existing hydrology and water quality of the Barry's Run Stillwater should therefore be maintained under future development conditions to prevent ground disturbance and preserve the cultural asset.

Increased runoff volumes discharged to the reservoir from future development could increase erosion, disturb contaminated soils, damage existing wetland plants and/or damage the existing dam, and therefore should not be allowed.

Conventional stormwater flow control measures (retention ponds) do not adequately control runoff volumes or water quality since they do not infiltrate stormwater, and they also tend to concentrate pollutants. Thus, source control LID stormwater practices are recommended and may be required for future upstream development to maintain the existing peak flows, runoff volumes and water quality of the runoff discharged to Barry's Run from both private properties and the road right-of-way.

There has been some discussion on the use of Barry's Run Stillwater as a stormwater retention pond for the proposed Port Wallace development. However, due to the above environmental and cultural concerns, it is our recommendation that Barry's Run Stillwater not be converted into a stormwater retention pond. Furthermore, stormwater treatment would still be required upstream of the pond, as the pond would not provide adequate phosphorous treatment.

4.2 Halifax Water Requirements

Stormwater management design will be required to follow the most up-to-date version of the Halifax Water Design Specification for Water, Wastewater and Stormwater Systems (2017). A summary of the key requirements from these standards are as follows:

- → The minor system shall convey the 1 in 5 year storm and the major system shall convey the 1 in 100 year storm event;
- → A stormwater management plan shall be submitted containing design criteria for 1 in 5, 10, 25, 50 and 100 year storm events; and,
- → Peak pre-development runoff rates shall be maintained for the 1 in 2, 1 in 5, 1 in 10 and 1 in 100 year storm events.

It is noted that to adhere to this requirement, this will include no increased risk of flooding in the downstream watersheds. As noted above, this can only be achieved through measures that maintain the current infiltration volumes, such as some LID or green infrastructure.

4.3 Nova Scotia Environment Requirements

Nova Scotia Environment (NSE) currently requires the following for stormwater management in the province:

- → Pre-development peak flows must be maintained under post-development conditions for up to the 1 in 5 year storm event; and
- → For the 1 in 5 year to 1 in 100 year storm events, peak flows cannot creating flooding or cause physical damage to property or structures down gradient of the development site. NSE will accept +/- 10% allowance when balancing pre/post development flows, except where pre-existing flooding conditions exist.

Since the current NSE regulatory requirements for stormwater management are less strict than those imposed by Halifax Water, following Halifax Water specifications will ensure that the NSE regulations are also met.

4.4 Summary of Stormwater Design Criteria for Port Wallace

The following is a summary of the stormwater design criteria required by this Master Plan for the proposed Port Wallace development.

Runoff needs be controlled at its source to prevent accumulation and therefore erosion risks, which precludes the use of detention ponds. Surface water has the potential to put contaminated sediments in suspension and therefore water needs to be infiltrated to prevent an increase in volume, and the use of plant material for filtration and uptake of metals should be encouraged wherever possible.

1. Maintain 1 in 2 year, 1 in 5 year, 1 in 10 year and 1 in 100 year pre-development peak flows and runoff volumes at any discharge point from the development area as well as any point downstream;
2. Preserve the Barry's Run Stillwater as it is unsuitable for stormwater management;
3. Achieve no increase in phosphorous in stormwater runoff by using LID for stormwater management with enhanced nutrient reduction methods;
4. Eliminate the use of detention ponds and promote runoff control at its source;
5. Promote biodiversity and the use of plant material for filtration and uptake of metals, implement wetland and riparian buffer of 20 metres for all development;
6. Include LID stormwater management infrastructure on both private properties and within the road right-of-way; and
7. Encourage the use of LID systems that enhance biodiversity, carbon sequestration, filtration and treatment of other pollutants than phosphorous, notably sediment, nitrogen and substances of concern in the area.

Chapter 5 Potable Water and Fire Suppression

The proposed Port Wallace Development extends from Avenue du Portage north to lands adjacent to Spider Lake Road on both sides of the Forest Hills Parkway, Highway 107. The development falls adjacent to the Burnside High Water Pressure Zone with existing ground elevations ranging from a low of 40 m (130 ft) to a high of 85 m (279 ft). The Burnside High Zone forms part of the East Region Water system which is primarily supplied with water by the Lake Major Water Treatment Plant (WTP).

Where existing infrastructure was found deficient, possible system upgrades necessary to service the development while maintaining the existing level of service today have been identified.

The Lake Major WTP supplies the East Dartmouth Region through a 1,050 mm (42”) diameter water transmission main to the Topsail control chamber located at Topsail Lake near Main Street in Dartmouth. From the Topsail chamber, water flows either to the Mount Edward Reservoirs or the Burnside High Zone. The 1,050 mm (42”) main continues parallel to Main Street to an interconnection at the former Lake Lamont Pump Station. The interconnection is connected to the Burnside High zone through an existing 600 mm (24”) diameter water feedermain starting at Lake Lamont and follows Caledonia Road west to Shubie Park then south along Highway 111 to Ilsley Avenue in Burnside. The Akerley Reservoir floats on the Burnside High Zone and is connected to the zone with a 600 mm (24”) diameter main.

This study is intended to establish the minimum water and fire flow service requirements necessary to achieve the Halifax Water design specification within the Port Wallace development. The addition of Port Wallace to the water system will increase water demands. As a result, an analysis of the existing infrastructure has been carried out to understand the impacts of the additional demand. Where existing infrastructure was found deficient, possible system upgrades necessary to service the development, while maintaining the existing level of service, have been identified.

5.1 Port Wallace

Proposed Port Wallace land use and master plans were used to establish likely pipe line routes to service the development. Local distribution mains are assumed to be 200 mm diameter and 300 mm diameter. Through iteration, the pipe size along the Avenue du Portage Extension was established for the development to ensure a suitable level of service for the entire study area.

Assumed potential points of connection to the existing Burnside High Zone are as follows:

→ Existing 600 mm diameter transmission main at intersection of Caledonia Road and Avenue du Portage;
→ Existing 350 mm diameter at 420 Waverley Road;
→ Existing 350 mm diameter at the intersection of Applewood Lane and Waverley Road;
→ Existing 350 mm diameter at 733 Waverley Road;
→ Existing 350 mm diameter at 804 Waverley Road;
→ Existing 300 mm diameter at Marjorie Ann Drive; and
→ Existing 200 mm diameter mains at the end of White Street and Belvedere Dr. and the intersection of Lexington Avenue and Rosecroft Drive.

5.2 Water System Analysis

The water system analysis follows the Halifax Water Design Specifications for Water, Wastewater & Stormwater, 2017 Edition, to establish a desired level of service, including water consumption, fire flows and peaking factors. For the purposes of the study, Halifax Water provided a copy of the water model understood to be representative of the system to 2017. WaterCAD V8i (SELECTSeries 6) was used to model current conditions, future background growth and the addition of Port Wallace. Meetings between Halifax Water and CBCL were held to develop an understanding of current system operation. The outcome from the meetings helped establish the design constraints for evaluating the impact of future growth within the Port Wallace study area and background growth to the existing system.

In addition to the meeting with Halifax Water, CBCL has reviewed previous reports and memos pertaining to the East Region Water System:

→ East Region (Dartmouth) Water Infrastructure Master Plan (July 1999) - Final Report, CBCL Limited;
→ Cost of Servicing Plan, Regional Planning Greenfield Sites (February 2009) - Final Report, CBCL Limited; and
→ Port Wallace: Municipal Services, Pre-Design Baseline Report, September 8 2014, Halifax Water.

Following the issue of the report on November 6, 2017 a meeting was held with stakeholders to review assumptions made in the report. Conrad has confirmed that the maximum service elevation for lands north of Highway 107 is to be 70 m (229 ft). The analysis was redone taking into consideration the revised service elevation.

Subsequent to the stakeholder meeting, a second meeting with Halifax Water and CBCL was coordinated. Discussions during the meeting confirmed that Halifax Water does not intend to establish a reduced pressure zone for the Port Wallace development. However, a reduced zone may be established in the future to address high pressures along Waverley road. Therefore, the analysis should consider an impact to the development should a reduced zone be established in the future.

5.3 Water Demands

CBCL reviewed historical water consumption records. The 99.5 percentile of daily water consumption from 2015 to 2017 was defined as the baseline maximum day demand (MDD) for the study. Port Wallace and background growth water demands have been established based on the background and development growth established in Chapter 1.

Port Wallace water demands have been developed in accordance with Halifax Water Design Specification and are a function of equivalent domestic population with a design average consumption of 410 L/cap/day. Maximum day and minimum hour peaking factors have been calculated based on a weighted average of the land uses. Land use populations have been established as follows, and are shown in Table 6:

→ Domestic:
→ Single Unit: 3.35 people / unit;
→ Semi-detached and Townhouse: 3.35 people / unit;
→ Multi-Unit: 2.25 people per unit;
→ Commercial & Industrial: 45 people / hectare;

→ Institutional; and
→ School: 115 L/student/day (Assumed 1000 students).

Table 6: Port Wallace Design Demands

Water Demand (MLD)	Residential		Comm.	Ind.	Inst.
	Single/ Town House	Multi-Unit			
Average Day Demand (ADD)	2.1	2.1	0.1	1.7	0.1
Maximum Day Factor	1.65	1.3	1.1	1.1	1.1
Maximum Day Demand (MDD)	3.5	2.7	0.1	1.9	0.1
Minimum Hour Factor	0.7	0.84	0.84	0.84	0.84
Minimum Hour Demand (Min HD)	1.5	1.8	0.1	1.4	0.1

Summary of Total Port Wallace Design Demands:
→ Average Day Demand: 6.1 MLD;
→ Maximum Day Demand: 8.1 MLD;
→ Weighted Maximum Day Factor: 1.33;
→ Minimum Hour Demand: 4.8 MLD; and
→ Weighted Min Hour Factor: 0.79.

The East Region maximum day demands under existing conditions and the study horizon are summarized in Table 7.

Table 7: East Region Maximum Day Demand

Demand Allocation Area	Baseline Year	15 year Horizon 2032	30 Year Horizon 2047
East Region MDD (excluding Port Wallace)	42.3 MLD	47.3 MLD	52.9 MLD
Port Wallace MDD	-	4.2 MLD	8.2 MLD
Total East Region MDD	**42.3 MLD**	**51.5 MLD**	**61.1 MLD**

Fire Flow requirements are based on the established Halifax Water Design Specification estimated flows and durations:
→ Domestic;
→ Single Unit: 3,300 L/min for 1.5 hours;
→ Semi-detached and Townhouse: 4,542 L/min for 1.75 hours;
→ Multi-Unit: 13,620 L/min for 3 hours;
→ Commercial & Industrial: 13,620 L/min for 3 hours; and
→ Institutional: 13,620 L/min for 3 hours.

The system should be capable of achieving the desired fire flow for the given land use while maintaining a minimum of 22 psi throughout the system. The above fire flow requirements are guidelines for the purposes of evaluating the system capacity only. Fire Underwriters Survey calculations have not been undertaken at this time.

5.4 Existing East Region Operation

The Mount Edward Reservoirs and the Burnside High Zone are on the same maximum Hydraulic Grade Line (HGL) of 119 m (390 ft). Water is supplied to either the Mount Edward Reservoirs or the Burnside High Zone utilizing the Topsail control chamber. Under typical operation, flow is controlled by Halifax Water to direct water to either the Mount Edward Reservoirs or to the Burnside High Zone or both at the same time. Under a fire flow scenario, it is assumed that water supply from the Lake Major WTP is unavailable, however, the Mount Edward Reservoirs can backfeed and supply the Burnside High Zone. Under these scenarios, it was assumed the Mount Edward Reservoirs are at 115.8 m (380 ft).

The Akerley Reservoir water level varies daily and has a maximum level of 119 m (390 ft) to a low of 115 m (375 ft) and is always available to supply water. For the purposes of the hydraulic analysis, the Akerley Reservoir HGL was assumed to be 115.8 m (380 ft) under all scenarios.

5.5 Hydraulic Modelling Results

A number of model scenarios were generated to establish existing conditions, and impact of future growth, with and without the addition of Port Wallace.

5.5.1 Transmission System Considerations

The model shows that under both current and future maximum day conditions, the Lake Major WTP can supply the Eastern Region system the required maximum day demand while maintaining the Akerley and Mount Edward Reservoirs at the Full Service Level (FSL) of 119 m (390 ft). These results were validated with historical data recorded by the Halifax Water SCADA system. Therefore, the existing transmission system appears sufficient to service the Port Wallace development and regional updates do not appear to be required.

5.5.2 Port Wallace Storage Requirements

The Port Wallace potable water storage requirements are established in accordance with the Atlantic Canada Guidelines for Supply, Treatment, Storage, Distribution and Operating of Drinking Water Supply systems and are a function of MDD and Fire Flow requirements. A summary of the water storage requirements is shown in Table 8.

Table 8: Water Storage Requirements

Item	Requirement
Fire Storage	Required fire flow over required duration (as per IAO – FUS Guidelines and/or as established by the Community's Regulators)
Peak Balancing Storage	25% of maximum day demand
Emergency Storage	25% of fire storage plus peak balancing storage OR 15% of projected average daily design flow

The water storage requirements for Port Wallace are calculated assuming development occurring over a 30 year horizon MDD and a 13,620 L/min fire flow resulting in a required storage volume of 5.7 ML (1.25 MIG).

The primary water storage for the Eastern Region is the Mount Edward Reservoirs at 45 ML and Akerley Reservoir with 36 ML for a total of 81 ML. The total required volume for the Eastern Region for the 30 year

horizon, including Port Wallace and allowing for two fire flow volumes, is 27.2 ML based on the above calculation. Alternatively, storage equivalent to an average day demand may be desirable from an operational perspective. The 30 year ADD is 47.1 ML which is less than current storage volume. Therefore, the total existing storage volume in the Eastern Region appears sufficient for the 30 year demand horizon including the proposed Port Wallace development.

The Akerley Reservoir has sufficient emergency and fire volume storage for future demands. However, peak balance is restricted to the top 4.57 m (15 ft) of the tank and represents a volume of 9 ML. The 30 year demand attributed to the Akerley Reservoir is 32.8 MLD which results in a required peak balance volume of 8.2 ML. Therefore, the Akerley Reservoir has sufficient volume for future growth including Port Wallace.

5.5.3 Port Wallace Internal Distribution

Water distribution mains within Port Wallace are assumed to follow proposed rights-of-way. A new primary watermain to connect the 600 mm diameter Caledonia Road feedermain(s) appears necessary to service the entire development. This primary watermain will also provide redundancy to the exiting 350 mm watermain on Waverley Road. The existing 300 mm diameter watermain along Avenue du Portage is not sufficient to satisfy fire flow requirements at the ends of the development. Therefore, it is assumed that a new watermain paralleling the existing will connect at Caledonia Road and be extended along Avenue du Portage, across Barry's Run and terminating at the existing 350 mm diameter Waverley Road watermain. A primary watermain leg off the Avenue du Portage main to connect to the Conrad Lands north of Highway 107 will also be required. This leg is assumed to connect to the existing 400 mm diameter main crossing Highway 107. All Conrad Lands north east of Highway 107 are understood to be light industrial. It is assumed that the watermain will be looped within Conrad lands with a connection to the existing 300 mm watermain on Marjorie Ann Drive providing a secondary connection.

A new primary watermain to connect the 600 mm diameter Caledonia Road feedermains will be necessary to service the entire development.

Utilizing existing contour information, it would appear that elevations within Port Wallace and along Waverley Road will result in pressures exceeding Halifax Water Design Specification maximums. Halifax Water's preference is to not affect the current level of service for existing customers along Waverley Road and would approve pressures exceeding the maximum pressure range for the Port Wallace development. Halifax Water noted that a pressure zone may be created in the future to address these high pressures and such a zone would not be tied to the development. For the purposes of the analysis, the reduced pressure zone was assumed to have a HGL of 103.6 m (340 ft). The primary watermain within Port Wallace would be excluded from a future zone.

It is understood that construction of Avenue du Portage may precede the initial phases of the development and it assumed that the primary watermain will be constructed at this time. Therefore, construction of the primary watermain may not be driven by buildout of the development. Conrad Lands south of Highway 107 can be serviced off the Waverley Road main.

The modelling shows that the primary watermain along Avenue du Portage should be a minimum of 400 mm diameter to provide an adequate level of service under a fire flow scenario to the proposed Port Wallace development. This primary watermain would also connect to the Conrad lands north of Highway 107. This primary watermain size appears to satisfy hydraulic constraints with or without regional feedermain twinning and/or with or without a future pressure zone. Note that should a pressure zone be implemented in the future,

it appears necessary for local watermain upgrades from 350 mm to 400 mm on Waverley Road from Avenue du Portage connection to the future Conrad Land Connection at 805 Waverley Road. It is assumed that the local watermain upgrades would be covered by Halifax Water under the implementation of the reduced pressure zone should that proceed in the future.

5.5.4 Hydrant Flow Testing Review

Hydrant flow testing was undertaken by Risk Management Services in May of 2016 and provided to CBCL by Port Wallace Holdings Ltd. A summary of the hydrant flow testing results and model outputs as shown in Table 9. The model outputs are based on an assumed Akerley reservoir level of 119 m (390 ft) and the Topsail Feed to the Burnside High Zone closed. System demands were modeled at 50% of current Maximum Day Demand. It would be recommend to collect the data recorded by the Halifax Water PI system during the flow testing to establish the actual baseline conditions at the time of the Hydrant flow testing. However, this is outside of the scope of this study.

Table 9: Hydrant Flow Testing and Model Output

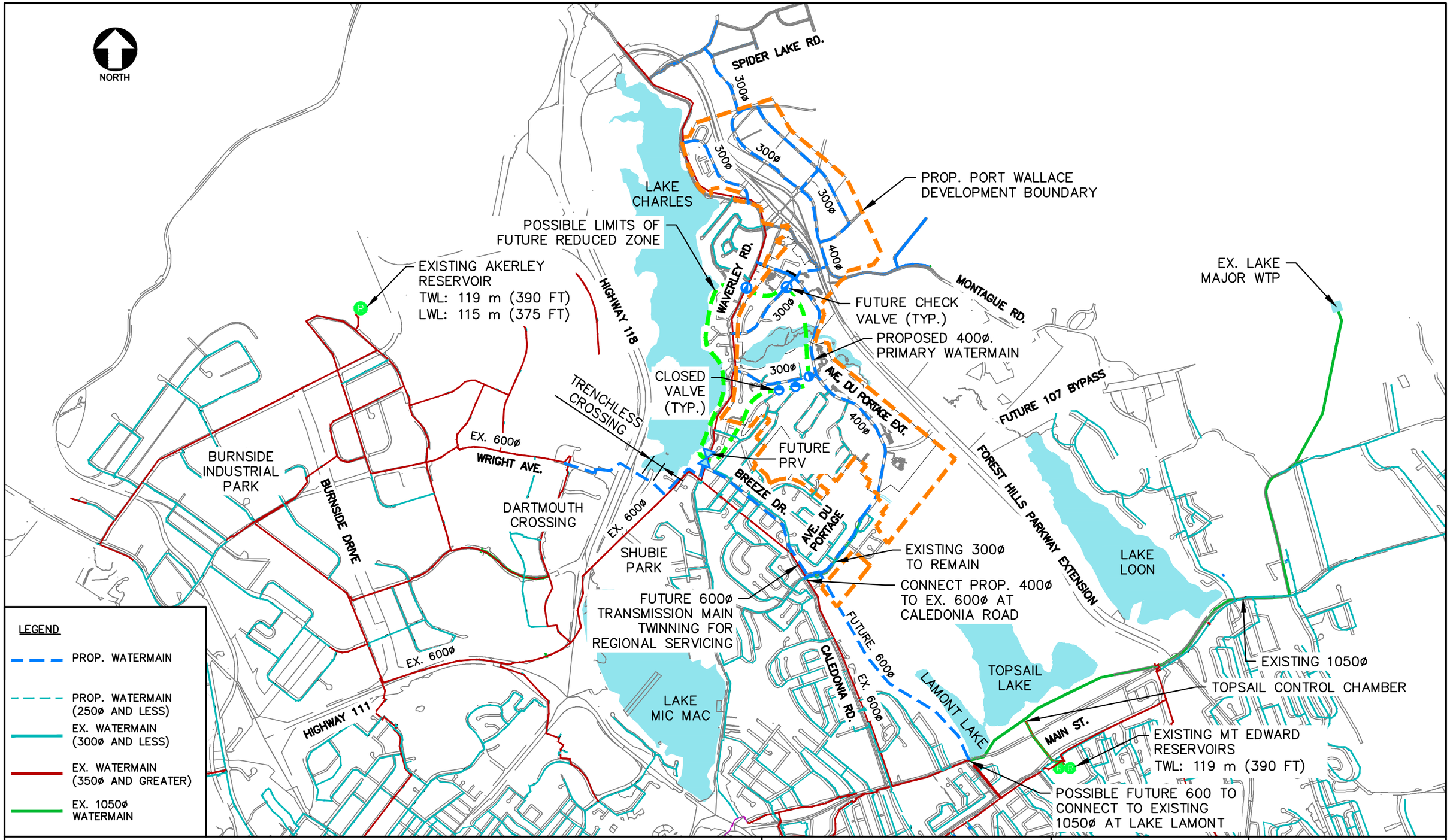
Item	Hydrant Flow Testing			Model Output	
Test #	Flow (L/min)	Static (Pre-test) Pressure (psi)	Residual Pressure (psi)	Static (Pre-test) Pressure (psi)	Residual Pressure (psi)
1	8,750	100	76	99	67
2	6,210	108	99	106	92
3	5,900	100	85	98	89
4	6,820	67	50	72	55
5	6,740	70	56	75	38
6	6,815	68	52	67	43
7	6,360	50	42	52	43

5.6 Water System Analysis Summary

The water system analysis is summarized as follows:

- → The existing Eastern Region water transmission system has sufficient capacity to service future growth, including Port Wallace. Regional upgrades are not required.
- → The existing Eastern Region water service area appears to have sufficient water storage considering the 30 year horizon, including the Port Wallace development;
- → Halifax Water may implement a reduced pressure zone for the low lands along Waverley Road in the future, however, the related infrastructure would not be tied to the development. The primary watermain along Ave du Portage Extension would not fall within the reduced pressure zone.
- → Halifax Water has approved pressures within Port Wallace to exceed design specification maximums;
- → The maximum service elevation within the Conrad Lands north of Highway 107 was confirmed by the developer to be no greater than 70 m (229 feet); and
- → The Port Wallace development can be adequately serviced with a 400 mm diameter primary watermain along the Avenue du Portage Extension.

Refer to Figure 17 for the Port Wallace water system master plan considered in the analysis.



CBCL LIMITED
Consulting Engineers

HALIFAX

PORT WALLACE MASTER PLAN
INFRASTRUCTURE STUDY

WATER SYSTEM MASTER PLAN

PROJECT NO.: 171013.00
DATE: JULY 2017

FIGURE
17

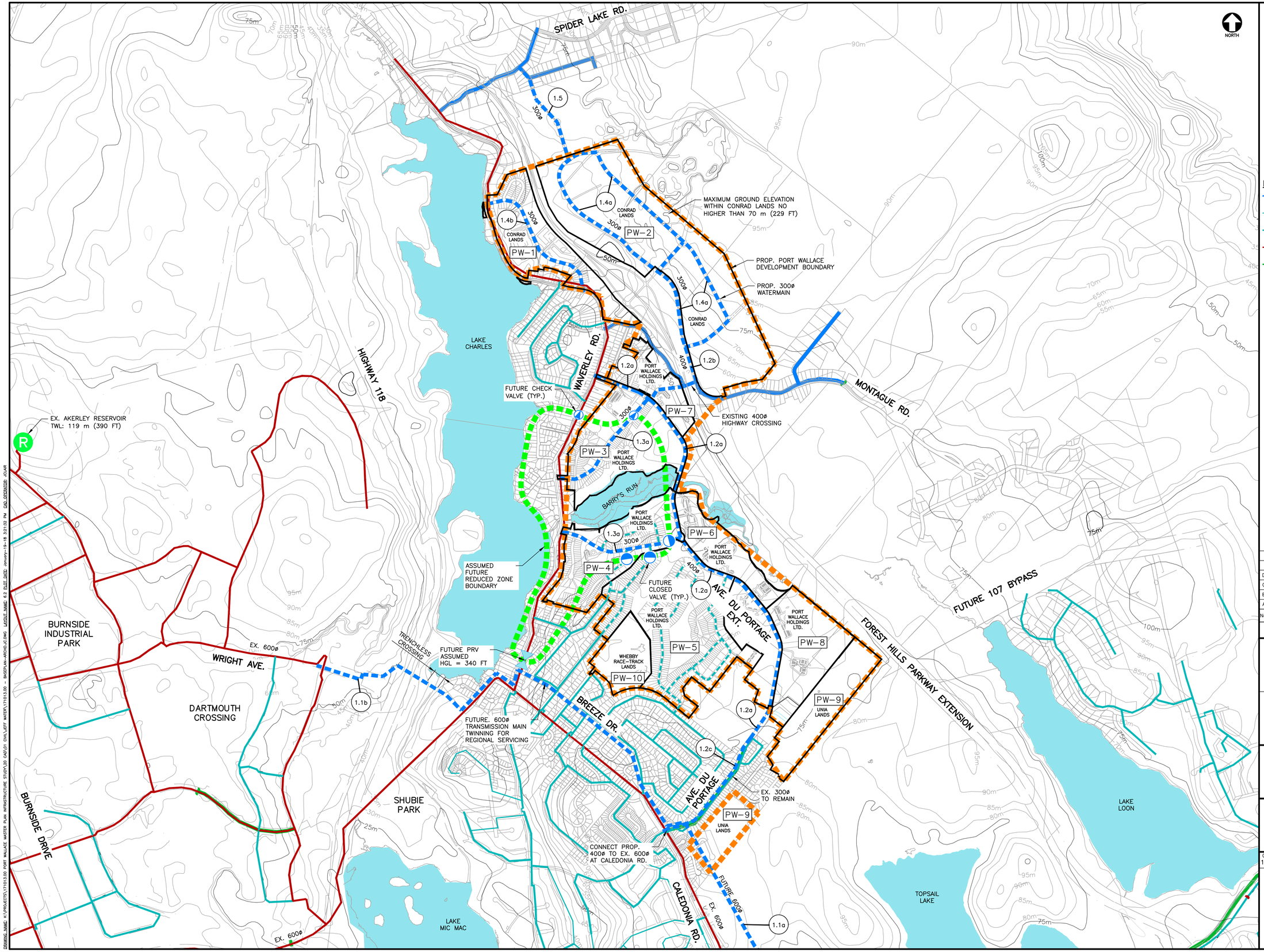
5.7 Water System Cost Sharing Mechanisim

The key infrastructure that is recommend for the Port Wallace development is identified on Figure 18 and summarized in Table 10. A proposed cost sharing mechanism along with infrastructure triggers have also been identified.

Estimates for key infrastructure have been included in the Appendix E.

Table 10: Water Infrastructure Phasing and Cost Sharing Mechanism

Water Infrastructure Phasing	Development Trigger	Recommended Cost Sharing Mechanism	
		Municipal	Developer
1.1a – 600 mm diameter Water Transmission Main (Lake Lamont to Ave du Portage)	Regionally Driven	100%	0%
1.1b – 600 mm diameter Water Transmission Main (Ave du Portage to Burnside)	Regionally Driven	100%	0%
1.2a - 400 mm diameter Primary Watermain along Ave du Portage	Construction of Ave du Portage Extension	0%	100% Developer Cost-Shared
1.2b - 400 mm diameter Primary from Ave du Portage to Conrad Lands	Development of PW-2 Lands	0%	100% Developer Cost-Shared
1.2c - 400 mm diameter from Caledonia Road to parallel existing 300 mm	Construction of 1.2a	0%	100% Developer Cost-Shared
1.3a – 300 mm diameter Mains from Waverley Road (base cost for developer)	0 – 10%	0%	100% Developer Cost-Shared
1.4a – 300 mm Conrad Lands Looping (base cost for developer)	Development of PW-2 Lands	0%	100% Developer Cost-Shared
1.4b – 300 mm diameter off Waverley Road to service Conrad Lands (base cost for developer)	Development of PW-1 Lands	0%	100% Developer Cost-Shared
1.5 – 300 mm Diameter connection to Spider Lake Rd (base cost for developer)	Development of PW-2 Lands	0%	100% Developer Cost-Shared



LEGEND

- PROP. WATERMAIN (300ø & LARGER)
- PROP. WATERMAIN (250ø & LESS)
- EX. WATERMAIN (LESS THAN 350ø)
- EX. WATERMAIN (350ø & GREATER)
- EX. WATERMAIN (1050ø & GREATER)

No.	Description	Date	By
D	REVISED FOR REISSUED FINAL RPT	15 JAN/18	JAB
C	REVISED FOR FINAL REPORT	27 OCT/17	JAB
B	RE–ISSUED FOR FINAL DRAFT	30 AUG/17	JAB
A	ISSUED FOR DRAFT REPORT	16 AUG/17	JAB

Revision or Issue

HALIFAX

PORT WALLACE MASTER PLAN INFRASTRUCTURE STUDY

WATER SYSTEM MASTER PLAN

HALIFAX

CBCL LIMITED
Consulting Engineers

CBCL No	Contract No	Date	Scale
171013.00		AUG 2017	N.T.S.

Designed	Drawn
JC	BWM
Checked	Approved
	JAB

Sheet No 1 of 1

Drawing No 18

DRAWING NAME: K:\PROJECTS\171013.00 PORT WALLACE MASTER PLAN INFRASTRUCTURE STUDY\20 CAD\01 CIVIL\ARF WATER\171013.00 – BASEPLAN–ARCHD.JC.DWG LAYOUT NAME: 8.2 PLOT DATE: January–19–18 3:21:32 PM CAD OPERATOR: JCAIR

APPENDIX A – Baseline Turning Movements

Port Wallace Master Plan- Infrastructure Study
2017 Existing Volumes - AM Peak Hour (Total)

Note: Total volume includes lights, mediums, articulated trucks , and bicycles

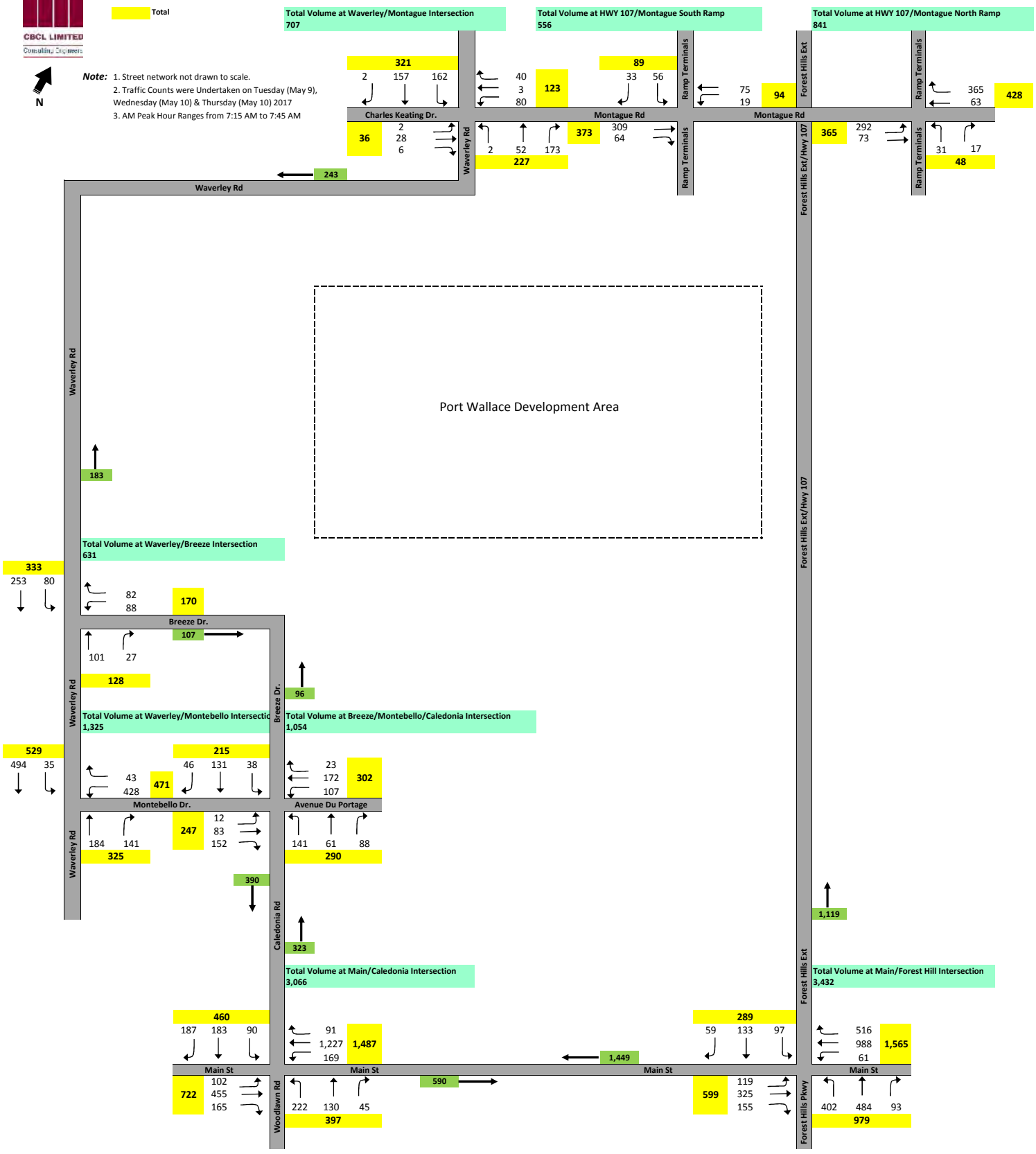
Run ID 1

CBCL LIMITED
Consulting Engineers

Total

Note:
1. Street network not drawn to scale.
2. Traffic Counts were Undertaken on Tuesday (May 9), Wednesday (May 10) & Thursday (May 10) 2017
3. AM Peak Hour Ranges from 7:15 AM to 7:45 AM

N



Port Wallace Master Plan- Infrastructure Study
2017 Existing Volumes - PM Peak Hour (Total)

Note: Total volume includes lights, mediums, articulated trucks , and bicycles

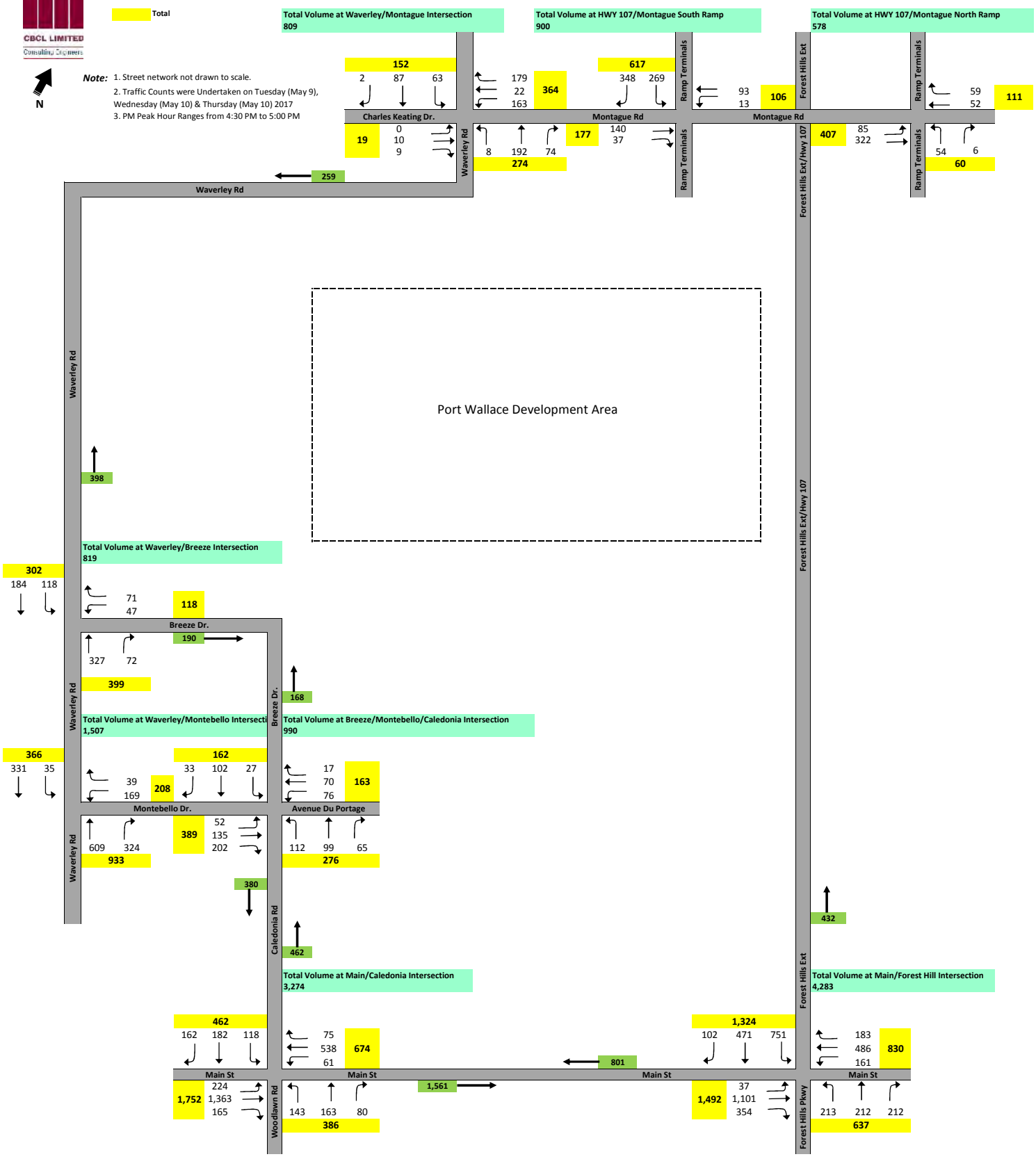
Run ID 2

CBCL LIMITED
Consulting Engineers

Total

Note:
1. Street network not drawn to scale.
2. Traffic Counts were Undertaken on Tuesday (May 9), Wednesday (May 10) & Thursday (May 10) 2017
3. PM Peak Hour Ranges from 4:30 PM to 5:00 PM

N



APPENDIX B – Trip Reduction Rates

Port Wallace Master Plan - Infrastructure Study - 171013.00
2031-Scene 1

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Clayton						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
987 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	186	556	**742**
PM Peak Hour of Adjacent Street	1.00	63%	37%	622	366	**988**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Clayton						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
176 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	14	65	**79**
PM Peak Hour of Adjacent Street	0.52	67%	33%	62	31	**93**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Clayton						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
1,582 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	162	646	**808**
PM Peak Hour of Adjacent Street	0.62	65%	35%	638	344	**982**

Port Wallace Master Plan - Infrastructure Study (Commercial)-Clayton						
ITE Land Use Code 820 (Shopping Center) pages 1562 and 1563						
152,000 sq.ft.	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.96	62%	38%	90	55	**146**
PM Peak Hour of Adjacent Street	3.71	48%	52%	271	293	**564**

Port Wallace Master Plan - Infrastructure Study (Institutional)-Clayton						
ITE Land Use Code 520 (Elementary School) pages 988 and 989						
37,674 sq.ft	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	5.20	56%	44%	110	86	**196**
PM Peak Hour of Adjacent Street	1.21	45%	55%	21	25	**46**

Port Wallace Master Plan - Infrastructure Study (Combined Trips)						
ITE Land Use Codes (as shown above)						
	Rate	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				**562**	**1409**	**1971**
PM Peak Hour of Adjacent Street				**1613**	**1059**	**2673**
					Check	1971
						2673

Option 1

Anticipated Trip Reduction Category	**Trip Reduction Rates**	**Entering Trip Reductions in AM Peak Hour**	**Exiting Trip Reductions in AM Peak Hour**	**Entering Trips in AM Peak Hour after Reduction**				**Exiting Trips in AM Peak Hour after Reduction**				**Total Trips in AM Peak Hour after Reduction**
Internal Trips	10%	57	141	**407**				**1027**				
Walking/cycling mode share	3%	19	47	**Waverley-EW-53%**	**Waverley-NS-7%**	**Main St-40%**	**Forest Hills-0%**	**Waverley-EW-53%**	**Waverley-NS-7%**	**Main St-40%**	**Forest Hills-0%**	
Transit mode share	7%	38	94	**216**	**29**	**163**	**0**	**545**	**72**	**411**	**0**	**1436**
Retired residents	2%	12	29									
Working from home	5%	29	71									
Total	**27%**	**155**	**382**									

Anticipated Trip Reduction Category	**Trip Reduction Rates**	**Entering Trip Reductions in PM Peak Hour**	**Exiting Trip Reductions in PM Peak Hour**	**Entering Trips in PM Peak Hour after Reduction**				**Exiting Trips in PM Peak Hour after Reduction**				**Total Trips in PM Peak Hour after Reduction**
Internal Trips	10%	162	106	**1175**				**771**				
Walking/cycling mode share	3%	54	36	**Waverley-EW-53%**	**Waverley-NS-7%**	**Main St-40%**	**Forest Hills-0%**	**Waverley-EW-53%**	**Waverley-NS-7%**	**Main St-40%**	**Forest Hills-0%**	
Transit mode share	7%	108	71	**623**	**83**	**471**	**0**	**409**	**54**	**309**	**0**	**1949**
Retired residents	2%	33	22									
Working from home	5%	81	53									
Total	**27%**	**438**	**288**									

Option 1A

Anticipated Trip Reduction Category	**Trip Reduction Rates**	**Entering Trip Reductions in AM Peak Hour**	**Exiting Trip Reductions in AM Peak Hour**	**Entering Trips in AM Peak Hour after Reduction**				**Exiting Trips in AM Peak Hour after Reduction**				**Total Trips in AM Peak Hour after Reduction**
Internal Trips	10%	57	141	**407**				**1027**				
Walking/cycling mode share	3%	19	47	**Waverley-EW-50%**	**Waverley-NS-7%**	**Main St-38%**	**Forest Hills-5%**	**Waverley-EW-50%**	**Waverley-NS-7%**	**Main St-38%**	**Forest Hills-5%**	
Transit mode share	7%	38	94	**204**	**29**	**155**	**21**	**514**	**72**	**391**	**52**	**1438**
Retired residents	2%	12	29									
Working from home	5%	29	71									
Total	**27%**	**155**	**382**									

Anticipated Trip Reduction Category	**Trip Reduction Rates**	**Entering Trip Reductions in PM Peak Hour**	**Exiting Trip Reductions in PM Peak Hour**	**Entering Trips in PM Peak Hour after Reduction**				**Exiting Trips in PM Peak Hour after Reduction**				**Total Trips in PM Peak Hour after Reduction**
Internal Trips	10%	162	106	**1175**				**771**				
Walking/cycling mode share	3%	54	36	**Waverley-EW-50%**	**Waverley-NS-7%**	**Main St-38%**	**Forest Hills-5%**	**Waverley-EW-50%**	**Waverley-NS-7%**	**Main St-38%**	**Forest Hills-5%**	
Transit mode share	7%	108	71	**588**	**83**	**447**	**59**	**386**	**54**	**294**	**39**	**1950**
Retired residents	2%	33	22									
Working from home	5%	81	53									
Total	**27%**	**438**	**288**									

Port Wallace Master Plan - Infrastructure Study - 171013.00
2047-Scene 2

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Clayton						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
987 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	186	556	**742**
PM Peak Hour of Adjacent Street	1.00	63%	37%	622	366	**988**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Unia Estates						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
64 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	12	36	**48**
PM Peak Hour of Adjacent Street	1.00	63%	37%	41	24	**65**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Whebbys						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
175 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	33	99	**132**
PM Peak Hour of Adjacent Street	1.00	63%	37%	111	65	**176**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-All Developers Total						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
1,226 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				231	691	**922**
PM Peak Hour of Adjacent Street				774	455	**1229**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Clayton						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
176 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	14	65	**79**
PM Peak Hour of Adjacent Street	0.52	67%	33%	62	31	**93**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Conrad						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
28 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	11	**14**
PM Peak Hour of Adjacent Street	0.52	67%	33%	10	5	**15**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Unia Estates						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
40 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	15	**18**
PM Peak Hour of Adjacent Street	0.52	67%	33%	14	7	**21**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-All Developers Total						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
244 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				20	91	**111**
PM Peak Hour of Adjacent Street				86	43	**129**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Clayton						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
1,582 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	162	646	**808**
PM Peak Hour of Adjacent Street	0.62	65%	35%	638	344	**982**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Conrad						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
468 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	48	191	**239**
PM Peak Hour of Adjacent Street	0.62	65%	35%	189	102	**291**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Unia Estates						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
224 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	23	92	**115**
PM Peak Hour of Adjacent Street	0.62	65%	35%	91	49	**140**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-All Developers Total						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
2,274 **Dwelling Units**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				233	929	**1162**
PM Peak Hour of Adjacent Street				918	495	**1413**

Port Wallace Master Plan - Infrastructure Study (Commercial)-Clayton						
ITE Land Use Code 820 (Shopping Center) pages 1562 and 1563						
152,000 **sq.ft.**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.96	62%	38%	90	55	**146**
PM Peak Hour of Adjacent Street	3.71	48%	52%	271	293	**564**

Port Wallace Master Plan - Infrastructure Study (Institutional)-Clayton						
ITE Land Use Code 520 (Elementary School) pages 988 and 989						
37,674 **sq.ft**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	5.20	56%	44%	110	86	**196**
PM Peak Hour of Adjacent Street	1.21	45%	55%	21	25	**46**

Port Wallace Master Plan - Infrastructure Study (Industrial)						
ITE Land Use Code 110 (General Light Industrial) pages 114 and 113-Fitted Curve						
184 **Acres**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street		85%	15%	689	122	**810**
PM Peak Hour of Adjacent Street		22%	78%	175	620	**795**

Port Wallace Master Plan - Infrastructure Study (Park)-Unia Estates						
ITE Land Use Code 411 (Park) page 693						
3 **Acres**	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**
PM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**

Port Wallace Master Plan - Infrastructure Study (Combined Trips)						
ITE Land Use Codes (as shown above)						
	Rate	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				**1376**	**1977**	**3353**
PM Peak Hour of Adjacent Street				**2247**	**1934**	**4182**
					Check	3353
						4182

Option 1

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	1003				1442				
Walking/cycling mode share	3%	46	66	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	
Transit mode share	7%	92	132	532	71	402	0	765	101	577	0	2448
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	**27%**	**373**	**535**									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1639				1410				
Walking/cycling mode share	3%	75	65	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	
Transit mode share	7%	150	129	869	115	656	0	748	99	565	0	3052
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	**27%**	**608**	**524**									

Option 1A

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	1003				1442				
Walking/cycling mode share	3%	46	66	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	
Transit mode share	7%	92	132	502	71	382	51	722	101	549	73	2451
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	**27%**	**373**	**535**									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1639				1410				
Walking/cycling mode share	3%	75	65	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	
Transit mode share	7%	150	129	820	115	623	82	706	99	536	71	3052
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	**27%**	**608**	**524**									

Option 2

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	1003				1442				
Walking/cycling mode share	3%	46	66	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	
Transit mode share	7%	92	132	432	71	351	151	621	101	505	217	2449
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	**27%**	**373**	**535**									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1639				1410				
Walking/cycling mode share	3%	75	65	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	
Transit mode share	7%	150	129	705	115	574	246	607	99	494	212	3052
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	**27%**	**608**	**524**									

Port Wallace Master Plan - Infrastructure Study - 171013.00

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Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Clayton						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
987 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	186	556	**742**
PM Peak Hour of Adjacent Street	1.00	63%	37%	622	366	**988**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Unia Estates						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
64 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	12	36	**48**
PM Peak Hour of Adjacent Street	1.00	63%	37%	41	24	**65**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Whebbys						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
175 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	33	99	**132**
PM Peak Hour of Adjacent Street	1.00	63%	37%	111	65	**176**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-All Developers Total						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
1,226 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				231	691	**922**
PM Peak Hour of Adjacent Street				774	455	**1229**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Clayton						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
176 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	14	65	**79**
PM Peak Hour of Adjacent Street	0.52	67%	33%	62	31	**93**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Conrad						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
28 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	11	**14**
PM Peak Hour of Adjacent Street	0.52	67%	33%	10	5	**15**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Unia Estates						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
40 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	15	**18**
PM Peak Hour of Adjacent Street	0.52	67%	33%	14	7	**21**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-All Developers Total						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
244 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				20	91	**111**
PM Peak Hour of Adjacent Street				86	43	**129**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Clayton						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
1,582 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	162	646	**808**
PM Peak Hour of Adjacent Street	0.62	65%	35%	638	344	**982**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Conrad						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
468 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	48	191	**239**
PM Peak Hour of Adjacent Street	0.62	65%	35%	189	102	**291**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Unia Estates						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
224 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	23	92	**115**
PM Peak Hour of Adjacent Street	0.62	65%	35%	91	49	**140**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-All Developers Total						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
2,274 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				233	929	**1162**
PM Peak Hour of Adjacent Street				918	495	**1413**

Port Wallace Master Plan - Infrastructure Study (Commercial)-Clayton						
ITE Land Use Code 820 (Shopping Center) pages 1562 and 1563						
152,000 sq.ft.	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.96	62%	38%	90	55	**146**
PM Peak Hour of Adjacent Street	3.71	48%	52%	271	293	**564**

Port Wallace Master Plan - Infrastructure Study (Institutional)-Clayton						
ITE Land Use Code 520 (Elementary School) pages 988 and 989						
87,674 sq.ft	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	5.20	56%	44%	110	86	**196**
PM Peak Hour of Adjacent Street	1.21	45%	55%	21	25	**46**

Port Wallace Master Plan - Infrastructure Study (Industrial)						
ITE Land Use Code 110 (General Light Industrial) pages 114 and 113-Fitted Curve						
184 Acres	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street		85%	15%	689	122	**810**
PM Peak Hour of Adjacent Street		22%	78%	175	620	**795**

Port Wallace Master Plan - Infrastructure Study (Park)-Unia Estates						
ITE Land Use Code 411 (Park) page 693						
3 Acres	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**
PM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**

Port Wallace Master Plan - Infrastructure Study (Combined Trips)						
ITE Land Use Codes (as shown above)						
	Rate	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				**1376**	**1977**	**3353**
PM Peak Hour of Adjacent Street				**2247**	**1934**	**4182**

Check	
	3353
	4182

Option 1

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	865				1244				
Walking/cycling mode share	7%	92	132	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	
Transit mode share	13%	184	264	459	61	346	0	660	88	498	0	2112
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	**37%**	**511**	**733**									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1414				1217				
Walking/cycling mode share	7%	150	129	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	Waverley-EW-53%	Waverley-NS-7%	Main St-40%	Forest Hills-0%	
Transit mode share	13%	300	258	750	99	566	0	646	86	487	0	2634
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	**37%**	**833**	**717**									

Option 1A

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	865				1244				
Walking/cycling mode share	7%	92	132	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	
Transit mode share	13%	184	264	433	61	329	44	623	88	473	63	2114
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	**37%**	**511**	**733**									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1414				1217				
Walking/cycling mode share	7%	150	129	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	Waverley-EW-50%	Waverley-NS-7%	Main St-38%	Forest Hills-5%	
Transit mode share	13%	300	258	708	99	538	71	609	86	463	61	2635
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	**37%**	**833**	**717**									

Option 2

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	865				1244				
Walking/cycling mode share	7%	92	132	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	
Transit mode share	13%	184	264	372	61	303	130	535	88	436	187	2112
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	**37%**	**511**	**733**									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1414				1217				
Walking/cycling mode share	7%	150	129	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	Waverley-EW-43%	Waverley-NS-7%	Main St-35%	Forest Hills-15%	
Transit mode share	13%	300	258	609	99	495	213	524	86	427	183	2636
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	**37%**	**833**	**717**									

Port Wallace Master Plan - Infrastructure Study - 171013.00
2047- Scene 4

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Clayton						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
987 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	186	556	**742**
PM Peak Hour of Adjacent Street	1.00	63%	37%	622	366	**988**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Unia Estates						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
64 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	12	36	**48**
PM Peak Hour of Adjacent Street	1.00	63%	37%	41	24	**65**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Whebbys						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
175 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	33	99	**132**
PM Peak Hour of Adjacent Street	1.00	63%	37%	111	65	**176**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-All Developers Total						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
1,226 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				231	691	**922**
PM Peak Hour of Adjacent Street				774	455	**1229**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Clayton						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
176 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	14	65	**79**
PM Peak Hour of Adjacent Street	0.52	67%	33%	62	31	**93**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Conrad						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
28 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	11	**14**
PM Peak Hour of Adjacent Street	0.52	67%	33%	10	5	**15**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Unia Estates						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
40 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	15	**18**
PM Peak Hour of Adjacent Street	0.52	67%	33%	14	7	**21**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-All Developers Total						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
244 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				20	91	**111**
PM Peak Hour of Adjacent Street				86	43	**129**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Clayton						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
1,582 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	162	646	**808**
PM Peak Hour of Adjacent Street	0.62	65%	35%	638	344	**982**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Conrad						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
468 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	48	191	**239**
PM Peak Hour of Adjacent Street	0.62	65%	35%	189	102	**291**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Unia Estates						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
224 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	23	92	**115**
PM Peak Hour of Adjacent Street	0.62	65%	35%	91	49	**140**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-All Developers Total						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
2,274 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				233	929	**1162**
PM Peak Hour of Adjacent Street				918	495	**1413**

Port Wallace Master Plan - Infrastructure Study (Commercial)-Clayton						
ITE Land Use Code 820 (Shopping Center) pages 1562 and 1563						
152,000 sq.ft.	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.96	62%	38%	90	55	**146**
PM Peak Hour of Adjacent Street	3.71	48%	52%	271	293	**564**

Port Wallace Master Plan - Infrastructure Study (Institutional)-Clayton						
ITE Land Use Code 520 (Elementary School) pages 988 and 989						
87,674 sq.ft	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	5.20	56%	44%	110	86	**196**
PM Peak Hour of Adjacent Street	1.21	45%	55%	21	25	**46**

Port Wallace Master Plan - Infrastructure Study (Industrial)						
ITE Land Use Code 110 (General Light Industrial) pages 114 and 113-Fitted Curve						
184 Acres	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street		85%	15%	689	122	**810**
PM Peak Hour of Adjacent Street		22%	78%	175	620	**795**

Port Wallace Master Plan - Infrastructure Study (Park)-Unia Estates						
ITE Land Use Code 411 (Park) page 693						
3 Acres	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**
PM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**

Port Wallace Master Plan - Infrastructure Study (Combined Trips)						
ITE Land Use Codes (as shown above)						
	Rate	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				**1376**	**1977**	**3353**
PM Peak Hour of Adjacent Street				**2247**	**1934**	**4182**

Check	
	3353
	4182

Option 3A

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	1003				1442				
Walking/cycling mode share	3%	46	66	Waverley-EW-50%	Waverley-NS-10%	Main St-40%	Forest Hills-0%	Waverley-EW-50%	Waverley-NS-10%	Main St-40%	Forest Hills-0%	
Transit mode share	7%	92	132	502	101	402	0	722	145	577	0	2449
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	27%	373	535									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1639				1410				
Walking/cycling mode share	3%	75	65	Waverley-EW-50%	Waverley-NS-10%	Main St-40%	Forest Hills-0%	Waverley-EW-50%	Waverley-NS-10%	Main St-40%	Forest Hills-0%	
Transit mode share	7%	150	129	820	164	656	0	706	142	565	0	3053
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	27%	608	524									

Port Wallace Master Plan - Infrastructure Study - 171013.00
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Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Clayton						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
987 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	186	556	**742**
PM Peak Hour of Adjacent Street	1.00	63%	37%	622	366	**988**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Unia Estates						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
64 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	12	36	**48**
PM Peak Hour of Adjacent Street	1.00	63%	37%	41	24	**65**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-Whebbys						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
175 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.75	25%	75%	33	99	**132**
PM Peak Hour of Adjacent Street	1.00	63%	37%	111	65	**176**

Port Wallace Master Plan - Infrastructure Study (Residential-Single Unit)-All Developers Total						
ITE Land Use Code 210 (Single-family Detached Housing) pages 297 and 298						
1,226 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				231	691	**922**
PM Peak Hour of Adjacent Street				774	455	**1229**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Clayton						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
176 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	14	65	**79**
PM Peak Hour of Adjacent Street	0.52	67%	33%	62	31	**93**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Conrad						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
28 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	11	**14**
PM Peak Hour of Adjacent Street	0.52	67%	33%	10	5	**15**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-Unia Estates						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
40 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.44	17%	83%	3	15	**18**
PM Peak Hour of Adjacent Street	0.52	67%	33%	14	7	**21**

Port Wallace Master Plan - Infrastructure Study (Residential-Town House)-All Developers Total						
ITE Land Use Code 230 (Residential Condominium/Townhouse) pages 395 and 396						
244 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				20	91	**111**
PM Peak Hour of Adjacent Street				86	43	**129**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Clayton						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
1,582 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	162	646	**808**
PM Peak Hour of Adjacent Street	0.62	65%	35%	638	344	**982**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Conrad						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
468 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	48	191	**239**
PM Peak Hour of Adjacent Street	0.62	65%	35%	189	102	**291**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-Unia Estates						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
224 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.51	20%	80%	23	92	**115**
PM Peak Hour of Adjacent Street	0.62	65%	35%	91	49	**140**

Port Wallace Master Plan - Infrastructure Study (Residential-Multi Unit)-All Developers Total						
ITE Land Use Code 220 (Apartment) pages 334 and 335						
2,274 Dwelling Units	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				233	929	**1162**
PM Peak Hour of Adjacent Street				918	495	**1413**

Port Wallace Master Plan - Infrastructure Study (Commercial)-Clayton						
ITE Land Use Code 820 (Shopping Center) pages 1562 and 1563						
152,000 sq.ft.	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	0.96	62%	38%	90	55	**146**
PM Peak Hour of Adjacent Street	3.71	48%	52%	271	293	**564**

Port Wallace Master Plan - Infrastructure Study (Institutional)-Clayton						
ITE Land Use Code 520 (Elementary School) pages 988 and 989						
87,674 sq.ft	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	5.20	56%	44%	110	86	**196**
PM Peak Hour of Adjacent Street	1.21	45%	55%	21	25	**46**

Port Wallace Master Plan - Infrastructure Study (Industrial)						
ITE Land Use Code 110 (General Light Industrial) pages 114 and 113-Fitted Curve						
184 Acres	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street		85%	15%	689	122	**810**
PM Peak Hour of Adjacent Street		22%	78%	175	620	**795**

Port Wallace Master Plan - Infrastructure Study (Park)-Unia Estates						
ITE Land Use Code 411 (Park) page 693						
3 Acres	**Rate**	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**
PM Peak Hour of Adjacent Street	1.89	50%	50%	3	3	**6**

Port Wallace Master Plan - Infrastructure Study (Combined Trips)						
ITE Land Use Codes (as shown above)						
	Rate	**Entering**	**Exiting**	**Trips Ent**	**Trips Ex**	**Total Trips**
AM Peak Hour of Adjacent Street				**1376**	**1977**	**3353**
PM Peak Hour of Adjacent Street				**2247**	**1934**	**4182**

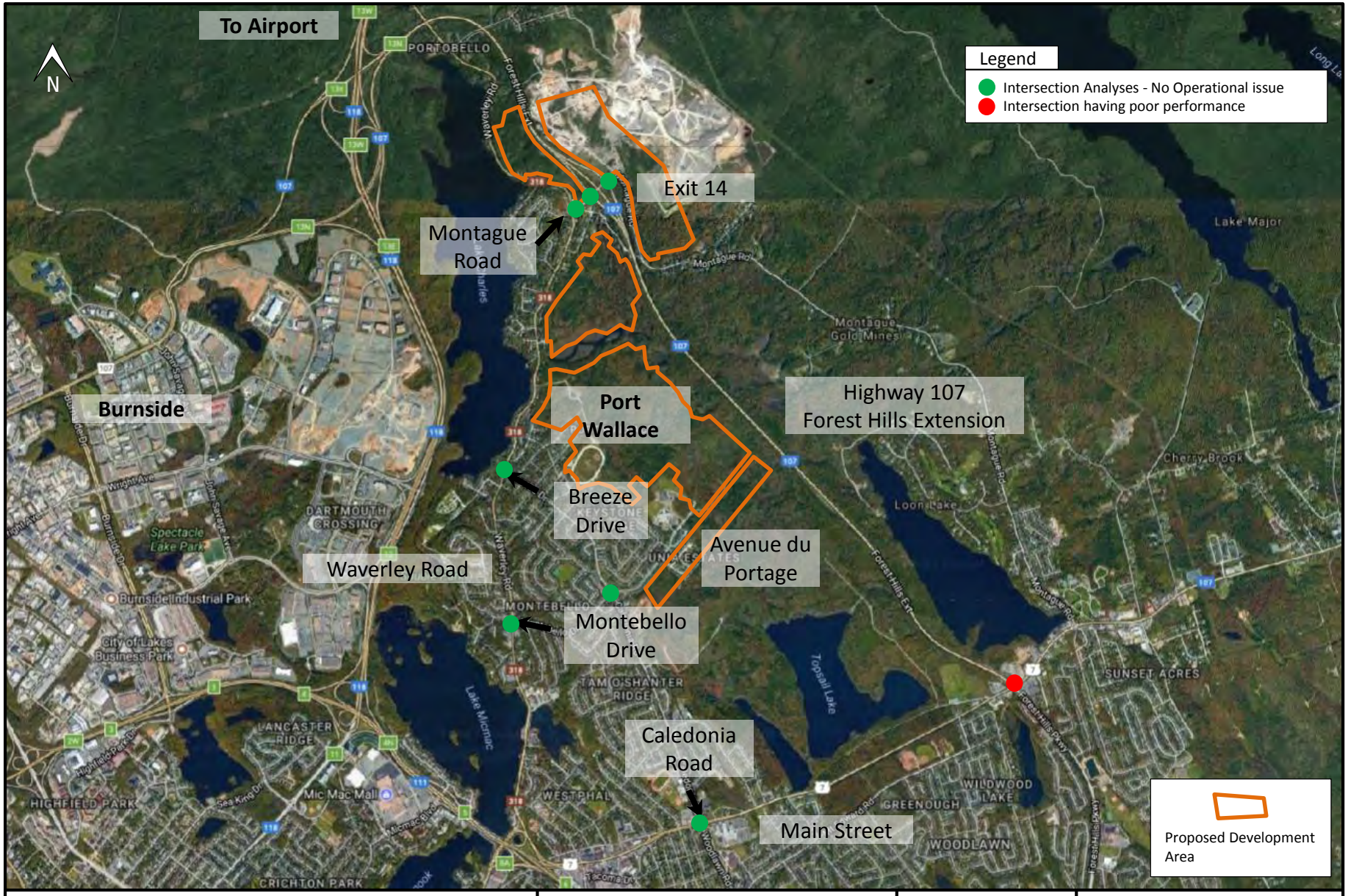
Check	
	3353
	4182

Option 3B

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in AM Peak Hour	Exiting Trip Reductions in AM Peak Hour	Entering Trips in AM Peak Hour after Reduction				Exiting Trips in AM Peak Hour after Reduction				Total Trips in AM Peak Hour after Reduction
Internal Trips	10%	138	198	1003				1442				
Walking/cycling mode share	3%	46	66	Waverley-EW-35%	Waverley-NS-10%	Main St-35%	Forest Hills-20%	Waverley-EW-35%	Waverley-NS-10%	Main St-35%	Forest Hills-20%	
Transit mode share	7%	92	132	351	101	351	201	505	145	505	289	2448
Retired residents	2%	28	40									
Working from home	5%	69	99									
Total	27%	373	535									

Anticipated Trip Reduction Category	Trip Reduction Rates	Entering Trip Reductions in PM Peak Hour	Exiting Trip Reductions in PM Peak Hour	Entering Trips in PM Peak Hour after Reduction				Exiting Trips in PM Peak Hour after Reduction				Total Trips in PM Peak Hour after Reduction
Internal Trips	10%	225	194	1639				1410				
Walking/cycling mode share	3%	75	65	Waverley-EW-35%	Waverley-NS-10%	Main St-35%	Forest Hills-20%	Waverley-EW-35%	Waverley-NS-10%	Main St-35%	Forest Hills-20%	
Transit mode share	7%	150	129	574	164	574	328	494	142	494	283	3053
Retired residents	2%	45	39									
Working from home	5%	113	97									
Total	27%	608	524									

APPENDIX C – Level of Service (LoS) Analysis



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Port Wallace Master Plan
Final Report

Project No.: 171013.00
Date: November 2017

Figure C1
LOS Table 1
2017 - Existing

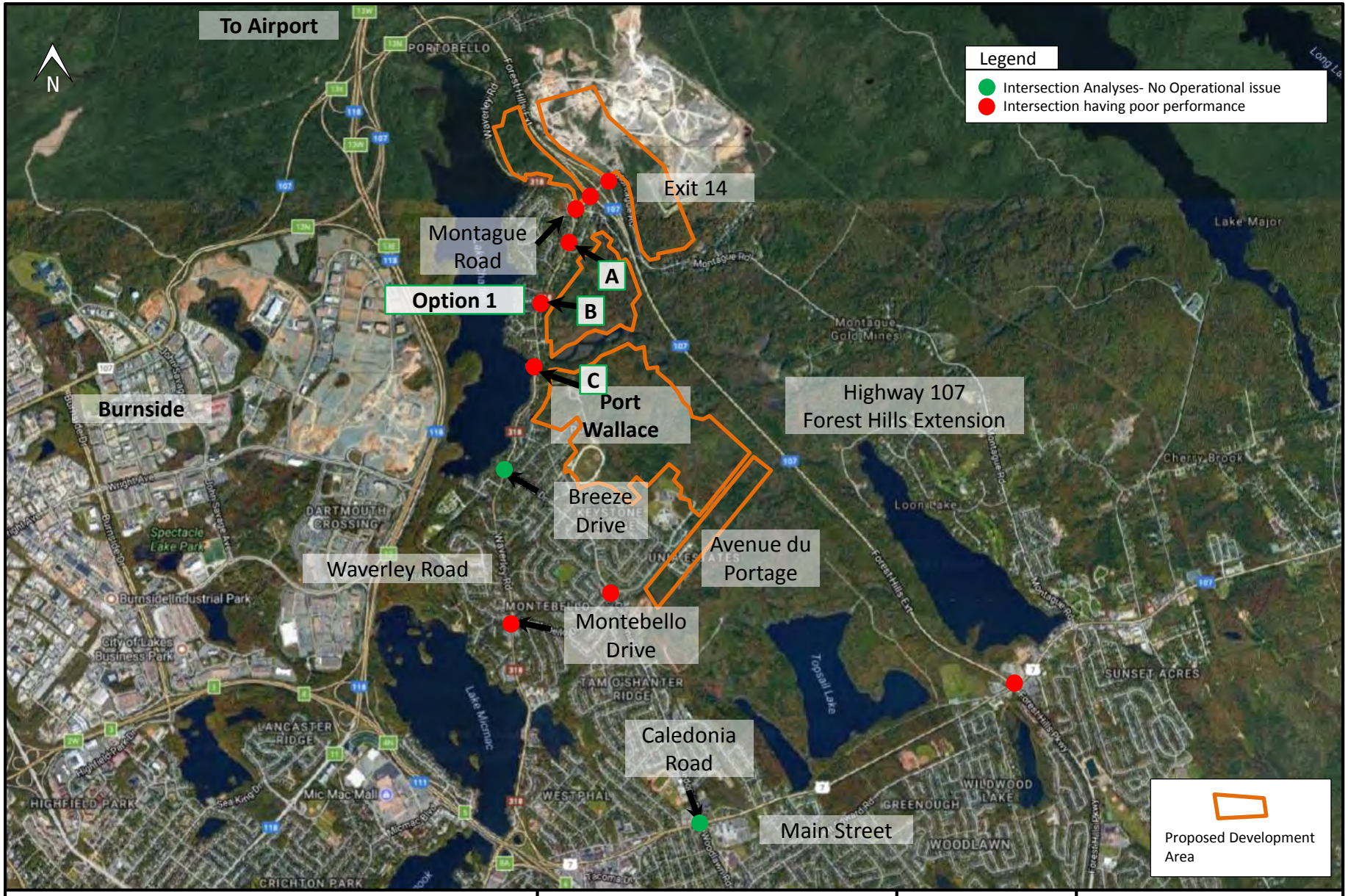

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Figure C2
LOS Table 2
2031 - 1% GR - Option 1-
50% Buildout - 10% NAMC

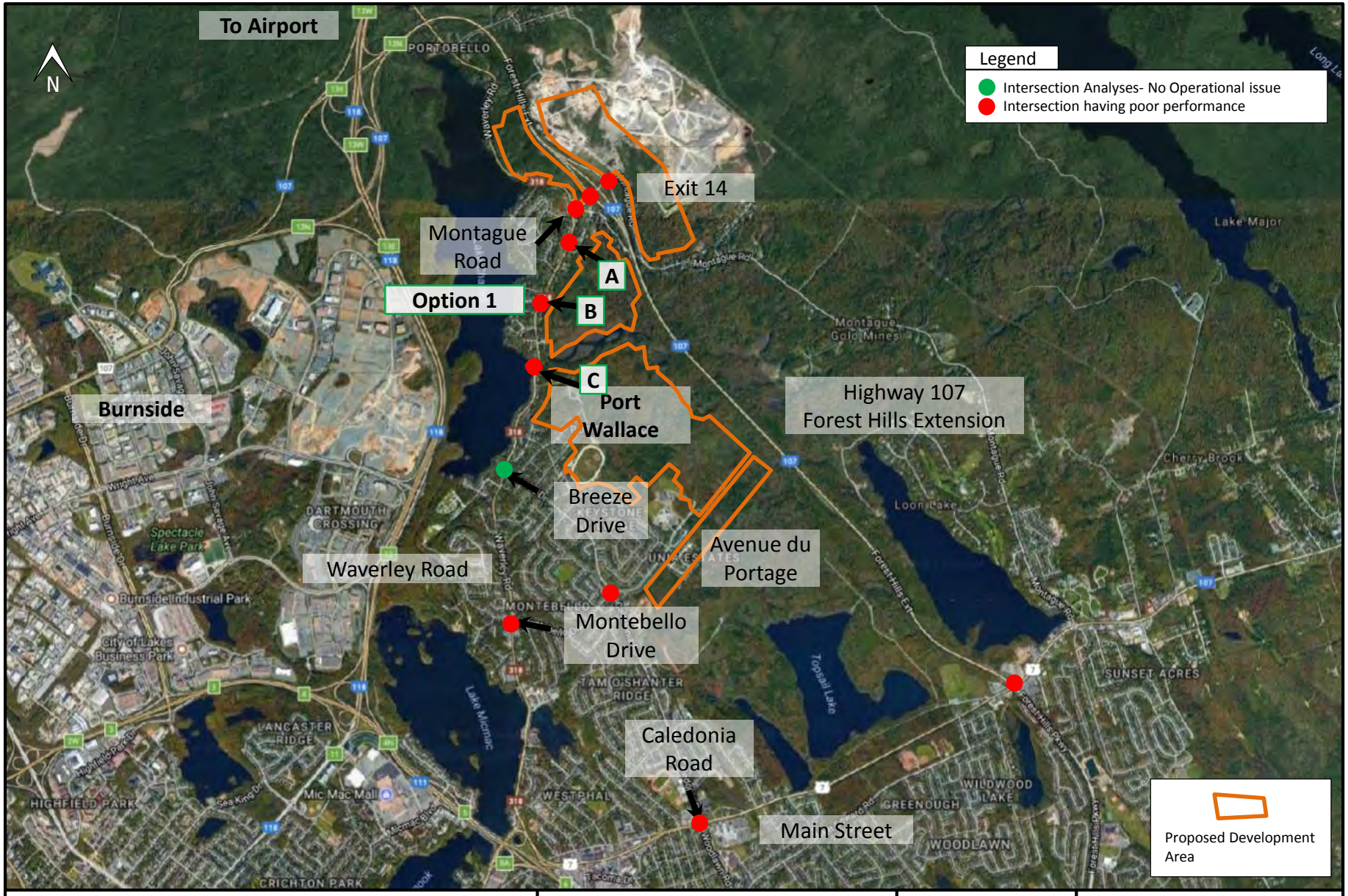

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Figure C3
LOS Table 4
2047 - 0.75% GR - Option 1-
Full Buildout - 10% NAMC

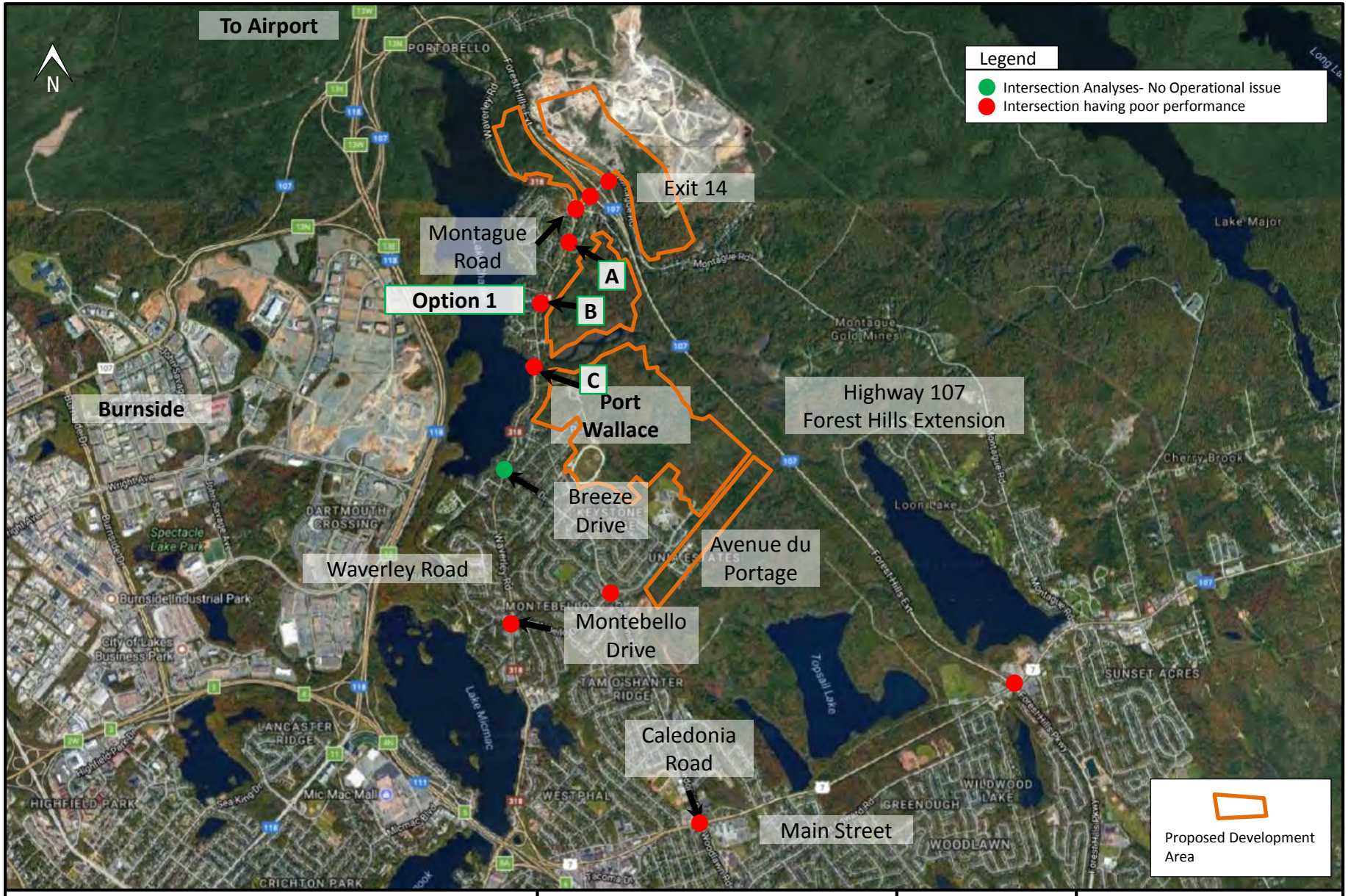

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Figure C4
LOS Table 7
2047 - 0.75% GR - Option 1-
Full Buildout - 20% NAMC

APPENDIX D – Synchro and Arcady Model Outputs

Port Wallace Master Plan-Infrastructure Study
CBCL Limited 171013.00
2-Aug-17

Table 1 - Synchro Analysis Results: 2017 Baseline Volumes & Existing Street Network

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	9.1	0.30	9.7	A	1.4	0.07	7.6	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	5.6	0.21	22.6	C	4.2	0.16	15.1	C
	Overall			**4.7**	**A**			**2.7**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.02	8.2	A	0.0	0.01	7.6	A
	SB Left/Thru/Right	4.2	0.16	12.1	B	70.7	0.85	29.0	D
	Overall			**2.2**	**A**			**20.0**	**C**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	2.8	0.13	18.1	C	0.7	0.04	11.6	B
	WB Left/Thru	9.8	0.33	23.8	C	17.5	0.48	20.7	C
	WB Right	1.4	0.05	9.3	A	7.0	0.25	11.1	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.4	A
	SB Left	3.5	0.14	8.2	A	1.4	0.06	8.0	A
	SB Thru/Right				A				A
	Overall			**6.1**	**A**			**8.2**	**A**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	9.8	0.33	14.2	B	9.1	0.31	17.5	C
	NB Thru/Right				A				A
	SB Left/Thru	1.4	0.06	7.7	A	2.8	0.12	8.7	A
	Overall			**4.8**	**A**			**3.8**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	86.8	0.68	21.0	C	50.0	0.60	38.0	D
	WB Right	5.7	0.07	4.9	A	8.1	0.13	10.8	B
	NB Thru/Right	47.9	0.52	14.5	B	234.2	0.89	22.1	C
	SB Left	8.5	0.12	13.4	B	9.1	0.29	12.9	B
	SB Thru	91.5	0.78	24.9	C	38.3	0.30	6.8	A
	Overall			**20.2**	**C**			**20.0**	**B**
Main & Forest Hills [56] (Signalized)	EB Left	49.6	0.69	42.6	D	11.8	0.11	19.3	B
	EB Thru	51.3	0.25	29.7	C	226.8	1.02	74.3	E
	EB Right	0.0	0.11	0.7	A	0.0	0.25	0.4	A
	WB Left	19.1	0.13	20.4	C	54.2	0.76	48.5	D
	WB Thru	176.5	0.79	44.6	D	69.3	0.38	30.0	C
	WB Right	0.0	0.37	0.7	A	0.0	0.13	0.2	A
	NB Left	71.8	0.48	46.2	D	42.8	0.50	56.3	E
	NB Thru	237.5	1.07	109.1	F	107.4	0.92	94.1	F
	NB Right	0.0	0.06	0.1	A	0.0	0.15	0.2	A
	SB Left	23.6	0.28	59.3	E	151.6	0.97	73.0	E
	SB Thru	62.9	0.71	79.5	E	223.5	1.12	124.6	F
	SB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	Overall			**43.2**	**D**			**58.5**	**E**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	22.2	0.52	20.1	C	40.8	0.45	12.3	B
	EB Thru	53.6	0.28	19.5	B	210.9	0.75	25.7	C
	EB Right	0.0	0.12	0.2	A	0.0	0.11	0.1	A
	WB Left	32.4	0.33	12.1	B	12.8	0.35	15.2	B
	WB Thru	184.2	0.73	28.1	C	70.3	0.33	20.6	C
	WB Right	0.0	0.06	0.1	A	0.0	0.05	0.1	A
	NB Left	76.4	0.82	58.8	E	47.7	0.60	46.6	D
	NB Thru	43.5	0.27	36.5	D	64.1	0.62	59.8	E
	NB Right	0.0	0.03	0.0	A	0.0	0.06	0.1	A
	SB Left	40.5	0.53	60.4	E	40.1	0.46	40.9	D
	SB Thru	72.1	0.70	65.2	E	71.4	0.70	64.3	E
	SB Right	0.0	0.13	0.2	A	0.0	0.11	0.1	A
	Overall			**26.9**	**C**			**25.3**	**C**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	2.5	0.47	14.7	B	35.7	0.67	19.2	C
	WB Left/Thru/Right	3.9	0.60	18.6	C	9.8	0.32	12.4	B
	NB Left/Thru/Right	3.5	0.57	17.6	C	21.0	0.52	15.6	C
	SB Left/Thru/Right	2.2	0.44	14.6	B	9.8	0.32	12.3	B
	Overall			**16.6**	**C**			**15.9**	**C**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E
4. LOS - Level of Service [highlighted for LOS E or F]

Table 12 - Synchro Analysis Results: 2031 Volumes & Existing Street Network, 1% Growth, No Developement

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	11.9	0.37	10.5	B	1.4	0.08	7.7	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	9.1	0.32	32.1	D	5.6	0.21	17.4	C
	Overall			**5.5**	**A**			**2.9**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.02	8.4	A	0.0	0.01	7.7	A
	SB Left/Thru/Right	5.6	0.20	13.1	B	126.7	1.02	60.4	F
	Overall			**2.4**	**A**			**41.5**	**E**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	4.2	0.17	21.5	C	0.7	0.05	12.3	B
	WB Left/Thru	16.1	0.47	34.2	D	28.0	0.62	28.9	D
	WB Right	1.4	0.06	9.4	A	9.1	0.31	11.9	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.5	A
	SB Left	4.2	0.16	8.4	A	1.4	0.07	8.2	A
	SB Thru/Right				A				A
	Overall			**7.6**	**A**			**10.2**	**B**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	14.0	0.42	16.7	C	14.7	0.43	22.6	C
	NB Thru/Right				A				A
	SB Left/Thru	1.4	0.07	7.8	A	3.5	0.14	9.0	A
	Overall			**5.5**	**A**			**4.6**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	133.1	0.73	25.6	C	57.2	0.72	48.4	D
	WB Right	6.7	0.07	5.3	A	8.9	0.15	10.1	B
	NB Thru/Right	56.5	0.58	17.0	B	295.0	0.96	32.3	C
	SB Left	9.3	0.16	14.3	B	22.8	0.53	37.2	D
	SB Thru	109.4	0.87	33.0	C	44.8	0.33	7.0	A
	Overall			**25.3**	**C**			**28.1**	**C**
Main & Forest Hills [56] (Signalized)	EB Left	72.1	0.83	64.6	E	13.4	0.14	19.7	B
	EB Thru	59.5	0.30	32.1	C	278.7	1.20	137.4	F
	EB Right	0.0	0.13	0.2	A	0.0	0.29	0.5	A
	WB Left	21.4	0.17	21.1	C	72.7	0.83	57.0	E
	WB Thru	228.8	0.94	57.0	E	80.6	0.44	31.1	C
	WB Right	0.0	0.42	0.8	A	0.0	0.15	0.2	A
	NB Left	82.7	0.55	47.8	D	48.5	0.56	57.8	E
	NB Thru	287.4	1.23	163.1	F	129.4	1.04	120.2	F
	NB Right	0.0	0.07	0.1	A	0.0	0.17	0.2	A
	SB Left	26.3	0.30	59.0	E	187.0	1.12	115.9	F
	SB Thru	71.7	0.77	83.5	F	268.0	1.30	190.3	F
	SB Right	0.0	0.05	0.1	A	0.0	0.08	0.1	A
	Overall			**55.7**	**E**			**91.3**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	42.5	0.70	44.0	D	49.7	0.57	15.4	B
	EB Thru	62.2	0.33	20.9	C	299.3	0.89	34.0	C
	EB Right	0.0	0.13	0.2	A	0.0	0.13	0.2	A
	WB Left	37.1	0.42	14.0	B	21.7	0.45	25.6	C
	WB Thru	246.6	0.87	35.4	D	88.1	0.40	24.0	C
	WB Right	0.0	0.07	0.1	A	0.0	0.06	0.1	A
	NB Left	106.6	0.97	87.7	F	52.6	0.70	50.9	D
	NB Thru	49.5	0.30	36.0	D	71.7	0.65	59.2	E
	NB Right	0.0	0.04	0.0	A	0.0	0.06	0.1	A
	SB Left	45.4	0.57	60.8	E	44.1	0.54	41.9	D
	SB Thru	82.8	0.75	66.2	E	79.8	0.73	63.9	E
	SB Right	0.0	0.15	0.2	A	0.0	0.13	0.2	A
	Overall			**32.7**	**C**			**29.9**	**C**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	31.5	0.64	22.7	C	65.1	0.85	35.2	E
	WB Left/Thru/Right	51.1	0.79	33.7	D	14.0	0.42	15.2	C
	NB Left/Thru/Right	46.9	0.76	31.0	D	34.3	0.66	22.4	C
	SB Left/Thru/Right	25.9	0.59	21.4	C	14.0	0.41	15.2	C
	Overall			**27.9**	**D**			**25.1**	**D**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Level of Service Table - HCM 2010

Level of Service	Average Delay per Vehicle (sec)	
	Signalized	Unisignalized
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

Legend

- Queue Length > 100m
- V/C > 0.85
- LOS E
- LOS F

Port Wallace Master Plan-Infrastructure Study
CBCL Limited 171013.00
2-Aug-17

Table 1 - Synchro Analysis Results: 2017 Baseline Volumes & Existing Street Network

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	9.1	0.30	9.7	A	1.4	0.07	7.6	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	5.6	0.21	22.6	C	4.2	0.16	15.1	C
	Overall			**4.7**	**A**			**2.7**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.02	8.2	A	0.0	0.01	7.6	A
	SB Left/Thru/Right	4.2	0.16	12.1	B	70.7	0.85	29.0	D
	Overall			**2.2**	**A**			**20.0**	**C**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	2.8	0.13	18.1	C	0.7	0.04	11.6	B
	WB Left/Thru	9.8	0.33	23.8	C	17.5	0.48	20.7	C
	WB Right	1.4	0.05	9.3	A	7.0	0.25	11.1	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.4	A
	SB Left	3.5	0.14	8.2	A	1.4	0.06	8.0	A
	SB Thru/Right				A				A
	Overall			**6.1**	**A**			**8.2**	**A**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	9.8	0.33	14.2	B	9.1	0.31	17.5	C
	NB Thru/Right				A				A
	SB Left/Thru	1.4	0.06	7.7	A	2.8	0.12	8.7	A
	Overall			**4.8**	**A**			**3.8**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	86.8	0.68	21.0	C	50.0	0.60	38.0	D
	WB Right	5.7	0.07	4.9	A	8.1	0.13	10.8	B
	NB Thru/Right	47.9	0.52	14.5	B	234.2	0.89	22.1	C
	SB Left	8.5	0.12	13.4	B	9.1	0.29	12.9	B
	SB Thru	91.5	0.78	24.9	C	38.3	0.30	6.8	A
	Overall			**20.2**	**C**			**20.0**	**B**
Main & Forest Hills [56] (Signalized)	EB Left	49.6	0.69	42.6	D	11.8	0.11	19.3	B
	EB Thru	51.3	0.25	29.7	C	226.8	1.02	74.3	E
	EB Right	0.0	0.11	0.7	A	0.0	0.25	0.4	A
	WB Left	19.1	0.13	20.4	C	54.2	0.76	48.5	D
	WB Thru	176.5	0.79	44.6	D	69.3	0.38	30.0	C
	WB Right	0.0	0.37	0.7	A	0.0	0.13	0.2	A
	NB Left	71.8	0.48	46.2	D	42.8	0.50	56.3	E
	NB Thru	237.5	1.07	103.1	F	107.4	0.92	94.1	F
	NB Right	0.0	0.06	0.1	A	0.0	0.15	0.2	A
	SB Left	23.6	0.28	59.3	E	151.6	0.97	73.0	E
	SB Thru	62.9	0.71	79.5	E	223.5	1.12	124.6	F
	SB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	Overall			**43.2**	**D**			**58.5**	**E**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	22.2	0.52	20.1	C	40.8	0.45	12.3	B
	EB Thru	53.6	0.28	19.5	B	210.9	0.75	25.7	C
	EB Right	0.0	0.12	0.2	A	0.0	0.11	0.1	A
	WB Left	32.4	0.33	12.1	B	12.8	0.35	15.2	B
	WB Thru	184.2	0.73	28.1	C	70.3	0.33	20.6	C
	WB Right	0.0	0.06	0.1	A	0.0	0.05	0.1	A
	NB Left	76.4	0.82	58.8	E	47.7	0.60	46.6	D
	NB Thru	43.5	0.27	36.5	D	64.1	0.62	59.8	E
	NB Right	0.0	0.03	0.0	A	0.0	0.06	0.1	A
	SB Left	40.5	0.53	60.4	E	40.1	0.46	40.9	D
	SB Thru	72.1	0.70	65.2	E	71.4	0.70	64.3	E
	SB Right	0.0	0.13	0.2	A	0.0	0.11	0.1	A
	Overall			**26.9**	**C**			**25.3**	**C**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	2.5	0.47	14.7	B	35.7	0.67	19.2	C
	WB Left/Thru/Right	3.9	0.60	18.6	C	9.8	0.32	12.4	B
	NB Left/Thru/Right	3.5	0.57	17.6	C	21.0	0.52	15.6	C
	SB Left/Thru/Right	2.2	0.44	14.6	B	9.8	0.32	12.3	B
	Overall			**16.6**	**C**			**15.9**	**C**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 2 - Synchro Analysis Results: 2031, 1% growth, Opt 1, 50% build-out, 10% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	71.4	0.84	23.4	C	9.8	0.33	8.7	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	63.0	5.66	2769.5	F	36.4	0.97	185.2	F
	Overall			**123.6**	**F**			**16.6**	**C**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.03	10.2	B	0.7	0.02	8.7	A
	SB Left/Thru/Right	23.8	0.56	19.5	C	609.7	1.95	447.6	F
	Overall			**4.5**	**A**			**290.7**	**F**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	10.5	0.36	47.9	E	1.4	0.07	16.1	C
	WB Left/Thru	182.0	2.42	721.5	F	476.0	2.85	868.5	F
	WB Right	2.1	0.08	11.2	B	12.6	0.39	14.9	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.5	A
	SB Left	7.0	0.25	10.6	B	2.1	0.09	9.4	A
	SB Thru/Right				A				A
	Overall			**138.9**	**F**			**353.9**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	24.5	0.58	27.2	D	32.9	0.72	56.1	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.08	8.0	A	4.2	0.18	10.1	B
	Overall			**6.1**	**A**			**7.0**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	184.6	0.87	44.3	D	57.2	0.72	48.4	D
	WB Right	8.6	0.09	7.6	A	8.9	0.15	10.1	B
	NB Thru/Right	70.0	0.56	15.3	B	387.1	1.14	91.1	F
	SB Left	8.7	0.13	11.6	B	22.8	0.53	37.2	D
	SB Thru	165.0	0.91	34.3	C	67.4	0.45	8.2	A
	Overall			**31.1**	**C**			**63.7**	**E**
Main & Forest Hills [56] (Signalized)	EB Left	72.1	0.83	64.6	E	13.4	0.17	20.1	C
	EB Thru	81.5	0.41	33.9	C	319.6	1.32	187.6	F
	EB Right	0.0	0.13	0.2	A	0.0	0.29	0.5	A
	WB Left	21.4	0.21	21.5	C	72.7	0.83	57.0	E
	WB Thru	255.4	1.00	69.5	E	100.2	0.53	32.9	C
	WB Right	0.0	0.42	0.8	A	0.0	0.15	0.2	A
	NB Left	82.7	0.55	47.8	D	48.5	0.56	57.8	E
	NB Thru	287.4	1.23	163.1	F	129.4	1.04	120.2	F
	NB Right	0.0	0.07	0.1	A	0.0	0.17	0.2	A
	SB Left	26.3	0.30	59.0	E	187.0	1.12	115.9	F
	SB Thru	71.7	0.77	83.5	F	268.0	1.30	190.3	F
	SB Right	0.0	0.05	0.1	A	0.0	0.08	0.1	A
	Overall			**58.8**	**E**			**104.9**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	102.8	1.15	142.6	F	246.1	1.13	99.7	F
	EB Thru	62.2	0.35	22.6	C	299.3	0.89	34.0	C
	EB Right	0.0	0.13	0.2	A	0.0	0.13	0.2	A
	WB Left	37.1	0.45	15.8	B	17.6	0.45	24.9	C
	WB Thru	246.6	0.93	44.2	D	90.4	0.52	33.8	C
	WB Right	0.0	0.13	0.2	A	0.0	0.14	0.2	A
	NB Left	98.1	0.84	57.4	E	52.6	0.70	51.1	D
	NB Thru	49.5	0.27	33.7	C	71.7	0.65	59.5	E
	NB Right	0.0	0.04	0.0	A	0.0	0.06	0.1	A
	SB Left	130.1	1.11	138.7	F	111.6	1.05	108.0	F
	SB Thru	82.8	0.63	56.4	E	79.8	0.73	63.9	E
	SB Right	0.0	0.35	0.6	A	0.0	0.26	0.4	A
	Overall			**41.7**	**D**			**43.7**	**D**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	5.5	0.99	40.7	E	97.3	1.56	122.5	F
	WB Left/Thru/Right	52.6	2.04	453.7	F	137.9	1.72	190.7	F
	NB Left/Thru/Right	18.2	1.54	150.2	F	368.2	2.13	457.9	F
	SB Left/Thru/Right	4.5	0.92	37.3	E	21.0	0.80	32.8	D
	Overall			**245.9**	**F**			**269.4**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	9.7	A	0.0	0.00	10.8	B
	WB Left/Thru/Right	7.7	0.28	11.1	B	6.3	0.24	11.9	B
	NB Left/Thru/Right	16.8	0.46	12.6	B	142.1	1.06	78.7	F
	SB Left/Thru/Right	71.4	0.85	30.3	D	88.9	0.95	43.5	E
	Overall			**22.3**	**C**			**58.1**	**F**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	10.0	A	0.0	0.00	11.1	B
	WB Left/Thru/Right	8.4	0.29	11.5	B	0.9	0.25	12.2	B
	NB Left/Thru/Right	28.7	0.61	16.2	C	22.6	1.14	94.3	F
	SB Left/Thru/Right	74.9	0.87	33.1	D	19.7	1.11	80.2	F
	Overall			**24.2**	**C**			**81.5**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	30.1	0.63	20.2	C	17.5	0.54	17.5	C
	NB Thru/Right	70.0	0.89	38.3	E	199.5	1.39	155.2	F
	SB Left/Thru	121.1	1.04	77.0	F	308.0	1.59	255.1	F
	Overall			**50.3**	**F**			**184.2**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 3 - Synchro Analysis Results: 2031, 1% growth, Opt 1A, 50% build-out, 10% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	65.1	0.81	21.6	C	9.8	0.31	8.6	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	60.9	4.44	2093.0	F	28.7	0.77	114.1	F
	Overall			**96.7**	**F**			**11.7**	**B**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.03	10.1	B	0.7	0.02	8.7	A
	SB Left/Thru/Right	21.7	0.54	18.8	C	583.1	1.90	424.1	F
	Overall			**4.3**	**A**			**275.9**	**F**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	9.8	0.34	45.1	E	1.4	0.07	15.9	C
	WB Left/Thru	170.8	2.26	646.1	F	448.0	2.70	801.2	F
	WB Right	2.1	0.08	11.1	B	12.6	0.38	14.7	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.5	A
	SB Left	6.3	0.24	10.5	B	2.1	0.09	9.3	A
	SB Thru/Right				A				A
	Overall			**123.6**	**F**			**322.7**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	29.4	0.65	33.2	D	31.5	0.70	52.6	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.08	8.0	A	4.2	0.17	10.0	A
	Overall			**7.4**	**A**			**6.7**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	184.6	0.87	43.4	D	57.2	0.72	48.4	D
	WB Right	8.6	0.09	7.6	A	8.9	0.15	10.1	B
	NB Thru/Right	69.0	0.56	15.3	B	382.2	1.13	87.2	F
	SB Left	8.7	0.13	11.6	B	22.8	0.53	37.2	D
	SB Thru	161.1	0.91	33.8	C	65.9	0.44	8.1	A
	Overall			**30.6**	**C**			**61.3**	**E**
Main & Forest Hills [56] (Signalized)	EB Left	72.1	0.83	64.6	E	13.4	0.17	20.1	C
	EB Thru	80.6	0.40	33.8	C	317.4	1.32	184.8	F
	EB Right	0.0	0.13	0.2	A	0.0	0.29	0.5	A
	WB Left	21.4	0.20	21.5	C	72.7	0.83	57.0	E
	WB Thru	253.8	1.00	68.6	E	99.4	0.53	32.8	C
	WB Right	0.0	0.42	0.8	A	0.0	0.15	0.2	A
	NB Left	82.7	0.55	47.8	D	48.5	0.56	57.8	E
	NB Thru	287.4	1.23	163.1	F	129.4	1.04	120.2	F
	NB Right	0.0	0.07	0.1	A	0.0	0.17	0.2	A
	SB Left	36.4	0.44	61.8	E	199.4	1.17	134.2	F
	SB Thru	71.7	0.77	83.5	F	268.0	1.30	190.3	F
	SB Right	0.0	0.05	0.1	A	0.0	0.08	0.1	A
	Overall			**58.7**	**E**			**107.3**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	100.1	1.13	134.1	F	234.8	1.09	87.5	F
	EB Thru	62.2	0.35	22.6	C	299.3	0.89	34.0	C
	EB Right	0.0	0.13	0.2	A	0.0	0.13	0.2	A
	WB Left	37.1	0.45	15.8	B	17.6	0.45	24.9	C
	WB Thru	246.6	0.93	44.2	D	90.4	0.52	33.8	C
	WB Right	0.0	0.13	0.2	A	0.0	0.14	0.2	A
	NB Left	98.1	0.84	57.4	E	52.6	0.70	51.1	D
	NB Thru	49.5	0.27	33.7	C	71.7	0.65	59.5	E
	NB Right	0.0	0.04	0.0	A	0.0	0.06	0.1	A
	SB Left	126.4	1.08	130.2	F	106.0	1.02	101.6	F
	SB Thru	82.8	0.63	56.4	E	79.8	0.73	63.9	E
	SB Right	0.0	0.34	0.6	A	0.0	0.25	0.4	A
	Overall			**40.7**	**D**			**41.6**	**D**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	38.5	0.97	40.0	E	98.7	2.04	430.3	F
	WB Left/Thru/Right	352.8	1.96	430.6	F	129.5	1.54	120.3	F
	NB Left/Thru/Right	123.9	1.49	142.4	F	350.7	1.64	173.3	F
	SB Left/Thru/Right	31.5	0.90	36.6	E	21.0	0.78	32.0	D
	Overall			**231.9**	**F**			**251.3**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	9.7	A	0.0	0.00	10.7	B
	WB Left/Thru/Right	7.0	0.26	10.9	B	5.6	0.23	11.6	B
	NB Left/Thru/Right	16.1	0.45	12.3	B	131.6	1.03	69.5	F
	SB Left/Thru/Right	66.5	0.83	27.9	D	81.2	0.93	38.5	E
	Overall			**20.9**	**C**			**51.6**	**F**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	9.9	A	0.0	0.00	11.0	B
	WB Left/Thru/Right	7.7	0.27	11.3	B	6.3	0.24	12.0	B
	NB Left/Thru/Right	27.3	0.59	15.5	C	146.3	1.11	83.5	F
	SB Left/Thru/Right	69.3	0.85	30.1	D	129.5	1.06	72.5	F
	Overall			**22.5**	**C**			**73.1**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	27.3	0.59	18.8	C	16.1	0.51	16.7	C
	NB Thru/Right	64.4	0.85	34.4	D	186.9	1.33	140.0	F
	SB Left/Thru	109.2	1.01	64.9	F	284.9	1.52	229.8	F
	Overall			**43.8**	**E**			**166.4**	**F**
Forest Hills Ext [89] (Unsignalised)	EB Right	1.4	0.07	9.8	A	3.5	0.15	19.5	C
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall			**0.3**	**A**			**0.4**	**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Intersection [Arcady Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	51.9		30.6	D	3.9		4.2	A
	WB Thru/Right	137.6		115.8	F	1.1		3.8	A
	NB Left/Thru/Right	0.4		3.6	A	0.4		2.1	A
	Overall			**61.7**	**F**			**3.9**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right	277.83		134.06	F	16.59		14.4	B
	WB Left/Thru	0.3		1.3	A	0.4		1.4	A
	SB Left/Thru/Right	1.3		2.0	A	373.5		129.7	F
	Overall			**92.8**	**F**			**88.5**	**F**

Notes:
Analysis by CBCL Limited using Arcady 8
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Level of Service Table - HCM 2010

Level of Service	Average Delay per Vehicle (sec)	
	Signalized	Unisignalized
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

Legend

Queue Length > 100m
V/C > 0.85
LOS E
LOS F

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Table 1 - Synchro Analysis Results: 2017 Baseline Volumes & Existing Street Network

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	9.1	0.30	9.7	A	1.4	0.07	7.6	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	5.6	0.21	22.6	C	4.2	0.16	15.1	C
	Overall			**4.7**	**A**			**2.7**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.02	8.2	A	0.0	0.01	7.6	A
	SB Left/Thru/Right	4.2	0.16	12.1	B	70.7	0.85	29.0	D
	Overall			**2.2**	**A**			**20.0**	**C**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	2.8	0.13	18.1	C	0.7	0.04	11.6	B
	WB Left/Thru	9.8	0.33	23.8	C	17.5	0.48	20.7	C
	WB Right	1.4	0.05	9.3	A	7.0	0.25	11.1	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.4	A
	SB Left	3.5	0.14	8.2	A	1.4	0.06	8.0	A
	SB Thru/Right				A				A
	Overall			**6.1**	**A**			**8.2**	**A**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	9.8	0.33	14.2	B	9.1	0.31	17.5	C
	NB Thru/Right				A				A
	SB Left/Thru	1.4	0.06	7.7	A	2.8	0.12	8.7	A
	Overall			**4.8**	**A**			**3.8**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	86.8	0.68	21.0	C	50.0	0.60	38.0	D
	WB Right	5.7	0.07	4.9	A	8.1	0.13	10.8	B
	NB Thru/Right	47.9	0.52	14.5	B	234.2	0.89	22.1	C
	SB Left	8.5	0.12	13.4	B	9.1	0.29	12.9	B
	SB Thru	91.5	0.78	24.9	C	38.3	0.30	6.8	A
	Overall			**20.2**	**C**			**20.0**	**B**
Main & Forest Hills [56] (Signalized)	EB Left	49.6	0.69	42.6	D	11.8	0.11	19.3	B
	EB Thru	51.3	0.25	29.7	C	226.8	1.02	74.3	E
	EB Right	0.0	0.11	0.7	A	0.0	0.25	0.4	A
	WB Left	19.1	0.13	20.4	C	54.2	0.76	48.5	D
	WB Thru	176.5	0.79	44.6	D	69.3	0.38	30.0	C
	WB Right	0.0	0.37	0.7	A	0.0	0.13	0.2	A
	NB Left	71.8	0.48	46.2	D	42.8	0.50	56.3	E
	NB Thru	237.5	1.07	109.1	F	107.4	0.92	94.1	F
	NB Right	0.0	0.06	0.1	A	0.0	0.15	0.2	A
	SB Left	23.6	0.28	59.3	E	151.6	0.97	73.0	E
	SB Thru	62.9	0.71	79.5	E	223.5	1.12	124.6	F
	SB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	Overall			**43.2**	**D**			**58.5**	**E**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	22.2	0.52	20.1	C	40.8	0.45	12.3	B
	EB Thru	53.6	0.28	19.5	B	210.9	0.75	25.7	C
	EB Right	0.0	0.12	0.2	A	0.0	0.11	0.1	A
	WB Left	32.4	0.33	12.1	B	12.8	0.35	15.2	B
	WB Thru	184.2	0.73	28.1	C	70.3	0.33	20.6	C
	WB Right	0.0	0.06	0.1	A	0.0	0.05	0.1	A
	NB Left	76.4	0.82	58.8	E	47.7	0.60	46.6	D
	NB Thru	43.5	0.27	36.5	D	64.1	0.62	59.8	E
	NB Right	0.0	0.03	0.0	A	0.0	0.06	0.1	A
	SB Left	40.5	0.53	60.4	E	40.1	0.46	40.9	D
	SB Thru	72.1	0.70	65.2	E	71.4	0.70	64.3	E
	SB Right	0.0	0.13	0.2	A	0.0	0.11	0.1	A
	Overall			**26.9**	**C**			**25.3**	**C**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	2.5	0.47	14.7	B	35.7	0.67	19.2	C
	WB Left/Thru/Right	3.9	0.60	18.6	C	9.8	0.32	12.4	B
	NB Left/Thru/Right	3.5	0.57	17.6	C	21.0	0.52	15.6	C
	SB Left/Thru/Right	2.2	0.44	14.6	B	9.8	0.32	12.3	B
	Overall			**16.6**	**C**			**15.9**	**C**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 13 - Synchro Analysis Results: 2047 Volumes & Existing Street Network, 0.75% Growth, No Development

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	14.7	0.41	11.2	B	2.1	0.08	7.8	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	14.7	0.47	50.5	F	7.0	0.25	19.4	C
	Overall			**6.8**	**A**			**3.2**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.03	8.5	A	0.0	0.01	7.8	A
	SB Left/Thru/Right	6.3	0.24	14.0	B	179.9	1.14	100.2	F
	Overall			**2.5**	**A**			**68.9**	**F**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	5.6	0.22	25.0	C	1.4	0.06	13.0	B
	WB Left/Thru	23.8	0.61	49.1	E	41.3	0.75	41.6	E
	WB Right	1.4	0.07	9.5	A	10.5	0.34	12.6	B
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	4.9	0.18	8.5	A	1.4	0.07	8.3	A
	SB Thru/Right				A				A
	Overall			**9.6**	**A**			**13.3**	**B**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	18.2	0.49	19.2	C	19.6	0.52	28.3	D
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.08	7.8	A	4.2	0.16	9.3	A
	Overall			**6.2**	**A**			**5.4**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	165.1	0.83	33.8	C	62.0	0.75	50.0	D
	WB Right	8.2	0.09	6.5	A	9.2	0.16	9.8	A
	NB Thru/Right	62.0	0.59	16.7	B	336.9	1.05	58.0	E
	SB Left	10.1	0.17	14.0	B	25.5	0.58	43.3	D
	SB Thru	122.6	0.88	33.2	C	49.9	0.36	7.5	A
	Overall			**28.0**	**C**			**44.4**	**D**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.16	20.0	B
	EB Thru	64.9	0.33	33.2	C	312.6	1.32	186.9	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.19	21.6	C	83.2	0.87	62.8	E
	WB Thru	263.1	1.04	79.9	E	88.7	0.48	31.8	C
	WB Right	0.0	0.46	1.0	A	0.0	0.16	0.2	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	28.1	0.32	58.8	E	211.3	1.22	153.1	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**69.0**	**E**			**117.2**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	50.0	0.74	47.8	D	55.3	0.65	18.4	B
	EB Thru	68.2	0.36	21.8	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.49	15.5	B	23.8	0.48	28.1	C
	WB Thru	285.6	0.96	46.1	D	99.6	0.45	26.3	C
	WB Right	0.0	0.08	0.1	A	0.0	0.07	0.1	A
	NB Left	110.0	1.09	116.7	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.32	36.0	D	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	50.3	0.62	63.0	E	47.5	0.59	43.4	D
	SB Thru	90.2	0.79	68.7	E	86.3	0.75	64.3	E
	SB Right	0.0	0.16	0.2	A	0.0	0.14	0.2	A
	Overall			**40.1**	**D**			**40.0**	**D**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	53.2	0.82	41.3	E	99.4	1.00	65.1	F
	WB Left/Thru/Right	88.2	1.00	75.8	F	18.9	0.50	18.5	C
	NB Left/Thru/Right	79.1	0.96	65.1	F	49.0	0.78	32.1	D
	SB Left/Thru/Right	43.4	0.76	35.7	E	18.9	0.50	18.4	C
	Overall			**56.6**	**F**			**40.6**	**E**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Level of Service Table - HCM 2010

Level of Service	Average Delay per Vehicle (sec)	
	Signalized	Unisignalized
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

Legend

Queue Length > 100m
V/C > 0.85
LOS E
LOS F

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2-Aug-17

Table 1 - Synchro Analysis Results: 2017 Baseline Volumes & Existing Street Network

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour 95th % Q[1] (m)	AM V/C Ratio[2]	AM Average Delay[3] (s)	AM LOS[4]	PM Peak Hour 95th % Q[1] (m)	PM V/C Ratio[2]	PM Average Delay[3] (s)	PM LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	9.1	0.30	9.7	A	1.4	0.07	7.6	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	5.6	0.21	22.6	C	4.2	0.16	15.1	C
	Overall			**4.7**	**A**			**2.7**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.02	8.2	A	0.0	0.01	7.6	A
	SB Left/Thru/Right	4.2	0.16	12.1	B	70.7	0.85	29.0	D
	Overall			**2.2**	**A**			**20.0**	**C**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	2.8	0.13	18.1	C	0.7	0.04	11.6	B
	WB Left/Thru	9.8	0.33	23.8	C	17.5	0.48	20.7	C
	WB Right	1.4	0.05	9.3	A	7.0	0.25	11.1	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.4	A
	SB Left	3.5	0.14	8.2	A	1.4	0.06	8.0	A
	SB Thru/Right				A				A
	Overall			**6.1**	**A**			**8.2**	**A**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	9.8	0.33	14.2	B	9.1	0.31	17.5	C
	NB Thru/Right				A				A
	SB Left/Thru	1.4	0.06	7.7	A	2.8	0.12	8.7	A
	Overall			**4.8**	**A**			**3.8**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	86.8	0.68	21.0	C	50.0	0.60	38.0	D
	WB Right	5.7	0.07	4.9	A	8.1	0.13	10.8	B
	NB Thru/Right	47.9	0.52	14.5	B	234.2	0.89	22.1	C
	SB Left	8.5	0.12	13.4	B	9.1	0.29	12.9	B
	SB Thru	91.5	0.78	24.9	C	38.3	0.30	6.8	A
	Overall			**20.2**	**C**			**20.0**	**B**
Main & Forest Hills [56] (Signalized)	EB Left	49.6	0.69	42.6	D	11.8	0.11	19.3	B
	EB Thru	51.3	0.25	29.7	C	226.8	1.02	74.3	E
	EB Right	0.0	0.11	0.7	A	0.0	0.25	0.4	A
	WB Left	19.1	0.13	20.4	C	54.2	0.76	48.5	D
	WB Thru	176.5	0.79	44.6	D	69.3	0.38	30.0	C
	WB Right	0.0	0.37	0.7	A	0.0	0.13	0.2	A
	NB Left	71.8	0.48	46.2	D	42.8	0.50	56.3	E
	NB Thru	237.5	1.07	109.1	F	107.4	0.92	94.1	F
	NB Right	0.0	0.06	0.1	A	0.0	0.15	0.2	A
	SB Left	23.6	0.28	59.3	E	151.6	0.97	73.0	E
	SB Thru	62.9	0.71	79.5	E	223.5	1.12	124.6	F
	SB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	Overall			**43.2**	**D**			**58.5**	**E**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	22.2	0.52	20.1	C	40.8	0.45	12.3	B
	EB Thru	53.6	0.28	19.5	B	210.9	0.75	25.7	C
	EB Right	0.0	0.12	0.2	A	0.0	0.11	0.1	A
	WB Left	32.4	0.33	12.1	B	12.8	0.35	15.2	B
	WB Thru	184.2	0.73	28.1	C	70.3	0.33	20.6	C
	WB Right	0.0	0.06	0.1	A	0.0	0.05	0.1	A
	NB Left	76.4	0.82	58.8	E	47.7	0.60	46.6	D
	NB Thru	43.5	0.27	36.5	D	64.1	0.62	59.8	E
	NB Right	0.0	0.03	0.0	A	0.0	0.06	0.1	A
	SB Left	40.5	0.53	60.4	E	40.1	0.46	40.9	D
	SB Thru	72.1	0.70	65.2	E	71.4	0.70	64.3	E
	SB Right	0.0	0.13	0.2	A	0.0	0.11	0.1	A
	Overall			**26.9**	**C**			**25.3**	**C**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	2.5	0.47	14.7	B	35.7	0.67	19.2	C
	WB Left/Thru/Right	3.9	0.60	18.6	C	9.8	0.32	12.4	B
	NB Left/Thru/Right	3.5	0.57	17.6	C	21.0	0.52	15.6	C
	SB Left/Thru/Right	2.2	0.44	14.6	B	9.8	0.32	12.3	B
	Overall			**16.6**	**C**			**15.9**	**C**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 4 - Synchro Analysis Results: 2047, 0.75% growth, Opt 1, 100% build-out, 10% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour 95th % Q[1] (m)	AM V/C Ratio[2]	AM Average Delay[3] (s)	AM LOS[4]	PM Peak Hour 95th % Q[1] (m)	PM V/C Ratio[2]	PM Average Delay[3] (s)	PM LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	191.1	1.10	80.1	F	23.8	0.55	10.5	B
	WB Thru/Right				A				A
	NB Left/Thru/Right	1.4	0.07	9.1	A	78.4	4.97	2236.4	F
	Overall			**47.2**	**E**			**134.7**	**F**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.05	11.4	B	0.7	0.02	9.9	A
	SB Left/Thru/Right	113.4	1.03	73.4	F	1006.6	3.20	1013.1	F
	Overall			**22.9**	**C**			**615.0**	**F**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	20.3	0.64	108.0	F	2.8	0.13	24.0	C
	WB Left/Thru	479.5	9.43	3918.9	F	759.5	5.56	2100.9	F
	WB Right	2.1	0.10	12.3	B	21.0	0.53	20.9	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	9.8	0.32	12.6	B	2.8	0.13	11.1	B
	SB Thru/Right				A				A
	Overall			**1080.7**	**F**			**845.8**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	56.0	0.90	74.8	F	70.0	1.23	215.1	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.10	8.4	A	5.6	0.22	11.0	B
	Overall			**13.6**	**B**			**21.3**	**C**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	1.07	93.2	F	62.0	0.75	50.0	D
	WB Right	9.7	0.11	9.0	A	902.0	0.16	9.8	A
	NB Thru/Right	107.2	0.65	17.2	B	463.4	1.31	164.2	F
	SB Left	10.1	0.18	11.8	B	25.5	0.58	43.3	D
	SB Thru	248.1	0.95	38.5	D	99.0	0.58	10.4	B
	Overall			**45.2**	**D**			**106.8**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.21	20.8	C
	EB Thru	97.5	0.49	36.0	D	388.3	1.55	285.9	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.25	22.4	C	83.2	0.87	62.8	E
	WB Thru	328.0	1.20	137.7	F	117.8	0.61	34.7	C
	WB Right	0.0	0.46	1.0	A	0.0	0.16	0.2	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	28.1	0.32	58.8	E	211.3	1.22	153.1	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**86.0**	**F**			**145.8**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	194.7	1.92	454.7	F	363.6	1.53	270.7	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.21	0.3	A	0.0	0.18	0.3	A
	NB Left	122.3	0.97	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	173.0	1.43	254.2	F	207.7	1.54	292.6	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.44	0.9	A	0.0	0.37	0.7	A
	Overall			**79.7**	**E**			**90.3**	**F**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	42.0	1.54	66.1	F	99.4	2.38	185.7	F
	WB Left/Thru/Right	476.0	3.12	735.6	F	282.1	3.13	525.7	F
	NB Left/Thru/Right	284.2	2.70	459.6	F	466.2	3.22	718.2	F
	SB Left/Thru/Right	35.0	1.41	58.9	F	23.1	1.27	50.3	F
	Overall			**474.3**	**F**			**497.5**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	11.2	B	0.0	0.00	12.6	B
	WB Left/Thru/Right	14.7	0.45	14.7	B	15.4	0.49	16.3	C
	NB Left/Thru/Right	44.1	0.77	24.2	C	252.0	1.45	196.0	F
	SB Left/Thru/Right	199.5	1.21	133.4	F	217.0	1.39	168.6	F
	Overall			**81.0**	**F**			**162.5**	**F**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	11.8	B	0.0	0.00	13.2	B
	WB Left/Thru/Right	15.4	0.47	15.5	C	15.4	0.51	16.9	C
	NB Left/Thru/Right	77.0	0.96	41.7	E	308.7	1.64	256.9	F
	SB Left/Thru/Right	246.4	1.32	180.1	F	300.3	1.64	253.4	F
	Overall			**108.2**	**F**			**229.0**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	67.2	1.05	48.3	E	59.5	1.12	46.7	E
	NB Thru/Right	178.5	1.45	168.8	F	394.8	2.33	445.2	F
	SB Left/Thru	375.9	1.85	374.2	F	520.1	2.56	580.5	F
	Overall			**232.2**	**F**			**435.0**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 5 - Synchro Analysis Results: 2047, 0.75% growth, Opt 1A, 100% build-out, 10% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour 95th % Q[1] (m)	AM V/C Ratio[2]	AM Average Delay[3] (s)	AM LOS[4]	PM Peak Hour 95th % Q[1] (m)	PM V/C Ratio[2]	PM Average Delay[3] (s)	PM LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	170.1	1.07	68.3	F	22.4	0.52	10.2	B
	WB Thru/Right				A				A
	NB Left/Thru/Right	1.4	0.07	9.1	A	75.6	4.02	1735.0	F
	Overall			**39.8**	**E**			**107.7**	**F**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.04	11.2	B	0.7	0.02	9.8	A
	SB Left/Thru/Right	98.0	0.98	59.9	F	918.4	2.77	818.4	F
	Overall			**18.5**	**C**			**498.3**	**F**
Montague/Charles Keating & Waverley [12] (Unignalized)	EB Left/Thru/Right	19.6	0.61	99.0	F	2.8	0.12	23.0	C
	WB Left/Thru	455.0	8.38	3437.3	F	720.3	5.18	1928.7	F
	WB Right	2.1	0.10	12.1	B	20.3	0.52	20.2	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	9.1	0.31	12.3	B	2.8	0.13	10.9	B
	SB Thru/Right				A				A
	Overall			**935.4**	**F**			**768.7**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	53.2	0.88	68.2	F	66.5	1.18	193.0	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.09	8.4	A	5.6	0.21	10.9	B
	Overall			**12.7**	**B**			**19.5**	**C**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	1.06	88.8	F	62.0	0.75	50.0	D
	WB Right	9.7	0.11	9.0	A	9.2	0.16	9.8	A
	NB Thru/Right	104.2	0.65	17.1	B	457.9	1.30	159.3	F
	SB Left	10.0	0.18	11.8	B	25.5	0.58	43.3	D
	SB Thru	241.9	0.94	37.7	D	95.9	0.57	10.2	B
	Overall			**43.9**	**D**			**104.0**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.20	20.8	C
	EB Thru	95.8	0.48	35.9	D	384.3	1.54	280.7	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.25	22.4	C	83.2	0.87	62.8	E
	WB Thru	324.6	0.19	134.4	F	116.0	0.60	34.5	C
	WB Right	0.0	0.46	1.0	A	0.0	0.16	0.2	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	42.5	0.51	62.8	E	233.5	1.32	190.2	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**84.8**	**F**			**150.8**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	188.7	1.86	430.6	F	347.4	1.48	249.0	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.21	0.3	A	0.0	0.18	0.2	A
	NB Left	122.3	0.97	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	167.1	1.39	237.3	F	200.8	1.50	273.1	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.43	0.8	A	0.0	0.36	0.6	A
	Overall			**76.3**	**E**			**85.0**	**F**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	42.7	1.49	64.5	F	101.5	2.27	183.7	F
	WB Left/Thru/Right	459.9	3.03	701.5	F	268.8	2.94	490.3	F
	NB Left/Thru/Right	275.1	2.63	437.6	F	450.1	3.13	681.7	F
	SB Left/Thru/Right	35.7	1.37	57.6	F	23.1	1.22	48.6	E
	Overall			**449.5**	**F**			**467.9**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	11.0	B	0.0	0.00	12.3	B
	WB Left/Thru/Right	13.3	0.42	14.0	B	14.0	0.46	15.7	C
	NB Left/Thru/Right	37.8	0.72	20.8	C	237.3	1.41	179.4	F
	SB Left/Thru/Right	179.9	1.16	114.0	F	200.9	1.35	150.7	F
	Overall			**69.7**	**F**			**147.9**	**F**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	11.6	B	0.0	0.00	12.9	B
	WB Left/Thru/Right	14.0	0.44	14.9	B	14.0	0.48	16.2	C
	NB Left/Thru/Right	70.0	0.92	36.5	E	291.9	1.59	236.3	F
	SB Left/Thru/Right	225.4	1.27	158.7	F	280.0	1.56	229.4	F
	Overall			**95.9**	**F**			**209.7**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	58.8	0.98	40.9	E	54.6	1.05	41.9	E
	NB Thru/Right	162.4	1.37	144.7	F	376.6	2.22	412.0	F
	SB Left/Thru	354.9	1.76	342.0	F	490.0	2.38	533.3	F
	Overall			**209.5**	**F**			**401.8**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right	2.1	0.11	10.2	B	9.1	0.31	25.3	D
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall			**0.4**	**A**			**0.8**	**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 6 - Synchro Analysis Results: 2047, 0.75% growth, Opt 2, 100% build-out, 10% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour 95th % Q[1] (m)	AM V/C Ratio[2]	AM Average Delay[3] (s)	AM LOS[4]	PM Peak Hour 95th % Q[1] (m)	PM V/C Ratio[2]	PM Average Delay[3] (s)	PM LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	128.1	0.99	46.4	E	18.2	0.47	9.7	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	1.4	0.07	9.1	A	68.6	2.64	1005.5	F
	Overall			**26.3**	**D**			**67.5**	**F**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right				A				A
	WB Left/Thru	0.7	0.04	10.8	B	0.7	0.02	9.4	A
	SB Left/Thru/Right	70.7	0.88	40.1	E	823.2	2.52	705.9	F
	Overall			**12.1**	**B**			**433.3**	**F**
Montague/Charles Keating & Waverley [12] (Unignalized)	EB Left/Thru/Right	16.8	0.53	78.9	F	2.8	0.11	21.0	C
	WB Left/Thru	396.9	6.33	2502.3	F	629.3	4.35	1551.2	F
	WB Right	2.1	0.09	11.7	B	18.9	0.49	18.8	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	8.4	0.29	11.6	B	2.8	0.18	10.5	B
	SB Thru/Right				A				A
	Overall			**658.0**	**F**			**603.2**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	46.2	0.81	54.2	F	58.1	1.04	140.7	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.09	8.3	A	5.6	0.21	10.7	B
	Overall			**10.7**	**B**			**15.1**	**C**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	1.03	79.3	E	62.0	0.75	50.0	D
	WB Right	9.7	0.10	9.0	A	9.2	0.16	9.8	A
	NB Thru/Right	98.0	0.64	17.0	B	442.8	1.27	146.0	F
	SB Left	9.9	0.17	11.8	B	25.5	0.58	43.3	D
	SB Thru	202.5	0.93	36.2	D	88.8	0.54	9.8	A
	Overall			**41.1**	**D**			**96.2**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.20	20.7	C
	EB Thru	93.2	0.47	35.6	D	379.0	1.53	273.3	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.24	22.3	C	83.2	0.87	62.8	E
	WB Thru	320.3	1.18	129.9	F	114.0	0.59	34.3	C
	WB Right	0.0	0.49	1.1	A	0.0	0.21	0.3	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	41.0	0.49	62.3	E	231.0	1.31	185.9	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**82.6**	**F**			**145.9**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	176.8	1.77	389.2	F	324.7	1.41	217.5	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.20	0.3	A	0.0	0.17	0.2	A
	NB Left	122.3	0.97	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	158.1	1.32	212.5	F	188.6	1.20	243.5	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.40	0.8	A	0.0	0.34	0.6	A
	Overall			**71.1**	**E**			**77.4**	**E**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	43.4	1.43	62.1	F	105.0	2.17	180.7	F
	WB Left/Thru/Right	432.6	2.78	647.1	F	249.2	2.70	439.4	F
	NB Left/Thru/Right	261.1	2.44	403.2	F	424.2	2.94	627.2	F
	SB Left/Thru/Right	35.7	1.32	55.3	F	23.1	1.15	46.1	E
	Overall			**410.6**	**F**			**425.0**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	10.6	B	0.0	0.00	11.9	B
	WB Left/Thru/Right	10.5	0.36	12.8	B	11.2	0.40	14.4	B
	NB Left/Thru/Right	31.5	0.65	17.7	C	206.5	1.30	145.0	F
	SB Left/Thru/Right	143.5	1.06	80.6	F	164.5	1.22	111.9	F
	Overall			**51.2**	**F**			**116.5**	**F**
Access B /Applewood lane & Waverley [84] (Unignalized)	EB Left/Thru/Right	0.0	0.00	11.0	B	0.0	0.00	12.3	B
	WB Left/Thru/Right	11.2	0.37	13.4	B	11.2	0.41	14.8	B
	NB Left/Thru/Right	52.5	0.82	26.2	D	252.7	1.45	191.2	F
	SB Left/Thru/Right	179.9	1.15	113.5	F	229.6	1.41	174.7	F
	Overall			**69.8**	**F**			**166.2**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	43.4	0.83	29.3	D	39.9	0.90	30.6	D
	NB Thru/Right	123.2	1.19	92.7	F	334.6	1.92	336.0	F
	SB Left/Thru	301.7	1.56	268.3	F	422.1	2.08	426.4	F
	Overall			**159.2**	**F**			**326.0**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Level of Service Table - HCM 2010

Level of Service	Average Delay per Vehicle (sec) Signalized	Unsignalized
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

Legend

- Queue Length > 100m
- V/C > 0.85
- LOS E
- LOS F

Port Wallace Master Plan-Infrastructure Study
CBCL Limited 171013.00
2-Aug-17

Table 1 - Synchro Analysis Results: 2017 Baseline Volumes & Existing Street Network

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	9.1	0.30	9.7	A	1.4	0.07	7.6	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	5.6	0.21	22.6	C	4.2	0.16	15.1	C
	Overall			**4.7**	**A**			**2.7**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.02	8.2	A	0.0	0.01	7.6	A
	SB Left/Thru/Right	4.2	0.16	12.1	B	70.7	0.85	29.0	D
	Overall			**2.2**	**A**			**20.0**	**C**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	2.8	0.13	18.1	C	0.7	0.04	11.6	B
	WB Left/Thru	9.8	0.33	23.8	C	17.5	0.48	20.7	C
	WB Right	1.4	0.05	9.3	A	7.0	0.25	11.1	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.4	A
	SB Left	3.5	0.14	8.2	A	1.4	0.06	8.0	A
	SB Thru/Right				A				A
	Overall			**6.1**	**A**			**8.2**	**A**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	9.8	0.33	14.2	B	9.1	0.31	17.5	C
	NB Thru/Right				A				A
	SB Left/Thru	1.4	0.06	7.7	A	2.8	0.12	8.7	A
	Overall			**4.8**	**A**			**3.8**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	86.8	0.68	21.0	C	50.0	0.60	38.0	D
	WB Right	5.7	0.07	4.9	A	8.1	0.13	10.8	B
	NB Thru/Right	47.9	0.52	14.5	B	234.2	0.89	22.1	C
	SB Left	8.5	0.12	13.4	B	9.1	0.29	12.9	B
	SB Thru	91.5	0.78	24.9	C	38.3	0.30	6.8	A
	Overall			**20.2**	**C**			**20.0**	**B**
Main & Forest Hills [56] (Signalized)	EB Left	49.6	0.69	42.6	D	11.8	0.11	19.3	B
	EB Thru	51.3	0.25	29.7	C	226.8	1.02	74.3	E
	EB Right	0.0	0.11	0.7	A	0.0	0.25	0.4	A
	WB Left	19.1	0.13	20.4	C	54.2	0.76	48.5	D
	WB Thru	176.5	0.79	44.6	D	69.3	0.38	30.0	C
	WB Right	0.0	0.37	0.7	A	0.0	0.13	0.2	A
	NB Left	71.8	0.48	46.2	D	42.8	0.50	56.3	E
	NB Thru	237.5	1.07	109.1	F	107.4	0.92	94.1	F
	NB Right	0.0	0.06	0.1	A	0.0	0.15	0.2	A
	SB Left	23.6	0.28	59.3	E	151.6	0.97	73.0	E
	SB Thru	62.9	0.71	79.5	E	223.5	1.12	124.6	F
	SB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	Overall			**43.2**	**D**			**58.5**	**E**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	22.2	0.52	20.1	C	40.8	0.45	12.3	B
	EB Thru	53.6	0.28	19.5	B	210.9	0.75	25.7	C
	EB Right	0.0	0.12	0.2	A	0.0	0.11	0.1	A
	WB Left	32.4	0.33	12.1	B	12.8	0.35	15.2	B
	WB Thru	184.2	0.73	28.1	C	70.3	0.33	20.6	C
	WB Right	0.0	0.06	0.1	A	0.0	0.05	0.1	A
	NB Left	76.4	0.82	58.8	E	47.7	0.60	46.6	D
	NB Thru	43.5	0.27	36.5	D	64.1	0.62	59.8	E
	NB Right	0.0	0.03	0.0	A	0.0	0.06	0.1	A
	SB Left	40.5	0.53	60.4	E	40.1	0.46	40.9	D
	SB Thru	72.1	0.70	65.2	E	71.4	0.70	64.3	E
	SB Right	0.0	0.13	0.2	A	0.0	0.11	0.1	A
	Overall			**26.9**	**C**			**25.3**	**C**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	2.5	0.47	14.7	B	35.7	0.67	19.2	C
	WB Left/Thru/Right	3.9	0.60	18.6	C	9.8	0.32	12.4	B
	NB Left/Thru/Right	3.5	0.57	17.6	C	21.0	0.52	15.6	C
	SB Left/Thru/Right	2.2	0.44	14.6	B	9.8	0.32	12.3	B
	Overall			**16.6**	**C**			**15.9**	**C**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 7 - Synchro Analysis Results: 2047, 0.75% growth, Opt 1, 100% build-out, 20% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	137.9	1.01	51.3	F	18.9	0.48	9.9	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	1.4	0.07	9.1	A	70.7	2.91	1149.0	F
	Overall			**29.3**	**D**			**75.6**	**F**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right				A				A
	WB Left/Thru	0.7	0.04	10.9	B	0.7	0.02	9.4	A
	SB Left/Thru/Right	76.3	0.90	43.8	E	835.8	2.52	706.1	F
	Overall			**13.3**	**B**			**438.2**	**F**
Montague/Charles Keating & Waverley [12] (Unignalized)	EB Left/Thru/Right	17.5	0.54	81.0	F	2.8	0.11	21.0	C
	WB Left/Thru	410.2	6.67	2654.3	F	652.4	4.54	1639.9	F
	WB Right	2.1	0.10	11.8	B	18.9	0.50	19.2	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	8.4	0.30	11.7	B	2.8	0.12	10.6	B
	SB Thru/Right				A				A
	Overall			**704.0**	**F**			**641.7**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	47.6	0.83	56.9	F	60.2	1.08	153.4	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.09	8.3	A	5.6	0.21	10.7	B
	Overall			**11.1**	**B**			**16.2**	**C**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	1.04	81.6	F	62.0	0.75	50.0	D
	WB Right	9.7	0.10	9.0	A	9.2	0.16	9.8	A
	NB Thru/Right	99.5	0.64	17.0	B	446.3	1.28	149.1	F
	SB Left	10.0	0.17	11.8	B	25.5	0.58	43.3	D
	SB Thru	208.7	0.94	36.7	D	90.7	0.55	9.9	A
	Overall			**41.8**	**D**			**98.0**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.20	20.7	C
	EB Thru	92.6	0.45	35.6	D	378.1	1.52	272.2	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.24	22.3	C	83.2	0.87	62.8	E
	WB Thru	318.7	1.18	128.7	F	113.4	0.59	34.3	C
	WB Right	0.0	0.46	1.0	A	0.0	0.16	0.2	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	28.1	0.32	58.8	E	211.3	1.22	153.1	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**83.2**	**F**			**141.6**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	175.7	1.76	384.9	F	320.9	1.39	212.1	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.20	0.3	A	0.0	0.17	0.2	A
	NB Left	122.3	1.00	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	156.0	1.30	206.0	F	186.5	1.41	237.7	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.40	0.8	A	0.0	0.34	0.6	A
	Overall			**70.3**	**E**			**76.0**	**E**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	43.4	1.41	61.7	F	105.7	2.13	180.2	F
	WB Left/Thru/Right	428.4	2.78	638.5	F	245.7	2.70	430.9	F
	NB Left/Thru/Right	259.0	2.44	397.4	F	419.3	2.86	618.3	F
	SB Left/Thru/Right	36.4	1.30	54.9	F	23.1	1.14	45.8	E
	Overall			**404.3**	**F**			**418.0**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	10.7	B	0.0	0.00	12.0	B
	WB Left/Thru/Right	11.2	0.38	13.2	B	11.9	0.41	14.7	B
	NB Left/Thru/Right	35.0	0.69	19.8	C	213.5	1.32	152.9	F
	SB Left/Thru/Right	155.4	1.10	91.0	F	173.6	1.25	121.5	F
	Overall			**57.4**	**F**			**124.0**	**F**
Access B /Applewood lane & Waverley [84] (Unignalized)	EB Left/Thru/Right	0.0	0.00	11.2	B	0.0	0.00	12.5	B
	WB Left/Thru/Right	11.9	0.39	13.7	B	11.9	0.43	15.2	C
	NB Left/Thru/Right	55.3	0.84	27.9	D	276.5	1.52	222.2	F
	SB Left/Thru/Right	191.8	1.18	124.4	F	240.8	1.45	188.4	F
	Overall			**75.9**	**F**			**186.1**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	46.2	0.87	31.1	D	43.4	0.94	33.1	D
	NB Thru/Right	133.0	1.23	105.2	F	346.5	2.00	355.7	F
	SB Left/Thru	315.7	1.59	286.4	F	440.3	2.17	453.7	F
	Overall			**171.2**	**F**			**345.4**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 8 - Synchro Analysis Results: 2047, 0.75% growth, Opt 1A, 100% build-out, 20% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	123.9	0.98	44.3	E	17.5	0.46	9.7	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	1.4	0.07	9.1	A	67.9	2.56	963.5	F
	Overall			**25.0**	**C**			**65.2**	**F**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right				A				A
	WB Left/Thru	0.7	0.04	10.8	B	0.7	0.02	9.4	A
	SB Left/Thru/Right	67.9	0.86	38.1	E	812.7	2.50	694.5	F
	Overall			**11.5**	**B**			**426.6**	**F**
Montague/Charles Keating & Waverley [12] (Unignalized)	EB Left/Thru/Right	16.1	0.52	75.0	F	2.8	0.11	21.0	C
	WB Left/Thru	388.5	6.02	2360.1	F	620.2	4.28	1519.9	F
	WB Right	2.1	0.09	11.7	B	18.9	0.49	18.7	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	8.4	0.29	11.5	B	2.8	0.12	10.5	B
	SB Thru/Right				A				A
	Overall			**617.6**	**F**			**589.3**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	45.5	0.80	52.6	F	57.4	1.03	138.3	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.09	8.3	A	5.6	0.21	10.7	B
	Overall			**10.4**	**B**			**14.9**	**B**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	1.03	77.9	E	62.0	0.75	50.0	D
	WB Right	9.7	0.10	9.0	A	9.2	0.16	9.8	A
	NB Thru/Right	97.4	0.64	17.0	B	441.3	1.26	144.6	F
	SB Left	9.9	0.17	11.9	B	25.5	0.58	43.3	D
	SB Thru	200.4	0.93	36.0	D	88.5	0.54	9.7	A
	Overall			**40.7**	**D**			**95.4**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.20	20.6	C
	EB Thru	91.2	0.46	35.5	D	375.0	1.51	268.1	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.24	22.2	C	83.2	0.87	62.8	E
	WB Thru	317.5	1.14	127.2	F	112.3	0.59	34.1	C
	WB Right	0.0	0.46	1.0	A	0.0	0.16	0.2	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	40.5	0.48	62.1	E	230.4	1.30	184.9	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**82.6**	**F**			**146.0**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	170.3	1.71	363.3	F	307.4	1.35	194.6	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.19	0.3	A	0.0	0.16	0.2	A
	NB Left	122.3	0.97	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	151.2	1.27	193.2	F	180.1	1.37	221.7	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.39	0.7	A	0.0	0.33	0.6	A
	Overall			**67.7**	**E**			**72.1**	**E**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	43.4	1.39	60.5	F	107.8	2.08	178.2	F
	WB Left/Thru/Right	413.0	2.70	608.0	F	234.5	2.56	402.0	F
	NB Left/Thru/Right	250.6	2.33	378.6	F	403.9	2.78	586.8	F
	SB Left/Thru/Right	36.4	1.27	53.7	F	23.1	1.10	44.3	E
	Overall			**382.9**	**F**			**393.8**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	10.5	B	0.0	0.00	11.8	B
	WB Left/Thru/Right	10.5	0.35	12.6	B	11.2	0.39	14.2	B
	NB Left/Thru/Right	30.8	0.65	17.4	C	202.3	1.28	140.5	F
	SB Left/Thru/Right	140.0	1.05	76.9	F	159.6	1.20	106.7	F
	Overall			**49.1**	**E**			**112.3**	**F**
Access B /Applewood lane & Waverley [84] (Unignalized)	EB Left/Thru/Right	0.0	0.00	11.0	B	0.0	0.00	12.1	B
	WB Left/Thru/Right	10.5	0.37	13.2	B	11.2	0.40	14.7	B
	NB Left/Thru/Right	51.1	0.81	25.4	D	247.8	1.43	186.1	F
	SB Left/Thru/Right	174.3	1.14	108.2	F	224.0	1.39	168.4	F
	Overall			**66.9**	**F**			**161.2**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	42.0	0.81	28.4	D	38.5	0.88	29.5	D
	NB Thru/Right	119.0	1.18	88.0	F	329.0	1.92	326.6	F
	SB Left/Thru	295.4	1.54	260.4	F	412.3	2.04	412.9	F
	Overall			**154.0**	**F**			**316.5**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right	2.1	0.09	10.1	B	7.0	0.26	23.9	C
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall			**0.3**	**A**			**0.6**	**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 9 - Synchro Analysis Results: 2047, 0.75% growth, Opt 2, 100% build-out, 20% NAMC, 7% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	94.5	0.91	31.9	D	14.7	0.42	9.3	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	72.8	22.22	11879.2	F	58.8	1.80	567.5	F
	Overall			**496.2**	**F**			**41.8**	**E**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right				A				A
	WB Left/Thru	0.7	0.04	10.4	B	0.7	0.02	9.2	A
	SB Left/Thru/Right	50.4	0.78	28.9	D	774.2	2.51	700.0	F
	Overall			**8.5**	**A**			**433.5**	**F**
Montague/Charles Keating & Waverley [12] (Unignalized)	EB Left/Thru/Right	14.0	0.47	63.0	F	2.1	0.10	19.0	C
	WB Left/Thru	338.1	4.81	1805.2	F	541.1	3.64	1232.8	F
	WB Right	2.1	0.09	11.4	B	17.5	0.47	17.6	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	7.7	0.27	11.0	B	2.8	0.11	10.1	B
	SB Thru/Right				A				A
	Overall			**455.4**	**F**			**466.1**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	51.8	0.86	65.2	F	51.1	0.95	107.9	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.09	8.2	A	4.9	0.20	10.5	B
	Overall			**13.3**	**B**			**12.3**	**B**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	1.00	68.8	E	62.0	0.75	50.0	D
	WB Right	9.7	0.10	8.8	A	9.2	0.16	9.8	A
	NB Thru/Right	92.4	0.64	17.1	B	428.3	1.24	133.0	F
	SB Left	9.9	0.17	12.1	B	25.5	0.58	43.3	D
	SB Thru	187.3	0.93	35.7	D	82.4	0.52	9.4	A
	Overall			**38.4**	**D**			**88.6**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.19	20.6	C
	EB Thru	89.2	0.45	35.3	D	370.2	1.50	261.8	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.24	22.2	C	83.2	0.87	62.8	E
	WB Thru	312.2	1.16	122.1	F	110.1	0.58	33.9	C
	WB Right	0.0	0.49	1.1	A	0.0	0.20	0.3	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.0	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	39.3	0.46	61.7	E	228.8	1.30	182.1	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**80.4**	**F**			**142.1**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	160.6	1.62	328.9	F	287.4	1.29	167.5	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.18	0.3	A	0.0	0.15	0.2	A
	NB Left	122.3	0.97	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	142.1	1.21	171.8	F	163.6	1.31	197.5	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.37	0.7	A	0.0	0.32	0.5	A
	Overall			**63.6**	**E**			**66.2**	**E**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	44.1	1.33	58.5	F	111.3	1.96	175.2	F
	WB Left/Thru/Right	389.9	2.56	563.2	F	216.3	2.38	357.7	F
	NB Left/Thru/Right	238.7	2.22	350.2	F	380.1	2.56	538.3	F
	SB Left/Thru/Right	36.4	1.22	52.0	F	23.1	1.04	42.0	E
	Overall			**351.5**	**F**			**357.1**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	10.3	B	0.0	0.00	11.4	B
	WB Left/Thru/Right	8.4	0.30	11.9	B	9.1	0.33	13.3	B
	NB Left/Thru/Right	27.3	0.60	16.0	C	177.1	1.19	114.1	F
	SB Left/Thru/Right	111.3	0.99	54.4	F	130.9	1.11	78.4	F
	Overall			**36.6**	**E**			**88.6**	**F**
Access B /Applewood lane & Waverley [84] (Unignalized)	EB Left/Thru/Right	0.0	0.00	10.7	B	0.0	0.00	11.8	B
	WB Left/Thru/Right	9.1	0.31	12.4	B	9.1	0.35	13.7	B
	NB Left/Thru/Right	44.8	0.76	23.0	C	213.5	1.32	149.1	F
	SB Left/Thru/Right	141.4	1.07	78.7	F	183.4	1.27	126.0	F
	Overall			**51.1**	**F**			**126.3**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	30.1	0.69	21.9	C	29.4	0.75	23.8	C
	NB Thru/Right	89.6	1.03	55.3	F	289.1	1.70	264.8	F
	SB Left/Thru	249.9	1.37	201.9	F	348.6	1.82	325.6	F
	Overall			**117.0**	**F**			**254.5**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Level of Service Table - HCM 2010

Level of Service	Average Delay per Vehicle (sec)	
	Signalized	Unisignalized
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

Legend

- Queue Length > 100m
- V/C > 0.85
- LOS E
- LOS F

Port Wallace Master Plan-Infrastructure Study
CBCL Limited 171013.00
2-Aug-17

Table 1 - Synchro Analysis Results: 2017 Baseline Volumes & Existing Street Network

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	9.1	0.30	9.7	A	1.4	0.07	7.6	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	5.6	0.21	22.6	C	4.2	0.16	15.1	C
	Overall			**4.7**	**A**			**2.7**	**A**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right								
	WB Left/Thru	0.7	0.02	8.2	A	0.0	0.01	7.6	A
	SB Left/Thru/Right	4.2	0.16	12.1	B	70.7	0.85	29.0	D
	Overall			**2.2**	**A**			**20.0**	**C**
Montague/Charles Keating & Waverley [12] (Unsignalized)	EB Left/Thru/Right	2.8	0.13	18.1	C	0.7	0.04	11.6	B
	WB Left/Thru	9.8	0.33	23.8	C	17.5	0.48	20.7	C
	WB Right	1.4	0.05	9.3	A	7.0	0.25	11.1	B
	NB Left/Thru/Right	0.0	0.00	7.6	A	0.0	0.01	7.4	A
	SB Left	3.5	0.14	8.2	A	1.4	0.06	8.0	A
	SB Thru/Right				A				A
	Overall			**6.1**	**A**			**8.2**	**A**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	9.8	0.33	14.2	B	9.1	0.31	17.5	C
	NB Thru/Right				A				A
	SB Left/Thru	1.4	0.06	7.7	A	2.8	0.12	8.7	A
	Overall			**4.8**	**A**			**3.8**	**A**
Montebello & Waverley [24] (Signalized)	WB Left	86.8	0.68	21.0	C	50.0	0.60	38.0	D
	WB Right	5.7	0.07	4.9	A	8.1	0.13	10.8	B
	NB Thru/Right	47.9	0.52	14.5	B	234.2	0.89	22.1	C
	SB Left	8.5	0.12	13.4	B	9.1	0.29	12.9	B
	SB Thru	91.5	0.78	24.9	C	38.3	0.30	6.8	A
	Overall			**20.2**	**C**			**20.0**	**B**
Main & Forest Hills [56] (Signalized)	EB Left	49.6	0.69	42.6	D	11.8	0.11	19.3	B
	EB Thru	51.3	0.25	29.7	C	226.8	1.02	74.3	E
	EB Right	0.0	0.11	0.7	A	0.0	0.25	0.4	A
	WB Left	19.1	0.13	20.4	C	54.2	0.76	48.5	D
	WB Thru	176.5	0.79	44.6	D	69.3	0.38	30.0	C
	WB Right	0.0	0.37	0.7	A	0.0	0.13	0.2	A
	NB Left	71.8	0.48	46.2	D	42.8	0.50	56.3	E
	NB Thru	237.5	1.07	109.1	F	107.4	0.92	94.1	F
	NB Right	0.0	0.06	0.1	A	0.0	0.15	0.2	A
	SB Left	23.6	0.28	59.3	E	151.6	0.97	73.0	E
	SB Thru	62.9	0.71	79.5	E	223.5	1.12	124.6	F
	SB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	Overall			**43.2**	**D**			**58.5**	**E**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	22.2	0.52	20.1	C	40.8	0.45	12.3	B
	EB Thru	53.6	0.28	19.5	B	210.9	0.75	25.7	C
	EB Right	0.0	0.12	0.2	A	0.0	0.11	0.1	A
	WB Left	32.4	0.33	12.1	B	12.8	0.35	15.2	B
	WB Thru	184.2	0.73	28.1	C	70.3	0.33	20.6	C
	WB Right	0.0	0.06	0.1	A	0.0	0.05	0.1	A
	NB Left	76.4	0.82	58.8	E	47.7	0.60	46.6	D
	NB Thru	43.5	0.27	36.5	D	64.1	0.62	59.8	E
	NB Right	0.0	0.03	0.0	A	0.0	0.06	0.1	A
	SB Left	40.5	0.53	60.4	E	40.1	0.46	40.9	D
	SB Thru	72.1	0.70	65.2	E	71.4	0.70	64.3	E
	SB Right	0.0	0.13	0.2	A	0.0	0.11	0.1	A
	Overall			**26.9**	**C**			**25.3**	**C**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	2.5	0.47	14.7	B	35.7	0.67	19.2	C
	WB Left/Thru/Right	3.9	0.60	18.6	C	9.8	0.32	12.4	B
	NB Left/Thru/Right	3.5	0.57	17.6	C	21.0	0.52	15.6	C
	SB Left/Thru/Right	2.2	0.44	14.6	B	9.8	0.32	12.3	B
	Overall			**16.6**	**C**			**15.9**	**C**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access B /Applewood lane & Waverley [84] (Unsignalized)	EB Left/Thru/Right				A				A
	WB Left/Thru/Right				A				A
	NB Left/Thru/Right				A				A
	SB Left/Thru/Right				A				A
	Overall				**A**				**A**
Access A & Waverley [87] (Unsignalized)	WB Left/Right				A				A
	NB Thru/Right				A				A
	SB Left/Thru				A				A
	Overall				**A**				**A**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 10 - Synchro Analysis Results: 2047, 0.75% growth, Opt 3A, 100% build-out, 10% NAMC, 10% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	191.1	1.10	80.1	F	24.5	0.55	10.5	B
	WB Thru/Right				A				A
	NB Left/Thru/Right	1.4	0.07	9.1	A	78.4	4.97	2236.4	F
	Overall			**47.2**	**E**			**134.6**	**F**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right				A				A
	WB Left/Thru	0.7	0.05	11.4	B	0.7	0.02	9.9	A
	SB Left/Thru/Right	113.4	1.03	73.4	F	958.3	2.88	866.3	F
	Overall			**22.8**	**C**			**525.7**	**F**
Montague/Charles Keating & Waverley [12] (Unignalized)	EB Left/Thru/Right	20.3	0.64	105.0	F	2.8	0.13	24.0	C
	WB Left/Thru	479.5	9.43	3918.9	F	761.6	5.59	2114.8	F
	WB Right	2.1	0.10	12.3	B	21.0	0.53	21.0	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	9.8	0.32	12.6	B	2.8	0.13	11.1	B
	SB Thru/Right				A				A
	Overall			**1080.7**	**F**			**851.1**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	56.0	0.91	75.7	F	70.0	1.23	215.1	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.10	8.4	A	5.6	0.22	11.0	B
	Overall			**13.8**	**B**			**21.3**	**C**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	1.07	93.2	F	62.0	0.75	50.0	D
	WB Right	9.7	0.11	9.0	A	9.2	0.16	9.8	A
	NB Thru/Right	107.2	0.65	17.2	B	463.4	1.31	164.2	F
	SB Left	10.1	0.18	11.8	B	25.5	0.58	43.3	D
	SB Thru	248.1	0.95	38.5	D	99.1	0.58	10.4	B
	Overall			**45.2**	**D**			**106.8**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.21	20.8	C
	EB Thru	97.5	0.49	36.0	D	388.3	1.55	285.9	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.25	22.4	C	83.2	0.87	62.8	E
	WB Thru	328.0	1.20	137.7	F	117.8	0.61	34.7	C
	WB Right	0.0	0.46	1.0	A	0.0	0.16	0.2	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.2	A
	SB Left	28.1	0.32	58.8	E	211.3	1.22	153.1	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**86.0**	**F**			**145.8**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	194.7	1.92	454.7	F	363.6	1.53	270.7	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.21	0.3	A	0.0	0.18	0.3	A
	NB Left	122.3	0.97	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	173.0	1.43	254.2	F	207.7	1.54	292.6	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.44	0.9	A	0.0	0.37	0.7	A
	Overall			**110.6**	**F**			**90.3**	**F**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	42.0	1.54	66.1	F	99.4	2.38	185.7	F
	WB Left/Thru/Right	476.0	3.12	735.6	F	282.1	3.13	525.7	F
	NB Left/Thru/Right	284.2	2.70	459.6	F	466.2	3.22	718.2	F
	SB Left/Thru/Right	35.0	1.41	58.9	F	23.1	1.27	50.3	F
	Overall			**474.3**	**F**			**497.5**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	11.2	B	0.0	0.00	12.6	B
	WB Left/Thru/Right	14.7	0.45	14.6	B	15.4	0.49	16.3	C
	NB Left/Thru/Right	40.6	0.74	22.2	C	252.0	1.12	196.0	F
	SB Left/Thru/Right	197.4	1.21	130.9	F	217.0	1.39	169.0	F
	Overall			**79.0**	**F**			**162.7**	**F**
Access B /Applewood lane & Waverley [84] (Unignalized)	EB Left/Thru/Right	0.0	0.00	11.8	B	0.0	0.00	13.2	B
	WB Left/Thru/Right	15.4	0.47	15.5	C	15.4	0.51	16.9	C
	NB Left/Thru/Right	77.0	0.96	41.7	E	308.7	1.64	256.9	F
	SB Left/Thru/Right	246.4	1.32	180.1	F	300.3	1.64	253.4	F
	Overall			**108.2**	**F**			**229.0**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	67.9	1.05	48.6	E	59.5	1.12	46.8	E
	NB Thru/Right	178.5	1.45	169.2	F	396.2	2.32	446.6	F
	SB Left/Thru	375.9	1.85	374.6	F	520.1	2.56	580.9	F
	Overall			**232.5**	**F**			**435.8**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Table 11 - Synchro Analysis Results: 2047, 0.75% growth, Opt 3B, 100% build-out, 10% NAMC, 10% Nth

Intersection [Synchro Node No.]	Lane / Movement	AM Peak Hour				PM Peak Hour			
		95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]	95th % Q[1] (m)	V/C Ratio[2]	Average Delay[3] (s)	LOS[4]
Montague Rd & Ramp Terminal (North) [5] (Unsignalized)	EB Left/Thru	89.6	0.90	30.3	D	15.4	0.43	9.4	A
	WB Thru/Right				A				A
	NB Left/Thru/Right	72.8	22.22	11879.2	F	62.3	2.01	677.6	F
	Overall			**498.7**	**F**			**48.4**	**E**
Montague Rd & Ramp Terminal (South) [6] (Unsignalized)	EB Thru/Right				A				A
	WB Left/Thru	0.7	0.04	10.4	B	0.7	0.02	9.2	A
	SB Left/Thru/Right	39.2	0.70	25.0	C	756.0	2.36	631.1	F
	Overall			**6.7**	**A**			**389.9**	**F**
Montague/Charles Keating & Waverley [12] (Unignalized)	EB Left/Thru/Right	14.0	0.46	61.7	F	2.1	0.10	20.1	C
	WB Left/Thru	280.7	4.01	1444.0	F	566.3	3.85	1327.6	F
	WB Right	2.1	0.09	11.3	B	17.5	0.48	17.9	C
	NB Left/Thru/Right	0.0	0.00	7.7	A	0.0	0.01	7.5	A
	SB Left	7.7	0.27	10.9	B	2.8	0.11	10.2	B
	SB Thru/Right				A				A
	Overall			**328.2**	**F**			**506.0**	**F**
Breeze & Waverley [18] (Unsignalized)	WB Left/Right	37.1	0.72	39.6	E	53.2	0.97	117.0	F
	NB Thru/Right				A				A
	SB Left/Thru	2.1	0.09	8.1	A	4.9	0.20	10.5	B
	Overall			**8.6**	**A**			**13.1**	**B**
Montebello & Waverley [24] (Signalized)	WB Left	206.9	0.99	67.2	E	62.0	0.75	50.0	D
	WB Right	9.7	0.10	8.7	A	9.2	0.16	9.8	A
	NB Thru/Right	85.7	0.61	16.4	B	431.6	1.25	136.1	F
	SB Left	9.7	0.16	11.8	B	25.5	0.58	43.3	D
	SB Thru	185.5	0.93	35.7	D	84.3	0.52	9.5	A
	Overall			**38.0**	**D**			**90.4**	**F**
Main & Forest Hills [56] (Signalized)	EB Left	81.4	0.89	74.8	E	14.2	0.20	20.7	C
	EB Thru	137.6	0.65	40.1	D	379.0	1.53	273.3	F
	EB Right	0.0	0.14	0.2	A	0.0	0.31	0.5	A
	WB Left	22.8	0.34	24.4	C	83.2	0.87	62.8	E
	WB Thru	320.3	1.18	129.9	F	114.0	0.59	34.3	C
	WB Right	0.0	0.50	1.1	A	0.0	0.23	0.3	A
	NB Left	90.7	0.60	49.0	D	52.6	0.62	59.3	E
	NB Thru	320.9	1.34	205.7	F	143.3	1.13	144.3	F
	NB Right	0.0	0.08	0.1	A	0.0	0.19	0.3	A
	SB Left	45.2	0.54	63.7	E	237.9	1.34	197.8	F
	SB Thru	82.0	0.80	85.6	F	298.6	1.42	236.5	F
	SB Right	0.0	0.05	0.1	A	0.0	0.09	0.1	A
	Overall			**81.0**	**F**			**147.5**	**F**
Main & Caledonia/ Woodlawn [71] (Signalized)	EB Left	176.8	1.77	389.2	F	324.7	1.41	217.5	F
	EB Thru	68.2	0.38	23.1	C	347.0	1.01	55.9	E
	EB Right	0.0	0.15	0.2	A	0.0	0.14	0.2	A
	WB Left	40.1	0.52	17.2	B	19.5	0.48	26.1	C
	WB Thru	285.6	1.02	61.0	E	99.6	0.57	34.8	C
	WB Right	0.0	0.20	0.3	A	0.0	0.17	0.2	A
	NB Left	122.3	0.97	81.0	F	58.3	0.78	57.6	E
	NB Thru	53.5	0.29	34.1	C	77.2	0.67	59.4	E
	NB Right	0.0	0.04	0.1	A	0.0	0.07	0.1	A
	SB Left	158.1	1.32	212.5	F	18.6	1.42	243.5	F
	SB Thru	90.2	0.69	59.1	E	86.3	0.75	64.3	E
	SB Right	0.0	0.40	0.8	A	0.0	0.34	0.6	A
	Overall			**71.1**	**E**			**77.4**	**E**
Montebello/Avenue Du Portage & Caledonia/ Breeze [30] (Unsignalized)	EB Left/Thru/Right	43.4	1.43	62.1	F	105.0	2.17	180.7	F
	WB Left/Thru/Right	432.6	2.78	647.1	F	249.2	2.70	439.4	F
	NB Left/Thru/Right	261.1	2.44	403.2	F	424.2	2.94	627.2	F
	SB Left/Thru/Right	35.7	1.32	55.3	F	23.1	1.15	46.1	E
	Overall			**410.6**	**F**			**425.0**	**F**
Access C/ Meadow Walk & Waverley [81] (Unsignalized)	EB Left/Thru/Right	0.0	0.00	10.1	B	0.0	0.00	11.5	B
	WB Left/Thru/Right	8.4	0.29	11.5	B	9.8	0.35	13.6	B
	NB Left/Thru/Right	23.1	0.55	14.6	B	187.6	1.22	124.2	F
	SB Left/Thru/Right	96.6	0.94	44.3	E	139.3	1.14	86.4	F
	Overall			**30.8**	**D**			**96.6**	**F**
Access B /Applewood lane & Waverley [84] (Unignalized)	EB Left/Thru/Right	0.0	0.00	10.4	B	0.0	0.00	11.9	B
	WB Left/Thru/Right	8.4	0.30	12.1	B	9.8	0.36	13.9	B
	NB Left/Thru/Right	38.5	0.69	19.6	C	223.3	1.35	159.4	F
	SB Left/Thru/Right	114.1	1.00	57.3	F	195.3	1.30	138.0	F
	Overall			**38.5**	**E**			**136.1**	**F**
Access A & Waverley [87] (Unsignalized)	WB Left/Right	28.7	0.65	20.5	C	32.2	0.79	25.3	D
	NB Thru/Right	80.5	0.97	46.7	E	301.7	1.75	283.4	F
	SB Left/Thru	197.4	1.25	148.5	F	367.5	1.89	350.9	F
	Overall			**87.5**	**F**			**272.8**	**F**
Forest Hills Ext Access [89] (Unsignalised)	EB Right				A				A
	NB thru				A				A
	SB Thru				A				A
	SB Thru/Right				A				A
	Overall				**A**				**A**

Notes:
Analysis by CBCL Limited using Synchro 9.0
1. 95% Queue - 95th percentile queue [highlighted if >100m or if available storage is exceeded]
2. V/C Ratio - Volume-to-Capacity ratio [highlighted if >0.85]
3. Average Delay - average total delay per vehicle [highlighted for LOS E or F]
4. LOS - Level of Service [highlighted for LOS E or F]

Level of Service Table - HCM 2010

Level of Service	Average Delay per Vehicle (sec)	
	Signalized	Unisignalized
A	<10	<10
B	>10 and <20	>10 and <15
C	>20 and <35	>15 and <25
D	>35 and <55	>25 and <35
E	>55 and <80	>35 and <50
F	>80	>50

Legend

Queue Length > 100m
V/C > 0.85
LOS E
LOS F

APPENDIX E – Cost Estimate

CBCL LIMITED
Consulting Engineers

OPINION PROBABLE CONSTRUCTION COST
MASTER PLAN PORT WALLACE
1.0 - WATER SERVICE
Halifax / Dartmouth, NS

DATE:	18/01/2017
CBCL FILE No.:	171013.00
EST. DESCRIPTION:	Class D
PREPARED BY:	CBCL

						Cost Sharing Mechanism				Notes
						HRM/HW Charges Area Portion		Developer Charge Area Portion		
1.0 WATER SYSTEM INFRASTRUCTURE		**Unit**	**Est Qty**	**Unit Rate**	**Total**	**%**	**$**	**%**	**$**	
1.2a	400mm Diameter Primary Watermain Upsize	m	2,700	$ 300	$ 810,000	0%		100%	$ 810,000	Shared Cost Among Developers
1.2b	400mm Diameter Watermain to Conrad Lands Upsize	m	420	$ 300	$ 126,000	0%		100%	$ 126,000	Shared Cost Among Developers
1.2c	400mm Diameter Watermain from Caledonia Rd to parallel existing 300 mm	m	770	$ 1,300	$ 1,001,000	0%		100%	$ 1,001,000	Shared Cost Among Developers
1.3a	300mm Diameter Mains from Waverly Road			Base Cost						Base Cost not evaluated
1.4a	300mm Diameter Watermain within Conrad Lands			Base Cost						Base Cost not evaluated
1.4b	300mm Diameter Watermain off Waverly Rd			Base Cost						Base Cost not evaluated
1.5	300mm Diameter Watermain Connection to Spider Lake			Base Cost						Base Cost not evaluated
ESTIMATED TOTAL CONSTRUCTION COST (Including General Conditions & Contingencies)					**$ 2,000,000**		**$ -**		**$ 2,000,000**	
11.0	**CONTINGENCIES and ALLOWANCES**			Included in Units						
A	Design Development Contingency - **Note 2**			Included in Units						
B	Construction Contingency - **Note 3**			Included in Units						
C	Escalation / Inflation **(Based on 2017 Dollars)**			Included in Units						
D	Location Factor - **Note 4**			Included in Units						
ESTIMATED TOTAL CONSTRUCTION COST without HST					**$ 2,000,000**					

Note 1 The summary only provide costs, allowances, contingencies & factors related to construction. Engineering fees not included.
Note 2 A Design Development Cont. is to allow so that the necessary design changes can be made as the design is developed.
Note 3 A Construction Contingency is to allow for the cost of additional work that is over and above the original contract price.
Note 4 Location Factor is to account for difference in costs at project location and location of historical cost data.

Form CBCL 034.Rev 0

CBCL LIMITED
Consulting Engineers

OPINION PROBABLE CONSTRUCTION COST
MASTER PLAN PORT WALLACE
2.0 - WASTEWATER SERVICES
Halifax / Dartmouth, NS

DATE:	30/10/2017
CBCL FILE No.:	171013.00
EST. DESCRIPTION:	Class D
PREPARED BY:	CBCL

						Cost Sharing Mechanism				Notes
						HRM/HW Charges Area Portion		Developer Charge Area Portion		
2.0 WASTEWATER INFRASTRUCTURE		**Unit**	**Est Qty**	**Unit Rate**	**Total**	**%**	**$**	**%**	**$**	
2.1	Forcemain- Sanitary Line c/w Rd Reinstatement from 390 Waverly Rd PS to North Dartmouth - Wright Ave	m	3,200	$ 1,616	$ 5,180,000	30%	$ 1,554,000	70%	$ 3,626,000	Shared between developer and HW
	Shubie Canal & Highway 118 Crossing not included see Item 3.0 Below									
2.2	**390 Waverly Road Pump Station**	Ea	1	$ 3,407,801	$ 3,410,000	30%	$ 1,023,000	70%	$ 2,387,000	Shared between developer and HW
	.1 Civil Earthworks, Excavation, Site Finishes	LS	1	$ 611,566						
	.2 Concrete Work	LS	1	$ 802,364						
	.3 Building Structure	LS	1	$ 242,494						
	.4 Pump Equipment & Piping3	LS	1	$ 1,194,336						
	.5 Building Mechanical & Piping	m2	125	$ 177,206						
	.6 Building Electrical & Instrumentation	LS	1	$ 359,040						
3.1 & 3.2	Crossing of canal and highway	LS	1	$ 4,700,000	$ 4,700,000	30%	$ 1,410,000	70%	$ 3,290,000	
	See separate broken out cost estimate									
ESTIMATED TOTAL CONSTRUCTION COST (Including General Conditions & Contingencies)					**$ 13,300,000**		**$ 4,000,000**		**$ 9,400,000**	
11.0	**CONTINGENCIES and ALLOWANCES**			Included in Units						
A	Design Development Contingency - **Note 2**			Included in Units						
B	Construction Contingency - **Note 3**			Included in Units						
C	Escalation / Inflation **(Based on 2017 Dollars)**			Included in Units						
D	Location Factor - **Note 4**			Included in Units						
ESTIMATED TOTAL CONSTRUCTION COST without HST					**$ 13,300,000**					

Note 1 The summary only provide costs, allowances, contingencies & factors related to construction. Engineering fees not included.
Note 2 A Design Development Cont. is to allow so that the necessary design changes can be made as the design is developed.
Note 3 A Construction Contingency is to allow for the cost of additional work that is over and above the original contract price.
Note 4 Location Factor is to account for difference in costs at project location and location of historical cost data.

THIS OPINION OF PROBABLE COSTS IS PRESENTED ON THE BASIS OF EXPERIENCE, QUALIFICATIONS AND BEST JUDGEMENT. IT HAS BEEN PREPARED IN ACCORDANCE WITH ACCEPTABLE PRINCIPLES AND PRACTICES. MARKET TRENDS, NON-COMPETITIVE BIDDING SITUATIONS, UNFORESEEN LABOUR AND MATERIAL ADJUSTMENTS AND THE LIKE ARE BEYOND THE CONTROL OF CBCL LIMITED. AS SUCH WE CANNOT WARRANT OR GUARANTEE THAT ACTUAL COSTS WILL NOT VARY FROM THE OPINION PROVIDED.

Form CBCL 034.Rev 0

CBCL LIMITED
Consulting Engineers

OPINION PROBABLE CONSTRUCTION COST
MASTER PLAN PORT WALLACE
3.0 - JOINT UTILITY TRENCHLESS CROSSINGS
Halifax / Dartmouth, NS

DATE:	30/10/2017
CBCL FILE No.:	171013.00
EST. DESCRIPTION:	Class D
PREPARED BY:	CBCL

						Cost Sharing Mechanism				Notes
						Water portion of costs		Sanitary Portion of Costs		
3.0 JOINT UTILITY CROSSINGS - TRENCHLESS		**Unit**	**Est Qty**	**Unit Rate**	**Total**	**%**	**$**	**%**	**$**	
3.1	Trenchless Shubie Canal Crossing (1 x600mm Dia Water & 2 x 525mm Dia Sanitary Joint Crossing)*	m	40	$ 40,500	$ 1,620,000	33%	$ 534,600	67%	$ 1,085,400	
3.2	Trenchless Highway 118 Crossing (1 x600mm Dia Water & 2 x 525mm Dia Sanitary Joint Crossing)*	m	150	$ 35,000	$ 5,250,000	33%	$ 1,732,500	67%	$ 3,517,500	
ESTIMATED TOTAL CONSTRUCTION COST (Including General Conditions & Contingencies)					**$ 6,900,000**		**$ 2,300,000**		**$ 4,700,000**	
11.0	**CONTINGENCIES and ALLOWANCES**			Included in Units						
A	Design Development Contingency - **Note 2**			Included in Units						
B	Construction Contingency - **Note 3**			Included in Units						
C	Escalation / Inflation **(Based on 2017 Dollars)**			Included in Units						
D	Location Factor - **Note 4**			Included in Units						
ESTIMATED TOTAL CONSTRUCTION COST without HST					**$ 6,900,000**					

Note 1 The summary only provide costs, allowances, contingencies & factors related to construction. Engineering fees not included.
Note 2 A Design Development Cont. is to allow so that the necessary design changes can be made as the design is developed.
Note 3 A Construction Contingency is to allow for the cost of additional work that is over and above the original contract price.
Note 4 Location Factor is to account for difference in costs at project location and location of historical cost data.

CBCL LIMITED
Consulting Engineers

OPINION PROBABLE CONSTRUCTION COST

MASTER PLAN PORT WALLACE
4.0 - TRANSPORTATION
Halifax / Dartmouth, NS

DATE:	10/01/2018
CBCL FILE No.:	171013.00
EST. DESCRIPTION:	Class D
PREPARED BY:	CBCL

						Cost Sharing Mechanism				Notes
						HRM/HW Charges Area Portion		Developer Charge Area Portion		
4.0	**INTERSECTIONS - PROPOSED UPGRADES**	**Unit**	**Est Qty**	**Unit Rate**	**Total**	**%**	**$**	**%**	**$**	
4.1	Cono Drive (Access F)	LS	1	$ 2,404,000	$ 2,404,000	55%	$ 1,322,200	45%	$ 1,081,800	
4.2	Montague Rd & Ramp Terminal (North)	LS	1	$ 2,404,000	$ 2,404,000	55%	$ 1,322,200	45%	$ 1,081,800	
4.3	Montague Rd & Ramp Terminal (South)	LS	1	$ 2,404,000	$ 2,404,000	65%	$ 1,562,600	35%	$ 841,400	
4.4	Montague/ Charles Keating & Waverley	LS	1	$ 2,404,000	$ 2,404,000	60%	$ 1,442,400	40%	$ 961,600	
5.1	Breeze & Waverly	LS	1	$ 680,000	$ 680,000	50%	$ 340,000	50%	$ 340,000	
5.2	Montebello & Waverley	LS	1	$ 344,000	$ 344,000	70%	$ 240,800	30%	$ 103,200	
6.1	Main & Forest	LS	1	$ 10,044,000	$ 10,044,000	95%	$ 9,541,800	5%	$ 502,200	
7.1	Montebello/ Avenue du Portage	LS	1	$ 350,000	$ 350,000	55%	$ 192,500	45%	$ 157,500	
8.1	Main and Caledonia	LS	1	$ 20,000	$ 20,000	75%	$ 15,000	25%	$ 5,000	
	ESTIMATED TOTAL CONSTRUCTION COST (Including General Conditions & Contingencies)				**$ 21,100,000**		**$ 16,000,000**		**$ 5,100,000**	
11.0	**CONTINGENCIES and ALLOWANCES**									
A	Design Development Contingency - **Note 2**			Included in Units						
B	Construction Contingency - **Note 3**			Included in Units						
C	Escalation / Inflation **(Based on 2017 Dollars)**			Included in Units						
D	Location Factor - **Note 4**			Included in Units						

ESTIMATED TOTAL CONSTRUCTION COST without HST $ 21,100,000

Note 1	The summary only provide costs, allowances, contingencies & factors related to construction. Engineering fees not included.
Note 2	A Design Development Cont. is to allow so that the necessary design changes can be made as the design is developed.
Note 3	A Construction Contingency is to allow for the cost of additional work that is over and above the original contract price.
Note 4	Location Factor is to account for difference in costs at project location and location of historical cost data.

Form CBCL 034.Rev 1

APPENDIX F – Sanitary Calculations

200 Waverley Road PS Drawdown Test

Pump Station Dimension 1 (m):	6.6
Pump Station Dimension 2 (m):	3.88
Pump Station Inside Area (m^2):	25.608

Action	Time (s)	Start WL (m)	End WL (m)	Change in WL (m)	Flow (L/s)
Pumps OFF	850	1.250	2.200	+0.950	28.6
P1 ON	230	2.200	1.250	-0.950	**134.4**
Pumps OFF	905	1.250	2.268	+1.018	28.8
P2 ON	230	2.268	1.250	-1.018	**142.1**
Pumps OFF	855	1.250	2.200	+0.950	28.5
P3 ON	215	2.200	1.250	-0.950	**141.6**
Pumps OFF	850	1.250	2.200	+0.950	28.6
P1 & P2 ON	125	2.200	1.250	-0.950	**223.2**

Automatic Controls

P1 startup depth @ 2.20m

P1 & P2 startup depth @ 2.50m

Pumps off @ 1.25m

Notes

-Drawdown test started on 19/Jun/2017 at approximately 11:30am and ended at approximately 12:45pm.

-All three pumps are used in rotation.

390 Waverley Road PS System

Existing Conditions

Pipe	U/S Manhole	D/S Manhole	Area (ha)	Total Area (ha)	Single Unit Houses (units)	Town Houses (units)	Multi-Unit Houses (units)	Population (people)	Total Population (people)	Average DWF (L/s)	Peaking Factor	I/I Allowance (L/s)	Design Flow (L/s)	Total Design Flow: Res (L/s)	Total Design Flow: ICI (L/s)	Total Design Flow (L/s)	Pipe Capacity (Percent Full)	Ramaining Capacity (L/s)
P46816	MH20743	MH20744	8.866	8.866	54	0	0	180.9	180.9	0.628	4.16	2.48	5.75	5.75	0.00	**5.75**	**12.5%**	**168**
P46817	MH20744	MH19872	0.494	9.361	2	0	0	6.7	187.6	0.651	4.16	2.62	6.01	6.007	0.000	**6.01**	**12.5%**	**173**
P45255	MH19872	MH19873	3.214	12.575	21	0	0	70.35	257.95	0.896	4.11	3.52	8.12	8.117	0.000	**8.12**	**15.9%**	**141**
P45256	MH19873	MH19874	0.108	12.683	1	0	0	3.35	261.3	0.907	4.10	3.55	8.20	8.205	0.000	**8.20**	**16.3%**	**134**
P45257	MH19874	MH19875	1.006	13.688	1	0	0	3.35	264.65	0.919	4.10	3.83	8.54	8.544	0.000	**8.54**	**18.1%**	**111**
P45258	MH19875	MH19876	1.892	15.580	11	0	0	36.85	301.5	1.047	4.08	4.36	9.70	9.698	0.000	**9.70**	**13.6%**	**233**
P45259	MH19876	MH19877	0.060	15.640	0	0	0	0	301.5	1.047	4.08	4.38	9.71	9.715	0.000	**9.71**	**13.7%**	**231**
P45260	MH19877	MH19878	1.625	17.265	10	0	0	33.5	335	1.163	4.06	4.83	10.73	10.734	0.000	**10.73**	**14.5%**	**226**
P45261	MH19878	MH19879	1.662	18.927	11	0	0	36.85	371.85	1.291	4.04	5.30	11.81	11.815	0.000	**11.81**	**15.2%**	**226**
P45262	MH19879	MH19880	0.872	19.798	0	0	0	0	371.85	1.291	4.04	5.54	12.06	12.059	0.000	**12.06**	**15.4%**	**224**
P45288	MH19880	MH19896	1.607	21.405	10	0	0	33.5	405.35	1.407	4.02	5.99	13.06	13.065	0.000	**13.06**	**15.9%**	**225**
P47186	MH19896	MH20896	1.680	23.085	8	0	0	26.8	432.15	1.501	4.01	6.46	13.98	13.978	0.000	**13.98**	**18.5%**	**173**
P47187	MH20896	MH19897	0.840	23.925	5	0	0	16.75	448.9	1.559	4.00	6.70	14.49	14.488	0.000	**14.49**	**15.3%**	**271**
P45290	MH19897	MH19901	20.165	44.090	140	0	0	469	917.9	3.187	3.82	12.35	27.58	27.579	0.000	**27.58**	**23.5%**	**200**
P45291	MH19901	MH19902	1.312	45.403	7	0	0	23.45	941.35	3.269	3.82	12.71	28.31	28.307	0.000	**28.31**	**23.7%**	**202**
P45301	MH19902	MH19904	6.536	51.938	51	0	0	170.85	1112.2	3.862	3.77	14.54	32.74	32.740	0.000	**32.74**	**25.2%**	**203**
P45302	MH19904	MH19905	0.332	52.270	3	0	0	10.05	1122.25	3.897	3.77	14.64	32.98	32.985	0.000	**32.98**	**23.7%**	**235**
P45303	MH19905	MH19906	0.663	52.932	5	0	0	16.75	1139	3.955	3.76	14.82	33.42	33.423	0.000	**33.42**	**26.2%**	**189**
P45304	MH19906	MH19907	1.170	54.102	7	0	0	23.45	1162.45	4.036	3.76	15.15	34.10	34.103	0.000	**34.10**	**25.3%**	**209**
P45305	MH19907	MH19908	0.909	55.012	4	0	0	13.4	1175.85	4.083	3.75	15.40	34.56	34.559	0.000	**34.56**	**25.5%**	**208**
P45306	MH19908	MH19909	4.256	59.267	25	0	0	83.75	1259.6	4.374	3.73	16.59	37.00	37.004	0.000	**37.00**	**26.4%**	**205**
P45307	MH19909	MH19910	0.583	59.850	1	0	0	3.35	1262.95	4.385	3.73	16.76	37.22	37.217	0.000	**37.22**	**27.1%**	**195**
P45308	MH19910	MH19911	1.986	61.836	10	0	0	33.5	1296.45	4.502	3.72	17.31	38.27	38.272	0.000	**38.27**	**26.5%**	**210**
P45309	MH19911	MH19912	0.873	62.710	6	0	0	20.1	1316.55	4.571	3.72	17.56	38.81	38.814	0.000	**38.81**	**19.0%**	**455**
P45310	MH19912	MH19913	0.196	62.906	1	0	0	3.35	1319.9	4.583	3.72	17.61	38.92	38.919	0.000	**38.92**	**19.0%**	**457**
P45311	MH19913	MH19914	0.897	63.803	4	0	0	13.4	1333.3	4.630	3.72	17.86	39.37	39.369	0.000	**39.37**	**24.3%**	**265**
P45312	MH19914	MH19915	0.390	64.193	0	0	0	0	1333.3	4.630	3.72	17.97	39.48	39.478	0.000	**39.48**	**24.0%**	**273**
P45313	MH19915	MH19916	0.699	64.891	1	0	0	3.35	1336.65	4.641	3.72	18.17	39.72	39.723	0.000	**39.72**	**19.0%**	**461**
P517347	MH19916	MH23876	0.910	65.802	2	0	0	6.7	1343.35	4.664	3.71	18.42	40.08	40.077	0.000	**40.08**	**19.2%**	**456**
P517348	MH23876	MH23875	0.264	66.065	1	0	0	3.35	1346.7	4.676	3.71	18.50	40.20	40.201	0.000	**40.20**	**19.5%**	**445**
P5173427	MH23875	MH23874	0.383	66.449	3	0	0	10.05	1356.75	4.711	3.71	18.61	40.46	40.456	0.000	**40.46**	**18.9%**	**480**
P517326	MH23874	MH23873	0.234	66.683	2	0	0	6.7	1363.45	4.734	3.71	18.67	40.62	40.621	0.000	**40.62**	**19.3%**	**456**
P517324	MH23873	MH23872	0.451	67.133	5	0	0	16.75	1380.2	4.792	3.71	18.80	40.99	40.994	0.000	**40.99**	**19.7%**	**444**
P517325	MH23872	MH23871	0.319	67.453	3	0	0	10.05	1390.25	4.827	3.70	18.89	41.23	41.232	0.000	**41.23**	**19.5%**	**455**
P517334	MH23871	Waverley Ro	9.878	77.331	78	0	0	261.3	1651.55	5.735	3.65	21.65	47.81	47.809	0.000	**47.81**	**12.5%**	**1394**
390 Waverley Road PS														47.809	0.000	**47.81**	**FULL**	**0**

205 68 420

200 Waverley Road PS System

Pipe	U/S Manhole	D/S Manhole	Area (ha)	Total Area (ha)	Single Unit Houses (units)	Town Houses (units)	Multi-Unit Houses (units)	Population (people)	Total Population (people)	Average DWF (L/s)	Peaking Factor	I/I Allowance (L/s)	Design Flow (L/s)	Total Design Flow: Res (L/s)	Total Design Flow: ICI (L/s)	Total Design Flow (L/s)	Pipe Capacity (Percent Full)	Ramaining Capacity (L/s)
P518354	MH19605	MH19599	37.547	114.878	195	0	0	653.25	2304.8	8.003	3.54	32.17	33.77	33.774	0.000	**33.77**	**47.0%**	**41**
P45427	MH19599	MH19600	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	34.541	0.000	**34.54**	**41.8%**	**60**
			1.374	1.374	6	0	0	20.1	20.1	0.070	4.38	0.38	0.77					
P518355	MH19600	MH28701	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	36.090	0.000	**36.09**	**42.8%**	**58**
			1.576	2.950	18	0	0	60.3	80.4	0.279	4.27	0.83	2.32					
P518356	MH28701	MH28702	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	79.166	0.000	**79.17**	**68.9%**	**17**
			59.263	62.213	457	0	74	1697.45	1777.85	6.173	3.62	17.42	45.39					
P518370	MH28702	MH28710	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	79.436	0.000	**79.44**	**59.2%**	**41**
			0.623	62.836	2	0	0	6.7	1784.55	6.196	3.62	17.59	45.66					
P518371	MH28710	MH28703	0.656	178.370	1	0	0	3.35	4092.7	14.211	3.32	49.94	109.00	108.997	0.000	**109.00**	**61.7%**	**47**
P518357	MH28703	MH19573	2.845	181.215	5	0	0	16.75	4109.45	14.269	3.32	50.74	110.01	110.006	0.000	**110.01**	**52.8%**	**91**
P518375	MH19573	MH28712	13.576	194.791	28	44	38	326.7	4436.15	15.403	3.29	54.54	117.94	117.940	2.272	**120.21**	**59.7%**	**60**
			2.438	2.438	-	-	-	212	212	0.848	1.50	0.68	2.27					
P518376	MH28712	MH19557	22.449	217.240	202	0	0	676.7	5112.85	17.753	3.24	60.83	132.64	132.638	2.272	**134.91**	**65.0%**	**43**
P518358	MH19557	MH28704	0.625	217.865	4	0	0	13.4	5126.25	17.799	3.23	61.00	132.98	132.978	2.272	**135.25**	**59.1%**	**71**
P518359	MH28704	MH28705	0.728	218.593	6	0	0	20.1	5146.35	17.869	3.23	61.21	133.43	133.428	2.272	**135.70**	**59.0%**	**72**
P518360	MH28705	MH19567	0.957	219.550	5	0	0	16.75	5163.1	17.927	3.23	61.47	133.90	133.902	2.272	**136.17**	**43.0%**	**218**
P518361	MH19567	MH28706	3.370	222.920	16	0	0	53.6	5216.7	18.114	3.23	62.42	135.50	135.503	2.272	**137.78**	**42.7%**	**226**
P518362	MH28706	MH19208	1.671	224.591	5	0	0	16.75	5233.45	18.172	3.23	62.89	136.18	136.176	2.272	**138.45**	**46.1%**	**180**
P47672	MH19208	MH20986	54.529	279.120	342	242	0	1956.4	7189.85	24.965	3.10	78.15	174.75	174.748	13.467	**188.21**	**38.4%**	**415**
			5.220	5.220	-	-	-	660	660	2.634	1.50	1.46	6.40					
			5.940	5.940	-	-	-	418	418	1.670	1.50	1.66	4.79					
P47452	MH20986	MH20987	0.342	279.461	2	0	0	6.7	7196.55	24.988	3.09	78.25	174.92	174.921	13.653	**188.57**	**29.8%**	**787**
			0.291	0.291	-	-	-	40	40	0.042	2.00	0.08	0.19					
P47453	MH20987	MH20988	0.267	279.728	0	0	0	0	7196.55	24.988	3.09	78.32	175.00	174.996	15.309	**190.30**	**44.6%**	**274**
			0.183	0.183	-	-	-	50	50	0.052	2.00	0.05	0.18					
			0.641	0.641	-	-	-	130	130	0.518	2.00	0.18	1.47					
P47454	MH20988	MH20989	0.160	279.888	1	0	0	3.35	7199.9	25.000	3.09	78.37	175.08	175.079	15.309	**190.39**	**50.2%**	**188**
P47455	MH20989	MH20990	22.343	302.231	136	6	50	588.2	7788.1	27.042	3.06	84.62	188.12	188.116	16.120	**204.24**	**59.4%**	**104**
			1.966	1.966	-	-	-	100	100	0.104	2.00	0.55	0.81					
P47456	MH20990	MH20991	1.402	303.633	1	0	0	3.35	7791.45	27.054	3.06	85.02	188.55	188.547	16.120	**204.67**	**57.7%**	**119**
P47457	MH20991	MH20992	1.814	305.447	17	0	0	56.95	7848.4	27.251	3.06	85.53	189.71	189.706	16.822	**206.53**	**73.8%**	**24**
			0.646	0.646	-	-	-	200	200	0.208	2.00	0.18	0.70					
P47458	MH20992	MH20993	0.176	305.623	0	0	0	0	7848.4	27.251	3.06	85.57	189.76	189.755	16.822	**206.58**	**57.6%**	**121**
P47459	MH20993	MH20972	1.301	306.924	1	0	0	3.35	7851.75	27.263	3.06	85.94	190.16	190.158	16.822	**206.98**	**65.0%**	**67**
P455700	MH20972	MH40500	38.859	345.783	366	0	0	1226.1	9077.85	31.520	3.00	96.82	214.87	214.875	20.144	**235.02**	**65.2%**	**75**
			1.784	1.784	-	-	-	377	377	1.505	1.50	0.50	3.32					
P455701	MH40500	MH40501	1.703	347.486	2	0	0	6.7	9084.55	31.544	3.00	97.30	215.43	215.426	24.947	**240.37**	**68.5%**	**55**
			0.252	0.252	-	-	-	96	96	0.756	4.00	0.07	3.85					
			1.085	1.085	-	-	-	250	250	0.260	2.00	0.30	0.95					

P455702	MH40501	MH40502	0.308	347.794	1	0	0	3.35	9087.9	31.555	3.00	97.38	215.55	215.550	25.407	**240.96**	**54.4%**	**178**
			0.452	0.452	-	-	-	288	288	0.067	4.00	0.13	0.46					
P455703	MH40502	Waverley Ro	0.287	348.080	0	0	0	0	9087.9	31.555	3.00	97.46	215.63	215.630	25.407	**241.04**	**55.5%**	**164**
200 Waverley Road PS			0.000	348.080	0	0	0	0	9087.9	31.555	3.00	97.46	215.63	215.630	25.407	**241.04**	**FULL**	**0**
P518366	MH19605	MH28707	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	33.774	0.000	**33.77**	**45.3%**	**46**
P518367	MH28707	MH28708	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	33.774	0.000	**33.77**	**42.7%**	**55**
P518368	MH28708	MH28709	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	33.774	0.000	**33.77**	**42.8%**	**55**
P518369	MH28709	MH28710	0.000	114.878	0	0	0	0	2304.8	8.003	3.54	32.17	33.77	33.774	0.000	**33.77**	**45.7%**	**45**

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Prince Edward Island: Charlottetown
New Brunswick: Saint John, Fredericton, Moncton
Newfoundland & Labrador: St. John's, Happy Valley-Goose Bay