HALIFAX

P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5 Canada

Info item No. 11.1
Transportation Standing Committee
April 23, 2019
May 23, 2019

TO: Chair and Members of the Transportation Standing Committee

SUBMITTED BY:
ORIGINAL SIGNED

Dave Reage, MCIP, LPP, Director, Halifax Transit

ORIGINAL SIGNED

Jacques Dubé, Chief Administrative Officer

DATE: February 13, 2019

SUBJECT: **Bus Rapid Transit (BRT) Study**

INFORMATION REPORT

ORIGIN

- The Halifax Transit *Moving Forward Together Plan*, approved by Regional Council in April 2016, has increasing priority for transit vehicles in the transportation network as one of its four principles. It further states that the Corridor Routes service types described in MFTP could be candidates for future Bus Rapid Transit (BRT) corridors.

- At the June 21, 2016 meeting of Regional Council, staff were directed to submit 16 proposed transit projects for cost-shared funding approval under the Public Transit Infrastructure Fund (PTIF). One of those projects proposed was the study to determine the feasibility of BRT in Halifax.

- At the February 21, 2017 meeting of Regional Council, Halifax Regional Council authorized the Mayor and Municipal Clerk to sign the fifteen Contribution Agreements with the Minister of Municipal Affairs, to receive funding for public transit projects approved under the Public Transit Infrastructure Fund (PTIF), including one for the *Bus Rapid Transit (BRT) Study*.

- In June 2017, RFP 17-046 was awarded to Dillon Consulting to prepare the *BRT Study*, of which the purpose was to study the feasibility of BRT as a higher order transportation option in Halifax.

LEGISLATIVE AUTHORITY

Transportation Standing Committee Terms of Reference, section 4(a) which states “The Transportation Standing Committee shall oversee and review the Municipality’s Regional Transportation Plans and initiatives, as follows: overseeing HRM’s Regional Transportation Objectives and Transportation Outcome Areas.”

BACKGROUND

In April 2016, Regional Council approved Halifax Transit's *Moving Forward Together Plan* (*MFTP*) which includes a phased implementation of a revised transit network, new and upgraded transit infrastructure (e.g., passenger amenities, transit terminals, Park & Ride lots, garage expansions), and transit priority measures to increase operating speeds and improve service reliability. One of the four core principles of the MFTP is to increase priority for transit vehicles in the transportation network. The MFTP further states that the Corridor Routes are potential candidates for future Bus Rapid Transit (BRT) corridors.

In June 2017, RFP 17-046 was awarded to Dillon Consulting to prepare the *BRT Study,* an analysis of the feasibility of BRT as a higher order transportation option in Halifax.

Since the award of this contract, several additional actions have been undertaken relevant to this *BRT Study*. On December 5, 2017, Regional Council approved the *Integrated Mobility Plan (IMP)* to encourage a broader choice of urban mobility options focused on public transit, active transportation, ridesharing, and newly developing sustainable services. The IMP makes specific reference to the *BRT Study*:

> *Action 97*: *"Increase the priority of transit in the transportation network by implementing a BRT system in Halifax with dedicated bus lanes, based on the findings of the Bus Rapid Transit Study currently underway.*

DISCUSSION

Bus Rapid Transit Service – An Overview

Dillon Consulting's report (Attachment A to this report) defines Bus Rapid Transit (BRT) as a rubber-tired, rapid transit service that combines stations, vehicles, running ways, a flexible operating plan, technology and distinct identity into a high quality, customer-focused service that is fast, reliable, comfortable, and typically more cost efficient than many other higher order transit modes.

General features of a BRT include:

- Prioritized running ways (in separated rights-of-way or within street rights-of-way customized with Transit Priority Measures) to provide reliable service and competitive travel times;
- High-quality stations, spaced at lengthier intervals than bus stops for conventional services, fully integrated with other modes and surrounding development, and featuring amenities for safe, comfortable, and accessible passenger use;
- Modern, accessible, comfortable vehicles;
- Intelligent Transportation System (ITS) technology to furnish real-time information to passengers prior to and during travel, and to provide safety and security systems;
- Flexible operating plans that enable service designs to be tailored to travel patterns;
- Prominent service branding; and
- Fare policy and technology.

In Canada, BRT applications in separated rights-of-way have been implemented in Ottawa, Gatineau, Mississauga, and Winnipeg. Examples of "In-Street" BRT (i.e. operating within an existing street right-of-way, as opposed to a separate corridor) include those in Quebec City, York Region, Calgary, and Vancouver, with several more planned in these and other jurisdictions.

Bus Rapid Transit in Halifax – Experience and Policy Direction

Halifax Transit's current limited experience with BRT type service is the provision of the MetroLink service to the Portland Hills and Sackville terminals, which commenced in 2005 and 2006, respectively. This service has some of the characteristics that define BRT such as limited stops, and the use of transit priority signalization and queue jump bus lanes to facilitate service, which also benefits the conventional transit network in these areas. However, unlike BRT service, MetroLink does not offer several key BRT characteristics such as dedicated right of way, high quality stations, and frequent service all day, seven days a week. Further, one of the objectives of MetroLink was to move commuters from suburban to core areas during peak commuter hours, whereas BRT is frequent service, operating all day, and connecting high density areas of the city.

Regional Council has provided direction to staff to explore the introduction of BRT in several recently approved policy documents, including the 2014 *Regional Municipal Planning Strategy* (Section 4.2.3), the MFTP (p. 34), and the IMP (Actions 96 and 97).

In June 2017, Dillon Consulting were awarded a contract to study the feasibility of implementing a BRT service in Halifax. The scope of work included the identification of candidate BRT corridors, evaluation of potential corridor segments, and the development of a conceptual BRT network. The consultants were also tasked with identifying an operating plan including level of service for each recommended route, opportunities for Transit Priority Measures (TPMs), candidate station locations and general station design. The consultant report included a fulsome description of the methodology and engagement activities undertaken as part of this project. It can be found in Attachment A to this report.

Proposed Bus Rapid Transit Network

Based on following best practices to identify candidate BRT corridors, and informed by feedback from public and stakeholder engagement, the consultants developed a recommended BRT network of four routes for Halifax, including a recommended network of Transit Priority Measures and station locations. In determining the corridors for the BRT network, the consultants completed a multi-stage evaluation. An initial list was developed by examining current and future potential ridership after which each corridor was ranked against criteria designed to assess its capacity to accommodate BRT. This included looking at overall connectivity, street layout, urban character/context, and implementation characteristics. This network is illustrated in Figure 1 below. The individual BRT routes proposed by the consultant are described in more detail in Table 1 on the following page.

Figure 1: Proposed BRT Route Network and Station Locations

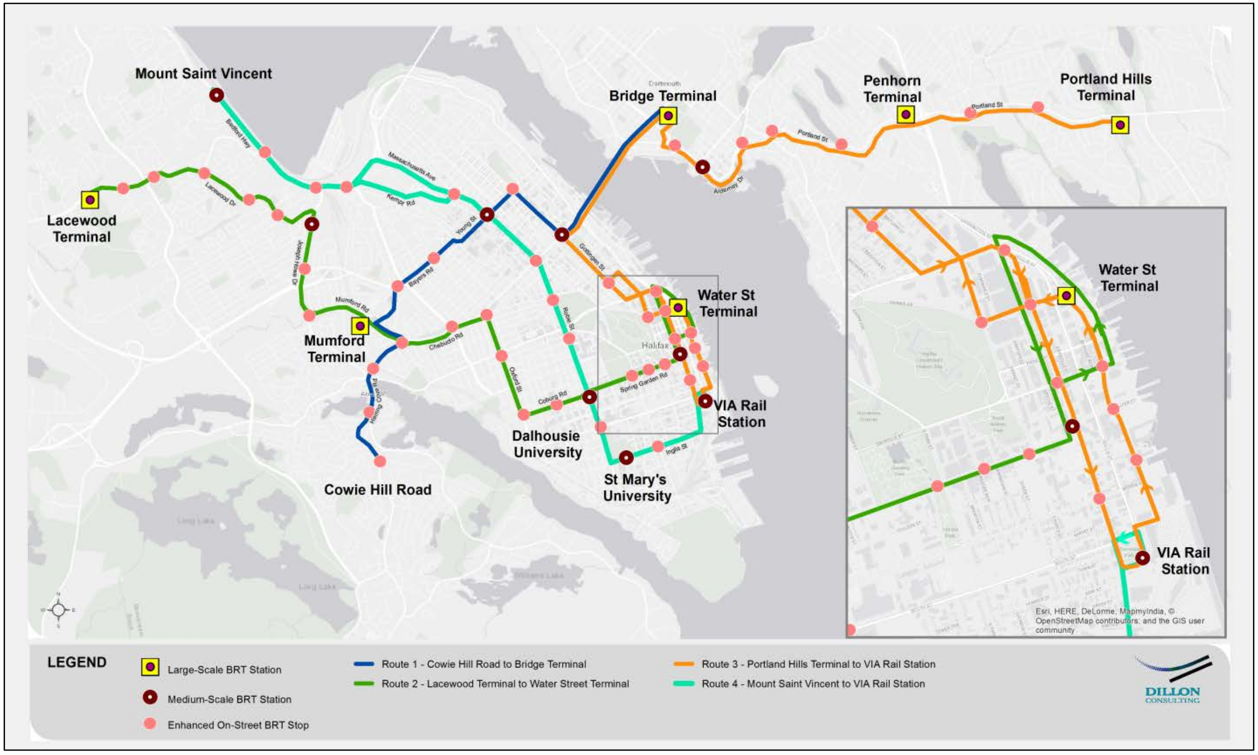


Table 1: Proposed BRT Network Routes

Route	From	To	Routing
1	Cowie Hill Road	Bridge Terminal	Herring Cove Road – Chebucto Road – Mumford Terminal – Bayers Road – Young Street – Gottingen Street – Macdonald Bridge
2	Lacewood Terminal	Water Street Terminal	Lacewood Drive – Joseph Howe Drive – Mumford Terminal – Chebucto Road – Oxford Street – Coburg Road – Spring Garden Road – Downtown Halifax
3	Portland Hills Terminal	VIA Rail Station	Portland Street – Alderney Drive – Bridge Terminal – Macdonald Bridge – Gottingen Street – Downtown Halifax
4	Mount Saint Vincent	VIA Rail Station	Bedford Highway – Kempt Road /Massachusetts Avenue – Robie Street – Dalhousie/Saint Mary's University – Inglis Street

Operating Plan

The proposed BRT routes described above would form a distinct service type, supplementing established Corridor, Local, Express, Regional Express, Rural, and Ferry services as described in the MFTP.

As described above, a key feature of BRT is frequent operation throughout the day on all days of the week, improving ease of access by passengers without the need to consult published schedules.

The consultant proposed BRT service spans and headways by schedule type are summarized in Table 2 below.

Table 2: Proposed BRT Service Levels

Schedule Type	Time Period	Headway (minutes)
Weekday	05:30 – 07:00	30
	07:00 – 22:00	10
	22:00 – 01:00	20
Saturday	05:30 – 08:00	30
	08:00 – 22:00	10
	22:00 – 01:00	20
Sunday/Holiday	06:30 – 09:00	30
	09:00 – 18:00	10
	18:00 – 01:00	30

These levels of service are intended as a general guideline, and were used to identify general operating costs of the conceptual BRT service. The resource requirements will be better defined during the implementation planning stages and would likely vary to some degree dependent on demand. The headways presented below are consistent, and in some cases, improve on, the Level of Service Guidelines for Corridor Routes presented in the MFTP and in operation today.

Based on these service levels and routings, resource requirements (annual revenue bus hours, number of peak vehicles) were estimated for the proposed BRT network. These are summarized in Table 3 below.

Table 3: Resource Requirements for Proposed BRT Network

Route	From	To	One-Way Route Length (in km)	Approximate One-Way Travel Time (mins)	Annual Revenue Bus Hours			
					Weekdays	Saturday	Sunday	Total
1	Cowie Hill Road	Bridge Terminal	7.5	25	25,500	5,194	4,526	35,220
2	Lacewood Terminal	Water Street Terminal	10.5	35	38,625	7,871	6,789	53,285
3	Portland Hills Terminal	VIA Rail Station	14.6	45	47,250	9,646	8,494	65,390
4	Mount Saint Vincent	VIA Rail Station	9.8	30	34,125	6,970	6,231	47,326
Total					**145,500**	**29,680**	**26,040**	**201,220**

Transit Priority Measures Described in the BRT Study

The IMP defines Transit Priority Measures (TPMs) as tools that prioritize the movement of buses over other vehicles, reducing travel times and increasing reliability. They are a key feature in ensuring the rapid and reliable service required to provide higher order transit service like BRT. The ideal application of TPMs for a BRT network would be the introduction of transit only facilities for the entirety of the network. As it was identified that at this time, the complete separation of the BRT network from mixed traffic is physically impossible for the entirety of the network, the consultant has identified through this report several specific TPMs which could improve the movement of buses in a higher order transit network.

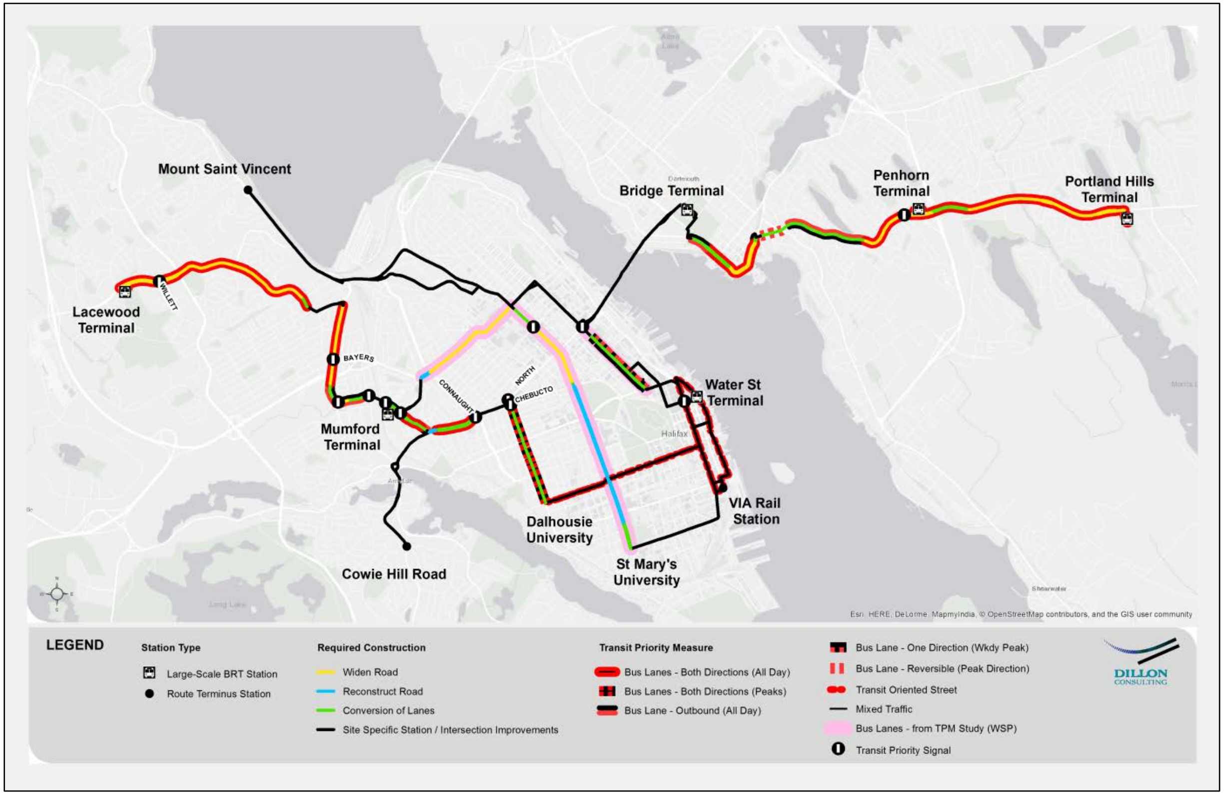
The proposed TPMs for the BRT route network were selected in accordance with the following general principles:

- TPMs should allow buses to bypass known places of traffic congestion and to realize benefits in operating speeds and service reliability;
- TPMs should be arranged in a logical manner to enable buses operating on a BRT route to take advantage of several TPMs along the route path to maximize travel time savings;
- In locations where different types of TPMs can be deployed, those that are simpler in operation and less costly in implementation are preferred;
- TPMs are to be deployed within existing street rights-of-way, acquisition of property for TPMs is to be minimized; and
- TPM initiatives already planned and/or approved by HRM are to be included for the BRT route network, where appropriate.

The TPMs proposed by the consultant, although generally consistent with the Transit Priority Corridors found in the IMP, are fairly conservative and in some cases may not be appropriate or required in order to provide transit priority (i.e. widening of Portland Street in order to provide bus lanes). Further, as shown in the report, they are preliminary concepts for consideration only and should not be considered a definitive intervention, as many of these corridors will be subject to functional and detailed design similar to the broader complete streets planning process currently underway for corridors such as the Bedford Highway and Herring Cove Road. The proposed location of the stations, including the enhanced on-street stop locations, are also preliminary concepts as well subject to further functional and detailed design.

The consultant-recommended TPMs for the proposed BRT route network are presented in Figure 2 below.

Figure 2: Proposed Transit Priority Measures



Impact to and Comparison with Approved MFTP Network

The BRT routes described as part of this study provide coverage to a significantly smaller area than the Corridor Routes described by the Moving Forward Together Plan, although would in most cases provide a higher level of service (i.e. higher frequency or longer service spans). The BRT routes would provide coverage to approximately 1/3 of the roadway corridors served by existing or planned Corridor Routes, with Corridor Routes extending significantly beyond the Regional Centre into areas with lower ridership and not recommended for BRT service at this time (i.e. Herring Cove, Eastern Passage, and Sackville).

It is important to note that the conceptual BRT network described in the preceding section would represent a new and complementary service type to those currently offered in the Halifax Transit network and would in many cases cause the displacement or redesign of existing service in order to establish a more effective, transfer based model as seen in many BRT networks across Canada. As described below, it is likely that the BRT network would displace sections of several routes, and in some cases may replace them entirely in order to increase efficiency and reduce network redundancy as per the Moving Forward Principles.

In order to understand in great detail the extent of changes that the proposed BRT network would likely have on the conventional transit network, significant further analysis would be required, including additional ridership analysis and more detailed public engagement. Further work would also be required in order to better understand the potential for economic and land-use benefits resulting from higher order transit like BRT, and to develop a comprehensive implementation plan.

However, to understand at a high level the net impact to service that the BRT would likely have on the rest of the MFTP network, staff undertook a planning level analysis to determine what routes would likely be changed in the event that BRT service was implemented as described by this plan. It was anticipated that while impact to the conventional transit network would be significant, it's likely that due to the structure of the route network described in the MFTP, only the following routes would see substantial changes:

- Route 1: This Route would likely be removed and replaced by BRT due to significant similarities in coverage;
- Route 2 and 4: As part of these routes would be covered by BRT, they would likely see a significant reduction in service or replacement with a Local Route;
- Route 3: Conventional service from Lacewood Terminal to Bridge Terminal would be eliminated;
- Route 5: This Route would likely be removed and replaced by BRT due to significant similarities in coverage;
- Route 9: Route would be removed from where the BRT begins in the Cowie Hill Road vicinity; and
- Route 90: Route would be terminated at MSVU where passengers will transfer to BRT.

Based on the service changes described above and summarized in Table 4 below, staff anticipate that with the introduction of BRT, there could be a reduction of approximately 223,000 revenue hours in the conventional transit network. As per section 8.4 of the consultant's report, and as summarized in Table 5 on the following page, the conceptual BRT network is anticipated to require approximately 201,000 annual revenue service hours to operate. The value in the study may be conservative, and staff estimate a contingency of 16% would be appropriate for budgeting purposes. Once adjusted to reflect this contingency, the annual figure would be closer to 233,400 revenue hours, or a difference of approximately 10,000 annual service hours between anticipated reductions on the conventional network, and increases likely for the BRT network. This represents an overall network-wide service hours increase of less than 1%, however, this considers the entirety of the network, and it's likely that there would be a requirement for additional service hours and budget dependant on how implementation is phased.

While these findings will need to be confirmed in greater detail through further analysis, engagement, and modelling, it would appear that the majority of the service requirement for the introduction of BRT in the network can be largely accommodated by the reorganization of conventional transit service.

Table 4: Comparison of Conceptual BRT Network with MFTP Corridor Routes

Route Impacted	Likely Changes as a Result of BRT Implementation	Revised Estimated Revenue Hours with BRT Implementation
1	Route removed and replaced by BRT	-
2	Significant reduction in service due to BRT coverage. Approximately 50% reduction in service hours.	18,424
3	Conventional service from Lacewood Terminal to Bridge Terminal replaced by BRT. Approximately 65% reduction in service hours.	16,910
4	Reduction in service due to BRT coverage. Approximately 70% reduction in service hours.	11,270
5	Entire route removed and replaced by BRT.	-
9	Route replaced by BRT from Cowie Hill Road to downtown Halifax. Approximately 65% reduction in service hours.	17,598
90	Route replaced by BRT from Mount Saint Vincent University to Halifax. Approximately 50% reduction in service hours.	14,888
Total		79,090
Anticipated Decrease in Conventional Service Hours		**- 223,046**

Table 5: Revised BRT Revenue Hours

BRT Route	Annual Revenue Bus Hours (Section 8.4)	Planning Level Service Hours
1	35,220	40,860
2	53,285	61,810
3	65,390	75,850
4	47,326	54,890
Total Hours for Anticipated BRT Network	**201,221**	**233,410**

Planning level service hours include a buffer of 16%

Impact to Ridership

In other municipalities where BRT has been implemented, ridership levels are influenced by a combination of transit (speed and reliability, fare structure, service span, service frequency, and comfort/ease of use) and non-transit related factors (development density, land use patterns, pedestrian facilities, economic conditions, demographics, and alternative transportation options). Due to the multiple factors, it is often quite challenging for municipalities to isolate ridership impacts attributed solely to a specific BRT project however numerous studies have reported ridership increases along routes when BRT replaces conventional bus service.

As part of the *BRT Study*, Dillon completed a jurisdictional scan on ridership impacts in other North American municipalities (see Attachment B). The ridership impacts generally reflect the percent change in boardings before and after implementation of a BRT project. For the examples provided, all have experienced a growth in ridership ranging from nine percent to over 100%. This is consistent with a number of studies including the US Government Accountability Office, which finds that increases in corridor-level ridership over one year can reach 80%.[1]

Alignment with *IMP* and Higher Order Alternatives

Higher order transit – often used interchangeably with rapid transit – is defined by the IMP as including "all forms of rapid transit typically within its own right-of-way," or separated from general vehicular traffic. Examples of this include, but are not limited to, bus rapid transit and light rail. Higher order transit is able to maintain higher levels of speed, reliability, and productivity than can typically be achieved by conventional bus services operating in mixed traffic.

The implementation of higher order transit, as well as its land use, fiscal, and economic implications, is integral to the goals of the IMP. The policies derived from the IMP directly related to higher order alternatives, and their status as of March 2019, are summarized in Table 6 below.

As described below, and in the IMP itself, the vision for higher order transit in Halifax includes several modes including BRT, a larger network of harbour ferries, and the potential inclusion of commuter rail services as well as consideration for other modes. In addition to this *BRT Study*, there are a number of projects occurring in parallel which could greatly impact the way in which transit priority and higher order transit could be provided in Halifax. These projects include:

- In conjunction with the Province of Nova Scotia, there is ongoing study and discussion related to the use of bus-only shoulder lanes on Highway 102;
- Functional design of key transportation corridors including Herring Cove Road, Bedford Highway, and Dutch Village Road (anticipated completed in April 2019); and
- Continued discussions for the potential location of a stadium in Shannon Park have reignited conversations about fast ferry service.

Due to the significant impact that any and all of the studies and projects described above could have on the final recommended BRT network and implementation, it is important that BRT not be considered in isolation, but within the context of other higher order alternatives of transportation also under consideration.

Table 6: IMP Action Items Related to Higher Order Transit

IMP Action Item	Action Status as of March 2019
Action 90: Prioritize transit in locations, identified on the Transit Priority Corridors Maps (see Figure 20 of the IMP) through the use of transit priority measure (e.g. queue jump lanes, dedicated bus lanes).	Work is ongoing. Recent examples of Transit Priority Measures (TPM) include Main Street @ Gordon Avenue and Barrington Street @ North Street (December 2018).
Action 91: Prioritize the delivery of Transit Priority Corridors, starting with but not limited to: Bayers Road (Romans Avenue to Windsor Street), Gottingen Street (North Street to Cogswell Street), Robie Street (Young Street to Inglis Street), Young Street (Windsor Street to Robie Street).	Gottingen Street TPM Corridor complete (December 2018), Bayers Road TPM Corridor detailed design underway, Robie Street and Young Street TPM Corridors in functional design.
Action 93: Implement the first phase of the Barrington Street Transit Priority Corridor in conjunction with the Cogswell Redevelopment project.	Work ongoing.
Action 96: Deliver a feasibility study of Bus Rapid Transit	Complete, as per this report.

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[1] US Government Accountability Office. "Bus Rapid Transit: Projects Improve Transit Service and Can Contribute to Economic Development," 2012.

IMP Action Item	Action Status as of March 2019
Action 97: Increase the priority of transit in the transportation network by implementing a BRT system in Halifax with dedicated bus lanes, based on the findings of the Bus Rapid Transit currently underway,	Not yet initiated.
Action 98: Complete a rail capacity study for the Windsor Junction – Bedford – Halifax rail corridor in collaboration with rail industry stakeholders to better understand the costs and logistics of operating a Commuter Rail service in Halifax.	Work ongoing.
Action 99. Continue to review the land use, fiscal and economic implications of higher order transit.	Work ongoing.
Action 100: Study the feasibility of other commuter rail options for the Halifax region, including: • The feasibility of extending commuter rail service into the core of downtown Halifax; and • The feasibility of a Woodside – Downtown Dartmouth – Burnside rail service.	Not yet initiated.
Action 101: Conduct a feasibility study to analyze opportunities for a ferry connection between North Dartmouth and Downtown Halifax.	Not yet initiated.
Action 102: Continue to monitor ridership trends and consider opportunities to upgrade sections of the network to higher order modes.	Work ongoing.

Next Steps

In order to further understand the potential for BRT in Halifax, staff will undertake the following work.

Develop a Higher Order Transit Network Plan

In light of the numerous projects in various stages of development which could significantly impact higher order transit in Halifax, staff will develop a Higher Order Transit Framework informed by the findings of these studies and projects. The intent of this framework is to build on direction provided by the IMP and other policy documents and provide a broad overview of potential higher order transit based on the findings of recently completed reports and projects. It will outline key components and modes, illustrating the relationships, and providing recommended actions based on a cohesive multi-modal network. It will also be undertaken in parallel for planning for appropriate land use intensification around existing or proposed terminal areas.

It is envisioned that this framework will build on existing policies and achievements, including the Transit Priority Corridors identified in the IMP and the findings of the initial *BRT Study*. It will support and guide future actions related to other significant transit investments.

Upon the completion of a higher order framework and approval by Regional Council and contingent on budget approval, Halifax Transit would recommend the establishment of a project office for the implementation of BRT. This group would then work to develop a comprehensive implementation strategy for BRT service in Halifax.

Continued Implementation of Transit Priority Corridors:

In parallel with the development of the Higher Order Transit Framework described above, key strategic investments consistent with the IMP will continue to be recommended by staff to introduce transit priority in the network.

One of the key elements of higher order bus service is the presence of transit priority and dedicated right of way space for buses, either as part of the infrastructure for a BRT network or via the provision of improvements for conventional transit vehicles and passengers. The practice of separating buses from general traffic, and subsequent congestion, allows for the provision of reliable service with competitive travel times. The IMP identifies a number of Transit Priority Corridors which were strategically selected to provide efficiencies and advantages for transit services. These Corridors are consistent with the priority routes identified by the *BRT Study* and are ideal foundations for developing the network.

Consistent with the actions identified in the IMP, preliminary work is already underway, or completed, on several of these routes. Specifically, a northbound peak period transit lane has already been implemented on Gottingen Street, and design work is underway for transit lanes on Bayers Road, Robie Street and Young Street. This work represents a significant building block in the potential implementation of higher order bus service.

FINANCIAL IMPLICATIONS

There are no financial implications associated with this information report at this time. The design and construction of significant TPMs as described in this report will be considered by Regional Council through the budget approval process.

The anticipated costs of full BRT implementation, including capital and operating costs, is included in the consultant's report in Attachment A. As proposed in the consultant's report, the BRT network would include a capital cost of approximately $116,395,000 – $132,795,000, which is the total sum for fleet, stations, and recommended TPMs. This cost assumes a net new fleet for the provision of BRT service, and makes some broad assumptions related to appropriate TPMs and infrastructure, which will have to be reviewed and are subject to functional and detailed design and approval.

Anticipated annual total operating costs are approximately $24,000,000. This cost assumes that BRT service would all be net new and in addition to existing service, which as described in the Discussion section of this report, will likely not be the case. It also includes provision for bus operator costs, fuel, bus servicing, service supervision, vehicles maintenance, facilities maintenance, and administrative costs.

The estimates above do not account for anticipated efficiencies which will be identified by reorganizing the existing conventional transit network or potential synergies with roadway projects. A more refined estimate for capital and operating costs for BRT will be established through the development of a comprehensive implementation strategy.

BRT is identified as key priority for federal and provincial funding opportunities, including future phases of the Public Transit Infrastructure Fund. In Attachment B, the consultant further identifies a number of potential funding mechanisms. Due the high capital expenditure required with the design and construction of a BRT system, external funding would be likely be required.

COMMUNITY ENGAGEMENT

Community engagement was undertaken by the consultant as part of this *BRT Study*. The objectives of the community engagement strategy were to:

- Inform the public and stakeholders about BRT (i.e. introduce the concept and show examples of BRT characteristics and elements);
- Illustrate a proposed preliminary BRT network in the HRM;
- Provide examples of possible BRT system elements in Halifax, including stations, stops, and infrastructure enhancements to support higher order transit;
- Gather feedback on the proposed BRT network; and
- Gauge public interest in developing a BRT network in Halifax.

A multi-platform engagement program was utilized, including an online project portal and survey, a public open house, Halifax Transit/HRM staff feedback, and a stakeholder roundtable. This resulted in a significant level of engagement:

- 250 people attended the open house on February 12, 2018;
- 2,179 people visited the project website and 560 people participated in the 'Shape Your City' online project survey from February 13 – 28, 2018;
- Input was gathered from Halifax Transit bus operators and HRM staff, including Planning & Development; and
- A facilitated community stakeholder session was held on February 21, 2018 at HRM's offices at Alderney Landing. Attendees included the Spring Garden Area Business Association, the Downtown Dartmouth Business Commission, the transit advocacy group It's More Than Buses, Walk 'n' Roll Halifax, and the Ecology Action Centre.

Overall, 95% of public open house attendees and 90% of online responses replied that BRT is a good initiative for Halifax. A summary of the stakeholder and public feedback is included in the consultant's report in Attachment A.

ATTACHMENTS

Attachment A: Bus Rapid Transit (BRT) Study

Attachment B: Briefing Note on Ridership and Funding

A copy of this report can be obtained online at halifax.ca or by contacting the Office of the Municipal Clerk at 902.490.4210.

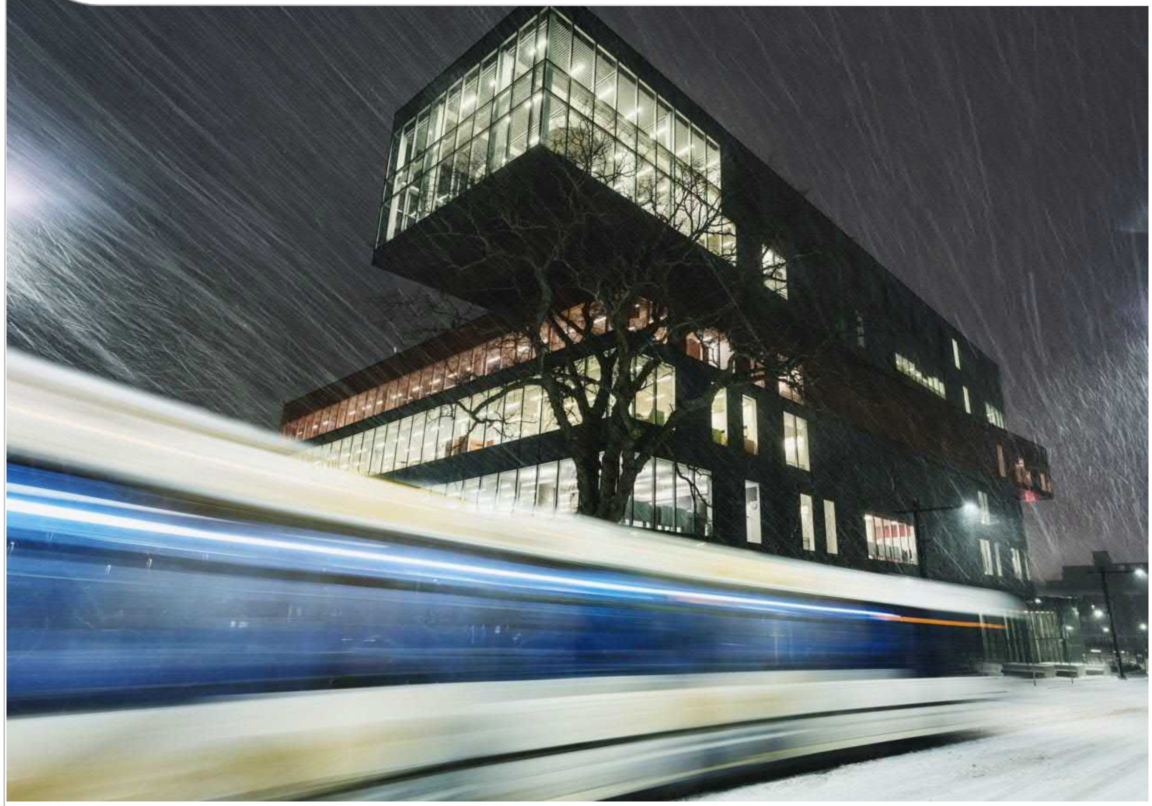
Report Prepared by:	Derek Nawrot, Coordinator – Project Planning, Halifax Transit 902.490.5956 Erin Blay, Supervisor, Service Design & Projects, Halifax Transit 902.490.4942

DILLON
CONSULTING

HALIFAX REGIONAL MUNICIPALITY

Bus Rapid Transit (BRT) Study

Final Report



November 2018

DILLON
CONSULTING

137 Chain Lake Drive
Suite 100
Halifax, Nova Scotia
Canada
B3S 1B3
Telephone
902.450.4000
Fax
902.450.2008

November 19, 2018

Derek Nawrot
Coordinator, Project Planning
Halifax Transit
P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5

Bus Rapid Transit (BRT) Study – Final Report

Dear Mr. Nawrot:

Dillon is pleased to submit the Final Report for the *Bus Rapid Transit (BRT) Study*.

The report includes an overview of the key elements of BRT, a description of our methodology and analysis, a summary of the stakeholder/public engagement program undertaken during the assignment, the conceptual design of a BRT network (including routings, station types and locations, transit priority measures, bus operations plan, technology components, and an approach for BRT identity and branding), capital and operating cost estimates, an implementation strategy, and potential future expansion of the initial BRT network.

We are grateful for the opportunity to have worked on this study and we hope that the findings will help shape the future of mobility in Halifax.

We appreciate the assistance that you and your colleagues at HRM provided our consulting team during the course of the project. We are available at your convenience to respond to any questions you may have.

Sincerely,

DILLON CONSULTING LIMITED

[redacted]

Bill Menzies, B. Comm., MBA
Project Manager

AML:jes
Our file: 17-5956-1000

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Appendices

Executive Summary

What is BRT?

Bus Rapid Transit (BRT) is a rubber-tired, rapid transit service that combines stations, vehicles, running ways, a flexible operating plan, technology and distinct identity into a high quality, customer-focused service that is fast, reliable, comfortable, and cost efficient. BRT can be implemented in various forms incorporating all or some of these features in various combinations.

BRT is most successful when applied in travel corridors that have high existing transit demand and in those that are expected to experience strong ridership growth in conjunction with planned intensification/transit-oriented development initiatives and increases in population and employment.

Methodological Approach

To identify potential candidate corridor segments for BRT, an analysis of existing transit ridership and a review of long-term forecasts of ridership patterns generated by HRM's transportation planning model were undertaken. Based on this analysis and review, a preliminary candidate list of high ridership "corridor segments" in the existing Halifax Transit network were identified.

Qualitative and quantitative criteria were then used to assess each candidate corridor segment on the following dimensions:

- Street Layout and Geometry (e.g., right-of-way width, number of travel lanes, intersection layouts, presence of on-street parking, sidewalks, cycling facilities, bus stops, etc.);
- Urban Context (e.g., connectivity, catchment areas, proximity to intensification areas, accessibility); and,
- Implementation Considerations (e.g., opportunity for coordination with other capital works, alignment with the Regional Plan, coordination requirements with the Province and the Halifax Harbour Bridges Authority).

Based on this evaluation, each of the candidate corridor segments was ranked with high, medium, or low potential for BRT. The results were then used to develop a preliminary network of BRT routes comprised of the highest ranked corridor segments. This network included:

- Four BRT routes serving high demand corridors and providing links to key destinations in Halifax and Dartmouth;
- Potential station locations spaced at intervals of 400 to 700 metres; and
- Potential transit priority measures (e.g., bus lanes, queue jumps, and transit signal priority).

This preliminary BRT plan was then put forward for comment and feedback during the stakeholder/ public engagement program. The engagement feedback was reviewed by the project team and used to prepare network options that addressed the identified issues. These options were then reviewed with Halifax Transit staff and a recommended conceptual BRT network was then developed.

Conceptual Design for BRT in HRM

The proposed BRT network will deliver daily high quality public transit featuring frequent service, well-appointed stops and stations at major destinations, transit priority measures to ensure fast reliable operations, state-of-the-art vehicles, and applications for real-time passenger information and operations management.

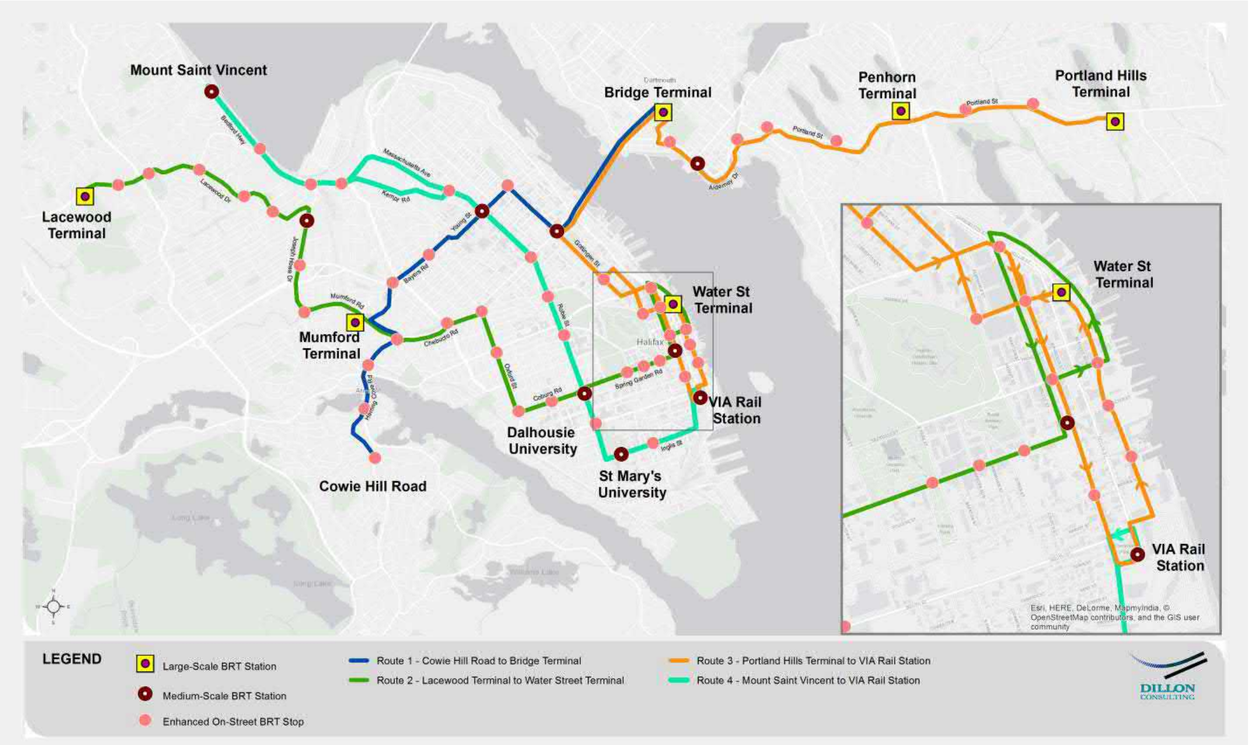
BRT Route Network

The recommended conceptual BRT route network is comprised of four routes:

Route	From	To	Via
1	Cowie Hill Road	Bridge Terminal	Chebucto Road – Mumford Terminal – Bayers Road – Young Street – Gottingen Street – Macdonald Bridge
2	Lacewood Terminal	Water Street Terminal	Lacewood Drive – Joseph Howe Drive – Mumford Terminal – Chebucto Road – Oxford Street – Coburg Road – Spring Garden Road – Downtown Halifax
3	Portland Hills Terminal	VIA Rail Station	Portland Street – Alderney Drive – Bridge Terminal – Macdonald Bridge – Gottingen Street – Downtown Halifax
4	Mount Saint Vincent	VIA Rail Station	Bedford Highway – Kempt Road/Massachusetts Avenue – Robie Street – Dalhousie/Saint Mary's University – Inglis Street

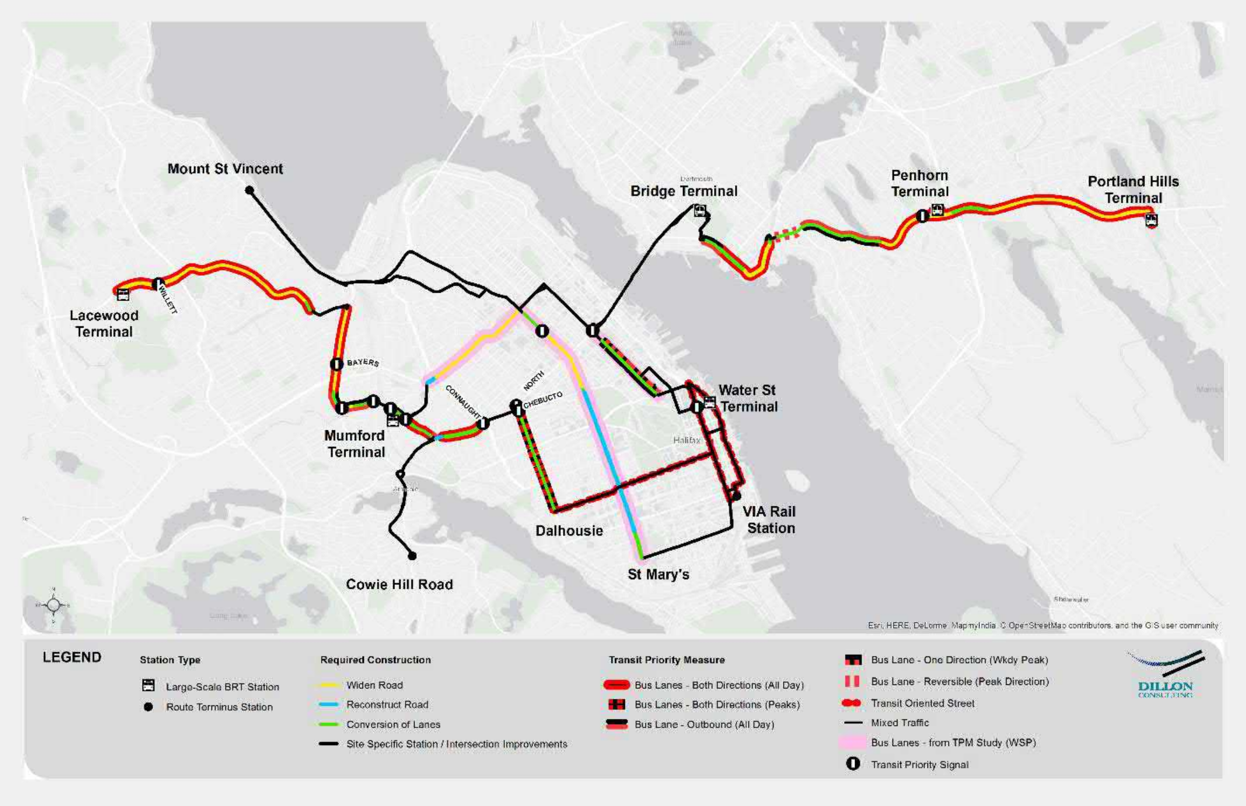
BRT Stations

Three different scales of station development are proposed: Enhanced On-Street Stop, Medium-Scale Station, and Large-Scale Station. The recommended BRT route network and station locations are illustrated in the following map.



Transit Priority Measures

For service reliability, a number of transit priority measures are proposed at several locations on the BRT network.



BRT Operating Plan

A key feature of BRT is frequent operation throughout the day on all days of the week, thus enabling spontaneous use by passengers without the need to consult published schedules during peak periods. Service on the BRT routes is proposed to operate throughout the day on all days of the week at the following frequencies:

Schedule Type	Time Period	Headway (minutes)
Weekday	05:30 – 07:00	30
	07:00 – 22:00	10
	22:00 – 01:00	20
Saturday	05:30 – 08:00	30
	08:00 – 22:00	10
	22:00 – 01:00	20
Sunday/Holiday	06:30 – 09:00	30
	09:00 – 18:00	10
	18:00 – 01:00	30

BRT Technology

Halifax Transit's comprehensive suite of technology-enabled features are to be extended to BRT service, including:

- On-Board Systems: Automated Vehicle Location (AVL), Next Stop Announcements/Displays, Video/Audio Surveillance System, and Automatic Passenger Counters;
- Passenger Information Systems: Real-Time Information Displays, web and mobile Traveller Information Systems; and
- Automated Fare Collection System (in development) for fare payment by smart card and/or mobile devices.

BRT Identity

BRT will form a new service type, complementary to and integrated with the overall transit network. An effective branding strategy is required that creates a coordinated visual identity for each of BRT and the other service types.

Costs and Implementation

As the system proposed for HRM is "in-street" BRT (i.e., within an existing street right-of-way, as opposed to a separate corridor within a transit, rail, hydro, or green field right-of-way), it is recommended that service on the BRT routes be implemented as early as possible. This will make the prime attributes of BRT (comfortable fast travel at frequent intervals throughout the day) available to the public, enabling ridership levels to build quickly. Key investments in stations and transit priority infrastructure can be added at opportune times to enhance these attributes, in combination with other major capital works and/or when funding is made available.

The scale and timing of investments for BRT and the annual operational costs depend on the approach taken for implementation. In this respect, BRT provides a great deal of flexibility. The report includes key steps to develop a BRT implementation plan. From that plan, an estimate and schedule of capital costs and bus operations costs can be developed based on cost indices included in the report for each BRT element.

1.0 Introduction and Background

Dillon Consulting Limited (Dillon), in association with Harbourside Transportation Consultants (HTC), was retained by the Halifax Regional Municipality (HRM) to conduct a Bus Rapid Transit Study that included transportation planning, conceptual design, and engagement services.

HRM recently adopted an *Integrated Mobility Plan (IMP)* to encourage a broader choice of urban mobility options focused on public transit, active transportation, ridesharing, and newly-developing sustainable services. One of the objectives of the IMP is to implement a sustainable transportation strategy by providing a choice of integrated and connected travel options. This includes the study of Bus Rapid Transit as a high-order mode of transportation.

In April 2016, Regional Council approved the Halifax Transit *Moving Forward Together Plan* (MFTP) which includes a phased implementation of a revised transit network, of new and upgraded transit infrastructure (e.g., passenger amenities, transit terminals, park and ride lots, garage expansions), and of transit priority measures to increase operating speeds and improve service reliability. One of the four core principles of the plan is to increase priority for transit vehicles in the transportation network. The MFTP further states that the Corridor Routes described in the plan are potential candidates for future Bus Rapid Transit (BRT) corridors.

A key element of this policy thrust to transition to a more sustainable future is the development of a Bus Rapid Transit (BRT) network in the HRM. Characteristic features of BRT include:

- Prioritized running ways (in separated rights-of-way or within street rights-of-way customized with transit priority measures) to provide reliable service and competitive travel times;
- High-quality stations, spaced at lengthier intervals than for conventional services, fully integrated with other modes and surrounding development, and featuring amenities for safe, comfortable, and accessible passenger use;
- Modern, accessible, comfortable vehicles;
- Intelligent Transportation System (ITS) technology to furnish real-time information to passengers prior to and during travel, and to provide safety and security systems;
- Flexible operating plans that enable service designs to be tailored to travel patterns;
- Prominent service branding; and
- Fare policy and technology integrated with the overall transit system.

BRT can be implemented in various forms incorporating all or some of these features in various combinations. In Canada, fully-featured BRT applications in separated rights-of-way have been implemented in Ottawa, Gatineau, Mississauga, and Winnipeg. Examples of "In-Street” BRT (i.e., within an existing street right-of-way, as opposed to a separate corridor within a transit, rail, hydro, or green field right-of-way) include those in Quebec City, York Region, Calgary, and Vancouver with several more planned in these and other jurisdictions.

BRT is most successful when applied in existing travel corridors that have high transit demand. In this respect, BRT is very consistent with core principles that guided the development of the *MFTP* (e.g., increasing the proportion of resources allocated towards high ridership services; invest in service quality and reliability; give transit increased priority in the transportation network).

2.0 Report Organization

The remainder of this report is organized as follows:

- **Section 3.0** outlines the **project objective and approach** used for the study;
- **Section 4.0** discusses the **key elements of BRT**;
- **Section 5.0** outlines the **methodology** used to identify and evaluate candidate corridors for the application of BRT;
- **Section 6.0** describes a **proposed network of four BRT routes** that was presented to HRM staff, project stakeholders, and the public for discussion and comment through a **public engagement program** for the study;
- **Section 7.0** provides a summary of the **feedback received on the proposed BRT network** during the public engagement program;
- **Section 8.0** outlines the **conceptual design for the recommended BRT network**, including routings, station types and locations, transit priority measures, service levels, technology components, and a branding strategy;
- **Section 9.0** provides estimated **costs for the conceptual network**, including infrastructure and operating resource requirements of bus hours and vehicles;
- **Section 10.0** outlines an **implementation strategy** to develop the BRT network in the Halifax Regional Municipality; and,
- **Section 11.0** illustrates areas in the HRM where **BRT could potentially be expanded** beyond the initial network in the future.

3.0 Project Objective and Approach

The primary objective of the assignment was the development of a conceptual plan for Bus Rapid Transit in the HRM. The work plan included:

1. A review of industry best practice;
2. An analysis of existing and expected transit demand in the region;
3. The identification of candidate BRT corridor segments;
4. An assessment of the candidate corridor segments across a comprehensive set of criteria within the categories of transit demand, street layout/geometry, urban context, and implementation considerations;
5. The preparation of a preliminary conceptual BRT plan to garner feedback through an engagement process involving HRM staff, stakeholders, and the public;
6. The development of a recommended conceptual BRT plan, incorporating feedback from the engagement process, that includes:
    - BRT route network and alignments;
    - Station types and locations;
    - Service levels;
    - Vehicle types;
    - Estimated resource requirements (bus hours, number of vehicles);
    - Estimated capital and operating costs; and
    - An implementation strategy for the development of the BRT network.
7. The preparation of a project report for use by HRM during subsequent planning and development of BRT in the region.

4.0 Elements of BRT

Bus Rapid Transit is a rubber-tired, rapid transit service that combines stations, vehicles, running ways, a flexible operating plan, technology and distinct identify into a high quality, customer-focused service that is fast, reliable, comfortable, and cost efficient.

A major attribute of BRT is that it can be customized to the local context. Typical examples include:

- Where there is sufficient space in existing rights-of-way, buses can operate in reserved lanes to bypass traffic, but can share lanes with other traffic where traffic congestion is less severe;
- Stations can be integrated with existing major focal points in the region, such as shopping centres, post-secondary institutions, and transit terminals;
- BRT service can be operated by a new dedicated fleet or by buses in the existing fleet; and
- Information technology investments already implemented across the transit network (e.g., real-time passenger information) can be applied seamlessly to BRT service.

At the start of the project, Dillon conducted a workshop with HRM staff from the transit, transportation planning, transportation infrastructure, urban planning, urban design, and real estate functions of the organization to provide an overview of BRT, to show examples of best practice in Canadian and international jurisdictions, to illustrate each of the fundamental elements of BRT, and to discuss potential application of these features in the HRM context. The workshop focused on the following elements of BRT:

1. Stations
2. Vehicles
3. Running Way
4. Operating Plan
5. Technology
6. Image and Identity

A brief description of each of these elements is provided below. The complete workshop contents are contained in **Appendix A**.

4.1 Stations

BRT stations provide a central focus for the BRT network; where transit activity takes place and where passengers interact with the service. To increase average operating speeds, BRT stations are typically spaced between 500 m to 1.5 km apart, which is typically longer than stop spacing for conventional transit routes. It is also generally understood that people are willing to walk further to a rapid transit station than they would for local transit services.

Stations are usually weather protected and include more permanent infrastructure compared to the traditional flag on a pole. Stations provide information and amenities for transit customers and offer a measure of safety and security to the user. The station design, including architecture and graphic arts, can play a role in the service's identity and image. BRT stations are typically designed for modal integration and make for easy connections amongst pedestrians, cyclists, transit users, and park/kiss and ride users.

4.2 Vehicles

BRT routes often feature low floor vehicles to facilitate accessibility for all users. Multiple doors and all door boarding policies can be used to minimize passenger congestion and shorten vehicle dwell times at stations. Interiors are comfortable (high quality seats, air conditioning) and can include amenities that may not be found on a conventional bus (such as Wi-Fi). Information is provided to passengers inside and outside of the bus, detailing route destination, next stop and arrival times.

High capacity vehicles (articulated, double decker) are often used on BRT networks. BRT routes usually accommodate the highest peak period transit demand, and using high capacity vehicles on these routes improves the route capacity and service efficiency. Articulated buses are beneficial for routes that have high boarding/alighting levels throughout the route, with multiple doors to minimize station dwell times, and with sufficient standing room for passenger circulation. Double decker buses are beneficial for longer journeys, as there are fewer doors, more seats but less standing room, and upper deck passengers are required to use stairs; all potentially increasing vehicle dwell times at stations.

With its distinct image, BRT provides an opportunity to showcase the latest in vehicle technology including innovations in vehicle propulsion, safety features, passenger amenities and design.

4.3 Running Way

A BRT running way can be provided with varying levels of exclusivity. A fully exclusive facility includes a running way that is separate from vehicular traffic with grade separations where the facility crosses roadways and railways. BRT service operates independently from the road network and is not impacted by traffic congestion. It is possible to operate a similar exclusive facility but with at-grade intersections.

On the street network, transit exclusivity can be provided by designating bus-only lanes on roadways. This enables buses to travel through the street system faster and more reliably than bus operations in mixed traffic. In these situations, however, buses are required to interact with vehicle traffic making turns to access intersecting streets.

While bus lanes can be used throughout the day, they are often designated for weekday peak period use only, allowing the lanes to be used for parking or for general traffic during off-peak periods.

Bus lanes can be positioned in the curb lane or, if sufficient right-of-way is available, within a street median. They can be located throughout the full length of a BRT corridor or more selectively where there is available space and/or significant traffic congestion. For example, short bus lanes can be positioned immediately upstream of an intersection and combined with transit signal priority and a downstream receiving lane to enable buses to efficiently bypass traffic queues.

BRT services can be operated in mixed traffic in areas where traffic congestion is not severe. BRT is often initially implemented in mixed traffic, with exclusivity added later in conjunction with other road and municipal works.

4.4 Operating Plan

As its vehicles can operate both in exclusive facilities and in the regular street system, very flexible operating plans can be deployed for BRT.

For example, all stops can be served by a BRT route throughout the day; skip-stop operation can be used where appropriate; short-turns can be utilized to provide higher frequencies on sections of the route with higher demand; and service levels can be customized for peak and off-peak directions.

A local arterial/feeder service can be provided and coordinated with the BRT service, but it is also possible to operate "express routes" that serve neighborhoods and then join the BRT network, thus making use of transit priority measures and stations along the BRT running way.

Service on BRT routes is sufficiently frequent to enable passengers to travel spontaneously without the need to consult schedules. Maximum headways of 10 to 15 minutes are commonly operated on BRT during the day and early evening, and at 20 to 30 minute intervals early in the morning and late at night.

4.5 Technology

The effective deployment of Intelligent Transportation Systems (ITS) provides convenience for passengers, improves safety for passengers and bus operations, and allows for faster and more reliable transit service. These technologies include automatic vehicle location (AVL), transit signal priority, real-time passenger information systems, on-board video surveillance systems, automatic passenger counting (APC), and automated fare collection (AFC).

While these technologies are usually integrated across the complete transit system to enable seamless travel by passengers, certain elements (e.g., real-time electronic bus departure displays, transit signal priority) are often prioritized for BRT routes.

4.6 Image and Identity

BRT provides a higher-order service within a transit network. To distinguish it from other service types, a unique identity for BRT is commonly established.

This is achieved through such techniques as the use of purpose built or articulated BRT vehicles, a distinct route identification system (using a designated route number series and/or colours), and a branding strategy applied to BRT infrastructure and information materials.

While BRT buses can be branded, this can impose restrictions on service scheduling and can increase overall fleet requirements. Restricting branded buses to BRT routes reduces opportunities to interline BRT vehicles with other service types. A separate BRT fleet usually includes spare BRT buses that are separate from spares used for the conventional fleet.

5.0 Methodology and Analysis

5.1 Identification of Candidate BRT Corridors

BRT is most successful when applied in travel corridors that have high existing transit demand and in those that are expected to experience strong ridership growth in conjunction with planned intensification/transit-oriented development initiatives and increases in population and employment.

To identify potential candidate corridor segments for BRT, an analysis of existing transit ridership and a review of long-term forecasts of ridership patterns generated by HRM's transportation planning model were undertaken.

To gain an understanding of existing ridership patterns, a dataset of boarding/alighting counts by route, direction, trip, and stop was analyzed for all weekday service in Halifax Transit's Fall 2016 schedule.

Average boarding/alighting counts for each stop and average passenger loads on each stop-to-stop link were calculated for each trip on each route. This data was then analyzed at the route level and at the system level (i.e., all routes) for each of the AM Peak, Midday, PM Peak, Evening, Late Night, and All Day time periods.

Maps of passenger load profiles and boarding/alighting activity at bus stops were generated from the analyzed data to identify those corridors that currently have the highest transit demand in the region.

Figure 1 and **Figure 2** illustrate these existing all day ridership patterns on weekdays. Note that the attributes shown in the vertical dimension are proportional to the volume of the attributes. In **Figure 1,** for example, passenger load volumes are illustrated vertically and with colour grading to distinguish various volume levels. In **Figure 2**, alightings (shown in red) and boardings (shown in blue) are vertically stacked to show the total volume of passenger activity at each bus stop.

Figure 1: Existing All Day Passenger Load Profile (Weekdays – Fall 2016)

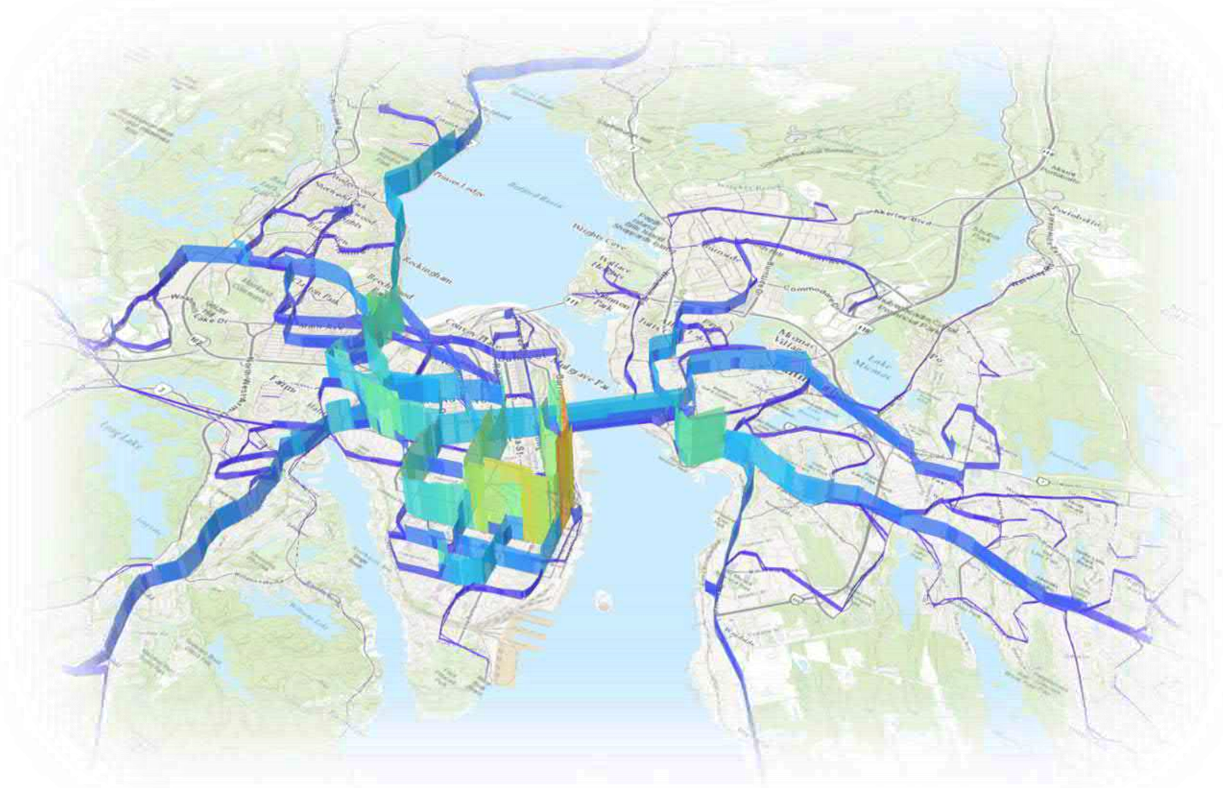
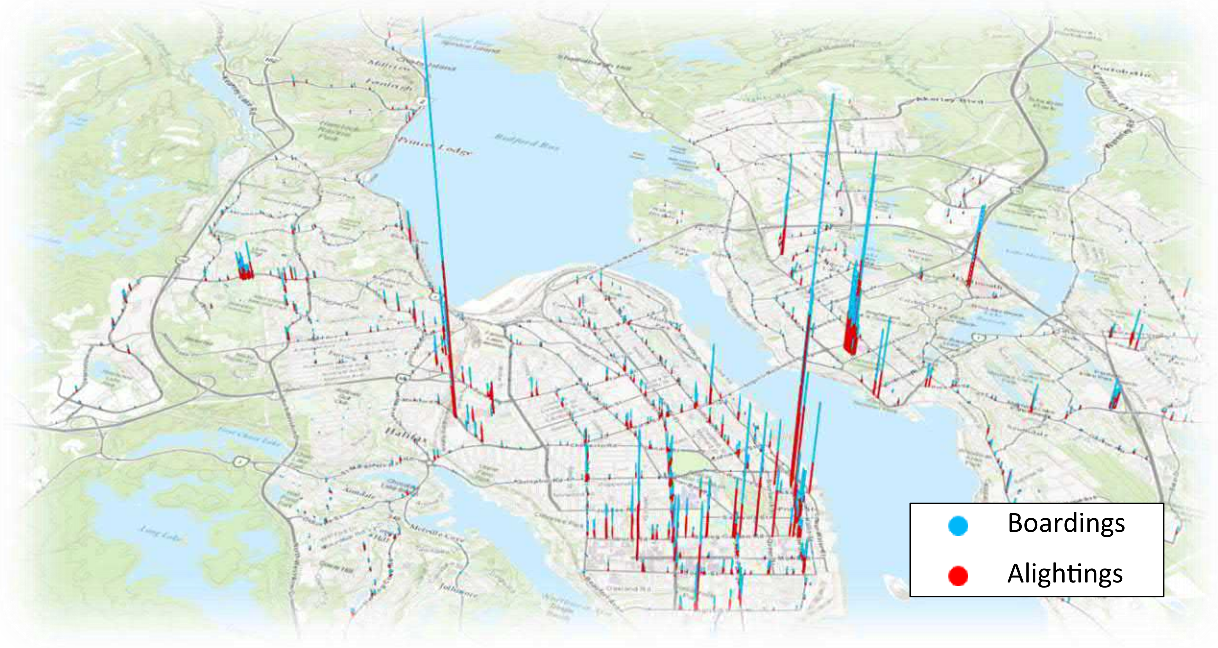


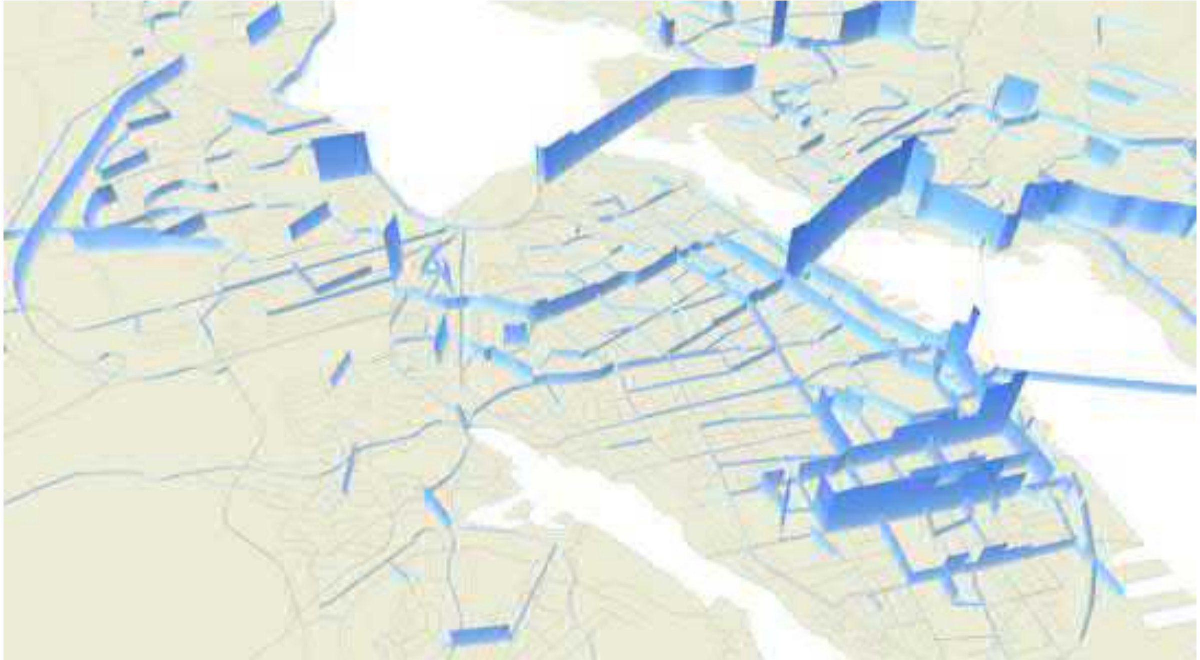
Figure 2: Existing All Day Boarding/Alighting Activity at Bus Stops (Weekdays - Fall 2016)



A comprehensive set of maps at more disaggregate levels (by time period, by inbound/outbound direction, by route, etc.), contained in **Appendix B**, were generated and examined to gain a thorough understanding of the existing transit demand patterns.

A review of anticipated future transit ridership patterns as forecast by HRM's regional transportation model was undertaken to identify corridors in which significant growth is expected. Existing and future models were used to identify estimated growth in travel demand in key corridors. The travel demand model is based on peak hour travel demand. The future 2031 transit ridership forecast is presented in **Figure 3.**

Figure 3: 2031 PM Peak Hour Transit Person Trips



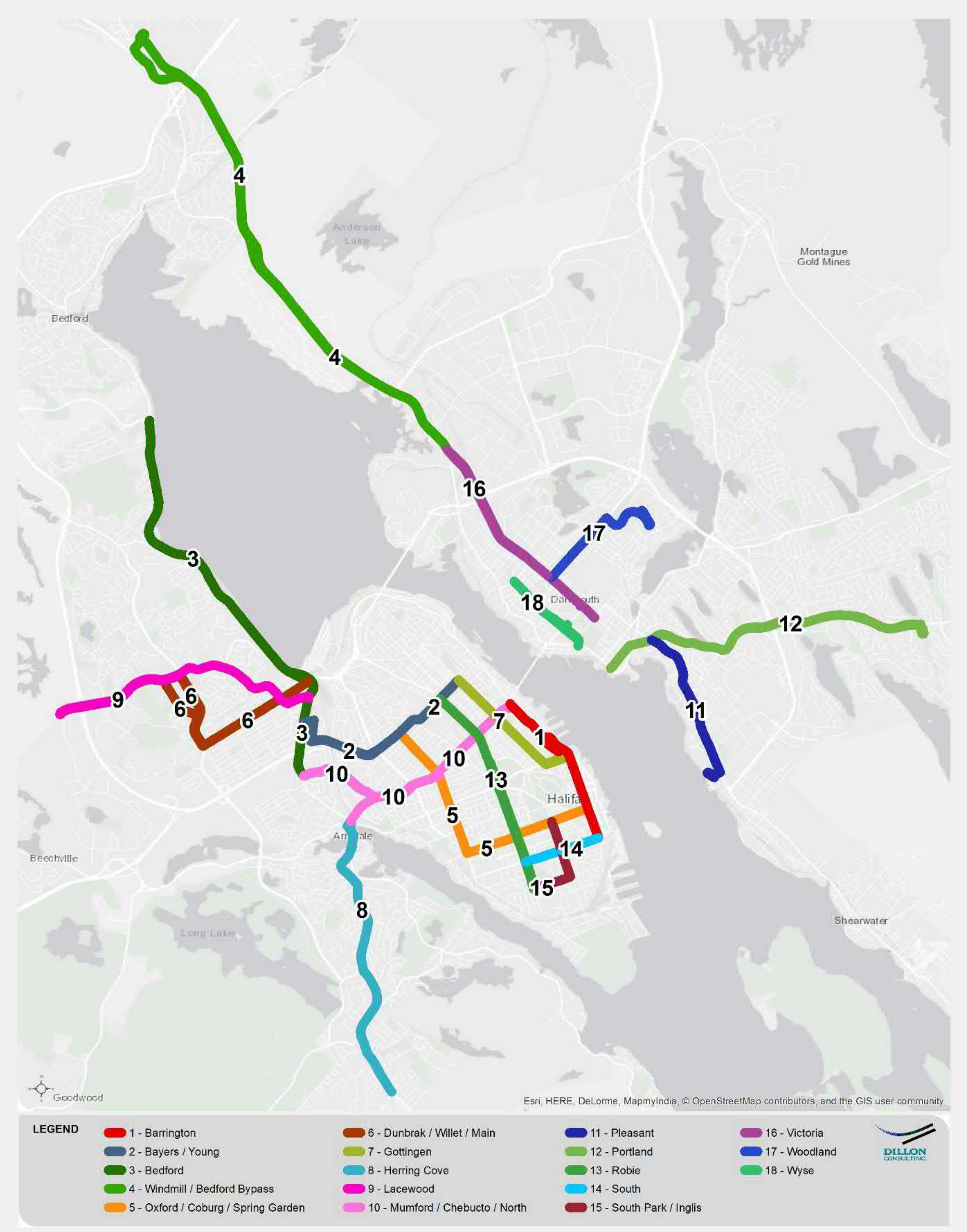
Based on this analysis and review, a preliminary candidate list of high ridership "corridor segments" in the existing Halifax Transit network were identified. These corridor segments are listed in **Table 1** and shown in **Figure 4**.

Table 1: Preliminary Candidate Corridor Segments

#	Corridor Segment Name	From	To
1	Barrington St.	North St.	South St.
2	Bayers Rd. – Young St.	Joseph Howe Dr.	Gottingen St.
3	Bedford Highway – Joseph Howe Dr.	Larry Uteck Blvd	Mumford Rd.
4	Windmill Rd – Bedford Bypass	Sackville	Victoria Rd.
5	Oxford St. – Coburg St. – Spring Garden Rd.	Bayers Rd.	Barrington St.
6	Dunbrack St. – Willet St. – Main Ave.	Lacewood Dr.	Bedford Highway
7	Gottingen St.	Young St.	Cogswell St.
8	Herring Cove Rd.	Greystone Dr.	Chebucto Rd.

#	Corridor Segment Name	From	To
9	Lacewood Dr.	Lacewood Terminal	Joseph Howe Dr.
10	Mumford Rd. – Chebucto Rd. – North St.	Joseph Howe Dr.	Barrington St.
11	Pleasant St.	Woodside Ferry Terminal	Portland St.
12	Portland St.	Portland Hills Terminal	Alderney Dr. & Portland St. (southern intersection)
13	Robie St.	Young St.	Inglis St.
14	South St.	Robie St.	Barrington St.
15	South Park St. – Inglis St.	Spring Garden Rd.	Robie St.
16	Victoria Rd.	Windmill Rd.	Bridge Terminal
17	Woodland Ave.	Mic Mac Terminal	Victoria Rd.
18	Wyse Rd.	Albro Lake Rd.	Windmill Rd.

Figure 4: Preliminary Candidate Corridor Segments



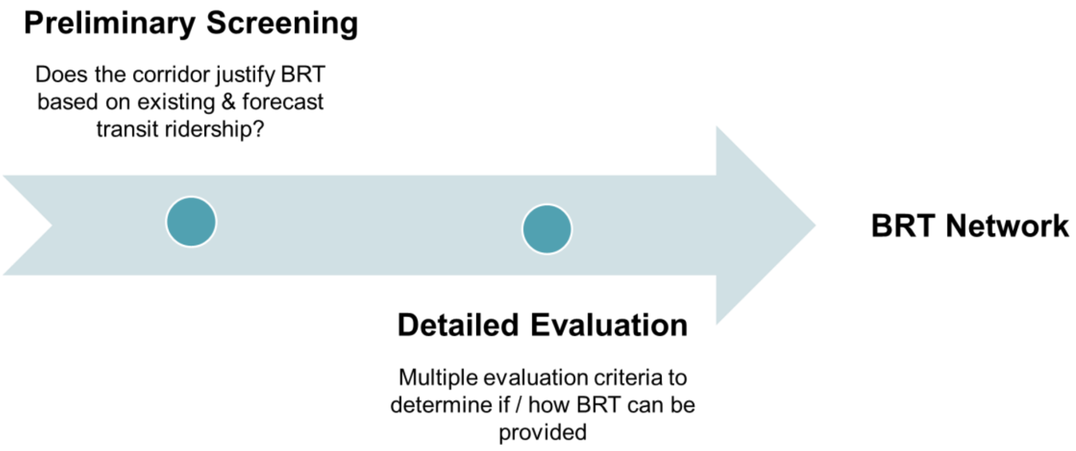
5.2 Evaluation of Candidate BRT Corridor Segments

5.2.1 Approach

A two-stage evaluation approach, illustrated in **Figure 5**, was used to assess the candidate corridors identified above:

1. A preliminary screening involved a further detailed analysis of the temporal and spatial nature of transit demand in each candidate corridor segment; and
2. The highest ranking candidate corridor segments were then assessed on a number of other dimensions to assess their capacity to accommodate BRT infrastructure and service levels, and to integrate BRT with the existing and planned urban context within the region.

Figure 5: Approach for Evaluation of Candidate BRT Corridors



Preliminary Screening

Does the corridor justify BRT based on existing & forecast transit ridership?

BRT Network

Detailed Evaluation

Multiple evaluation criteria to determine if / how BRT can be provided

5.2.2 Evaluation Criteria

5.2.2.1 Preliminary Screening Criteria

For each candidate corridor segment, the following indicators of existing ridership were calculated:

1. Total weekday passenger load volume on the busiest stop-to-stop link (Max Link Load – All Day);
2. Average weekday passenger load volume across all stop-to-stop links (Average Link Load – All Day);
3. Total weekday boarding/alighting activity at all bus stops (Total Stop Activity – All Day); and
4. Total AM Peak passenger load volume on the busiest stop-to-stop link (Max Link Load – AM Peak).

These indicators measured transit demand from two perspectives:

- Items 1, 2, and 4 provided indicators of **passenger loading patterns** within each candidate corridor segment; and
- Item 3 provided a measure of the **total transit demand** within each candidate corridor segment.

Note that patterns of passenger load volumes between stops are not inherently associated with the patterns of boarding/alighting at stops along a corridor segment:

> *e.g., While a corridor segment on which only express routes operate may have similar passenger loads between stops as a corridor segment on which non-express routes operate, the express corridor will have boarding/activity at only a few stops, while the non-express corridor will have activity at many stops.*

In this way, corridor segments with similar stop-to-stop passenger load volumes may have very different distributions of stop activity at stops along their alignments. Consequently, it is important to measure each of these aspects of ridership demand.

For each candidate corridor segment, the stop-to-stop passenger load volume and stop activity indicators were rounded to the nearest 50 and scored as shown in **Table 2**.

Table 2: Evaluation of Transit Demand

Indicator	Description	High (Rank = 1)	Medium (Rank = 2)	Low (Rank = 3)
Max Link Load (All Day)	Total weekday passenger load volume on the busiest part of the segment (in the peak direction)	**> 4,000**	**2,500 - 4,000**	**<2,500**
Average Link Load (All Day)	Average weekday passenger load volume between stops (both directions)	**>2,000**	**1,000 - 2,000**	**<1,000**
Total Stop Activity (All Day)	Total weekday boarding/alighting activity at all bus stops (both directions)	**>12,500**	**5,000 - 12,500**	**<5,000**
Max Link Load (AM Peak)	Total passenger load volume on the busiest part of the segment during the AM Peak (in the peak direction)	**>1,000**	**500 - 1,000**	**<500**

Following this preliminary ranking of transit demand in the candidate corridor segments, travel forecasts from HRM's regional transportation model were reviewed. HRM's VISUM model provides forecasts over a 20-year planning horizon to 2031. Growth in total travel demand and, in particular, corridors with high growth were identified. Average annual growth rates in transit demand were estimated for each of the indicators for each of the corridor segments, and the rankings were then updated.

5.2.2.2 Detailed Evaluation Criteria

Both qualitative and quantitative criteria were used to assess each candidate corridor segment carried forward from the Preliminary Screening.

For each category of criteria (outlined below), qualitative assessments of each corridor segment were made. Ratings take the form of "high/medium/low potential" or "easier/moderate/difficult to implement", for example.

These ratings were used to assess the potential to apply elements of BRT in each of the corridor segments and to identify how the corridor segments might be combined to form a BRT route network.

The components of the Detailed Evaluation were as follows:

Street Layout and Geometry

The following features of each corridor segment were documented:

- Right of Way (ROW) width (between intersections and at intersections);
- Proportion of corridor segment that contains a median;
- Number of travel lanes by direction;
- Presence of on-street parking by direction;
- Number of signalized intersections;
- Number of pedestrian crossings;
- Boulevard, sidewalk and streetscaping conditions; and
- Bus stop locations and configurations.

Street layout features, such as the number of lanes (typical, maximum, and minimum), the presence of parking, and the presence of traffic and pedestrian signals provide an indication of whether BRT infrastructure might fit within the public right-of-way. The presence of sidewalks/streetscaping and the configuration of existing bus stops assist in the identification of potential BRT stations.

Based on this information, each corridor segment's capacity to accommodate each of the following BRT elements was assessed:

- Running Ways (transit-only street, curbside reserved lanes, median reserved lanes, general purpose lanes, etc.);
- Intersection Treatments (transit signal priority, queue jumps, bypass lanes, etc.); and
- Stops/Stations (e.g., locations, scale of amenities, etc.).

Urban Context

The urban context of each candidate corridor segment was reviewed to determine BRT's compatibility with existing and planned urban development, to identify any major constraints, and to ascertain the scale of BRT investment that might be possible.

As shown in **Table 3**, different types of Urban Context factors were included in the evaluation.

Table 3: Urban Context Criteria

Type	Criterion	Comments
Connectivity	1. Number of dwelling units located within 600 m and within 700 m walking distance of corridor segment	Used to measure residential catchment area
	2. Number of "destinations" or "attractions" served by the corridor segment	Includes such major activity centres as educational institutions, hospitals, shopping centres, recreation centres, libraries, etc.
	3. Number of connections to the planned MFTP transit route network	Used to measure integration with the regular route network
	4. Number of connections to existing and planned active transportation facilities	Used to measure opportunities for integrated mobility
Visibility	5. Potential for BRT to shape urban environment	Does the corridor support planned intensification initiatives envisioned in HRM's

Type	Criterion	Comments
		approved or planned policy documents (e.g. Regional Plan, Centre Plan)?
	6. Prominence of transit Infrastructure	Does the corridor have potential to encourage, enhance and promote transit?
	7. Potential to serve active pedestrian areas	Can BRT stations be fully integrated in major visible locations or would they be isolated?
Accessibility	8. Ease of pedestrian access	Used as indicator of accessibility for persons dependent on public transit for their travel

Implementation Considerations

Each candidate corridor segment was reviewed to identify:

- Potential opportunities to coordinate BRT with other capital projects, such as transit priority measures planned for the Halifax Peninsula, major transit terminal redevelopment projects, and major road/underground utilities works. Planned major initiatives are listed in **Table 4**;
- Alignment with the Regional Plan, including policies and vision for the downtown, centre area, major corridors, and future growth nodes. Such areas along the candidate corridor segments are listed in
- **Table** 5; and
- Requirements to obtain approvals from Province of Nova Scotia, Government of Canada, or the Halifax Harbour Bridges Authority. Existing roadway ownerships by these entities are shown in **Figure 6**.

Table 4: Major Planning and Infrastructure Projects

Major Projects	
Minimum Cycling Grid[1]	Highway 102 Shoulder Bus Lanes
Mumford Terminal Replacement	Woodside Ferry Terminal Upgrades
Young Street Transit Priority Corridor	Windsor Exchange Redesign
MacKay Bridge Redecking	Burnside Connector
Cogswell Redevelopment	Transit Terminal Upgrades (e.g., Cobequid, Penhorn)
Spring Garden Road – Streetscaping	Commuter Rail
Macdonald Bridge Cycling Improvements[2]	Herring Cove Widening Functional Design Study
Bayers Road Transit Priority Corridor	Sawmill River Daylighting
Robie Street Transit Priority Corridor	New Hospital Outpatient - Bayers Lake

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[1] Includes the following Cycling Corridors: North, Barrington, Brunswick, Creighton/Maynard, Cogswell, Bayers, South Park, Robie (South), University, Wyse, Alderney, Dartmouth Waterfront

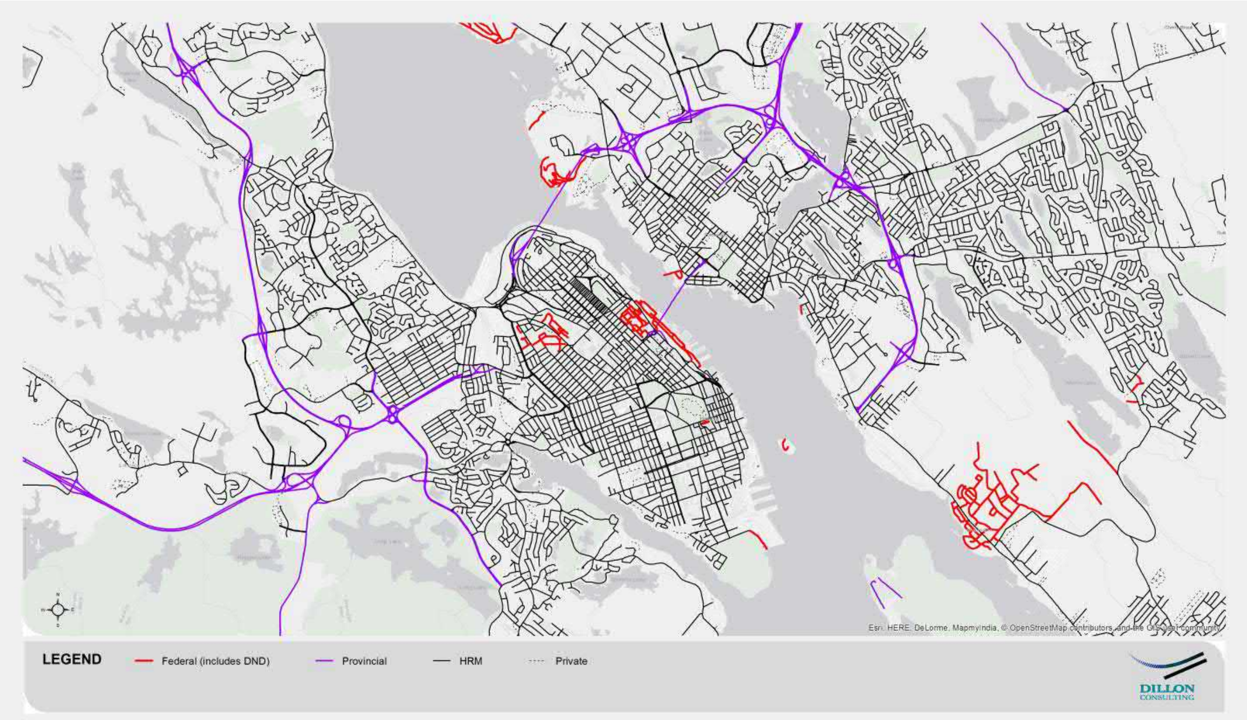
[2] Includes reconstruction of North/Gottingen intersection, which will allow buses to make a westbound left turn onto Gottingen (not currently possible); removes bus bay on North immediately west of the bridge

Major Projects	
Gottingen Street Transit Priority Corridor	Chebucto/Windsor/Cunard - Int. Rebuild

Table 5: Alignment with Regional Plan

Regional Plan Designation	Areas Included	
	Halifax	Dartmouth
Downtown	Downtown Halifax	Downtown Dartmouth
Centre Plan	Quinpool Road Spring Garden Road Young Street Gottingen Street	Wyse Road
Corridors	Bayers Road Oxford Street Chebucto Road Agricola Street Young Street Gottingen Street Cunard Street Robie Street Inglis Street	Victoria Road Pleasant Street Portland Street Prince Albert Road
Future Growth Nodes	Mumford Terminal Area Joseph Howe Superstore Area	Highfield Park Penhorn Mall Mic Mac Mall Shannon Park

Figure 6: Roadway Ownership



5.2.3 Evaluation Results

5.2.3.1 Transit Demand in Candidate Corridor Segments

Based on existing ridership patterns and on anticipated ridership growth rates, **Table 6** classifies each of the candidate corridor segments into one of High, Medium, and Low priority categories.

Table 6: Priority Rating for Candidate Corridor Segments Based on Transit Demand

Priority Rating	#	Corridor Segment	Max Link Load (All Day)	Avg. Link Load (All Day)	Total Stop Activity (All Day)	Max Link Load (AM Peak)	Annual Ridership Growth
High Priority	1	Barrington	5,100	3,000	28,550	1,950	+5%
	3	Bedford	1,800	1,150	13,300	900	-3%
	5	Oxford/Coburg/Spring Garden	4,100	2,300	44,650	1,000	+2%
	9	Lacewood	2,000	550	14,900	400	+7%
	10	Mumford Chebucto/North	2,750	1,250	26,550	1,050	+2%
	12	Portland	2,800	700	6,150	1,050	+2%
	13	Robie	3,350	2,050	17,800	1,150	0%
Medium Priority	2	Bayers/Young	2,500	1,550	8,500	650	+10%
	7	Gottingen	3,750	1,200	5,050	900	+4%
	8	Herring Cove	1,400	750	6,600	500	+3%
	14	South	1,200	1,000	1,900	250	0%
	15	South-Park/Inglis	2,200	1,400	10,550	500	+1%
	6	Dunbrack/Willet/Main	1,950	300	6,150	550	+1%
Low Priority	11	Pleasant	1,400	800	2,100	350	+2%
	17	Woodland	1,150	800	2,100	300	+1%
	18	Wyse	1,450	950	3,100	450	+2%
	16	Victoria	1,350	700	1,550	500	+2%
	4	Windmill/Bedford Bypass	1,650	500	650	800	+2%

When the ridership growth rates forecast by the Region's transportation planning model were applied, the analysis showed that, in the longer term, the priority rating for five of the corridors can be eventually upgraded as shown in **Table 7**.

Table 7: Future Upgrade of Priority Rating Based on Forecast Ridership Growth Rates

From	To	#	Corridor Segment
Medium Priority	**High Priority**	2	Bayers – Young
		7	Gottingen
Low Priority	**Medium Priority**	11	Pleasant
		17	Woodland
		18	Wyse

5.2.3.2 Detailed Evaluation Results

Street Layout and Geometry

Characteristics of each of the corridor segments, including right-of-way width, the number of lanes (typical, maximum, and minimum), sidewalks, boulevards, landscaped medians, sidewalks, bus stops, loading zones, on-street parking, private approaches, etc. were reviewed to identify opportunities for potential implementation of physical BRT infrastructure (i.e., bus lanes, queue jumps, stations). Typical conditions providing such opportunities are listed in **Table 8**.

Table 8: Typical Conditions for Potential Installation of BRT Infrastructure

BRT Infrastructure Element	Opportunities
Exclusive Running Way	Sufficient right-of-way width to add bus lane Conversion of existing on-street parking lane to a bus lane Reduce width of existing traffic lanes, boulevards, and medians to create a bus lane
Queue Jump	Utilize existing right-turn lane for transit queue jump Reduce width of corner median near-side of intersection to create space for queue jump Site-specific street widening near-side (for short queue jump lane) and far-side (for bus receiving lane) of intersections
Station	Utilization of existing wide sidewalks Conversion of unused boulevard space Extension of sidewalks and bus stop platforms into existing parking/curb lane

An inventory of existing street characteristics for each candidate corridor segment is shown in **Table 9**. Following that, **Table 10** summarizes the assessment of each candidate corridor segment's potential to accommodate BRT infrastructure elements (exclusive bus lanes, queue jumps at intersections, and stations that offer a high standard of amenities).

Bus lanes and/or queue jumps can be implemented **within the Halifax peninsula** on streets that have more than one travel lane in each direction, on streets with curb lane parking, and on streets that can be reconfigured to accommodate an additional lane. For example, Oxford Street and Robie Street are high demand corridor segments that could accommodate bus lanes through the prohibition of on-street parking (weekday peak periods or all day) or through the conversion of an existing general traffic lane to transit use.

Some **arterial streets that extend to suburban areas** from the Halifax peninsula or from downtown Dartmouth (e.g., Lacewood Drive, Herring Cove Road, Portland Street) have at least two lanes in each direction, wide boulevards, and wide medians. Some reallocation of these spaces and/or street widenings can potentially accommodate the implementation of bus lanes, queue jumps and high quality stations.

Within downtown Halifax, initiatives to transition key rights-of-way into "transit-oriented streets" or "complete streets" can be an important part of BRT development. Within busy downtowns, it is common for service reliability to have a higher priority than bus operating speeds. It is important, therefore, that a street's geometry permit consistent, predictable, and reliable bus operation between bus stops with minimal delays. Such "transit-oriented streets" are characterized by:

- A single through lane of traffic in each direction (can be mixed traffic, or restricted to buses and cyclists only);
- The extension of bus stop platforms into the existing curb lane to meet the through traffic lane;
- The installation of amenities on the widened bus stop platforms (e.g., heated shelters, station identification signs, electronic variable message signs, benches, re-cycling receptacles, landscaping, etc.);
- The designation of those sections of the former curb lane located between bus stop platforms to “all day” on-street parking or loading zones;
- A high level of streetscaping (e.g., landscaping, street furniture, pedestrian-scale lighting, etc.) along the length of the street;
- Separate cycling paths where space permits;
- Traffic signal timing strategies (e.g., double-cycling) that provide relatively short red phases, thereby providing frequent opportunities for buses to travel through signalized intersections.

For transit service, these arrangements permit buses to operate in a “straight line” in the through lane without any need to weave in and out of bus stops. The widened bus stop platforms provide space for amenities and weather-protection for waiting passengers. In sections of the street where there is a high concentration of retail stores, the recessed parking/loading areas between bus stops provide access for customers and suppliers for those businesses. The streetscaping can create a new identity or reinforce an existing one along the street.

In those sections of a “transit-oriented street” for which there are alternative routes for other traffic and for which the need for vehicular access to adjacent businesses is not high, consideration can be given to converting such sections into a transit mall (i.e., restricted to buses and cyclists).

This approach for “transit oriented streets” has been used successfully in several cities. Examples include the Graham Mall (see photo at right) and Portage Avenue in Winnipeg, Albert Street and Slater Street in Ottawa, and transit malls in Vancouver, Minneapolis, and Denver.

Within downtown Halifax, initiatives to introduce “transit-oriented” features on Barrington Street, Spring Garden Road (currently underway), and Lower Water Street can be integral components of the BRT network in HRM.

Table 9: Existing Street Characteristics

#	Corridor Segment	% of Corridor That Contains Median	Traffic Lanes/Direction	Max Lanes/Direction	Min Lanes/Direction	On-Street Parking	Signalized Intersections	Pedestrian Crossings	Boulevard Conditions	Bus Stop Conditions
1	Barrington	30%	1	2	1	NB	8	2	• None	• Parking lane/Mixed traffic
2	Bayers	0%	2	3	1	Limited EB	6	1	• Powerlines & Trees	• 2nd lane & Bus Bay
	Young	0%	2 WB, 1 EB	2	1	No	5	2	• Powerlines & Trees	• EB Parking lane • 2nd WB lane
3	Bedford/J. Howe	6%	1	2	1	No	5 (+6)	4 (+0)	• NB: Powerlines & trees • SB: AT Path offset from street	• Bus Bays (2nd lane)
4	Bedford Bypass	Barrier	2	2	2	No	2	0	• Shoulders	• n/a
	Windmill	100%	2	3	2	No	3	0	• NB: streetlights from Wright Ave to Akerley Blvd	• Transit priority signals • Right lane must turn right, except buses, at intersections
5	Coburg	0%	1	1	1	WB	2	3	• W of Lemarchant: Trees WB • E of Lemarchant: Trees WB, EB	• WB parking, EB Mixed
	Oxford	0%	1	2	1	NB & SB	7	2	• Trees, both directions	• 2nd lane/Parking lane
	Spring Garden	0%	1	1	1	Various	6	5	• None	• Parking lane • Wide traffic lane
6	Dunbrack - Willet	0%	2	2	2	No	4	4	• Trees & Streetlights, both directions	• Bus Bays
	Main (Halifax)	0%	1	1	1	EB + limited WB	3	2	• WB trees	• Mixed/Parking lane
7	Gottingen	17%	1	2	1	SB	6	5	• None	• SB Parking • NB Mixed Traffic
8	Herring Cove	4%	2	3	1	No	4	9	• Selected locations • Non-continuous sidewalks	• Far-side and mid-block bus bays
9	Lacewood	50%	2	2	2	No	12	5	• Most of corridor	• Mixed Traffic east of Dunbrack
10	Mumford - Chebucto	30%	2	3	1	Limited	6	4	• None in front of Halifax Shopping Center	• Bus bays on Mumford • Mixed traffic on Chebucto
	North	0%	1	1	1	No	6	2	• Trees, both directions	• Mixed traffic

#	Corridor Segment	% of Corridor That Contains Median	Traffic Lanes/Direction	Max Lanes/Direction	Min Lanes/Direction	On-Street Parking	Signalized Intersections	Pedestrian Crossings	Boulevard Conditions	Bus Stop Conditions
11	Pleasant	0%	2	2	1	Limited	3	6	• Trees & Powerlines, both directions	• 2nd lane/parking lane/wide mixed
12	Portland	27%	2	3	1	Limited	15	4	• Trees & Powerlines, both directions	• Bus Bays east of HWY111; • Parking Lane • Mixed traffic
13	Robie	69%	2	3	1	NB & SB (south of Chebucto), NB (north of Chebucto)	10	6	• Trees, both directions	• Parking lane • SB Mixed traffic (north of Chebucto)
14	South	0%	1	1	1	Alternating EB/WB	3	3	• Powerlines & Trees	• Parking lane • Mixed traffic
15	South Park - Inglis	0%	1	1	1	Inglis (both directions)	5	4	• Powerlines & Trees	• Parking lane • Wide traffic lane
16	Victoria	59%	1	3	1	No	8	2	• Powerlines & Trees	• Wide lanes
17	Woodland	20%	1	2	1	Yes	3	3	• WB: Powerlines & Trees • EB: Grass	• Parking lane • Wide traffic lane
18	Wyse	42%	1	3	1	No	5	4	• Trees & Powerlines, both directions	• Wide traffic lane

Table 10: Opportunities for BRT Infrastructure Elements

#	Corridor Segment	Opportunity for Bus Lanes?		Opportunity for Queue Jumps?		Space for Stations?		Notes	Overall
1	Barrington	• Difficult in the downtown	0	• Southbound at Duke	2	• Narrow sidewalks • Limited space for shelters and other BRT amenities	0	• Wide from ALM Bridge to Cogswell • Very constrained in downtown • Redevelopment of Cogswell Interchange may create opportunities for station development • Potential may exist for some "transit-oriented street" features	🔴
2	Bayers	• Possible in curb lanes • Planned road widening	2	• Yes	5	• Yes	5	• Limited space on Desmond, Scot • Design of transit priority measures, including bus lanes, on Bayers and Young approved by Regional Council	🟡
	Young	• Limited space	0	• Narrow corridor	1	• Yes	4		
3	Bedford / Joseph Howe	• Constrained on Bedford • Widening for bus lanes possible on Joseph Howe	2	• Potential to provide queue jumps at specific intersections	3	• Bus bay stations possible on Bedford to minimize vehicle impacts with single lane; Boulevard on Joseph Howe Dr. provides space for stations	4	• Joseph Howe segment has higher demand and can better accommodate bus lanes • Bedford Highway is more constrained	🟡
5	Coburg	• Potential for WB lane in existing parking lane	2	• Intersections are not very wide	3	• Potential to create space by removing parking at select locations	4	• Residential, many driveways • Vehicular loading/stopping on Spring Garden Road creates delays for transit service • Excellent potential for "transit-oriented street" features on Spring Garden Road	🟡
	Oxford	• Potential to provide bus lane by removing parking • Possible peak bus lane	3	• Buses could bypass through vehicles using right turn lanes	3	• Wide vehicle lanes and parking lane can be reconfigured to create space	4		
	Spring Garden	• Potential to transition Spring Garden Road to a "transit oriented street" between Barrington and South Park • Opportunity for short bus lane segments west of South Park	1	• Turn lanes at intersections can be designated for exclusive transit use (constrain vehicles) or enable through buses to share lane with other turning vehicles.	2	• Wide lanes • Potential for improved station areas with sidewalk extensions to meet the travel lane	5		
6	Dunbrack - Willet	• Potential to designate existing lanes for bus or widen road	5	• Connect to existing bus bays	4	• Yes	5	• Dunbrack is a divided roadway, Willet is not	🟢
	Main	• Potential to provide lane in one direction by removing parking	2	• Tight intersections	1	• Yes	4		
7	Gottingen	• Potential to provide lane in one direction by removing	2	• Potential to provide transit queue jump using parking lane in one	3	• Potential for improved stations using parking lane if buses stop	4	• Approved transit priority corridor (loading restrictions all day, parking	🟡

#	Corridor Segment	Opportunity for Bus Lanes?		Opportunity for Queue Jumps?		Space for Stations?		Notes	Overall
		parking		direction only		in mixed traffic		restrictions for part of day) • Detailed design for peak period peak direction transit priority corridor to be completed in 2018	
8	Herring Cove	• More opportunity in suburban areas in the south • Less opportunity north of Highfield	4	• Yes, potential to use boulevards and reconfigure lanes and medians	5	• Yes	5	• Two lanes per direction: south of Old Sambro, • One NB, two SB lanes: Old Sambro to Highfield, • One lane per direction: Highfield to Purcells, • Three lanes with center reversible lane: Purcells to Armdale, • Potential opportunity for bus lanes in conjunction with potential future widening of Herring Cove Road	🟢
9	Lacewood	• Potential for road widening and conversion of existing lanes west of Dunbrack • Potential road widening from Dunbrack to Evans	4	• Wide ROW west of Dunbrack with large intersections	4	• Yes	5	• Wide ROW on west portion can accommodate BRT lanes through road widening • East portion could include peak period lanes and queue jumps where possible	🟢
10	Mumford - Chebucto	• Widening possible adjacent to cemetery • Potential conversion of existing curb lanes in Halifax Shopping Centre precinct	3	• Yes, select locations	3	• Yes	4	• Cross-section significantly varies along corridor • Potential for widening along cemetery • Two lane Mumford bridge over rail line is a constraint • Opportunity for integration with new Mumford Terminal	🟡
	North	• Limited potential • Street widening required to provide bus lane in one direction by removing trees, and using narrow lanes	1	• Difficult, narrow intersections	2	• Yes	4		
12	Portland	• ROW varies significantly • Widening and conversion of existing curb lanes possible east of Prince Albert	4	• Potential for transit priority east of Penhorn Terminal/Highway 111	4	• Yes, wide vehicle lanes & parking lane	4	• Wide corridor east of Highway 111 • Residential between Highway 111 and Prince Albert • Urban main street (limited ROW) from Prince Albert to Alderney • Redevelopment of Maitland – Canal block expected within next 10 years; requires coordination with bus lane initiative on Portland	🟢

#	Corridor Segment	Opportunity for Bus Lanes?		Opportunity for Queue Jumps?		Space for Stations?		Notes	Overall
13	Robie	• On segments with 3 lanes per direction. Potential conversion of existing lanes • Would require ROW reconfiguration using boulevards/medians	5	• Potential to provide transit queue jump using parking lane	5	• Yes, boulevard available for stations	5	• Transit Priority Corridor functional design underway (as per IMP) • Between Cunard and South: • Three existing lanes per direction with boulevards and wide median • Potential to be reconfigured • Curbside and median bus lanes explored as part of TPM Study • Constrained north of Cunard	🟢
14	South	• Potential to provide lane in one direction by removing parking	2	• Potential to provide transit queue jump using parking lane in one direction only	3	• Sidewalk extension possible to create space for stations	5	• Difficult to accommodate bus lanes • Limited opportunity for queue jumps	🟡
15	South Park - Inglis	• Potential to provide bus lanes by removing parking	4	• Potential to provide transit queue jump using parking lane in one direction only	4	• Limited space available for stations	4	• Removal of on-street parking undesirable in this residential/ university area • Can consider peak parking restrictions; however limited traffic road congestion suggests provision of BRT stations may be adequate without bus lanes.	🟢

Rating Scale: 0 (no potential) to 5 (highest potential)

Overall Score: 🟢 >10 🟡 5 – 10 🔴 <5

Urban Context

This part of the detailed evaluation of the candidate corridor segments included three components: *Corridor Connectivity*, *Corridor Visibility*, and *Corridor Accessibility*. These are discussed in turn below, followed by tables that summarize the component ratings for each corridor segment.

Corridor Connectivity assesses whether BRT in a candidate corridor segment would serve major travel movements and how well it would connect with the overall transportation network. For example, corridor segments that serve higher density areas (existing or planned), that serve major travel destinations, and that have convenient interchange opportunities with other transit routes and other modes are prime candidates for BRT.

The candidate corridor segments rated highest for *Corridor Connectivity* included:

- Barrington Street;
- Oxford Street/Cobourg Street/Spring Garden Road;
- Mumford Road/Chebucto Road/North Street; and
- Robie Street.

These corridor segments serve the heart of the Halifax peninsula, where many daily destinations are located and where there is a high concentration of residential and mixed land uses. These corridor segments provide connections to several transit routes and to a number of planned active transportation facilities.

The detailed ratings are shown in **Table 11**.

Corridor Visibility assesses how well BRT in a candidate corridor serves planned intensification areas in the municipality. By providing a high quality transit service in these areas and, in turn, being supported by the ridership generated by them, BRT can help shape development in a manner consistent with HRM's long-term vision.

This component was assessed with the assistance of HRM planning staff. The candidate corridor segments rated highest for *Corridor Visibility* included:

- Barrington Street;
- Oxford Street/Cobourg Street/Spring Garden Road;
- Gottingen Street;
- Mumford Road/Chebucto Road/North Street;
- Portland Street; and
- Robie Street.

Other corridor segments were rated lower for a number of reasons. Some areas are already well developed (e.g., South Park – Inglis). Some are not a priority for redevelopment (e.g., Woodland), while others have challenging pedestrian environments (e.g., Windmill).

The detailed ratings are shown in **Table 12.**

Corridor Accessibility assesses the degree to which BRT in a candidate corridor could be accessed by those dependent on transit for their travel. Although BRT would include features in its infrastructure, vehicles, and service that provide for universal access, this component assessed the number of assisted living residences and health care facilities adjacent to each corridor segment.

The candidate corridor segments serving the highest number of such facilities included:

- Barrington Street;
- Oxford Street/Cobourg Street/Spring Garden Road;
- Gottingen Street;
- Mumford Road/Chebucto Road/North Street; and
- Robie Street.

The detailed ratings are shown in **Table 13.**

Table 11: Corridor Connectivity Assessment

#	Corridor Segment	Buildings within 600m (750m) of Corridor Segment	Dwellings within 600m (750m) of Corridor Segment	Attractions within 600m (750m) of Corridor Segment	Terminals, Park & Ride Lots	Transit Routes Within/Crossing Segment	Multi-Modal Connections	Overall[3]
1	Barrington	1,100 (1,550)	8,550 (11,600)	77	1	28	4	🟢
2	Bayers – Young	2,850 (4,050)	5,550 (8,350)	87	2	15	3	🟡
3	Bedford	1,900 (2,700)	3,550 (5,750)	46	0	19	1	🔴
4	Windmill – Bedford Bypass	100 (250)	500 (600)	7	2	9	0	🔴
5	Oxford - Coburg - Spring Garden	4,600 (5,600)	13,100 (17,150)	121	0	20	4	🟢
6	Dunbrack - Willet – Main	1,850 (2,500)	7,050 (8,900)	50	0	11	0	🟡
7	Gottingen	1,800 (2,200)	7,250 (8,500)	84	0	20	4	🟡
8	Herring Cove	2,600 (3,500)	6,200 (8,250)	44	0	6	1	🟡
9	Lacewood	1,550 (2,300)	6,050 (8,800)	40	2	14	1	🟡
10	Mumford - Chebucto - North	4,750 (5,900)	11,050 (14,300)	103	2	22	5	🟢
11	Pleasant	1,400 (2,300)	2,950 (5,450)	50	2	5	1	🔴
12	Portland	2,550 (3,600)	5,850 (7,850)	71	3	14	2	🟡
13	Robie	3,450 (4,750)	11,450 (16,050)	122	0	9	3	🟢
14	South	1,100 (1,500)	9,800 (11,750)	60	0	2	1	🟡
15	South Park – Inglis	1,300 (1,750)	8,950 (11,250)	61	0	0	2	🟡
16	Victoria	1,600 (2,300)	4,300 (6,600)	41	1	12	2	🔴
17	Woodland	1,250 (1,800)	2,350 (4,300)	14	2	8	2	🔴
18	Wyse	1,200 (1,750)	2,800 (4,050)	36	2	20	3	🔴

Legend: High Connectivity 🟢 🟡 🔴 Low Connectivity

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[3] Overall Index Value = *Dwellings + (10 x Attractions) + (100 x Terminals) + Routes + Multi-Modal Connections*

Table 12: Corridor Visibility Assessment

#	Corridor Segment	Potential to Shape Development (Serves Planned Intensification)	Prominence of BRT Infrastructure (Transit Priority Measures, Stations)	Ease of Pedestrian Access	Overall
1	Barrington	🟢	🟢	🟢	🟢
2	Bayers	🟡	🟢	🟡	🟡
3	Bedford	🟡	🟢	🟢	🟡
4	Windmill – Bedford Bypass	🔴	🟢	🔴	🔴
5	Oxford - Coburg - Spring Garden	🟢	🟢	🟢	🟢
6	Dunbrack - Willet – Main	🟡	🔴	🟡	🔴
7	Gottingen	🟢	🟢	🟢	🟢
8	Herring Cove	🟢	🟢	🟡	🟡
9	Lacewood	🟡	🟡	🟡	🟡
10	Mumford - Chebucto - North	🟢	🟢	🟢	🟢
11	Pleasant	🟢	🔴	🟢	🔴
12	Portland	🟢	🟢	🟢	🟢
13	Robie	🟢	🟢	🟢	🟢
14	South	🟡	🔴	🟢	🔴
15	South Park – Inglis	🔴	🟡	🟢	🔴
16	Victoria	🟡	🟢	🟡	🟡
17	Woodland	🔴	🟢	🟡	🔴
18	Wyse	🟢	🟡	🟡	🟡

Legend: High Visibility 🟢 🟡 🔴 Low Visibility

Table 13: Corridor Accessibility Assessment

#	Corridor Segment	Assisted Living Residences (Developmental Residence, Group Home, Seniors Residence, etc.)	Health Care Facilities (Hospital, Regional Rehab Centre)	Total	Overall
1	Barrington	17	-	17	🟢
2	Bayers – Young	11	-	11	🟡
3	Bedford	6	-	6	🟡
4	Windmill - Bedford Bypass	2	1	3	🔴
5	Oxford - Coburg - Spring Garden	13	6	19	🟢
6	Dunbrack - Willet – Main	10	-	10	🟡
7	Gottingen	16	-	16	🟢
8	Herring Cove	8	-	8	🟡
9	Lacewood	14	-	14	🟡
10	Mumford - Chebucto - North	20	-	20	🟢
11	Pleasant	9	3	12	🟡
12	Portland	8	-	8	🟡
13	Robie	20	7	27	🟢
14	South	5	4	9	🟡
15	South Park – Inglis	7	4	11	🟡
16	Victoria	5	-	5	🟡
17	Woodland	1	-	1	🔴
18	Wyse	7	-	7	🟡

Legend: Good 🟢 🟡 🔴 Poor

Implementation Considerations

It is common for BRT networks to be developed over time, with the phasing strategy influenced by opportunities for coordination with other major projects and with approved urban development priorities, and by complexities related to jurisdictional and stakeholder requirements. For this part of the detailed evaluation, the following were assessed for each candidate corridor segment:

- Opportunities to coordinate BRT Implementation with other urban infrastructure projects;
- Alignment with Regional Plan priorities; and
- Requirement for multi-jurisdictional project approvals.

There are some candidate corridor segments on which other major projects are planned and, consequently, present an opportunity for integration with BRT infrastructure features. These include:

- Bayers Road-Young Street;
- Gottingen Street;
- Robie Street;
- Barrington Street; and
- Spring Garden Road.

While other projects are planned on Mumford-Chebucto-North and Bedford, these are on only a portion of those candidate corridor segments; the potential for coordinated implementation with BRT infrastructure is somewhat less.

Corridor segments on which BRT best aligned with the adopted Regional Plans included:

- Robie Street;
- Bayers Road-Young Street;
- Portland Street; and
- Oxford Street-Cobourg Street-Spring Garden Road.

While most of the corridor segments are owned and maintained by HRM, several of them intersect with a provincial highway or bridge. BRT implementation for them will require provincial and/or federal approvals. Corridor segments likely to not require such jurisdictional complexity for BRT development include:

- Bedford Highway;
- Oxford Street/Coburg Street/Spring Garden Road;
- Herring Cove Road;
- Robie Street;
- South Street; and
- South Park Street – Inglis Street.

The overall ratings for Implementation Considerations are shown in **Table 14**.

Table 14: Implementation Considerations

#	Corridor	Ownership	Jurisdictional Complexity	Project Integration Opportunities	Regional Plan Alignment	Total	Overall
1	Barrington	Province (i.e., Connections to Macdonald Bridge)	2	7	3	12	🟡
2	Bayers - Young	Province (i.e., Ramps from Highway 102)	3	10	5	18	🟢
3	Bedford	HRM/CN Rail	5	4	2	11	🟡
4	Windmill - Bedford Bypass	Province (i.e., Windmill Road north of Akerley & Bedford Bypass)	1	2	0	3	🔴
5	Oxford - Coburg - Spring Garden	HRM	5	2	5	12	🟡
6	Dunbrak - Willet - Main	Province (i.e., Dunbrack & Main intersection)	3	0	0	3	🔴
7	Gottingen	Province (i.e., Connections to Macdonald Bridge)	3	8	4	15	🟢
8	Herring Cove	HRM	5	1	0	6	🔴
9	Lacewood	Province (i.e., Highway 102 interchange; Lacewood west of interchange)	3	0	0	3	🔴
10	Mumford - Chebucto - North	Province (i.e., Connections to Macdonald Bridge)	2	5	4	11	🟡
11	Pleasant	HRM	5	1	3	9	🟡
12	Portland	Province (i.e., Highway 111 interchange; Portland east to Baker Dr)	1	1	5	7	🔴
13	Robie	HRM	5	8	5	18	🟢
14	South	HRM	5	1	2	8	🟡
15	South Park - Inglis	HRM	5	1	4	10	🟡
16	Victoria	Province (i.e., Connections to Macdonald Bridge)	3	0	4	7	🔴
17	Woodland	Province (i.e., Highway 111 interchange; Woodland south to Pinehill Rd	1	0	1	2	🔴
18	Wyse	Province (i.e., Connections to Macdonald Bridge)	3	1	2	6	🔴

Jurisdictional Complexity:
5 – Owned by HRM

3 - Owned by HRM, consult with other jurisdictions
2 - Abuts provincial or federal roadway
1 – Owned by Province or Federal Government

Project Integration Ranking:
10 = Opportunity to integrate with other projects
0 = No opportunity

Regional Plan Alignment Ranking:
5 = High Applicability, Likelihood and Influence
0 = Does not align with Regional Plan documents
(e.g. Integrated Mobility Plan, CentrePlan)

Overall Score: 🟢 >=15 (potentially easier to Implement) 🟡 8 – 14 🔴 <=7 (potentially more difficult to Implement)

5.2.3.3 Evaluation Summary

Table 15 provides an overall summary of the detailed evaluation. It shows the overall ranking for each of the candidate corridor segments for each evaluation criterion. These rankings are displayed in the map in **Figure 7.**

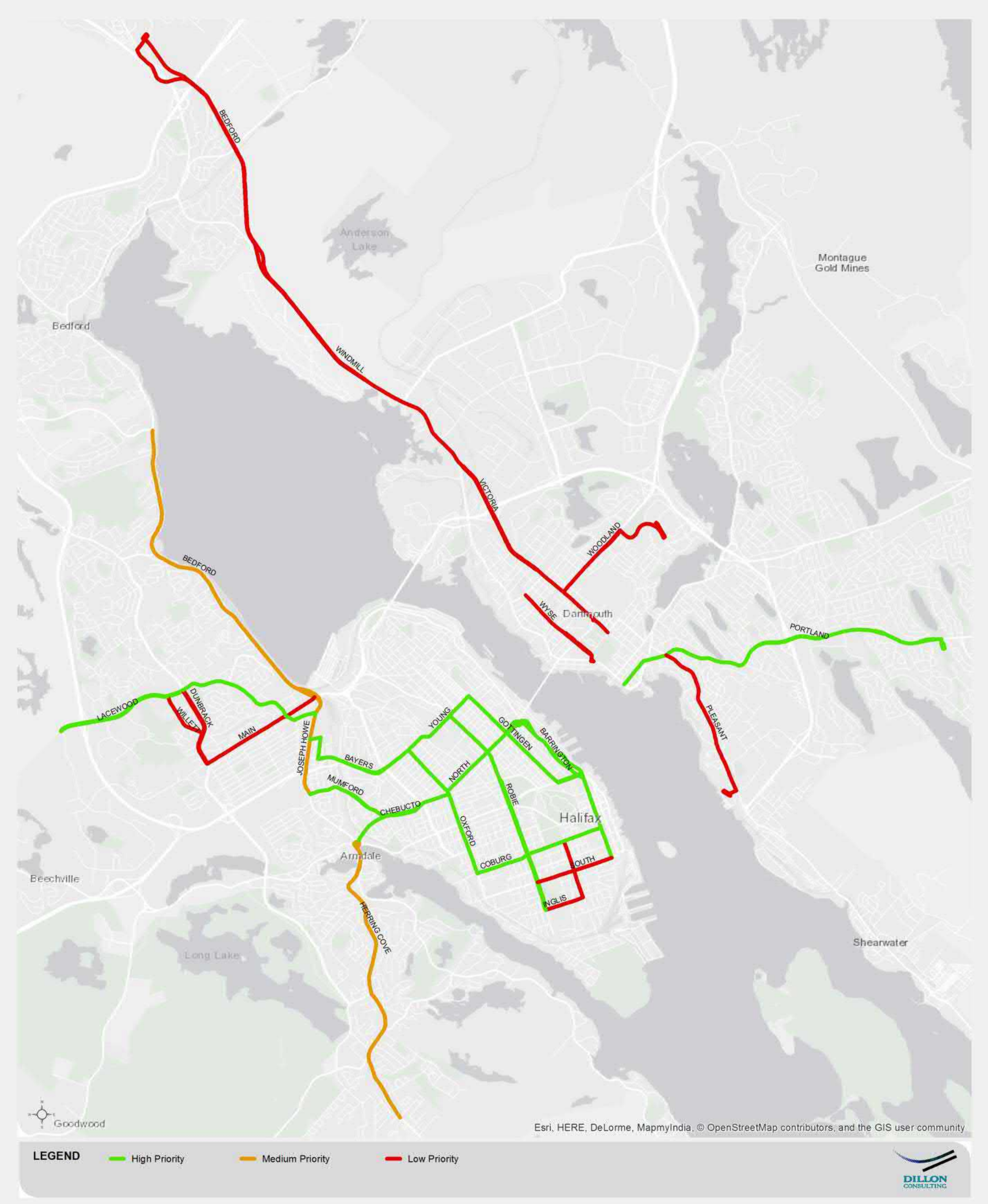
These results were used to develop a preliminary network of BRT routes comprised of the highest ranked corridor segments. This preliminary network, in turn, was presented for consideration and feedback during the stakeholder/public consultation phase of the work.

Table 15: Evaluation Summary

#	1	3	5	9	10	12	13	2	6	7	8	14	15	4	11	16	17	18
Corridor Segment	**Barrington**	**Bedford**	**Oxford - Coburg - Spring Garden**	**Lacewood**	**Mumford - Chebucto - North**	**Portland**	**Robie**	**Bayers - Young**	**Dunbrack - Willet - Main**	**Gottingen**	**Herring Cove**	**South**	**South Park - Inglis**	**Windmill**	**Pleasant**	**Victoria**	**Woodland**	**Wyse**
Transit Demand	High Demand							Medium Demand						Low Demand				
	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢🟡	🟡	🟢🟡	🟡	🟡	🟡	🔴	🔴	🔴	🔴	🔴
Street Layout	🔴	🔴	🟡	🟢	🟡	🟢	🟢	🟡	🟢	🟡	🟢	🟡	🟢					
Connectivity	🟢	🔴	🟢	🟡	🟢	🟡	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🔴	🔴	🔴	🔴
Visibility	🟢	🟡	🟢	🟡	🟢	🟢	🟢	🟡	🔴	🟢	🟡	🔴	🔴	🔴	🔴	🟡	🔴	🟡
Accessibility	🟢	🟡	🟢	🟡	🟢	🟡	🟢	🟡	🟡	🟢	🟡	🟡	🟡	🔴	🟡	🟡	🔴	🟡
Implementation	🟡	🟡	🟡	🔴	🟡	🔴	🟢	🟢	🔴	🟢	🔴	🟡	🟡	🔴	🟡	🔴	🔴	🔴
OVERALL	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟡	🔴	🔴	🔴	🔴	🔴	🔴	🔴

Legend: **High Score** 🟢 🟡 🔴 **Low Score**

Figure 7: Overall Rating for Candidate Corridor Segments



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6.0 BRT Route Network Proposed for Stakeholder/Public Engagement Program

Using the results of the detailed evaluation, a preliminary BRT route network was developed from the highest ranked candidate corridor segments. This network was comprised of four BRT routes, serving high demand corridors and providing links to key destinations (e.g., downtowns, hospitals, post-secondary institutions, shopping/services areas, transit terminals, etc.) in Halifax and Dartmouth.

The following principles were used to guide the development of the preliminary BRT route network:

1. **Provide BRT Connections to the Downtown Areas of Halifax and Dartmouth:**
   - Downtown Halifax is a major transit destination and, consequently, such corridor segments as Barrington Street and Spring Garden Road had a high ranking. It is important that BRT be operated on them to deliver passengers close to downtown destinations. While there is limited right-of-way on these streets, there may be opportunities to implement features of “transit-oriented streets” to provide reliable bus operations and to create high visibility for the BRT service in the downtown areas.
   - While the corridor segments in downtown Dartmouth were not ranked as high as those in downtown Halifax, it is important that the BRT network connect to routes serving the Bridge Terminal and surrounding area in downtown Dartmouth.
2. **Provide BRT Connections between Suburban Areas and Urban Areas:**
   - The frequent service, lengthy service span, and higher speeds of BRT are important attributes to attract new ridership amongst those travelling between suburban areas and destinations in the central urban areas. Consequently, the High and Medium Priority corridor segments in suburban areas on Lacewood Drive, Portland Street, Herring Cove Road, and Bedford Highway were included in the BRT route network to provide faster, more direct travel for these types of trips.
3. **Provide BRT Connections with Post-Secondary Institutions:**
   - Post-secondary students are frequent users of transit. Consequently, it is important that post-secondary institutions on the High and Medium Priority corridor segments (i.e., Dalhousie, St. Mary’s, Mount Saint Vincent) be served by the BRT route network.
4. **Provide BRT Connections with the Overall Transit Network at Transit Terminals:**
   - It is important that the BRT network be integrated with the overall transit network. Consequently, the preliminary BRT route network was designed to provide connections with other routes at several of the transit terminals in HRM (e.g., Portland Hills, Penhorn, Bridge, Barrington & Duke, Water Street (for ferry connections), Mumford, and Lacewood).
5. **Focus BRT Routes on Streets with Highest Potential for Transit Priority Measures:**
   - Several corridor segments were identified as either having approved initiatives for transit priority (i.e., Bayers, Young, Robie, Gottingen) or having potential for transit priority (i.e., Lacewood, Joseph Howe, Mumford, Portland). Consequently, corridor segments on these streets were incorporated into the preliminary BRT route network.

The preliminary BRT network, as outlined in **Table 16**, includes four routes:

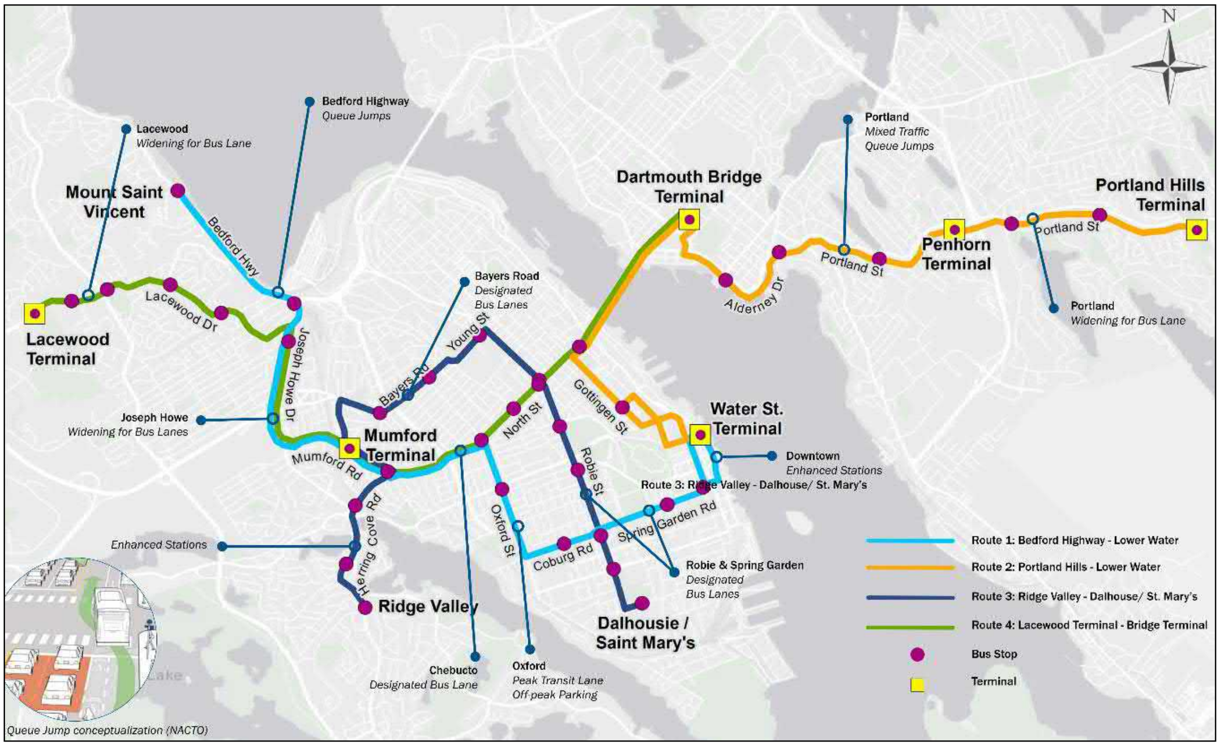
Table 16: Preliminary BRT Network Routes

Route	From	To	Via
1	Mount Saint Vincent	Water Street Terminal	Bedford Highway – Joseph Howe Drive – Mumford Terminal – Chebucto Road – Oxford Street – Coburg Road – Spring Garden Road – Downtown Halifax
2	Portland Hills Terminal	Water Street Terminal	Portland Street – Alderney Drive – Bridge Terminal – Macdonald Bridge – Gottingen Street – Downtown Halifax
3	Cowie Hill Road	Dalhousie/ St. Mary's	Herring Cove Road – Mumford Terminal – Bayers Road – Young Street – Robie Street
4	Lacewood Terminal	Bridge Terminal	Lacewood Drive – Joseph Howe Drive – Mumford Terminal – Chebucto Road – North Street -Macdonald Bridge

Potential station locations were identified during the development of the preliminary network. Considerations for station locations included passenger activity levels at existing bus stops, access to major destinations, connections to other transit routes, and links to active transportation facilities. Stations were spaced at intervals of 400 to 700 metres to strike a balance between service speeds and coverage. Within downtown Halifax (e.g., Spring Garden Road, Barrington Street), stations are spaced at shorter intervals to provide convenient access to major destinations.

Potential transit priority measures for implementation on these four BRT routes, such as bus lanes and queue jumps, routes were also identified. This preliminary route network, with proposed station locations and example transit priority measures, is illustrated in **Figure 8**. It was subsequently proposed for comment and feedback during the stakeholder/public engagement program.

Figure 8: Preliminary BRT Route Network and Station Locations for Stakeholder/Public Engagement Program



7.0 Stakeholder/Public Engagement Program

The objectives of the engagement strategy were to:

- Inform the public and stakeholders about Bus Rapid Transit (i.e., Introduce the concept and show example BRT characteristics and elements);
- Illustrate a proposed preliminary BRT network in the HRM;
- Provide examples of possible BRT system elements in Halifax, including stations, stops, and infrastructure enhancements to support higher order transit;
- Gather feedback on the proposed BRT network; and
- Gauge public interest in developing a BRT network in Halifax.

A multi-platform engagement program was utilized, including an online project portal and survey, a public open house, Halifax Transit/HRM staff feedback, and a stakeholder round table. This resulted in a significant level of engagement:

- 250 people attended the open house on February 12, 2018;
- 2,179 people visited the project website and 560 people participated in the “Shape Your City” online project survey from February 13 – February 25, 2018;
- Input was gathered from Halifax Transit bus operators and HRM’s planning staff, including the urban design and strategic transportation planning departments from February 14 – February 21, 2018; and
- A facilitated Stakeholder session was held on February 21, 2018 at HRM’s offices at Alderney Landing. Participants were invited to the session directly by Halifax Transit and, with the aid of maps and facilitation by members of the project team, the proposed BRT network was reviewed with them. Attendees included the *Spring Garden Area Business Association*, the *Downtown Dartmouth Business Commission*, the transit advocacy group *It’s More Than Buses*, *Walk n’ Roll Halifax*, and the *Ecology Action Centre*.

A summary of comments received on the preliminary BRT network is included in **Table 17.** The detailed Public and Stakeholder Engagement Report including the materials presented and comments received is included in **Appendix C**.

Table 17: Summary of Stakeholder and Public Feedback

Engagement Initiative	Summary of Discussion and Comments Received
Public Open House	The public is generally in support of developing a BRT network in Halifax. Noted concerns about the proposed network include: • The network should be expanded to capture a further reach beyond the core; • There were a number of business owners along Gottingen who oppose a BRT corridor on Gottingen due to loss of parking and negative impacts of the street environment due to increased bus traffic; • BRT should operate at an increased service level, including on weekends and evenings to make transit more appealing; and • People are generally supportive of infrastructure enhancements to support BRT, such as queue jumping, transit priority measures at intersections, bus lanes and loss of on-street parking; however, there was a mixed reaction to street widening, with people indicating that street widening should be a last resort.
Project Website & Online Survey	• Participants were supportive of BRT being introduced in Halifax (90% in support). Participants noted that: ○ The proposed network was limited in its geographic scope and should connect

Engagement Initiative	Summary of Discussion and Comments Received
	areas beyond the core; ○ To make this service viable, there should be a focus on infrastructure enhancements to make it 'rapid' in addition to having improved service (frequency and expanded service hours); and ○ BRT may add congestion to an already congested core and residents were curious how this will interact with the existing transit network.
Transit Operators & Staff	Overall, operators and staff are supportive of BRT, but have noted a number of concerns with the proposed network, which may threaten its viability: • Existing bottlenecks must be addressed, such as Spring Garden Road and the Macdonald Bridge; • Need for educating the public about rapid transit (i.e., off-board fare collection, all door boarding); • Enforcement of illegal parking is critical, particularly if parking lanes are used as bus lanes in peak periods; • Existing bus stops are too close together limiting transit speeds; and • The proposed 'end points' should be expanded to other areas, such as north Dartmouth, Larry Uteck, and Bedford.
Project Stakeholders	Although generally supportive of Rapid Transit, community stakeholders are curious about: • The relationship between this rapid transit network and the local bus network (e.g., Should service enhancements be made on the local network and marketed as express routes?); • Realigning and expanding the proposed BRT network. Suggestions included introducing a 'loop' route around the peninsula and expanding the network to Bedford, Larry Uteck and the Burnside Industrial Park; and • Duplication of service (and lack of station) on Joseph Howe.

With respect to the proposed preliminary BRT route network, the major issues identified during the engagement program focused on the following:

1. Circuitous and indirect routings (e.g., Routes 1 and 3);
2. A lack of BRT coverage in the north part of the Halifax peninsula (and an associated suggestion for for a loop route around the peninsula);
3. A lack of BRT coverage in the north part of Dartmouth;
4. Concerns about the loss of on-street parking and high bus volumes on Gottingen Street;
5. Duplication of BRT routes and lack of a BRT Station on Joseph Howe Drive; and
6. Longer term expansion of the BRT network to other parts of the region.

The engagement feedback was reviewed by the project team and used to prepare network options that addressed these issues. These options were then reviewed with Halifax Transit staff and a recommended conceptual BRT network was then developed.

8.0 Conceptual Design of BRT Network

8.1 BRT Route Network

The engagement feedback was used by the project team to identify and assess options to improve the preliminary BRT network.

The recommended conceptual BRT route network that resulted from this is shown in **Figure 9.** It is comprised of four routes illustrated in **Table 18**.

Table 18: Recommended BRT Network Routes

Route	From	To	Via
1	Cowie Hill Road	Bridge Terminal	Herring Cove Road – Chebucto Road – Mumford Terminal – Bayers Road – Young Street – Gottingen Street – Macdonald Bridge
2	Lacewood Terminal	Water Street Terminal	Lacewood Drive – Joseph Howe Drive – Mumford Terminal – Chebucto Road – Oxford Street – Coburg Road – Spring Garden Road – Downtown Halifax
3	Portland Hills Terminal	VIA Rail Station	Portland Street – Alderney Drive – Bridge Terminal – Macdonald Bridge – Gottingen Street – Downtown Halifax
4	Mount Saint Vincent	VIA Rail Station	Bedford Highway – Kempt Road /Massachusetts Avenue – Robie Street – Dalhousie/Saint Mary's University – Inglis Street

Figure 9: Recommended Conceptual BRT Route Network

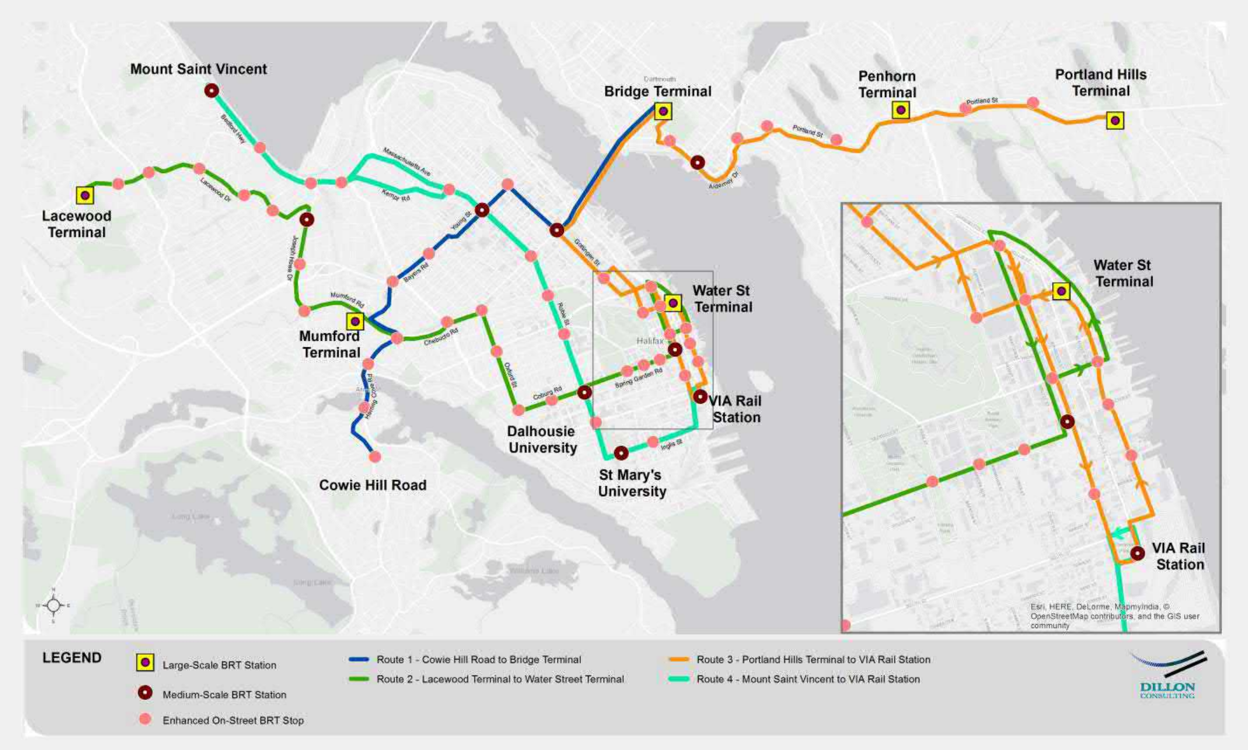


Table 19 summarizes the network modifications that were made to address the major issues identified during the engagement.

Table 19: Summary of Modifications to the Preliminary BRT Network

Issue Identified During Engagement		Recommended Modifications To Preliminary BRT Network
1	**Circuitous and indirect routings**	The corridor segments were reconfigured to provide more direct travel for major travel movements: • The BRT link between Lacewood Terminal and Bridge Terminal was replaced by one between Lacewood Terminal and downtown Halifax via Joseph Howe, Mumford Terminal, Chebucto, Oxford, Coburg, and Spring Garden (revised Route 2); • The indirect BRT link between Cowie Hill and Dalhousie/Saint Mary's was replaced with a direct link between Cowie Hill and Bridge Terminal via Mumford Terminal, Bayers, Young, Gottingen, and the Macdonald Bridge (revised Route 1); • The indirect BRT link between Mount Saint Vincent and downtown Halifax was replaced by a direct north-south link between Mount Saint Vincent Dalhousie/Saint Mary's/Via Rail Station via Kempt/Massachusetts, Robie, and Inglis (revised Route 4); and, • The BRT link between Portland Hills and downtown Halifax was extended further south to the VIA Rail station to provide further coverage in the downtown (Revised Route 3).
2	**Lack of BRT coverage in the north part of the Halifax peninsula**	Two of the route modifications provide some additional coverage of the north end: • A new direct north-south link between Mount Saint Vincent Dalhousie/Saint Mary's/Via Rail Station that operates via Kempt/Massachusetts (Revised Route 4); and • A direct link between Cowie Hill and Bridge Terminal that operates via Young and Gottingen (Revised Route 1). These provide some BRT access for the north part of the peninsula and to employment areas on Kempt Road. Moreover, there is some potential for future intensification in this area that would further support BRT service. It is not recommended that the BRT network be extended further in the northern part of the Halifax peninsula at this time. Transit demand in the area north of Young Street is significantly lower than in areas further south on the peninsula. Service north of Young is to be provided by the planned Corridor Route 7. The existing transit connection between the north end and downtown works well, providing frequent service and a relatively short trip (10 to 15 minutes) to/from downtown Halifax.
3	**Lack of BRT coverage in the north part of Dartmouth**	The analysis of transit demand did not result in corridor segments in north Dartmouth being ranked as high or medium priority for BRT in the short term. This area is served by Corridor Route 3, providing a higher level of service than local services. As discussed in **Section 11.0**, there is potential to expand BRT in Dartmouth when additional growth and intensification occurs. Until then, the implementation of site specific transit priority measures, where opportunities exist, would be consistent with any future extension of BRT in Dartmouth.
4	**Loss of on-street parking and high bus volumes on Gottingen Street**	Gottingen Street is being considered for transit priority measures in conjunction with a separate study. While BRT service will benefit from these measures, their implementation is planned as separate initiative from the BRT one. The proposed BRT service on Gottingen would operate at approximate intervals of 10 minutes. A BRT station is proposed at only one intersection.
5	**Joseph Howe Drive:** • **Duplication of BRT routes**	In the preliminary network, the routes from Mount Saint Vincent and from Lacewood Terminal were proposed to both operate on Joseph Howe, Mumford,

Issue Identified During Engagement		Recommended Modifications To Preliminary BRT Network
	- **Lack of a BRT Station**	and Chebucto between Main Street and Oxford Street. As described above, the recommended network includes a direct north-south link between Mount Saint Vincent and Dalhousie/Saint Mary's/Via Rail Station via Kempt/Massachusetts, Robie, and Inglis (Route 4); and a modification of the Lacewood route to operate to downtown Halifax instead of Bridge Terminal (Route 2). These modifications eliminate the duplication of BRT routes on Joseph Howe, Mumford, and Chebucto. Furthermore, the Lacewood BRT route is proposed to include a station on Joseph Howe opposite the Atlantic Superstore. While the realignment of the Mount Saint Vincent BRT route eliminates a BRT link between Bedford Highway and Mumford Terminal, other routes in the transit network do provide frequent service for that connection.
6	**Longer term expansion of the BRT network to other parts of the region**	This is discussed further in **Section 11.0**. Potential future expansion of the BRT network could include: • Expansion of the initial BRT routes (e.g., South to Herring Cove, North to Bedford, and East to Mic Mac Mall); and • New BRT routes in Dartmouth (e.g., Victoria/Wyse, Pleasant/Alderney).

8.2 Station Types and Locations

8.2.1 Station Types

Bus Rapid Transit station types can range from relatively simple bus stops to large-scale stations with multiple stop locations that are fully integrated with adjacent land uses. The arrangements developed for any particular potential stop location depend on site factors such as passenger demand, available right-of-way, surrounding land use, and available budget. Different types of stops are typically used along each individual BRT corridor in accordance with variations in site factors.

Three distinct types of stations are recommended: Enhanced On-Street BRT Stop; Medium-Scale BRT Station; and Large-Scale BRT Station.

8.2.1.1 Enhanced On-Street BRT Stop

While the most basic type of bus stop is one where a bus stop sign is attached to a post at a safe and appropriate location at the side of the street, a BRT stop must be more than this. The stop needs to reflect the branding of the BRT service and provide for an enhanced set of amenities designed to improve the experience for the customer. Ideally, each stop location includes a distinctive marker or kiosk highlighting that it is a BRT stop, an appropriately sized shelter and seating for customers, and information about the available transit service. These features are the minimum that should be applied to every BRT station. An example of an enhanced on-street BRT stop is illustrated in **Figure 10**.

Figure 10: On-Street BRT Stop (Kansas City - Troost Corridor)

8.2.1.2 Medium-Scale BRT Station

The medium-scale BRT station is designed to accommodate larger numbers of customers and/or more frequent BRT service. This type of station has the same key features as the enhanced on-street BRT stop, but on a larger scale. The shelter is larger, there is more seating, there is the same information available (but in multiple locations within the station area), and there is the same, consistent branding provided. In addition, there may be a canopy over part of the platform, nearby bike racks for integration with active transportation infrastructure, and allowances for improved landscaping and lighting. An example of a medium-scale BRT station is provided in **Figure 11**.

Figure 11: BRT Station Shelter (Grand Rapids, Michigan)

8.2.1.3 Large-Scale BRT Station

Large-scale BRT stations will be found at the busiest locations. These will likely include transit terminals, the busiest transfer locations, and key downtown stops. As with the enhanced on-street BRT stop and the medium-scale BRT station, the large-scale BRT station includes significant shelter space, substantial seating, multiple types and locations for information, consistent branding, integration for multi-modal access, appropriate landscaping and lighting to provide a safe and pleasant environment, and decorative fencing to assist with safely guiding customers to, from and within the station. An example of a large-scale BRT station is illustrated in **Figure 12**.

Figure 12: VIVANext Station Platform (York Region)

8.2.1.4 Station Type Summary

A summary of the suggested features and scale of each of the enhanced on-street BRT stop, median-scale BRT station and large-scale BRT station is presented in **Table 20**.

Table 20: Summary of Station Types and Features

Station Feature	Enhanced On-Street BRT Stop	Medium-Scale BRT Station	Large-Scale BRT Station
Concrete Platform	30 m long	40 m long	60 m long
Yellow Platform Edge Warning Strip	Yes	Yes	Yes
Station ID Sign Structure	Yes	Yes	Yes
Transit Information Kiosk	Combine with Station ID Sign Structure	Yes	Yes
Real Time Electronic Display	Yes	Yes	Yes
Bus Stop Pole and Flag with Graphics, Tactile Info.	Yes	Yes	Yes
Shelter (heat, light, bench)	2.5 m x 6.0 m	2.5 m x 12.0 m	2.5 m x 12.0 m
Canopy over Platform	No	Yes	Yes
Benches (external to shelter)	1	2	2
Waste/Recycling Receptacles	Yes	Yes	Yes
Bike Racks	No	Yes	Yes
Bike Racks with Canopy	No	No	Yes
Bike Lockers	No	No	Yes
Decorative Median Fence	No	No	Yes
Landscaping	No	Yes	Yes
Pedestrian Lighting	No	Yes	Yes
Electrical and Communications Supply	Yes	Yes	Yes

Representative layouts for each of the three station types are provided in **Figure 13**, **Figure 14**, and **Figure 15**. Further information about suggested station needs and dimensions can be found in **Appendix D**.

Figure 13: Example Station Layout – Enhanced On-Street BRT Stop

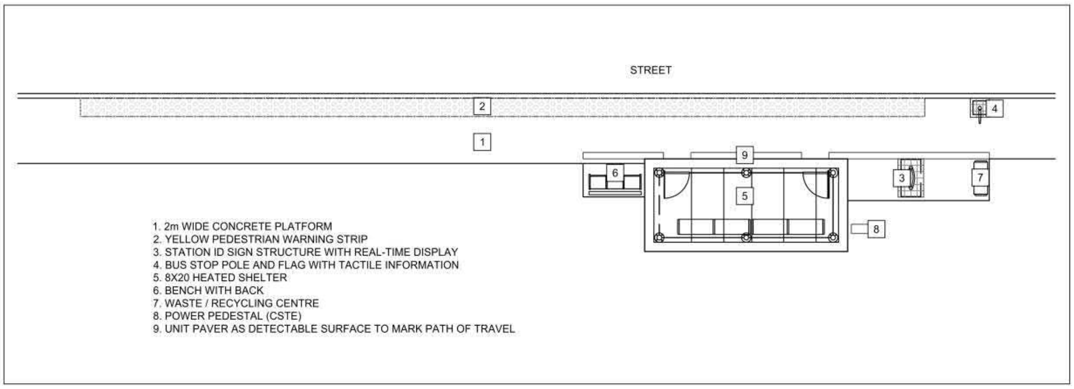


Figure 14: Example Station Layout – Medium Scale BRT Station

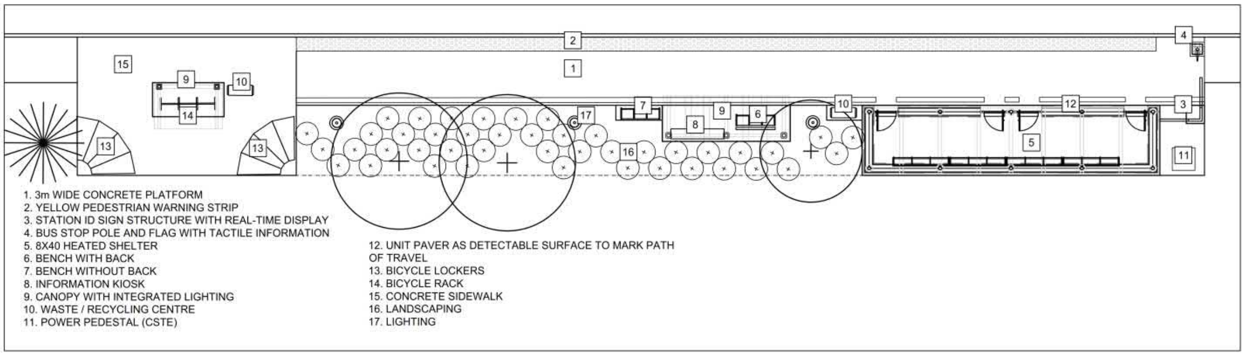
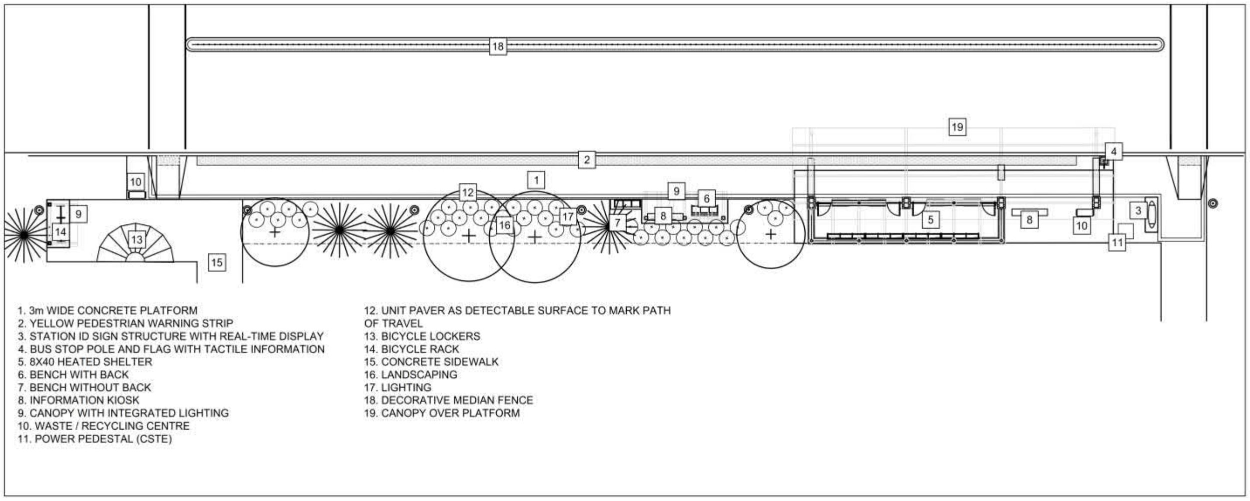


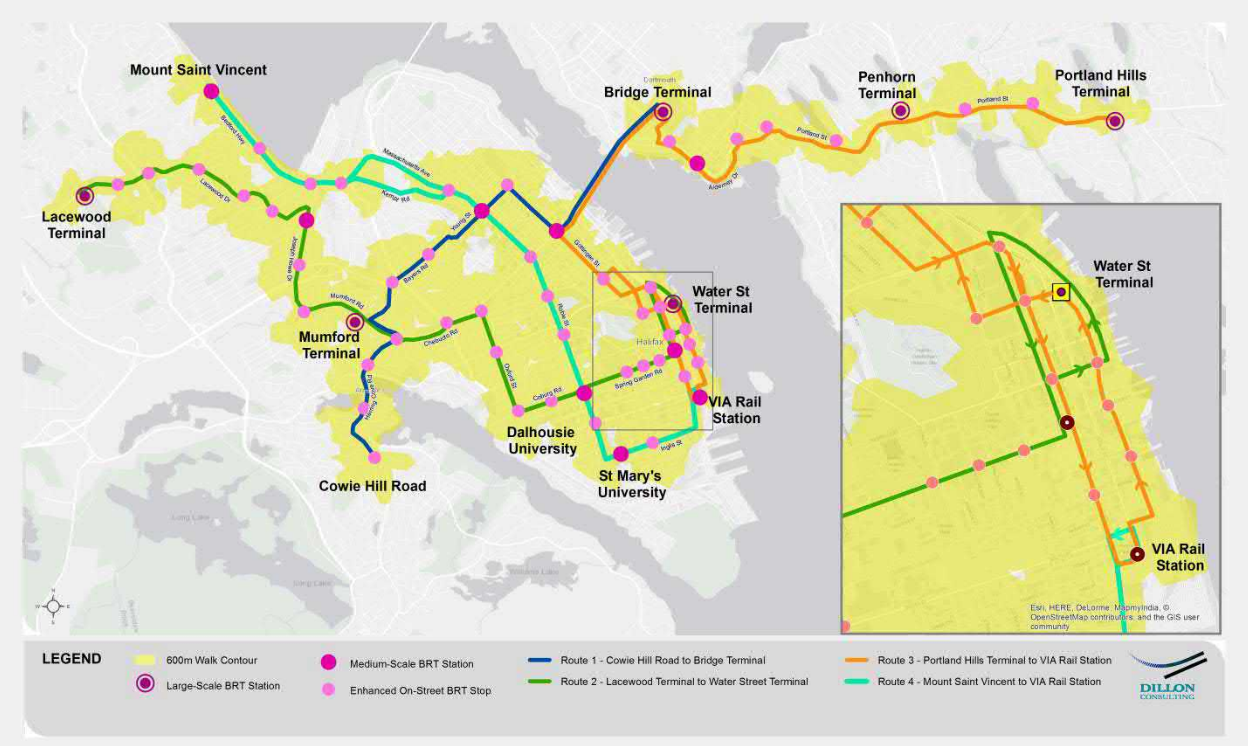
Figure 15: Example Station Layout – Large Scale BRT Station



8.2.2 Station Locations

Station locations for the proposed BRT network described in **Section 8.1** are presented in **Figure 16**. The figure also indicates which locations are proposed to be enhanced on-street BRT stops, medium-scale BRT stations and large-scale BRT stations.

Figure 16: Proposed BRT Station Locations and Types



The proposed locations of the stations are listed in **Table 21**. Note that some of the Large-Scale Stations are proposed at recently developed terminals (e.g., Bridge, Lacewood) or at ones anticipated to be redeveloped in the near future (e.g., Mumford). As these facilities generally incorporate the required features, they can certainly function as Large-Scale Stations, allowing convenient connections with other transit routes and transportation services.

In instances where an on-street stop is located immediately adjacent to a transit terminal and transfers between BRT and other routes at that stop would not require a passenger to cross a street, then such stops should be incorporated into the station design.

In suburban areas, BRT stations are typically spaced at intervals of 500 to 1,000 metres to enable buses to achieve reasonable operating speeds while still providing adequate coverage. Within the downtown areas, station spacing is typically shorter to provide convenient access to major destinations. The station locations illustrated in **Figure 16** result in approximately 24% of all dwelling units within HRM being within a 600 metre walk of a BRT station.

Table 21: Proposed Station Locations by Station Type

Station Type	Station #	On	At	BRT Routes	Platforms
Large-Scale	1	Mumford Rd.	Mumford Terminal	1, 2	2
	4	Lower Water St.	Water Street Terminal	2, 3	1
	5	Nantucket Ave.	Dartmouth Bridge Terminal	1, 3	2
	13	Lacewood Dr.	Lacewood Terminal	2	2
	29	Portland St.	Penhorn Terminal	3	2
	34	Portland St.	Portland Hills Terminal	3	2
Medium-Scale	3	Inglis St.	Wellington St.	4	2
	6	Gottingen St.	North St.	1, 3	3
	7	Barrington St.	Spring Garden Rd.	2, 3	2
	9	Joseph Howe Dr.	Dutch Village Rd.	2	2
	10	Alderney Dr.	Dartmouth Ferry Terminal	3	2
	12	Bedford Hwy.	Melody Dr.	4	2
	20	Coburg Rd.	Robie St.	2, 4	4
	38	Robie St.	Young St.	1, 4	4
	46	Barrington St.	VIA Rail Station	3, 4	1
	2	Spring Garden Rd.	Dresden Row	2	2
Enhanced On-Street	8	Coburg Rd.	Lemarchant St.	2	2
	11	Oxford St.	Quinpool Rd.	2	2
	14	Portland St.	Rodney Rd.	3	2
	15	Portland St.	Alderney Dr.	3	2
	16	Robie St.	Cunard St.	4	2
	17	Robie St.	Shirley St.	4	2
	18	Mumford Rd.	Leppert St.	1, 2	2
	19	Lacewood Dr.	Glenforest Dr.	2	2
	21	Robie St.	North St.	4	2
	23	Lacewood Dr.	Willett St.	2	2
	24	Robie St.	University Ave.	4	2
	25	Chebucto Rd.	Oxford St.	2	2
	26	Portland St.	Baker Dr.	3	2
	27	Bedford Hwy.	Main Ave.	4	2
	28	Chebucto Rd.	Armdale Roundabout	1	2
	31	Lacewood Dr.	Dunbrack St.	2	2
	32	Portland St.	Spring Ave.	3	2
	33	Herring Cove Rd.	Winchester Ave.	1	2
	35	Lacewood Dr.	Clayton Park Dr.	2	2
	36	Coleman St.	Bayers Rd.	1	2
	39	Bayers Rd.	Oxford St.	1	2
	40	Gottingen St.	Cornwallis St.	3	2
	41	Joseph Howe Dr.	Mumford Rd.	2	2
	42	Joseph Howe Dr.	Bayers Rd.	2	2
	44	Massachusetts Ave.	Columbus St.	4	2
	45	Chebucto Rd.	Connaught Ave.	2	2
	47	Barrington St.	Sackville St.	2, 3	2

Station Type	Station #	On	At	BRT Routes	Platforms
	48	Cogswell St.	Barrington St.	2, 3	1
	49	Duke St.	Brunswick St.	3	1
	50	Coburg Rd.	Oxford St.	2	2
	51	Inglis St.	South Park St.	4	2
	52	Lady Hammond Rd.	Kempt Rd.	4	2
	53	Young St.	Gottingen St.	1	2
	54	Portland St.	Gaston Rd.	3	2
	55	Windmill Rd.	Wyse Rd.	3	2
	56	Herring Cove Rd.	Melwood Ave.	1	2
	57	Lacewood Dr.	Main Ave.	2	2
	58	Bedford Hwy.	Bayview Rd.	4	2
	59	Lower Water St.	Bishop	3	1
	60	Lower Water St.	Salter St.	3	1
	61	Lower Water St.	Sackville St.	2, 3	1
	62	Barrington St.	Duke St.	2, 3	2
	63	Barrington St.	Morris St.	3	1
	64	Spring Garden Rd.	Brunswick St.	2	2
	65	Spring Garden Rd.	South Park St.	2	2

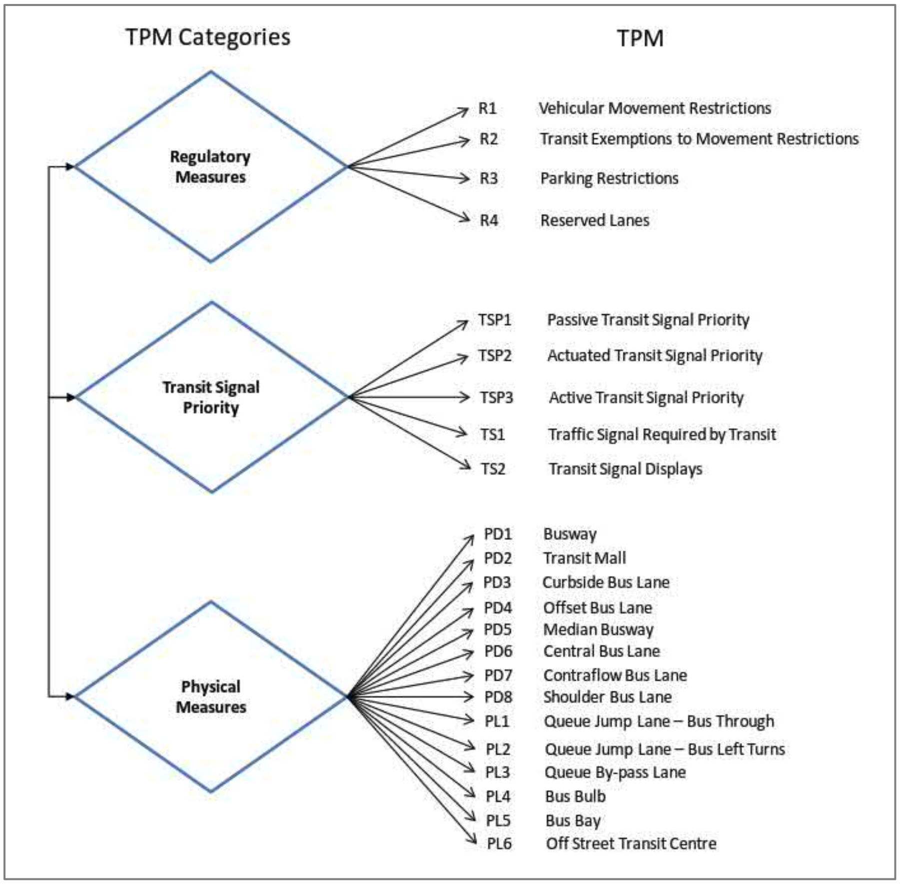
8.3 Transit Priority Measures

This section provides a general overview of transit priority, a summary of the approach used to select certain types of transit priority for BRT in HRM, and a description of the types and locations of recommended transit priority measures for the BRT network.

8.3.1 Types of Transit Priority

There are three categories of transit priority: regulatory measures, transit signal priority, and physical measures. Specific measures are itemized in **Figure 17**. The applicability of any particular transit priority measure (TPM) is dependent on its potential benefit for transit users, on its possible combination with upstream or downstream measures, on its impact on traffic operations, and on local site conditions.

Figure 17: Types of Transit Priority by Category



***Source**: Guidelines for Planning and Implementation of Transit Priority Measures in Urban Areas*, 2013, TAC, pg. 8

8.3.1.1 Regulatory Measures

Regulatory measures can usually be implemented with special signage and pavement markings; there is little requirement for construction or specialized equipment. These measures can be implemented **at** intersections (e.g., Use of a right-turn lane by buses to bypass traffic queues to travel through an intersection) or **between** intersections (e.g., Designating an existing traffic lane for buses only). They can be in effect throughout the day or only during certain time periods. For example, curb lanes can be designated as bus-only lanes during weekday peak periods (or only in the peak direction), but used for on-street parking or loading at other times.

Example applications of regulatory TPMs include:

- Conversion of existing traffic lanes to bus-only lanes, either during peak periods only or all day, on streets that have at least two lanes in each direction;
- Implementation of on-street parking/loading/stopping regulations on streets with bus-only lanes for the time periods during which the bus lanes are in effect;
- Implementation of a *Right Lane Must Turn Right, Except Buses* regulation at all locations where bus lanes intersect cross-streets; and
- Exemptions from existing *Right Lane Must Turn Right* regulations for buses using a right turn lane as a queue jump to bypass traffic and travel directly through an intersection.

8.3.1.2 Transit Signal Priority

There are three types of transit signal priority (TSP):

- **Passive TSP** involves the design of traffic signal timings to favour high volume bus movements. This includes the reallocation of green time to through movements on streets with frequent bus service by reducing green time for traffic on cross-streets on which no or infrequent transit service operates. Another effective technique is the double-cycling of signals to provide more opportunities for buses to cross busy intersections. No special equipment on buses and no special signal displays at intersections are required for Passive TSP.

- **Actuated TSP** involves the physical detection of a bus on the near-side of an intersection and the subsequent display of a transit-only signal to permit the bus to cross the intersection while other traffic is held by a red signal. Buses can be detected by an in-pavement induction loop or by other means. The transit-only signal is usually displayed for a few seconds to permit a specified number of buses to proceed. This type of TSP is often combined with a short queue-jump lane on the near-side of the intersection and/or a receiving lane on the far-side of the intersection. It is a particularly effective technique when the roadway narrows by a lane on the far-side of the intersection, when left turns are required at a busy intersection, and when buses exit from a transit terminal to a highly-trafficked street. No special equipment is required on buses. The in-pavement induction loop is directly connected to the traffic signal controller, with the latter invoking the bus only phase at the next opportunity. The detection equipment generally distinguishes the type of vehicle being detected by vehicle length. If vehicles other than buses are permitted in the detection zone (e.g. semi-trailer truck, school bus, lined-up automobiles), the TSP can be accidentally enacted.

- **Active TSP** permits the adjustment of traffic signals in real time to allow buses to proceed through intersections with minimal delay. Automated vehicle location (AVL) technology is required to be deployed on the bus fleet. When the AVL system reports the location of a bus at a designated location a short distance upstream of a signalized intersection, the predicted arrival of the bus at the intersection is conveyed to the traffic signal controller, and appropriate adjustments to the traffic signals are made to enable the bus to pass through the intersection. Various types of signal timing adjustments can be executed, including green extension, red truncation, phase shifting, etc. As the bus exits the intersection, its location is confirmed and the traffic signal controller resumes its regular signal timing plan.

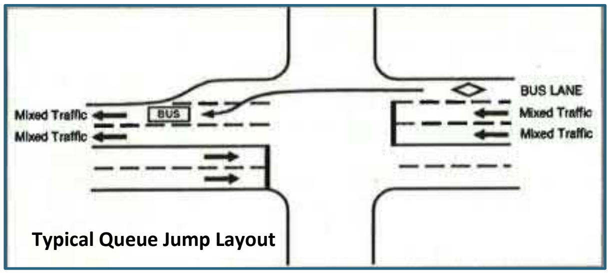
Data communications between the bus and the traffic signal controller can be performed locally or centrally. In the local configuration, the AVL system on the bus communicates directly with the traffic signal controller at the intersection. In the central approach, requests for signal priority are managed automatically by a traffic management centre or transit control centre and communications are conveyed from the central site to the traffic signal controller. While special transit signal displays are not generally required for Active TSP, they can be used in special circumstances when other traffic needs to be controlled by a red signal while a bus makes a turn across traffic while the signal priority is in effect.

A particular advantage of Active TSP is that "conditional priority" protocols can be established. For example, signal priority can be restricted to only those buses that are running late (schedule adherence is continually monitored by the AVL system) or to only those buses that have a minimum passenger load (if the bus has an Automatic Passenger Counting system that monitors passenger load in real time). Active TSP works best when stops/stations are located on the far-side of intersections.

The type of TSP to deploy depends on a number of factors: the nature of the signal priority required, the presence of AVL technology on buses, the technical capabilities of the traffic signal controller at the intersection, the degree of integration of the controllers with a traffic management centre or transit control centre, the volume of buses operating on cross-streets or on the same street in the opposite direction, stop/station siting at the intersection, and the physical layout of the intersection (e.g., the presence or absence of a congestion-free approach lane to the intersection).

8.3.1.3 Physical Measures

Physical measures involve additions or modification to the transportation infrastructure to provide priority for transit. These can include new transit-only facilities such as busways, transit malls, and transit by-pass lanes; or modifications to existing rights-of-way such as road widening to create bus lanes, intersection rearrangements and right turn channelization to create queue jumps/receiving lanes, and sidewalk extensions to remove bus bays (thereby allowing buses to operate in a travel lane without weaving).



Typical Queue Jump Layout

8.3.2 Approach to Identify Transit Priority Measures for the BRT Route Network

The proposed TPMs for the BRT route network were selected in accordance with the following general principles:

- TPMs should allow buses to bypass known places of traffic congestion and to realize benefits in operating speeds and service reliability;
- TPMs should be arranged in a logical manner to enable buses operating on a BRT route to take advantage of several TPMs along the route path to maximize travel time savings;
- In locations where different types of TPMs can be deployed, those that provide higher ratios of benefits to implementation/operating costs are preferred;
- TPMs are to be deployed within existing street rights-of-way; acquisition of property for TPMs is to be minimized; and

- TPM initiatives already planned and/or approved by HRM are to be included for the BRT route network, where appropriate.

To identify appropriate TPMs for the BRT route network, the following approach was used:

1. In those street segments in which on-street parking lanes exist, the conversion of those parking lanes to bus lanes is proposed;
2. In those street segments in which there is more than one travel lane in each direction and in which the street right-of-way cannot be widened, the conversion of one traffic lane per direction (usually the curb lane) to a bus lane is proposed;
3. In those street segments in which there is more than one travel lane in each direction, in which traffic volumes are high, and in which there is available property within the right-of-way to reconfigure or widen the street, a road widening to create bus lane(s) is proposed;
4. In those street segments in downtown Halifax in which there is one travel lane in each direction and/or limited space for curbside uses, reconfiguration to a "transit oriented street" (as described in Section 5.2.3.2) is proposed;
5. In those street segments in suburban areas in which there is one travel lane in each direction, BRT service is proposed to operate in mixed traffic;
6. In those street segments where bus lanes transition to general traffic lanes, where buses are required to move through a congested intersection, or where buses are required to weave across several traffic lanes to make left turns, TSP and/or queue jump measures at intersections are proposed.

8.3.3 Recommended Transit Priority Measures for the BRT Route Network

While the detailed specification and design of TPMs is a task to be undertaken during a later stage of design for BRT in Halifax, the recommended types of TPM for the proposed BRT route network are outlined below, followed by illustration of their proposed locations in **Figure 19**.

Note that, while these TPMs are to be developed as part of the BRT network, buses operating on non-BRT routes should also be eligible to use them. Improving the speed and reliability of all transit service, including BRT and conventional routes, provides value to transit passengers and operating economy for Halifax Transit.

8.3.3.1 Regulatory and Physical Measures

Concurrent with the *BRT Study*, a *Transit Priority Study* was undertaken by WSP to identify the potential for bus lanes on Bayers Road, Young Street, Robie Street, and Gottingen Street.

A list of the opportunities for regulatory and physical measures identified during the *BRT Study* and the physical measures identified by the *Transit Priority Study* is listed in **Table 22**.

Table 22: Opportunities for Regulatory and Physical Transit Priority Measures

Study	Street	Between	Modification	To Create
BRT Study	Lacewood Drive	Lacewood Terminal and Evans Avenue	Street widening	Curbside Bus Lanes
	Joseph Howe Drive	Dutch Village Road and Abbott Drive	Street widening	Curbside Bus Lanes
	Mumford Road	Joseph Howe Drive and Ashbury Street	Street widening	Queue Jump

Study	Street	Between	Modification	To Create
		Ashbury and Olivet Street	Reconfiguration	Bus Lanes
	Alderney Drive	Mill Lane and Portland Street	Street widening	Curbside Bus Lanes
	Portland Street	Prince Arthur Avenue and Penhorn Terminal; and Baker Drive and Portland Hills Terminal	Street widening	Curbside Bus Lanes
	Barrington Street	Cogswell Street and South Street	Reconfiguration	Transit Oriented Street
	Spring Garden Road	Barrington Street and Robie Street	Reconfiguration	Transit Oriented Street
	Lower Water Street	Terminal Road and Historic Properties	Reconfiguration	Transit Oriented Street
Transit Priority Study	Bayers Road/Young St.	Connaught Street and Robie Street	Street widening	Curbside Bus Lanes
	Robie Street	Young Street and Cunard Street	Under Review	Bus Lanes
		Cunard Street and South Street	Reconfiguration	Bus Lanes
		South Street and Inglis Street	Under Review	Bus Lanes
	Gottingen Street	North Street and Cogswell Street	Reconfiguration	Northbound bus lane during AM/PM Peaks

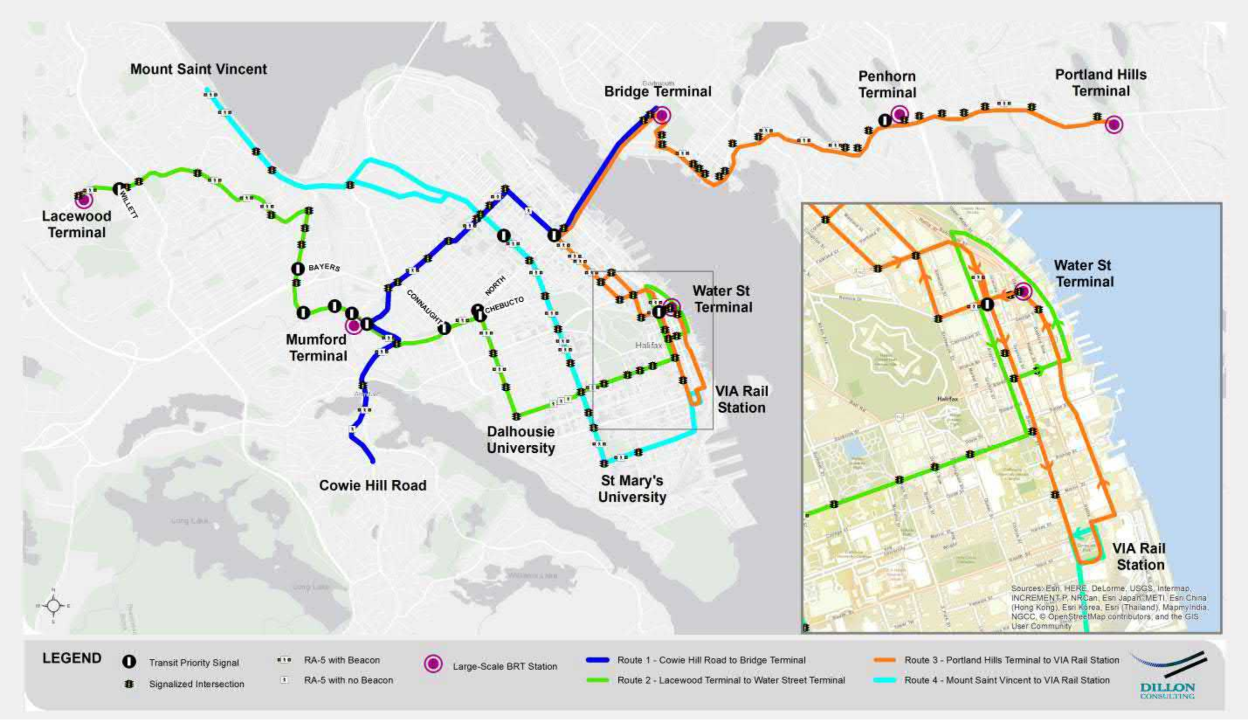
8.3.3.2 Transit Signal Priority

While the development of a comprehensive TSP strategy will require a collaborative approach by HRM's transit, traffic signalling, and traffic operations staff, there are a number of locations on the recommended BRT network where Actuated TSP would assist bus operations. Shown in **Figure 18**, these intersections include:

- Lacewood Drive at Willett Street;
- Joseph Howe Drive at Bayers Road;
- Joseph Howe Drive at Mumford Road;
- Mumford Road at Olivet Street;
- Mumford Road at Romans Avenue (existing at Mumford Terminal);
- Mumford Road at Coleman Street;
- Chebucto Road at Connaught Avenue;
- Oxford Street at Chebucto Road;
- Oxford Street at North Street;
- Robie Street at Almon Street;
- Gottingen Street at North Street;
- Barrington Street at Duke Street; and
- Portland Street at Green Village Lane.

Note that all existing signalized intersections on the proposed BRT network are also shown in **Figure 18**. During the development of a comprehensive TSP strategy for HRM, it may be determined that TSP might be effective at some of these other intersections. Furthermore, there are a significant number of pedestrian crossings on the proposed BRT routes; should BRT service experience consistent delays at these locations, some consideration to installing half-signals should be given.

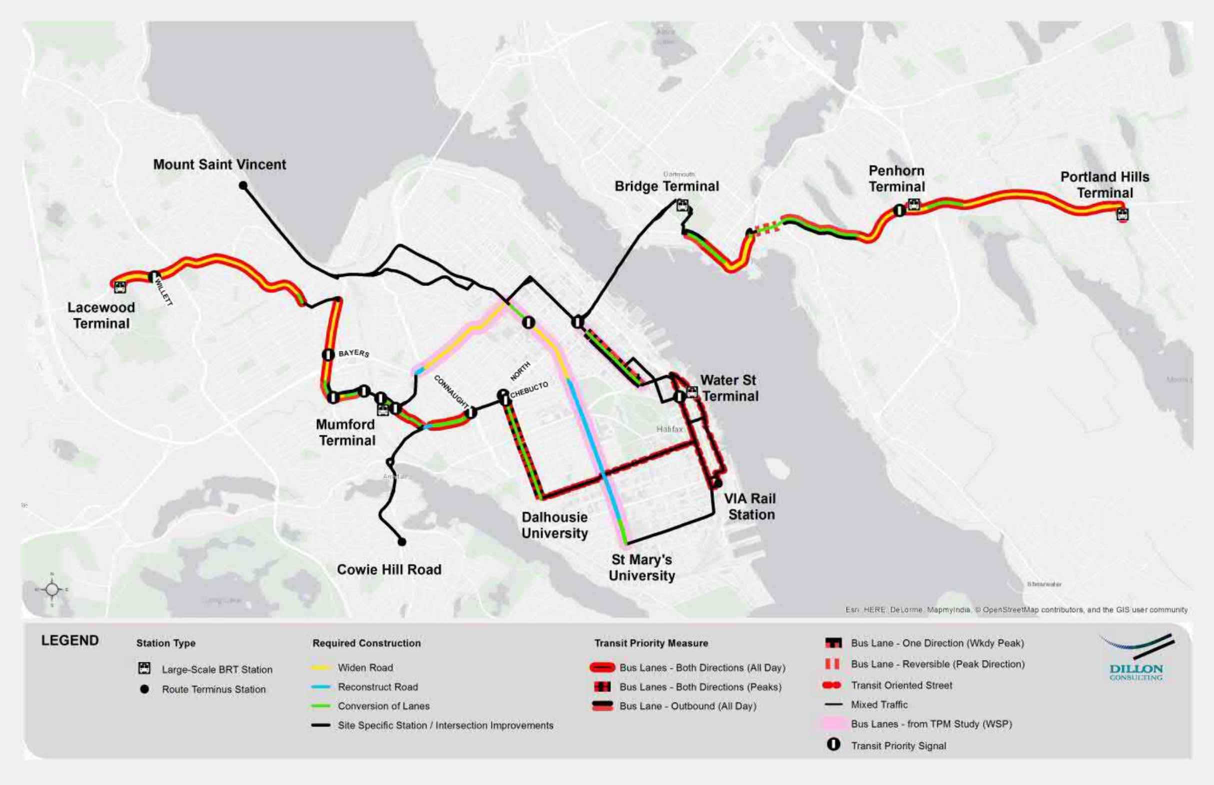
Figure 18: Proposed Intersections for Transit Signal Priority



8.3.3.3 Summary of Recommended Transit Priority Measures

Figure 19 illustrates the recommended TPMs (regulatory measures, transit signal priority, and physical measures) for the proposed BRT network.

Figure 19: Recommended Transit Priority Measures



Drawings of a representative set of these TPMs, in plan view and cross-section, are contained in **Appendix E**.

8.4 BRT Operating Plan

The proposed BRT network forms a distinct service type, supplementing established *Corridor, Local, Express, Regional Express, Rural,* and *Ferry* services within the overall MFTP network currently being implemented by Halifax Transit.

A key feature of BRT is frequent operation throughout the day on all days of the week, thus enabling spontaneous use by passengers without the need to consult published schedules.

Recommended BRT service spans and headways by schedule type are shown in **Table 23**.

Table 23: Recommended BRT Service Levels

Schedule Type	Time Period	Headway (minutes)
Weekday	05:30 – 07:00	30
	07:00 – 22:00	10
	22:00 – 01:00	20
Saturday	05:30 – 08:00	30
	08:00 – 22:00	10
	22:00 – 01:00	20
Sunday/Holiday	06:30 – 09:00	30
	09:00 – 18:00	10
	18:00 – 01:00	30

Based on these service levels, resource requirements (annual revenue bus hours, number of peak vehicles) were estimated for the proposed BRT network. These estimates were based on the following assumptions:

- Existing running times in Halifax Transit's Fall 2017 schedule were used to create preliminary running times in each direction for each major segment of each of the four BRT routes;
- The preliminary running times were reduced for each route segment, where appropriate, to reflect faster operating speeds resulting from wider station spacing for BRT (compared to stop spacing for other service types) and utilization of the transit priority measures identified above by BRT vehicles. This resulted in running time savings of 20%, on average;
- Recovery times at route terminals were assumed to be 10% of terminal-to-terminal running times;
- Articulated buses were assumed to operate on each BRT route; and
- Maximum capacity per articulated bus was assumed to be 70 passengers (55 seated + 15 standees) during weekday peak periods and 55 passengers (55 seated + 0 standees) during off-peak periods.

The estimate of resource requirements for the proposed BRT network is summarized in **Table 24**. Note that these estimates are for revenue service only; they do not include provision for pull trips to/from garages.

Table 24: Resource Requirements for Proposed BRT Network

Route	From	To	One-Way Route Length (kms)	Peak Vehicles	Annual Revenue Bus Hours			
					WKD	SAT	SUN	Total
1	Cowie Hill Road	Bridge Terminal	7.5	6	25,500	5,194	4,526	35,220
2	Lacewood Terminal	Water Street Terminal	10.5	9	38,625	7,871	6,789	53,285
3	Portland Hills Terminal	VIA Rail Station	14.6	11	47,250	9,646	8,494	65,390
4	Mount Saint Vincent	VIA Rail Station	9.8	8	34,125	6,970	6,231	47,326
Total			**42.4**	**34**	**145,500**	**29,680**	**26,040**	**201,220**

8.5 Technology Components

Halifax Transit is currently implementing a comprehensive suite of technology-enabled features across its network to improve operational efficiency and to enable seamless travel by passengers. **Table 25** summarizes the status of the various technology initiatives that are particularly applicable to BRT.

Table 25: Halifax Transit - Technology Initiatives Applicable to BRT

Category	Technology	Major Functions	Status	Extended to BRT?
On-Board Systems	***Automated Vehicle Location (AVL)***	• Tracks buses in real-time • Bus Operator – Control Centre communications • Schedule Adherence monitoring • Location data for real-time passenger information systems	• Deployed on complete fleet	• On all BRT vehicles
	Next Stop Announcements/ Displays	• Announces/displays next stop on route after a bus leaves a stop	• Deployed on complete fleet	• On all BRT vehicles
	External Bus Destination Announcements	• Destination is announced on external speaker of bus when a bus arrives at a bus stop	• Deployed on complete fleet	• On all BRT vehicles
	Surveillance System	• Video and audio recording for passenger and operations safety	• Deployed on complete fleet	• On all BRT vehicles
	Automatic Passenger Counters (APC)	• Records number of boardings/alightings at each bus stop on each bus trip • Permits effective monitoring of passenger demand and service productivity	• Deployed on complete fleet	• On all BRT vehicles
	Automated Fare Collection (AFC)	• Phase 1: – Validating fareboxes • Phase 2: – Alternative payment methods	• In progress	• On all BRT vehicles • Potential for off-board fare payment at Large-Scale Stations
Passenger Information Systems	***Variable Message Signs***	• Displays scheduled and real-time bus departure times by route	• Installed at major transit terminals	• At all BRT stops/stations • Should display real-time information • Information for connecting routes should be displayed at major transfer stations
	Traveller Information Systems	• Web and mobile trip planners • Web and mobile route and stop schedule lookup	• Deployed	• For all BRT service
Transit Signal Priority (TSP)	***Actuated TSP***	• Transit signal displayed when bus detected on near-side of intersection	• Deployed in several locations (e.g., Windmill Rd at Wright Ave.)	• At locations identified above in **Section 8.3.1.2**
	Active TSP	• Automatic adjustment of traffic signals in real time to minimize delays to buses	• Planned	• As part of a comprehensive TSP strategy developed by HRM

8.6 BRT Identity and Branding

The proposed BRT network will deliver high quality public transit throughout the day on all days of the week featuring frequent service, well-appointed stops and stations at major destinations, transit priority measures to ensure fast reliable operations, state-of-the-art vehicles, and ITS applications for real-time passenger information and operations management.

Within the context of the overall transit network, BRT will form a new service type, complementary to and integrated with the major service types outlined in the *Moving Forward Together Plan*. For the network to serve the public well, the role of each of these service types needs to be easily comprehended. While a distinct image is an integral element of BRT, any service branding strategy should be comprehensive in scope to cover all components of the transit network.

The constituents of an effective branding strategy for transit include:

- Visual Elements – logical use of wordmarks, logos, colours, and route identifiers; and
- Locational Elements – where the visual elements are applied.

While Halifax Transit has an established organizational wordmark[4] and a blue/yellow/white colour palette used on buses and information media, a branding strategy can be developed from these to create a coordinated visual identify for each of BRT and the other service types. An example approach is outlined in **Table 26.**

Table 26: Visual Elements of Branding Strategy

Service Type	Wordmark/Logo		Route Identification	
	Type	Colour	Route # Series	Route Colours?
BRT	Distinct	Distinct	A, B, C, D….	Yes
Corridor	Distinct	Distinct	1 – 19	No
Local	Distinct	Distinct	20 – 99	No
Express	Distinct	Distinct	100 – 199	No
Regional Express	Distinct	Distinct	300 – 399	No
Rural	Distinct	Distinct	499 – 499	No
Ferry	Distinct	Distinct	500 – 599	No

For example, variations of the existing Halifax Transit wordmark/logo could be created for each service type by adding the service type name and displaying the amended wordmark/logo in a distinct colour for each. While it is a good practice to designate a series of route numbers for each service type, BRT routes can also be designated by colour (e.g., Blue Line, Green Line, etc.) to reinforce the rapid transit nature of the service.

Once they have been established, a branding strategy's visual elements can be incorporated into the transit system's physical infrastructure and communication channels. Examples of opportunities to apply each service type's branding elements are shown in **Table 27**.

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[4] HALIFAX TRANSIT

Table 27: Locational Elements of Branding Strategy

Location	Branding Opportunities by Service Type						
	BRT	Corridor	Local	Express	Regional Express	Rural	Ferry
At Bus Stops:							
Bus Stop Signs	√	√	√	√	√	√	√
Maps/Route/Schedule Posters	√	√	√	√	√	√	√
Shelter Graphics	√						
At Stations and Terminals:							
Station Identification Signs	√						
Bus Stop Signs	√	√					
Wayfinding Signs	√	√					
Maps/Route/Schedule Posters	√	√	√	√	√	√	√
Shelter Graphics	√		√	√	√	√	√
Canopy Graphics	√		√	√	√	√	√
Decorative Fencing Graphics	√						
Bench Graphics	√						
Waste/Recycling Receptacles	√						
On Buses:							
Destination Signs	√	√	√	√	√	√	√
Vehicle Livery Graphics							
On Printed Communications:							
Route Maps	√	√	√	√	√	√	√
Route/Schedule Brochures	√	√	√	√	√	√	√
Information Pamphlets	√	√	√	√	√	√	√
Print Advertisements	√	√	√	√	√	√	√
On Electronic Communications:							
Website	√	√	√	√	√	√	√
Mobile Apps	√	√	√	√	√	√	√
Real-Time Display Information	√	√	√	√	√	√	√
Electronic Advertisements	√	√	√	√	√	√	√

Note that, for BRT in particular, it is important that its branding be applied consistently in instances where the public interacts with the service, whether that be in the information that customers use to learn about the service and plan their trips, at the places where they access the service, and on the vehicles on which they ride.

Note that it is not recommended that specialized graphics be applied to buses for BRT. While some transit systems do brand a set of buses for exclusive use on BRT services, it does impose restrictions on service scheduling. In particular, it reduces the capacity for interlining BRT buses with other service types. As Halifax Transit realizes significant operational economies through interlining, any specialized branding of buses would tend to compromise those efficiencies. Alternative strategies that Halifax Transit can deploy to distinguish BRT services include:

- Assigning a specific bus type to BRT service (e.g., articulated vehicles);
- Dispatching the newest buses in the fleet to BRT service; and
- Relying on a well-developed route identification system for display in bus destination signs.

9.0 Cost Estimates

This section summarizes capital cost and operating cost estimates, in 2018 dollars, for implementation of the proposed BRT network. It is important to note that the plan documented in this report is a conceptual one to guide HRM in the development of a BRT network over time. The conceptual planning work did not include the development of functional or detailed designs and, consequently, the cost estimates reported here are “order of magnitude” ones for reference during future planning.

9.1 Capital Costs

9.1.1 BRT Vehicles

Based on the operating plan outlined in **Section 8.4**, the BRT service would require a peak fleet of 34 vehicles. Assuming a 20% spare ratio, the total fleet requirement is 41 articulated buses. **Table 28** summarizes the fleet acquisition costs for each BRT route. For planning purposes, the following unit costs were assumed: $800,000 for a diesel articulated bus; $1,200,000 for a hybrid articulated bus.

Table 28: Capital Costs - BRT Fleet

Route	From	To	Peak Vehicles	Capital Costs by Vehicle Type	
				Diesel Articulated	Hybrid Articulated
1	Cowie Hill Road	Bridge Terminal	6	$4,800,000	$7,200,000
2	Lacewood Terminal	Water Street Terminal	9	$7,200,000	$10,800,000
3	Portland Hills Terminal	VIA Rail Station	11	$8,800,000	$13,200,000
4	Mount Saint Vincent	VIA Rail Station	8	$6,400,000	$9,600,000
Sub-Total			**34**	$27,200,000	$40,800,000
Spare Vehicles			7	$5,600,000	$8,400,000
Total			**41**	**$32,800,000**	**$49,200,000**

9.1.2 BRT Station Costs

Representative costs were developed for each of the station types described in **Section 8.2.1**. Note that these costs are for each platform at each station. For example, a station at a street intersection will usually have two platforms, one in each route direction.

Typical costs for each station type were estimated for the following components: excavation and grading; concrete foundations; electrical and communications; paving; shelters, signage and site furniture; and landscaping.

Note that these are representative costs only and assume that there would be sufficient space for installation of all components at a station site. In practice; however, it is likely that there will be insufficient space to accommodate all amenities at certain locations. Consequently, the estimates listed here provide an upper bound on the development costs for a complete installation of each station type. At station locations where such an installation is not possible, the station costs will be lower.

A summary of the station development costs for each station type is shown in **Table 29**. Estimated cost components for each station type are listed in **Appendix F**.

Table 29: Capital Costs - BRT Stations

Station Type	No. of Stations	No. of Platforms	Estimated Cost per Platform
Enhanced On-Street Stop	46	86	$280,000
Medium-Scale Station	9	22	$646,000
Large-Scale Station	6	11	$2,100,000

9.1.3 Transit Priority Measures

Capital costs were estimated for Actuated Transit Signal Priority installations and for the proposed Regulatory and Physical Measures that would create bus lanes and queue jumps in the BRT network (see **Section 8.3**).

9.1.3.1 Actuated Transit Signal Priority

Actuated TSP is proposed at 13 intersections. Typical costs at each intersection include installation of loop detectors, cabling, upgrades to the traffic signal controller, installation of a transit signal display, and signage. At a typical cost of $200,000 per intersection (including provision for an upgraded signal controller, signal display, bus detection equipment, cabling, and labour), the total estimate for **Actuated TSP is $2,600,000**.

As discussed in **Section 8.3**, a comprehensive TSP strategy is planned to be developed by HRM. An element of that strategy will be Active TSP, which will provide further benefits to BRT operations. Cost estimates for Active TSP would be prepared as part of that initiative.

9.1.3.2 Regulatory and Physical Measures

The Regulatory Measures primarily involve the conversion of existing traffic lanes to bus-only lanes. The costs associated with these include line painting, pavement markings, and signage.

The Physical Measures involve additions or modifications to a number of street segments and intersections to provide priority for BRT vehicles. The costs associated with these include removals, paving, curbs, sidewalks, and signage.

Note that the preparation of costs estimates for the reconfiguration of some streets in downtown Halifax (Barrington, Spring Garden Road, Lower Water Street) to be “transit oriented” was beyond the scope of this study; such estimates are dependent on the completion of a functional design studies for those initiatives.

Estimates of the capital costs for these works is summarized in **Table 30**. Note that estimates for works on Bayers/Young, Robie, and Gottingen were developed by others in a separate Transit Priority Study.

Table 30: Capital Costs: Regulatory and Physical Transit Priority Measures

Study	Street	Between	Modification	Estimated Cost
BRT Study	Lacewood Drive	Lacewood Terminal and Evans Street	Street widening	$3,387,000
	Joseph Howe Drive	Dutch Village Road and Abbott Drive	Street widening	$1,011,000
	Mumford Road	Joseph Howe Drive and Olivet Street	Reconfiguration	$ 185,000

Study	Street	Between	Modification	Estimated Cost
	Alderney Drive	Mill Lane and Portland Street	Street widening	$4,220,000
	Portland Street	Prince Arthur Avenue and Penhorn Terminal;	Street widening	
		Baker Drive and Portland Hills Terminal	Street widening	
Transit Priority Study	Bayers Road/Young St	Connaught Street and Robie Street	Street widening	$4,800,000
	Robie Street	Young Street and Chebucto Road	Under Review	$5,800,000
		Chebucto Road and South Street	Reconfiguration	
		South Street and Inglis Street	Under Review	
	Gottingen Street	North Street and Cogswell Street	Under Review	$200,000

9.2 Annual Bus Operating Costs

The estimate of annual revenue bus hours prepared in **Section 8.4** was used to develop an estimate of annual bus operating costs. Based on Halifax Transit's existing ratio of non-revenue bus hours (primarily for pull and deadhead trip) to revenue bus hours, the number of revenue bus hours identified in **Section 8.4** was increased by 10% to determine annual total bus hours for the BRT network.

The annual total bus hours were then multiplied by a unit cost of $110 per bus hour. This unit cost, used by Halifax Transit to calculate service costs, includes provision for bus operator costs, fuel, bus servicing, service supervision, vehicle maintenance, facilities maintenance, and administration costs.

Annual total bus hours and annual bus operating costs are shown in **Table 31** for each combination of route and schedule type.

Table 31: Annual Bus Hours and Bus Operations Costs

Route	From	To	Annual Bus Hours and *Annual Bus Operating Costs*			
			WKD	SAT	SUN	Total
1	Cowie Hill Road	Bridge Terminal	28,000 *$3,080,000*	6,000 *$660,000*	5,000 *$550,000*	39,000 *$4,290,000*
2	Lacewood Terminal	Water Street Terminal	42,000 *$4,620,000*	9,000 *$990,000*	7,000 *$770,000*	58,000 *$6,380,000*
3	Portland Hills Terminal	VIA Rail Station	52,000 *$5,720,000*	11,000 *$1,210,000*	9,000 *$990,000*	72,000 *$7,920,000*
4	Mount Saint Vincent	VIA Rail Station	38,000 *$4,180,000*	8,000 *$880,000*	7,000 *$770,000*	53,000 *$5,830,000*
Total			**160,000** ***$17,600,000***	**34,000** ***$3,740,000***	**28,000** ***$3,080,000***	**222,000** ***$24,420,000***

It is important to note that, coincident with the implementation of the BRT routes, it would be necessary to make adjustments to the rest of the MFTP network, where appropriate, to remove routing duplications and to arrange convenient connections with the BRT routes. Potential adjustments could include changes to route alignments, service spans, and service frequencies. Operating savings resulting from these changes would be reallocated to the operating costs for the BRT services.

10.0 Implementation Strategy

There are two general approaches to the implementation of BRT:

- In situations where the BRT system is to operate primarily on new separated infrastructure (such as exclusive transitways in new rights-of-way, or median busways), the BRT infrastructure (running way, stations, etc.) necessarily needs to be constructed first before BRT service can be implemented; and
- In situations where the BRT system is to operate primarily in the existing street network, then the BRT service can be implemented initially with infrastructure elements (stations and transit priority measures) added over time as funding becomes available.

As the system proposed in this study is “in-street” BRT, the latter approach is applicable for HRM. By implementing service on the BRT routes as early as possible, prime attributes of BRT (comfortable fast travel at frequent intervals throughout the day) are made available to the public at the outset, enabling ridership levels to build quickly. Station and transit priority infrastructure can be added at opportune times to enhance these attributes, in combination with other major capital works and/or when funding is made available.

Following an organizational commitment to go forward with BRT, there are several key steps to take with this “service first” approach. These are described below with accompanying actions, where appropriate, outlined for consideration during the implementation process.

STEP 1: Develop Visual Identity for BRT and Other Service Types

BRT ELEMENT: Image and Identity

DISCUSSION:

At all stages of the implementation process, effective communications with elected officials, stakeholders, the public, and staff about BRT (its distinguishing elements, its benefits, its role in the overall transit network, its implementation schedule, etc.) is paramount. It is important that an identity for BRT be established at the outset and that it be used in a consistent manner before, during, and after implementation.

ACTION:

a) *That the Visual Elements of a branding strategy for each of the MFTP service types, including BRT, as outlined in **Section 8.6**, be developed. This includes a coordinated set of wordmarks, logos, colours, and route identifiers for each service type for use in all communications about BRT.*

STEP 2: Develop an Implementation Schedule for the Proposed BRT Routes

BRT ELEMENT: Operating Plan

DISCUSSION:

The operating resources for the proposed BRT network, as outlined in **Section 9.2**, are significant. If sufficient resources are available, then the concurrent implementation of all four BRT routes at the service levels outlined in **Section 8.4** is recommended. The network connectivity provided by the four routes will build ridership more quickly than if fewer routes were in operation.

As part of the detailed service planning, it would be necessary to make adjustments to the rest of the MFTP network, where appropriate, to remove routing duplications and to arrange convenient connections with the BRT routes. Potential adjustments could include changes to route alignments, service spans, and service frequencies. If a BRT route duplicates much of an existing Express route, for example, then consideration should be given to cancellation of the Express service. Operating savings resulting from these changes can be reallocated to the planned BRT service.

If operating funding is not available for the concurrent implementation of the four routes, then it is recommended that the two routes operating to downtown Halifax, Route 2 (Lacewood Terminal – Water Street Terminal) and Route 3 (Portland Hills Terminal – VIA Rail Station), be implemented initially. These two routes serve high demand corridors in Halifax and Dartmouth, respectively, and jointly provide coverage of major transit terminals (Lacewood, Mumford, Lower Water Street, Barrington & Duke, Bridge, Penhorn, and Portland Hills) and of major destinations in downtown Halifax.

The subsequent implementation phase could include either or both of Route 1 (Cowie Hill Road – Bridge Terminal) and Route 4 (Mount Saint Vincent – VIA Rail Station). It is recommended that the order be coordinated with the phased implementation of planned transit priority measures on Bayers/Young (for Route 1) and on Robie (for Route 4).

ACTION:

b) *That operating plan options be developed for the scenarios described above: concurrent implementation of all four BRT routes and a phased implementation of the BRT services. These plans would include adjustments to route alignments and service levels on MFTP routes that would accompany BRT implementation, the resource requirements (bus hours, peak vehicles) for each service type, and the overall impact on bus operations costs.*

STEP 3: Develop a Fleet Assignment Plan for BRT

BRT ELEMENT: Vehicles

DISCUSSION:

The service levels outlined in **Section 8.4** proposed that articulated vehicles be operated on the BRT routes. While new vehicles can be acquired (acquisition costs are listed in **Section 9.1.1**), it may be feasible to use the newest existing articulated buses in the fleet for BRT in the short-term, especially if a phased implementation of the BRT routes is decided upon. As discussed in **Section 8.6**, it is not necessary that BRT vehicles be branded with a special livery, so the initial use of the existing fleet would provide operational flexibility and permit the acquisition of new articulated vehicles for BRT to be integrated with the overall fleet replacement/expansion plan for Halifax Transit.

ACTION:

c) *That, based on the phasing plan for the implementation of BRT routes decided upon in Step 2, a plan for BRT vehicle assignments be developed for the short-term and that BRT fleet requirements be integrated with Halifax Transit's overall fleet replacement/expansion strategy.*

STEP 4: Extend Halifax Transit's Technology Features to BRT Service

BRT ELEMENT: Technology

DISCUSSION:

Based on the fleet assignment plan for BRT decided upon in Step 3, the On-Board systems described in **Section 8.5** need to be extended to the buses that will be used on BRT service. These features include AVL, Next Stop Announcements/Displays, Video/Audio Surveillance, and APC. Existing buses that may be initially used for BRT service are already outfitted with these systems. If new buses are to be acquired for BRT, then these technologies will need to be installed on them.

Halifax Transit's suite of Traveller Information Systems will need to be updated to include information for BRT service. These include Web and Mobile Trip Planners and real-time Web and Mobile Route and Stop Schedule Lookup features. While databases for these systems are routinely created after detailed schedules for a booking have been prepared, there may be some system updates required (e.g., use of alphabetic route identifiers for BRT routes may or may not be consistent with existing database structures).

Halifax Transit plans to introduce an Automated Fare Collection (AFC) system that utilizes alternative payment methods. Because it is important that BRT service be fully integrated with the overall MFTP network, the same fare technology should be used on all vehicles for all service types. Many passengers will use a combination of BRT routes and other MFTP routes to complete their trips. Consequently, the fare structure for BRT should be the same as used for the rest of the system.

At busy stations, off-board fare payment can be used to speed the boarding of BRT vehicles. Until the new fare collection system is installed, boarding levels can be monitored during the first year of BRT operation (using data generated by APC) to determine those locations where off-board fare collection might be warranted. The design of the AFC will need to consider how best to accommodate this function.

ACTIONS:

d) *That Halifax Transit's existing On-Board technologies be installed on any new buses acquired for BRT service;*

e) *That the Traveller Information Systems be updated to provide real-time information for BRT; and*

f) *That, during the first year of BRT operation, boarding levels be monitored at stations to determine locations where off-board fare payment might be warranted, and that design requirements to accommodate this function be considered for the planned Automated Fare Collection system.*

STEP 5: Develop a Phased Plan of Station Development

BRT ELEMENT: Stations

DISCUSSION:

The implementation schedule for the BRT routes developed in Step 2 can be used to guide the order in which stations are developed. Whether all routes are to be implemented concurrently or whether a phased approach is used with Routes 2 and 3 implemented initially, a number of existing transit terminals are common to each (Lacewood, Mumford, Barrington & Duke, Bridge, Penhorn, and Portland Hills). While Lacewood and Bridge terminals are of recent construction, there are plans to replace Mumford, and significant upgrades to Barrington & Duke, Penhorn and Portland Hills are required. Consequently, initial investments should focus on upgrades to these major facilities in coordination with BRT development.

Additional priorities for station investment include major transfer points in the BRT network (e.g., Gottingen & North, Young & Robie, Spring Garden & Robie), connections with other travel modes (e.g., Water Street Terminal, Alderney Ferry Terminal in Dartmouth, VIA Rail Station), and major destinations (e.g., Dalhousie/Saint Mary's/Mount Saint Vincent post-secondary institutions, Coburg/Spring Garden, etc.).

While as many as possible of the features illustrated in the example station layouts in **Section 8.2** should be included in the stations, specific designs will depend on the space available at each site and adjacent street/utility layouts. These will directly affect the types of amenities that can be provided and actual development costs.

ACTIONS:

g) *That, in conjunction with plans to replace/upgrade existing transit terminals and based on the phasing plan for the implementation of BRT routes decided upon in Step 2, a multi-year schedule of station development be prepared; and*

h) *That preliminary design work for the highest priority stations be undertaken at the earliest opportunity.*

STEP 6: Coordinate Transit Priority Implementation with BRT Route Deployment

BRT ELEMENT: Running Ways

DISCUSSION:

Most of the Actuated Transit Signal Priority installations are recommended at intersections on which Routes 2 and 3 are proposed to operate. Furthermore, HRM is currently considering some potential re-designation of an existing traffic lane on Gottingen between Cogswell Street and North Street to a northbound bus only lane. As the installation costs for these are relatively small (in comparison to street widenings to create bus lanes), it would be advantageous to install them in conjunction with the deployment of Routes 2 and 3.

It is expected that the Transit Priority Study undertaken in parallel with this study will recommend a series of transit priority measures on Bayers/Young and Robie. These are streets on which BRT Routes 1 and 4 are proposed to operate. If the BRT routes are to be phased in a manner discussed in Step 2, then these routes could be deployed in conjunction with the installation of the TPMs on those streets.

Other major transit priority measures, such as street widenings to create bus lanes, can be undertaken at times when funding may become available and/or in conjunction with other major capital works.

ACTIONS:

i) *That preliminary design work for the installation of Actuated Transit Signal Priority installations on the streets on which Routes 2 and 3 are proposed to operate be undertaken at the earliest opportunity;*

j) *That, pending conclusion of deliberations on the re-designation of existing traffic lanes on Gottingen Street, any appropriate regulatory changes be implemented at the earliest opportunity;*

k) *That, following completion of the Transit Priority Study, a multi-year schedule of major capital works to create new bus lanes identified in both the Transit Priority Study and the BRT Study be prepared; and*

l) *That HRM's transit, traffic signalling, and traffic operations staff develop a comprehensive strategy for Transit Signal Priority in the region (including Passive TSP, Actuated TSP, and Active TSP).*

11.0 Future Expansion of BRT

During the Stakeholder and Public Engagement for this study, there were inquiries about how BRT in the HRM might expand beyond the initial network of four routes.

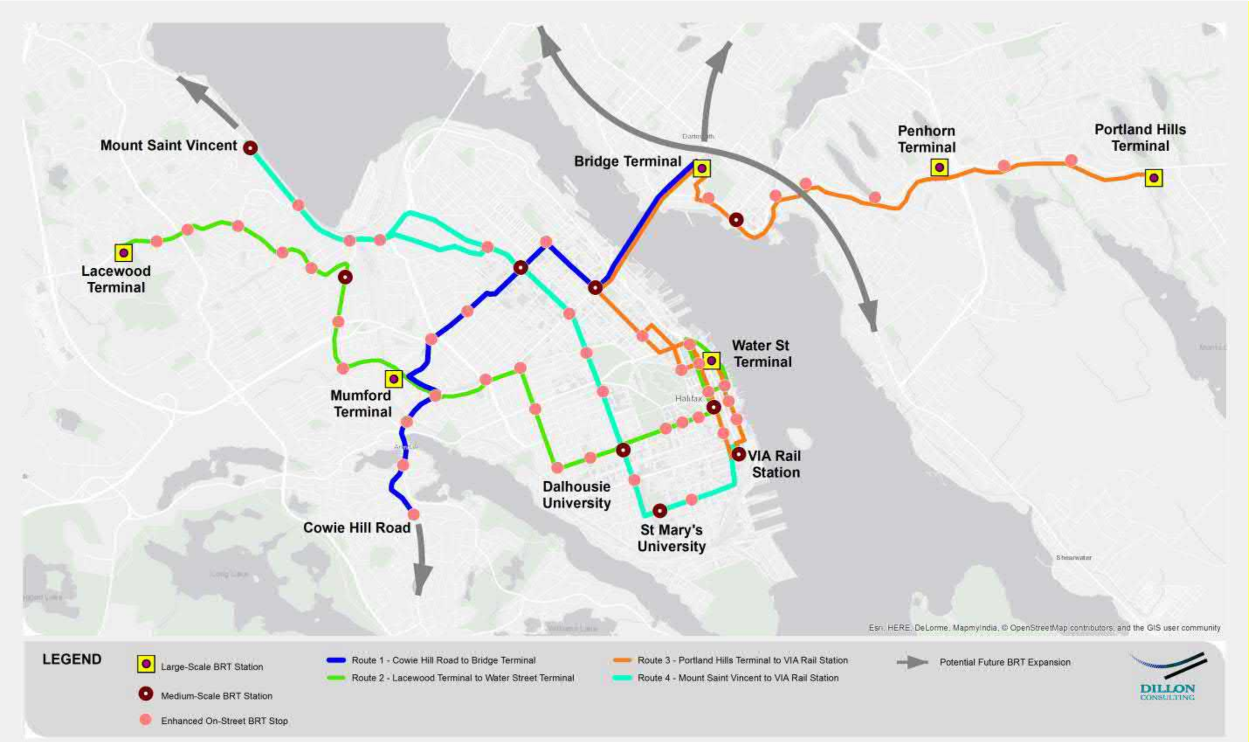
While the initial network will provide higher-order public transit that serves major destinations and intensification initiatives in established busy travel corridors, future expansion will be guided by growth in population, employment, and transit demand in other sectors of the region.

While specification of future alignments for BRT requires further analysis, it is conceivable that the BRT network could be expanded in two manners:

1. The suburban extension of initial BRT routes:
    - The southern extension of Route 1 from Cowie Hill Road to Herring Cove;
    - The northern extension of Route 1 from Bridge Terminal to Mic Mac Mall; and
    - The northern extension of Route 4 from Mount Saint Vincent to Bedford.
2. The implementation of a new north-south route in Dartmouth via Wyse, Victoria, Bridge Terminal, Alderney, and Pleasant.

These potential BRT expansion options are shown in **Figure 20**.

Figure 20: Potential Future Expansion of BRT Network



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Appendix A

BRT Overview, Industry Examples

BRT Overview, Industry Examples

BRT Definition

- Bus Rapid Transit is a rubber-tired, rapid transit service that combines stations, vehicles, running ways, a flexible operating plan, technology and a distinct identity into a high quality, customer-focused service that is fast, reliable, comfortable and cost efficient.

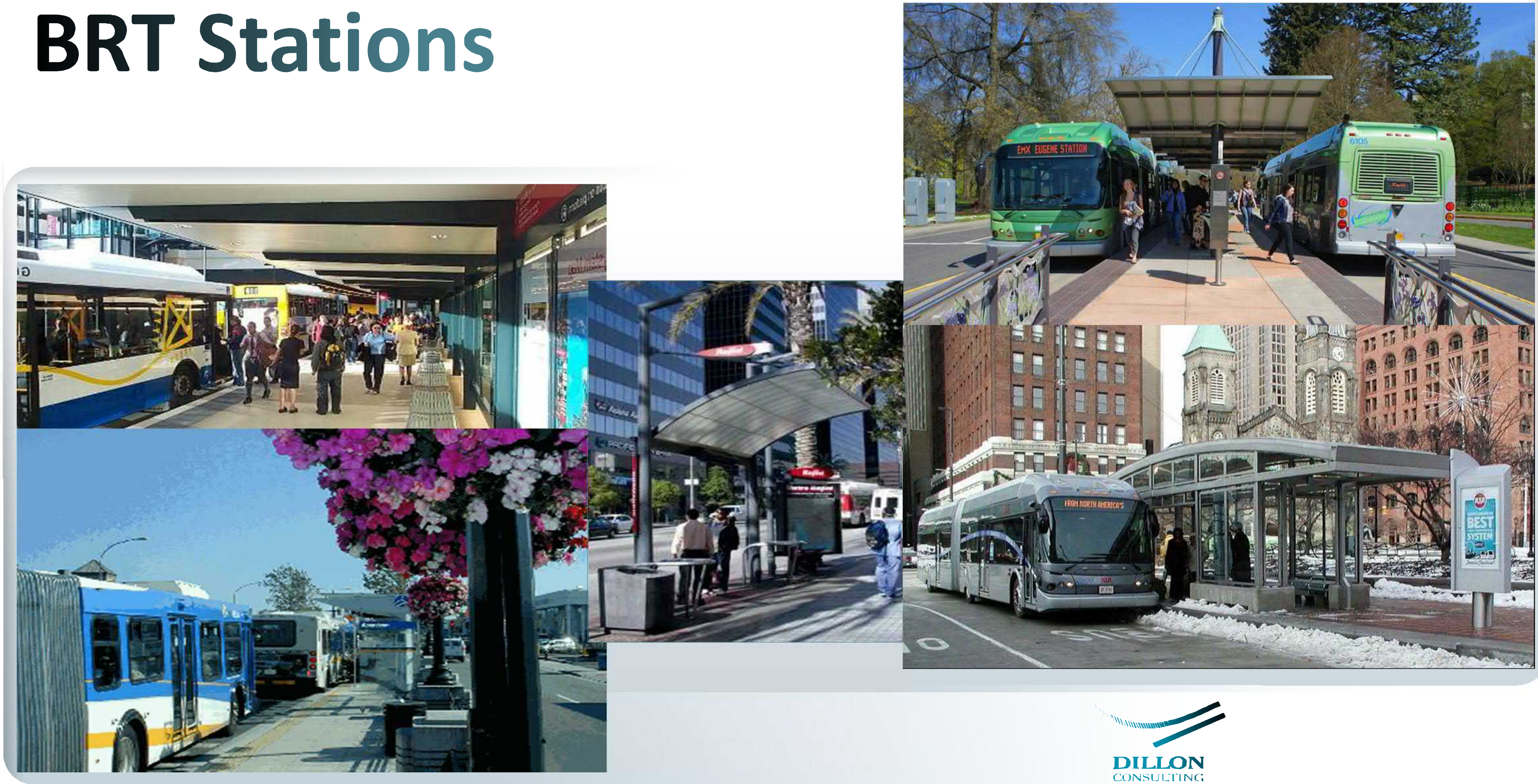
Elements of BRT

- Stations
- Vehicles
- Running Way
- Operating Plan
- Technology
  - ITS
  - Fare Collection
- Image & Identity

BRT Stations

- Spacing – 500 m to 1.5 km
- Permanent, weather protected
- Customer information & amenities
- Safety & Security
- System or service identity & image
- Integrated with surroundings
- Access – walk, bike, transit, taxi, park & ride, kiss & ride

BRT Stations



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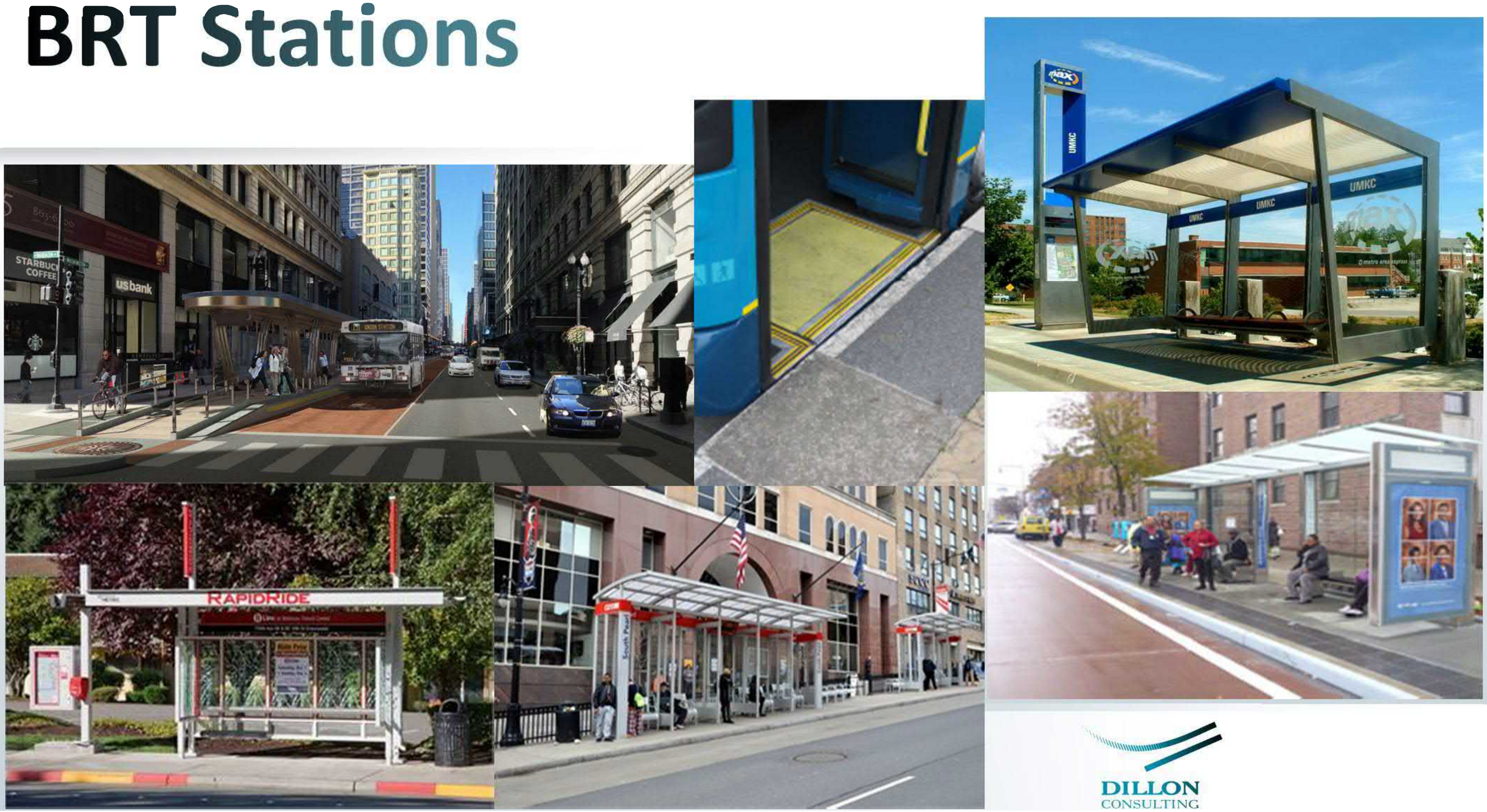
BRT Stations



Vehicles

- Rubber-tired
- Low Floors, accessible
- Multiple Wide Doors
- Comfortable & Attractive Seating & Interior
- High Capacity
- Advanced Information
- Unique Identity
- Alternative & Advanced Technology
- Environmentally friendly

BRT Vehicles

BRT Vehicles

BRT Vehicle Interior

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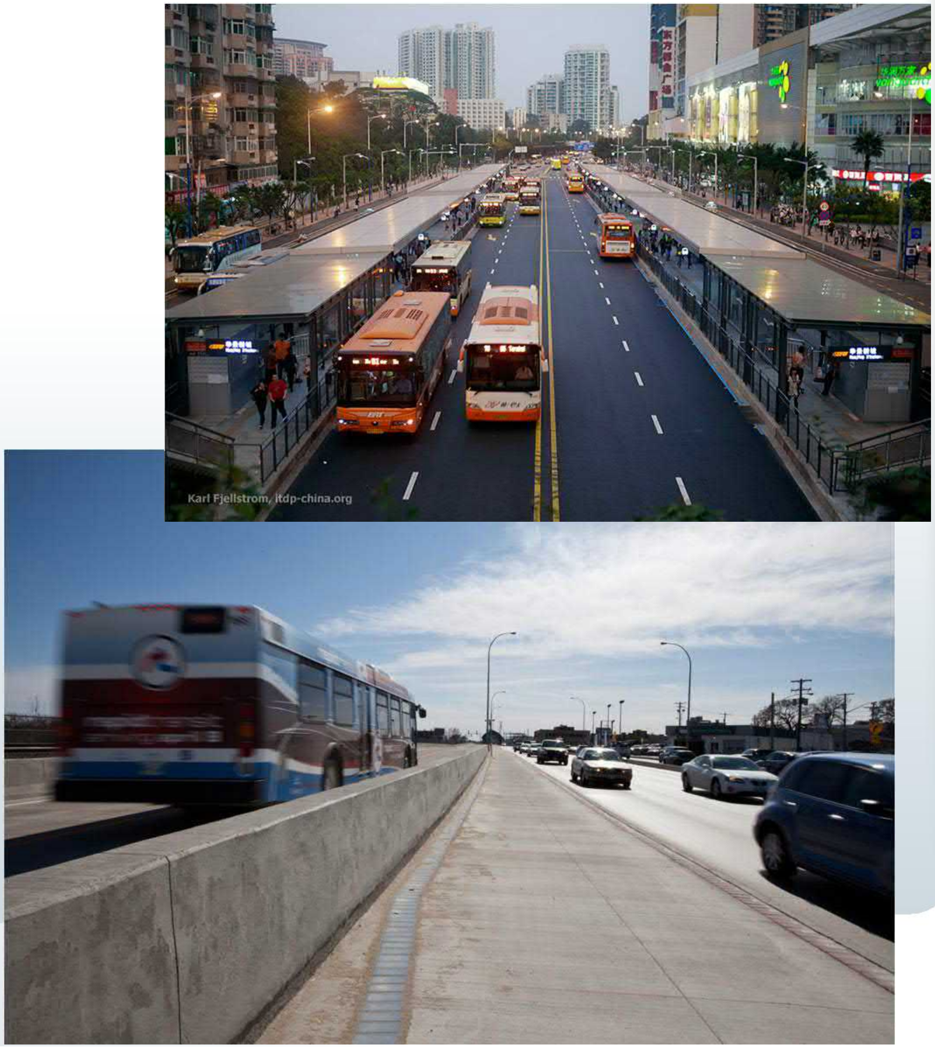
BRT Running Ways

1. Exclusive Busways – grade separated or at-grade
2. Dedicated Lanes
3. Mixed Traffic with Priority



Karl Fjellstrom, itdp-china.org

BRT Running Ways

BRT Running Ways

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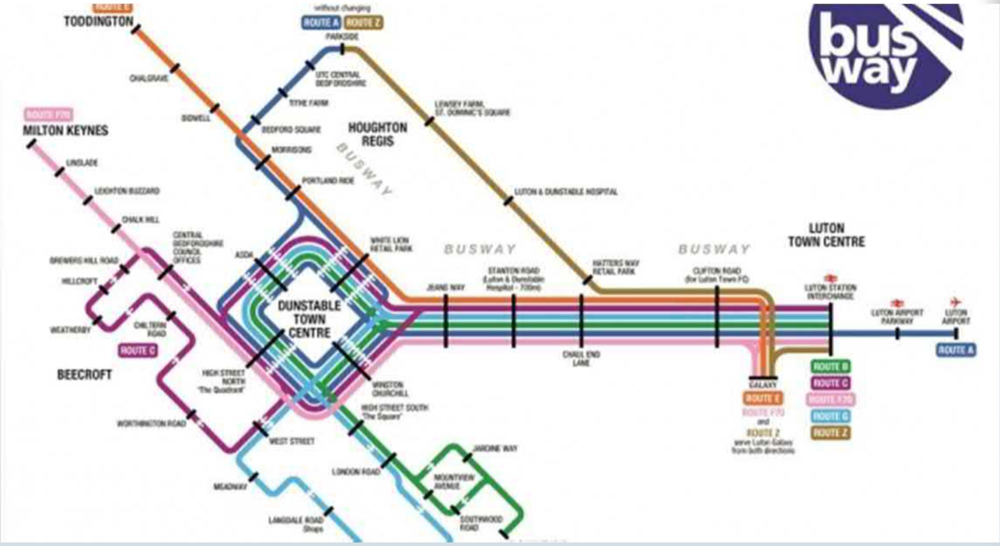
BRT Running Ways

Webster Av / E 178 St

Operating Plan

- A Variety of Service Alternatives
  - All Stops Routes
  - Peak Direction Limited Stop Services
  - Counter Peak Limited Stop Services
  - Local Arterial/Feeder Services



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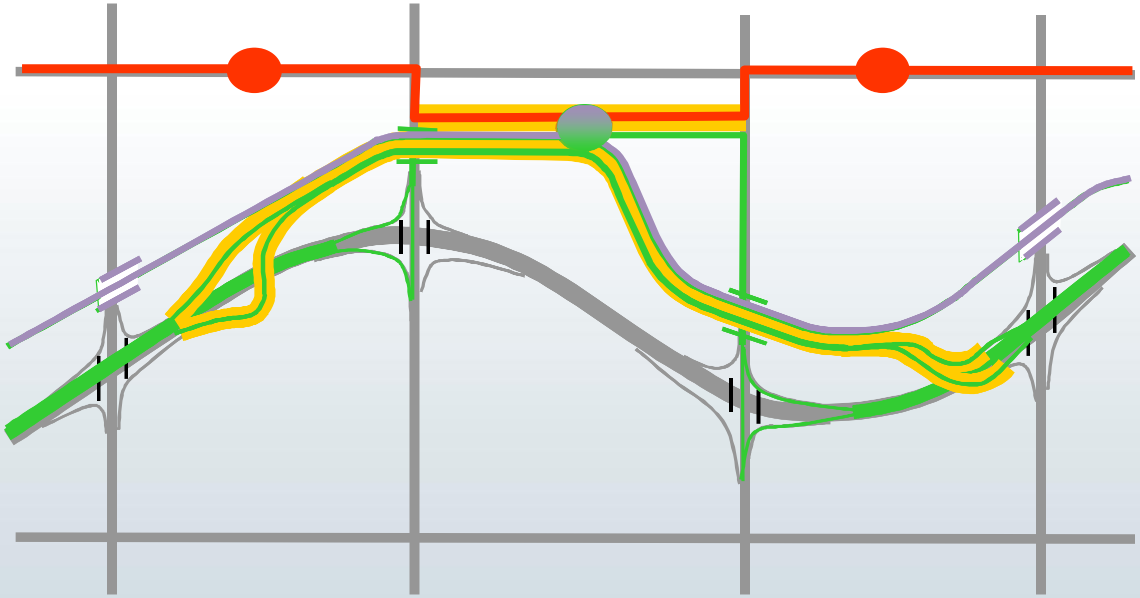
BRT Level of Service

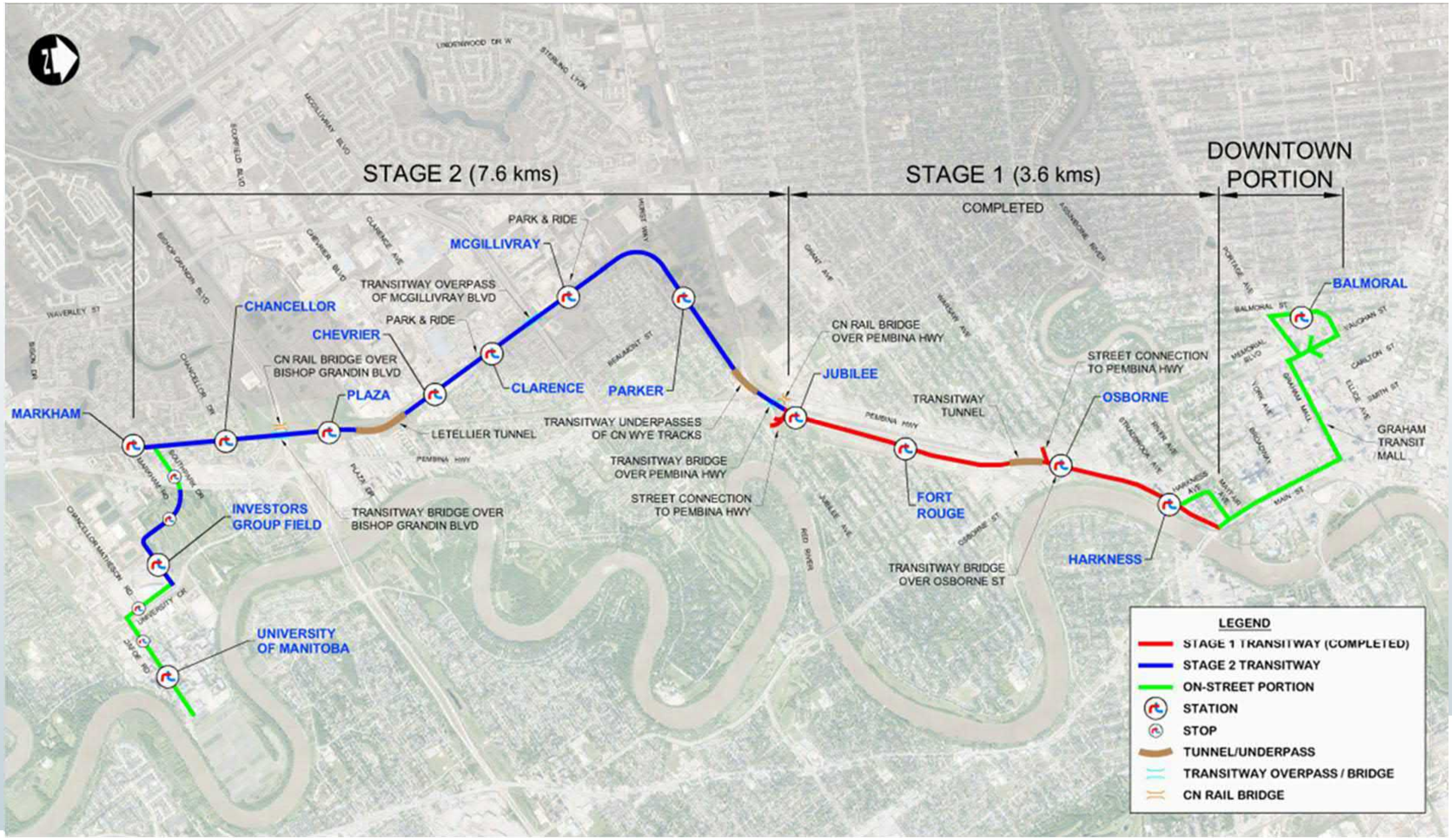
- Speed
  - Max 80-100 km/h, Average Commercial 30-50 km/h
- Frequency
  - 8-10 minutes or better during peaks
  - No schedule required
- Reliability
  - “On time every time”
  - Consistent running time throughout the day and throughout the year

BRT Can Be Built In Stages



LRT replaces the BRT all-stops

BRT Staging – Winnipeg Example



BRT Fare Collection

- Pre-paid Tickets & Passes
- Multi-Door Boarding
- Proof of Payment
- Off-Board Fare Collection
- Smart Cards
- Integrated with rest of transit system

BRT Fare Collection

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Intelligent Transportation Systems

- ITS = Technology to Enhance Convenience, Safety & Reliability
  - AVL
  - Customer Info
  - Signal Priority
  - Safety & Security
  - Maintenance
  - Communications

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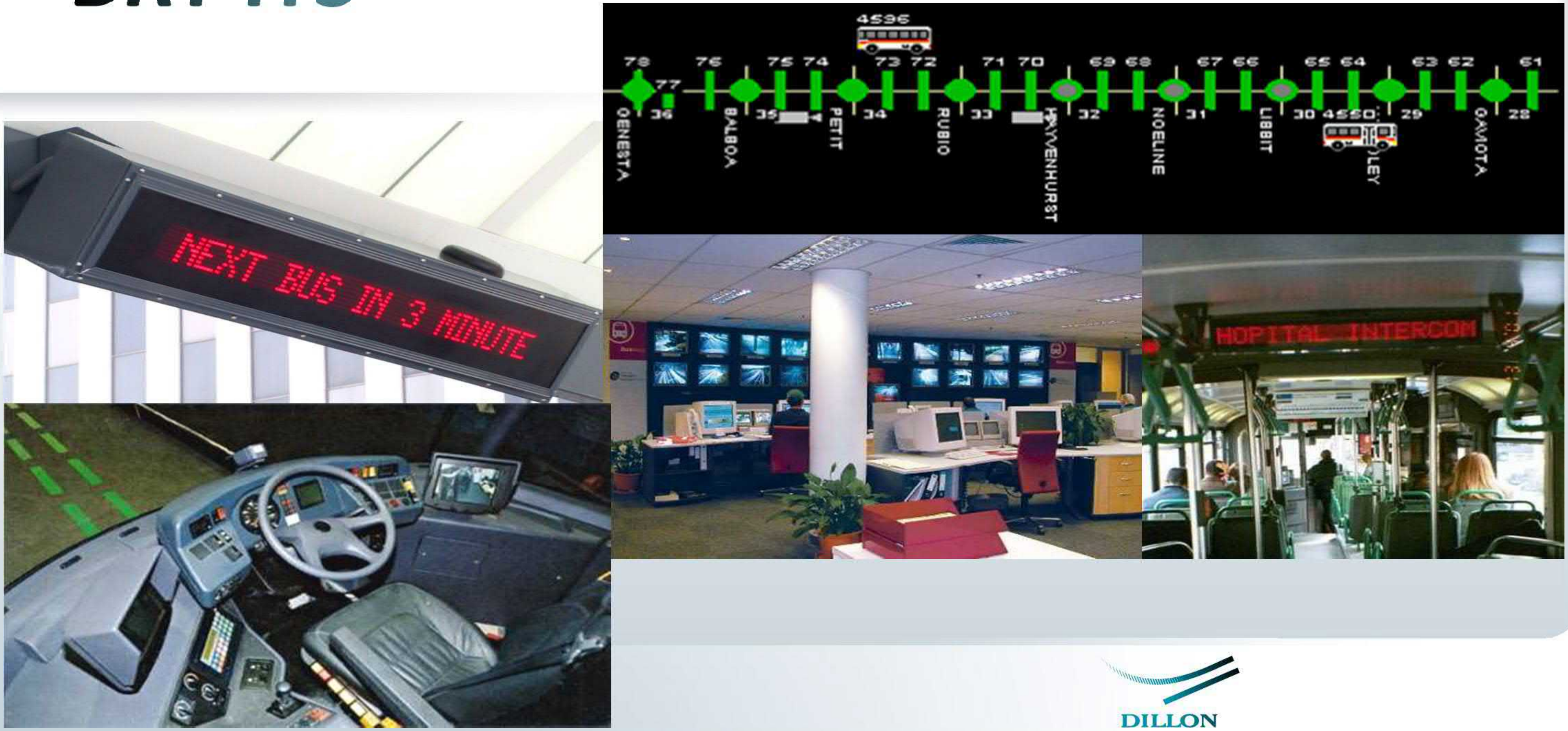
BRT ITS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30
4550
29
28
QENESTA
BALBOA
PETIT
RUBIO
HAVENHURST
NOELINE
LIBBIT
LEY
GAVIOTA
NEXT BUS IN 3 MINUTE
HOPITAL INTERCOM

BRT Image & Identity

TRANSITWAY

MAX

rapidtransit

BRT
Belfast Rapid Transit

BRT ROUTE

EmX
a service of LANE TRANSIT DISTRICT

busway

T-WAY

Brampton
züm
See you sooner.

BRT

Swiftway
Bus Rapid Transit

Rapibus
Système rapide de transport en commun pour l'Outaouais

BRT Image & Identity

BRT Image& Identity

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Different Types of BRT

- BRT System/Facility
  - BRT Facilities are used as the basis for the systematic development of a wide variety of services (Ottawa, Winnipeg, Pittsburgh, Mississauga, Brisbane)
- BRT Service/Route
  - A single BRT route is developed on either a separate facility or in mixed flow traffic (York Region, Brampton, Los Angeles, Kansas City)

Why BRT is Popular

- Corridors not dense enough for rail
- Provides higher-order service over conventional bus
- Incremental Implementation
- Operational Flexibility
- Potentially Lower Costs
- High Capacity
- Encourages Land Use Change
- Speed & Reliability
- Ridership
- Air Quality

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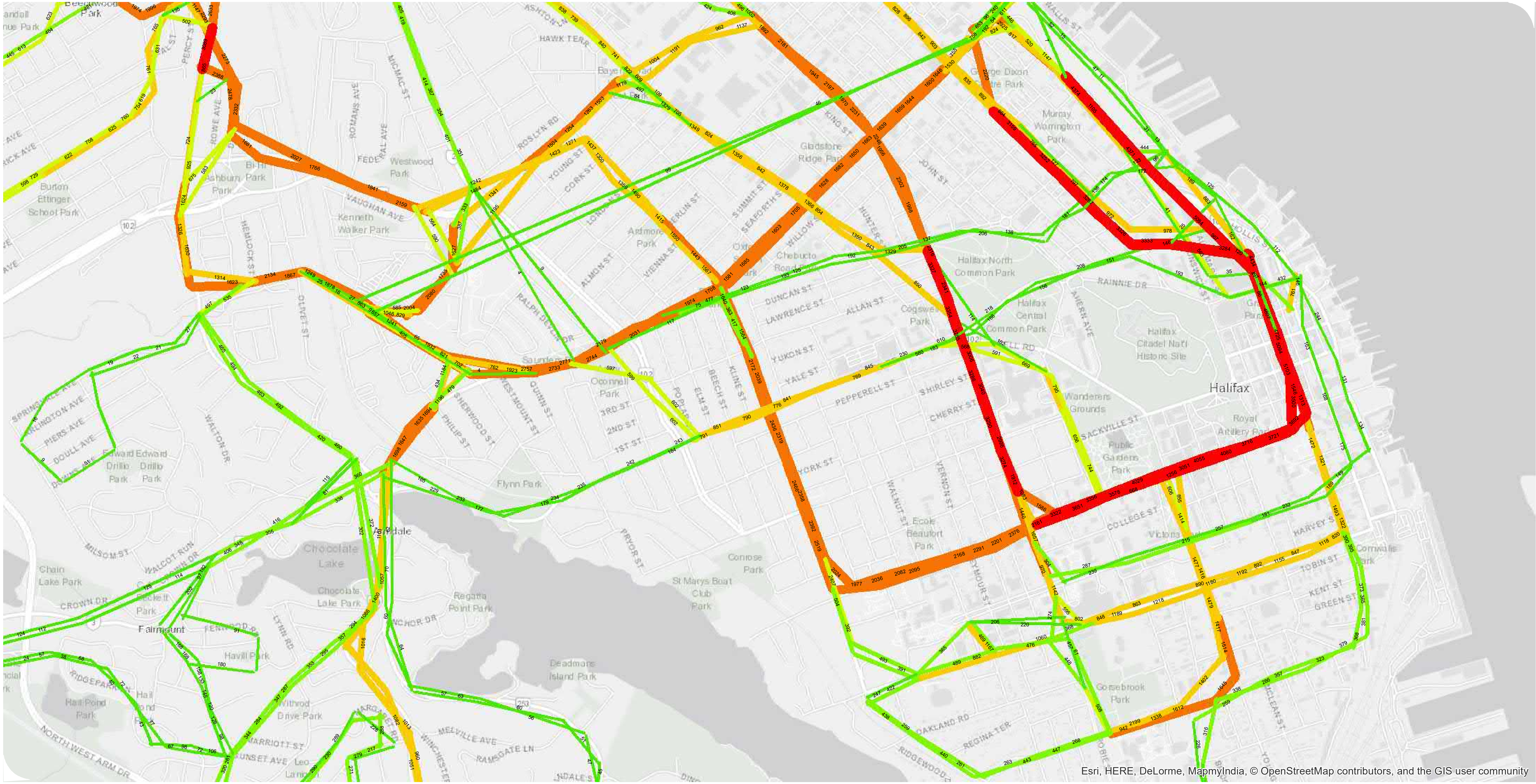
Appendix B

Maps of Existing Transit Demand Patterns



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LEGEND

Passengers per Day (No long links)

🟥 3000 - 5200
🟧 1500 - 3000
🟨 750 - 1500
🟨 500 - 750
🟩 250 - 500
🟩 0 - 250

Existing Transit Demand
(1: Center Area)

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LEGEND

Passengers per Day (No long links)

🟥 3000 - 5200
🟧 1500 - 3000
🟨 750 - 1500
🟨 500 - 750
🟩 250 - 500
🟩 0 - 250

Existing Transit Demand
(2: Northwest Area)

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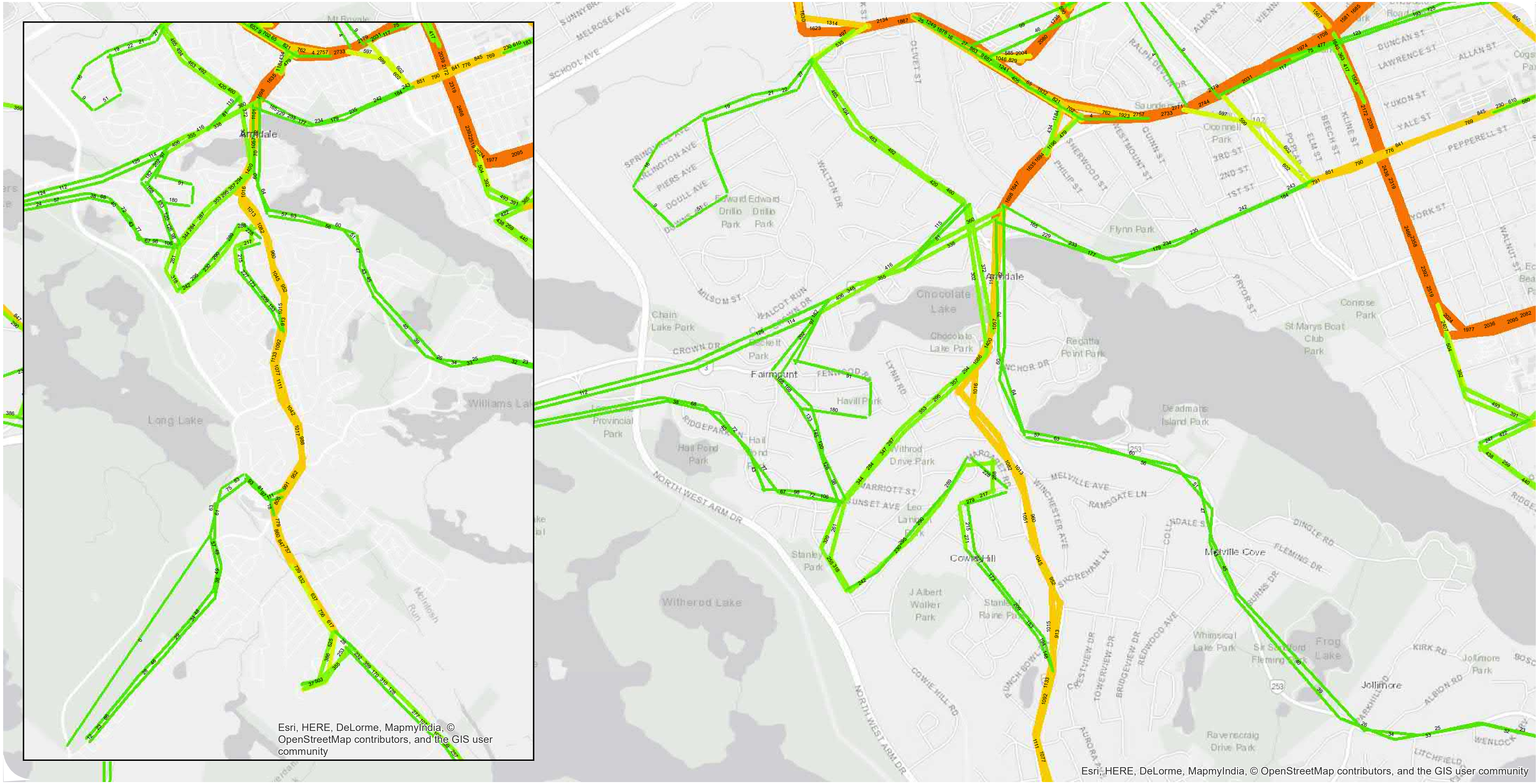

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LEGEND

Passengers per Day (No long links)

🟥 3000 - 5200

🟧 1500 - 3000

🟨 750 - 1500

🟨 500 - 750

🟩 250 - 500

🟩 0 - 250

Existing Transit Demand
(3: Southwest Area)

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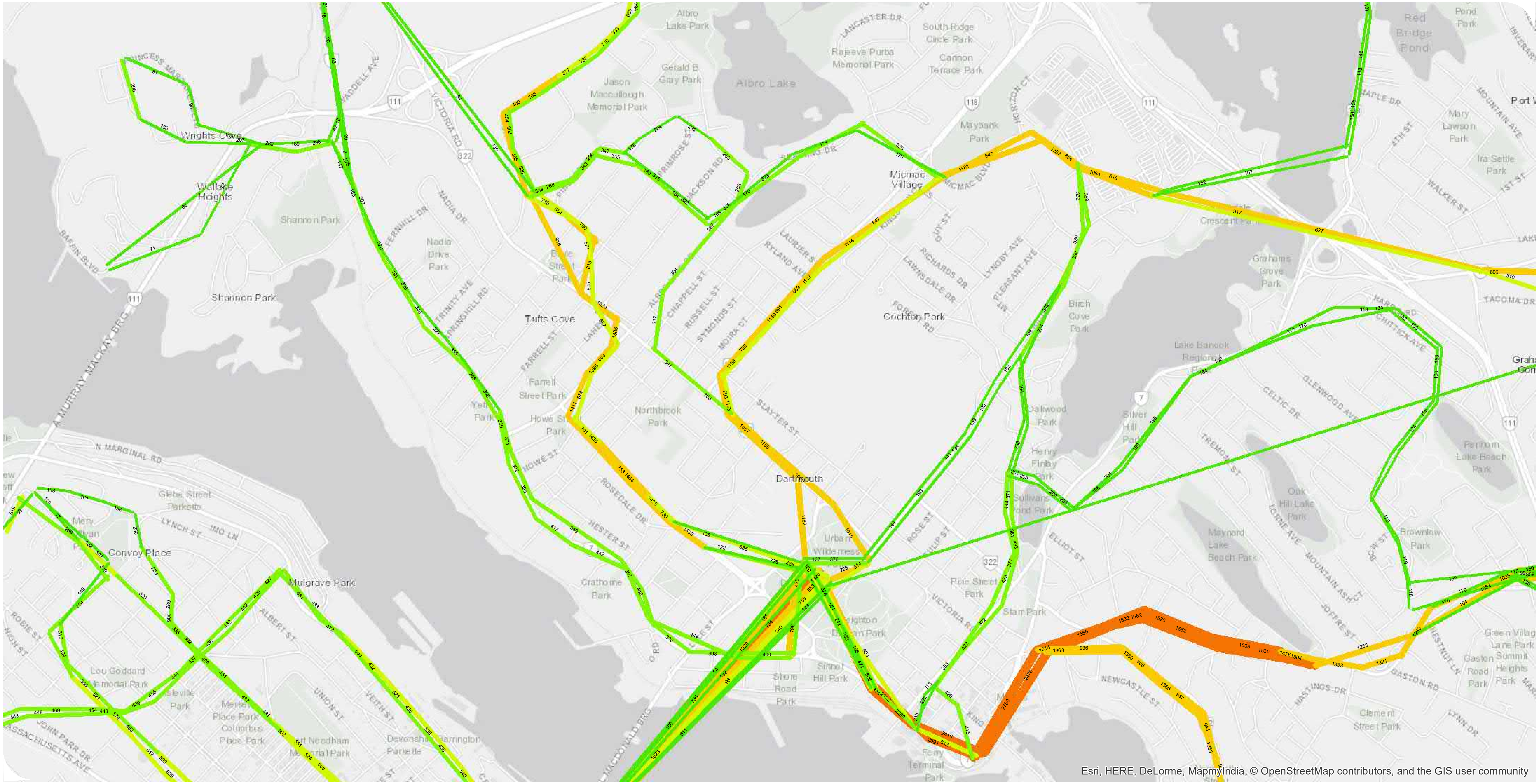

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LEGEND

Passengers per Day (No long links)

🟥 3000 - 5200
🟧 1500 - 3000
🟨 750 - 1500
🟨 500 - 750
🟩 250 - 500
🟩 0 - 250

Existing Transit Demand
(4: Northeast Area)

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LEGEND

Passengers per Day (No long links)

🟥 3000 - 5200

🟧 1500 - 3000

🟨 750 - 1500

🟨 500 - 750

🟩 250 - 500

🟩 0 - 250

Existing Transit Demand (5: Southeast Area)

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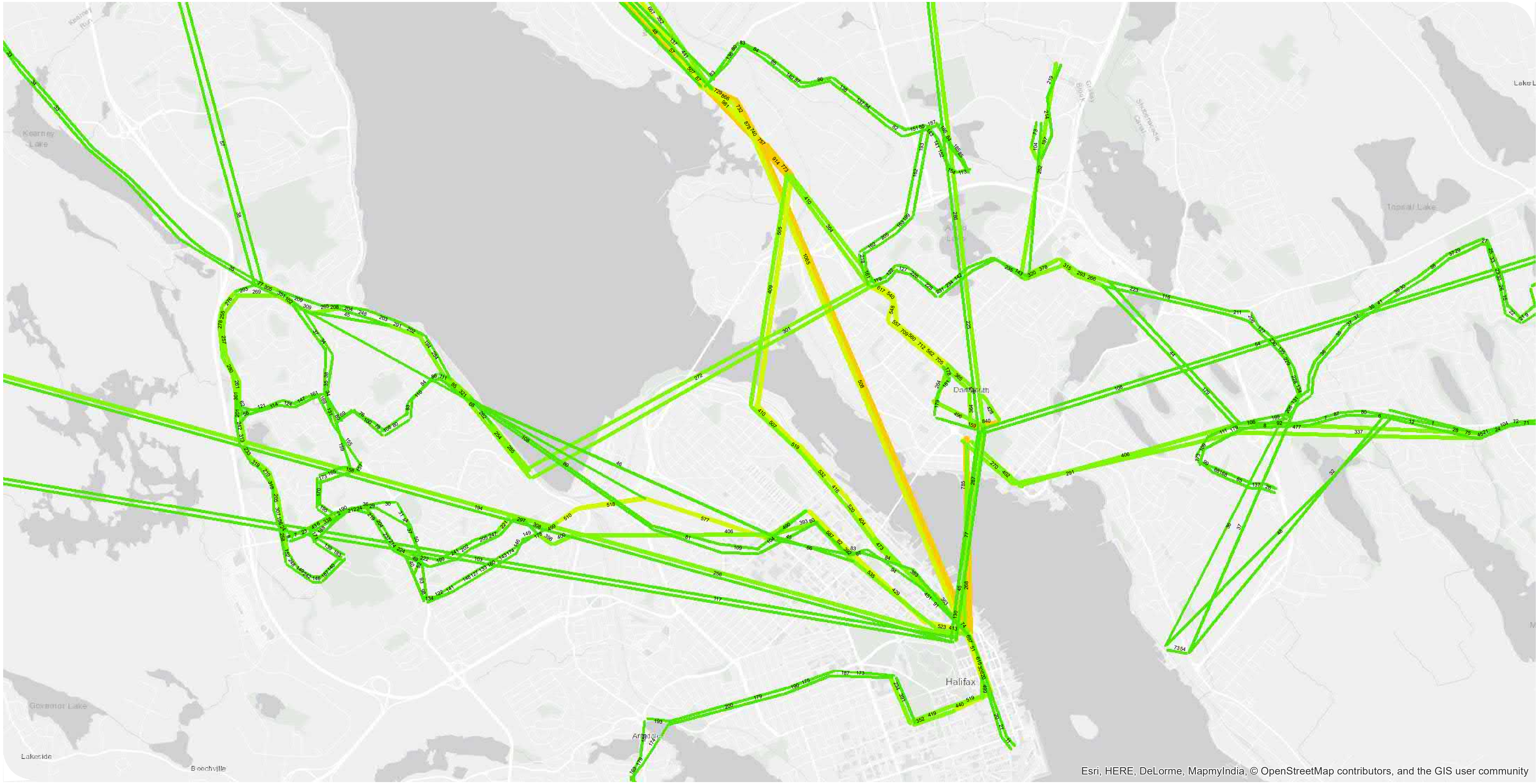

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LEGEND

Passengers per Day (Long links only)

🟥	3000 - 5200	🟨	750 - 1500	🟩	250 - 500
🟧	1500 - 3000	🟨	500 - 750	🟩	0 - 250

Existing Transit Demand
(6: Long Links)

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Appendix C

Stakeholder/Public Engagement Program

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HALIFAX TRANSIT

Bus Rapid Transit Feasibility Study

Task Report: Stakeholder / Public Engagement

March 2018 – 17-5956

Table of Contents

1.0 Overview

The Bus Rapid Transit (BRT) feasibility study assesses the feasibility and phasing of a proposed higher-order transit system in Halifax. Included in the process was an engagement program designed to gather informed feedback from the public and stakeholders. The objectives of the engagement strategy were to:

- Inform the public and stakeholders on Bus Rapid Transit, i.e., introduce the concept and show example BRT characteristics and elements;
- Show a proposed, feasible BRT network in Halifax;
- Provide examples of possible BRT system elements in Halifax, including stations, stops, and infrastructure enhancements to support higher order transit;
- Gather feedback on the proposed BRT network; and
- Gauge public interest in developing a BRT network in Halifax.

To achieve the above stated objectives, Halifax Transit sought a multiplatform engagement program consisting of an online project portal and survey, a public open house, operators' and staff feedback, and a stakeholder round table.

1.1 *Public Open House*

A Public Open House was held at the Halifax Central Library on February 12th, 2018. Two sessions were held, 2:00 p.m. – 4:30 p.m. and 5:30 p.m. – 8:00 p.m. The sessions were advertised via promoted social media postings, including Twitter, Instagram and Facebook. Additionally, it was advertised on screens at civic buildings. The session was designed 'open house' style, with the information presented on poster boards around the room, rather than a formal presentation. Halifax Transit staff and project consultants were on hand to walk participants through the material and engage in-person. Input was sought on specific boards and participants were encouraged to share their considerations on the boards or with project staff. Twelve information boards were presented and are provided in Appendix A. The boards consisted of the following information:

- A welcome poster, introducing the project and intent of the session;
- Project goal and guiding principles;
- What is BRT?

- Why BRT?
- Existing and future transit demand;
- BRT corridor screening criteria;
- Proposed BRT Network; and
- Bus Rapid Transit Elements.

Additionally, the final four boards were designed to be interactive and encouraged the following input:

- Do you think BRT is a good initiative for Halifax?
- Do you have any comments on the proposed network of BRT routes and stations?
- Which BRT route should be implemented first?
- What else should Halifax Transit consider when developing Bus Rapid Transit services?

In addition to the public, a number of media outlets were present and produced stories on the project, including The Chronicle Herald, CBC News, Global TV, CTV, Metro News, and the Halifax Examiner.

1.2 *Online Project Portal and Survey*

A project website and online survey was setup on Halifax's civic engagement platform, 'Shape Your City'. The project portal provided an overview of the project, the project's objectives, links to relevant strategic planning documents (Halifax Regional Municipality's Integrated Mobility Plan and Halifax Transit's Moving Forward Together Plan), key project milestones, a link to the information posters provided at the public open house, and an online survey. The online survey was active from February 13th – February 25th. The online survey was designed to replicate the feedback requested at the Public Open House and featured the following questions:

- Do you think Bus Rapid Transit is a good initiative for the Municipality? Why or why not?
- Do you have any comments on the proposed network for BRT routes and stations?
- Which Bus Rapid Transit route should be implemented first?
- What else should Halifax Transit consider when developing BRT?
- Did we miss anything?

1.3 *Stakeholder Engagement*

A stakeholder engagement session was held between the consulting team, Halifax Transit and local interest groups. The session was held on February 21st from 2:00 pm to 4:00 pm at HRM's offices at Alderney Landing. Participants were invited to the session directly by Halifax Transit. The session included a brief presentation providing an overview of the project and some key findings to date. Following the presentation, the stakeholders were split into two groups, where a facilitated discussion was held with the aid of maps and facilitation by members of the project team.

1.4 Operators' and Staff Feedback

In addition to public and stakeholder feedback, Halifax Transit sought input from transit operators and Halifax planning and strategic transportation planning staff. The poster boards that were provided at the public open house were provided to transit operators at a staff lounge at Halifax Transit's Burnside operations depot from February 14th – February 21st, 2018. Input was gathered via direct input on the boards, mirroring the public sessions. Additionally, consideration of the proposed BRT network and elements was sought by Halifax's planning staff, including urban design and strategic transportation planning via email.

2.0 Results

2.1 Public Open House

It is estimated that, throughout the course of the two sessions, approximately 250 people participated in the public open house. Participants were encouraged to learn more about the project by reading information provided on the boards, or being walked through the information by the project team. The results are the interactive poster boards are summarized into key findings below:

Q1. Do you have any comments on the proposed network of BRT routes and stations?

- BRT routes in Halifax should have further reach and connect Bedford, Bedford West, Bayers Lake, Burnside, Dartmouth, Sackville, Spryfield, Herring Cove, Beaver Bank, Highfield Park, Mulgrave Park and the Dockyards;
- Generally not supportive of additional bus traffic on Gottingen – opportunity to use Barrington?;
- Reduce parking areas downtown and on bus routes;
- Keep fares the same price as existing transit network;
- Robie Street is an ideal connection in/out of downtown;
- Why corridors on both Bayers and Chebucto – do one right and put all BRT on it;
- Opportunity to implement electronic payment;
- Focus on electric/ hybrid vehicles.

Q2. Which route should be implemented first?

The majority of participants indicated that Route 1: Bedford Highway to Lower Water should be implemented first, with equal responses for Routes 2, 3, and 4. Additional comments included:

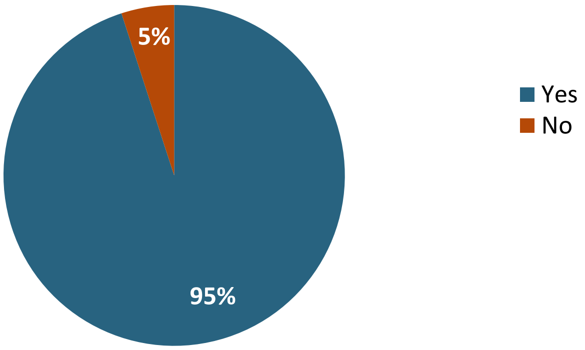
- BRT route should extend to Bedford with increased service;
- BRT should use Barrington rather than Gottingen; and

- Should promote transfer based network, rather than duplicating service (such has Route 1 and #1, should transfer at Bridge Terminal).

Q3. What else should Halifax Transit consider when developing BRT service?

- Extend BRT to all of HRM;
- Increase service hours on weekends and evenings;
- Dedicated bus lanes should also be used as High Occupancy Vehicle lanes;
- Focus on Transit Priority Measures on corridors and intersections;
- Street widening is not ideal;
- More shelters with better lighting and cleaner washrooms;
- Additional consultation should occur in local neighbourhoods;
- Adjust existing network to accommodate BRT – promote transfer-based system;
- Don't add buses to busy streets – this will simply add traffic; and
- Look beyond existing ridership; consider what BRT could be.

Q4. Do you think BRT is a good initiative for Halifax?



- Connect to further areas, not just downtown;
- Remove on-street parking on corridors rather than widening streets; and
- Make sure connections to BRT from local network is timely;

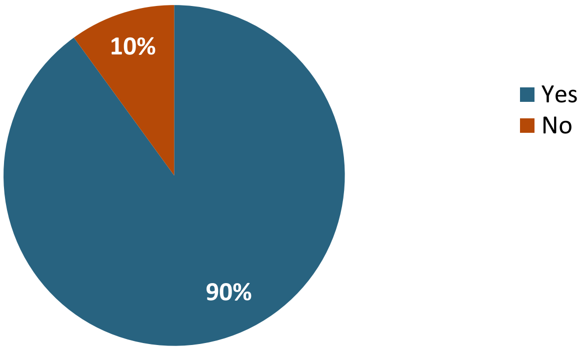
2.1.1 *Summary*

Overall, results from the public open house indicate that the public is in support of developing a bus rapid transit network in Halifax; however, there are some concerns about the proposed network. Participants indicated that BRT network should be expanded to capture a further reach beyond the core, there were a number of business owners along Gottingen present who oppose a BRT corridor on Gottingen due to loss of parking and negative impacts of the street environment due to increased bus traffic. Additionally, participants indicated that BRT should operate at an increased service level, including on weekends and evenings to make transit more appealing. People are generally supportive of infrastructure enhancements to support BRT, such as queue jumping, TPMs at intersections, bus lanes and loss of on-street parking; however, there was a mixed reaction to street widening, with people indicating that street widening should be a last resort.

2.2 Online Project Portal and Survey

The project's 'Shape Your City' project portal had 2,179 people visit the site and 560 people participated in the survey. Additionally, 856 visitors downloaded the information posters from the February 12th engagement session.

Q1. Do you think BRT is a good initiative for Halifax?



- Rapid Transit will improve transit efficiency and promote increased ridership;
- There should be fewer bus stops on BRT;
- Expand service beyond the core; and
- Infrastructure enhancements need to be included to make transit more efficient (bus lanes, loss of on-street parking, etc.)

For those who indicated that they are not supportive of BRT, the main reasons for this included: the need to improve the existing transit network first, a concern that this will increase traffic congestion (for non-buses), and the BRT network is limited in its reach.

Q2. Do you have any comments on the proposed network of BRT routes and stations?

- Too limited in geographic scope, should look to Burnside, Bedford, Dartmouth North and South;
- Will this increase congestion in the already congested core?;
- There are too many stops and 'meandering' to make this truly rapid; and

- This seems to be adding more buses to already congested routes (such as Barrington and Spring Garden).

Q3. Which BRT Route should be implemented first?
Similar to the open house results, the majority of participants indicated that Route 1 Bedford Highway to Lower Water Terminal should be implemented first.

Q4. What else should Halifax Transit consider when developing BRT?

- Focus on making it truly rapid through infrastructure enhancements;
- Service should be frequent and expanded (weekends and evenings);
- There should be a focus on developing a transfer-based network; and
- How will BRT exist alongside regular network, i.e. will BRT get stuck behind local buses in bus lanes?;

2.2.1 Summary

Overall, results from the online survey mirror those from the public open house. Participants were supportive of BRT being introduced in Halifax (90% in support). Participants noted that the proposed network was limited in its geographic scope and should connect areas beyond the core. Additionally, to make this service viable, there should be a focus on infrastructure enhancements to make it ‘rapid’ in addition to having improved service (frequency and expanded service hours). Participants were cautious that this may add congestion to an already congested core and were curious how this will interact with the existing transit network.

2.3 Operators’ and Staff Feedback

Overall, Operators and staff consider BRT a good initiative in Halifax. There were a number of key themes that emerged in their feedback that is summarized below:

Key Theme	Considerations/ Comments
Education	• “When developing new routes or revamping existing routes, instead of revising old numbers perhaps we could use colours…so colours for different lines.” • Still some confusion amongst the general public about the difference between BRT and express services • Confusion how BRT is integrated with bike system. What do other cities do?
Enforcement	• Supervisors, traffic control, HRPD enforce illegal parking • “Have the police ticket and enforce no parking zones, parking in bus stops, etc..

Key Theme	Considerations/ Comments
Technology	• Scan cards and all door boarding should be standard practice
Expansion	• Expand beyond current corridors; • Consideration should be given to building the system from the end terminals (i.e. further beyond the core); • Consider allowing taxis access to BRT priority lanes at certain parts of the day; • Consider connecting to train/bus terminal at via station. • Potential to add a circular route around peninsular Halifax • Expand to North Dartmouth • Increase efficiency of existing network
Efficiency	• Consider a transfer-based system, with smaller routes, better frequency, fewer choke points and bottlenecks, smaller terminals, with express connector routes. • Need to address key bottlenecks, such as Spring Garden, Barrington and MacDonald Bridge, potential to lose viability of rapid transit if BRT gets stuck in traffic.

2.3.1 *Summary*

Overall, operators and staff are supportive of BRT, but have noted a number of concerns with the proposed network, which may threaten its viability. These include, addressing existing bottlenecks, such as Spring Garden Road and the MacDonald Bridge. There also needs to be further consideration on educating the public on rapid transit (i.e. off-board fare collection, all door boarding), enforcement of illegal parking, and realigning bus stops (too close together). There was also some concern on the proposed 'end points' and perhaps these should be expanded to other areas, such as north Dartmouth, Larry Uteck, and Bedford.

2.4 *Stakeholder Feedback*

A number of key points and proposed alignments to the network were made at the community stakeholder session and are summarized below:

General Comments

- If some existing routes are operating at 15 minute intervals along the proposed BRT network, why not add more TPMs on these routes and sell them as "express routes" rather than BRT?;
- Consideration should be given to expand the routes;
- Address how buses will deal with local traffic congestion along corridors;

- Park n' rides should be included at end terminals;
- Scan cards and all door boarding need to be included;
- Lower Water Street terminal is not a great terminal for increased bus traffic;
- Focus on a transfer-based network;
- Reduce congestion on Spring Garden by removing buses and putting them on Sackville;
- Should we instead be branding corridors as Rapid Transit corridors that all buses take advantage of?
- Existing peninsula bus network is badly flawed and needs to be looked at before BRT can be developed; and
- Introduction of a circular, peninsula route.

Proposed alignments to BRT network

- Circular route around the peninsula;
- Instead of running the blue and green lines in parallel down Joseph Howe, Mumford, Chebucto, why not re-route the blue route along Robie to better service the North part of the peninsula?
- Feed Joseph Howe and Robie Street from Sackville and Main/ Portland Streets
- Portland Hills – Robie via McKay – SMU and MicMac – MacKay – Robie - SMU
- The rail cut should be explored again, simply widen and introduce bus lanes on both sides with access to Highway 102;
- Macdonald Bridge, make the second lane bus only, make a bus only lane on Barrington;
- Why is there nothing along Wyse Road/ Victoria?
- Why is Fairview not considered?
- Coverage on the peninsula may be redundant, lots of overlap between blue and green routes on Joseph Howe with no stops. Possibility to reroute Bedford highway route through Windsor exchange and down length of Robie.
- As an employment centre, Burnside should be a focus

Additionally, local transit advocacy group, It's More Than Buses, submitted written feedback on the proposed BRT network and elements in Halifax. Their feedback is summarized below:

Positives:

- Introducing Transit Priority Corridors;
- Introducing Off-board fare collection;
- Introducing all-door boarding;
- Transfer stations

Negatives:

Concern	Rationale
Fare Structure	If the BRT system requires an additional fare within the Urban Transit Service Boundary, it will not have the needed impact for people from all socioeconomic groups. There is limited precedent for multiple fare classes within the same geographic area. Ottawa, Toronto, and New York are just three examples where the same fare is paid for the same trip, whether on BRT, subway, local bus, or express service. We support a BRT system only where the fare for a given trip is the same whether the user is on BRT or local bus service
Retention of Local Service	In the stakeholder session for BRT, we were informed that due to the stop spacing proposed for BRT, local service would need to be preserved along the BRT corridors. Presumably, this will mean a reduced frequency for the local service, compared with that envisioned in the Moving Forward Together Plan. Instead, we call on Halifax Transit to reduce the stop spacing on the BRT system to 400m to meet the MFTP access goal, replacing local service with BRT for all BRT corridors. The local service can be redeployed to feed the BRT network, providing greater frequency in the suburbs
Coverage	Similar to the local service concern, the proposed BRT network has far less coverage of 15-minute frequencies than the Moving Forward Together Plan. As many of the benefits will be accrued simply through off-board fare collection and all-door boarding, it would be preferable to focus efforts on implementing the proposed TPMs and refining the 15-minute network (corridors and other high-frequency services such as the 29) to optimize the routes and increase stop spacing, rather than switching to the proposed BRT network to the Moving Forward Together Plan.
Branding	We do not support a unique brand for the BRT network. Simply, a new brand would introduce confusion, with passengers – especially those with low socioeconomic status, unsure whether their transfer is valid for every bus in the network. BRT should be the backbone of the Halifax Transit network, not a niche service. Any branding should be through the route numbering and naming conventions, if at all. Toronto provides great leadership here – the rapid network is identified at the stops, with stickers indicating that the stop is on the 10-minute network.
Impact on MFTP Corridors	It was indicated at the stakeholder meeting that the BRT network would result in reductions to the local network, which includes the MFTP corridors. The MFTP corridors have much greater coverage than the BRT proposal (see previous page), and already stood to benefit from the TPMs proposed in the MFTP and the IMP. Reductions in the frequency and service spans of the corridors means reductions in transit access across most of the city.
Route Straightness	The proposed network retains Halifax Transit's preference for meandering routes. There is no obvious reason for a bus from Herring Cove Road to go to Bayers Road prior to heading downtown (via Spring Garden Road). This is just one example where a "rapid" bus is detoured far beyond its desire line. This routing has additional implications – with no plan to prioritize the bus through the Armdale Roundabout, and with the routing surely resulting in a reduction in frequency on MFTP route 1, this proposal seems poised to starve Oxford & Spring Garden of a route that comes every 10 minutes for a route that meanders and will rarely be on time due to the roundabout.
Service Span	Without guarantees on the service span and off-peak frequency, it is difficult to support this proposal. True BRT needs 15-minute service from 6am-2am, seven days per week. The MFTP

Concern	Rationale
	comes close to this mark on the corridors and would require comparably minimal investment to achieve the standard. BRT needs to be the backbone of the network, all day, every day.

Summary of It's More Than Buses Feedback

Overall, It's More Than Buses believes that Halifax Transit is best served by implementing the TPMs, off-board fare payment, and all-door boarding, while ensuring that every transfer point on the MFTP corridors features a seamless transfer and a shelter. The proposed routes should be scrapped in favour of the corridors from the upcoming MFTP corridor routes review, with stop spacing increased per the standards set in the MFTP. It's More Than Buses also believes that additional service investment capacity should be directed to improving off-peak frequency on the corridor routes to benefit those who do not work traditional 9-5 hours.

2.4.1 *Summary*

Although generally supportive of Rapid Transit, community stakeholders are curious about the relationship between this rapid transit network and the local bus network and if service enhancements should be made on the local network and marketed as express routes. There were a number of suggestions offered on realigning and expanding the proposed BRT network that included introducing a 'loop' route around the peninsula and expanding the existing network to Bedford, Larry Uteck and the Burnside Industrial Park.

Appendix A

Open House Information Boards

Welcome

Bus Rapid Transit Feasibility Study Open House.

AGENDA

1. REVIEW the information boards

2. DISCUSS aspects of the project with the project team

3. SHARE your thoughts on Bus Rapid Transit in Halifax

4. STAY INVOLVED as the project progresses on the project portal: *www.shapeyourcityhalifax.ca/bus-rapid-transit*

PURPOSE

At today's open house we would like to:

INTRODUCE BUS RAPID TRANSIT

SHARE THE CRITERIA USED TO IDENTIFY CANDIDATE CORRIDORS

GET YOUR FEEDBACK ON BUS RAPID TRANSIT IN HALIFAX

PROJECT SCHEDULE

PHASE 1
Background and Identification and Evaluation of potential Corridors for BRT

July - October 2017

→

we are here ▼

PHASE 2
Develop Conceptual Plans for Feasible BRT Corridors

November - February 2018

→

PHASE 3
Prepare BRT Implementation Strategy & Final Report

February - April 2018

HALIFAX
TRANSIT

Project Goal

Halifax Transit is currently studying the feasibility of Bus Rapid Transit as a viable higher order transportation option in Halifax.

The Guiding Principles of this project are:

- Direction provided by ***Integrated Mobility Plan*** and ***Moving Forward Together Plan*** policies;
- Plan, design, and build to meet current and future transit operational growth;
- Informed by industry best practices, tailored for Halifax's unique conditions;
- Design to provide universal accessibility; and
- Improve Halifax Transit operational efficiencies and customer service.

What is Bus Rapid Transit?

*Bus Rapid Transit is a rubber-tired, rapid transit service that combines **stations, vehicles, running ways, a flexible operating plan, technology** and a **distinct identity** into a high quality, customer-focused service that is fast, reliable, comfortable and cost efficient.*

(Transportation Research Board, 2003)

EXAMPLE COMPONENTS OF BUS RAPID TRANSIT SYSTEMS

Stations

Permanent, Weather Protected, BRT Identity, Customer Information & Amenities, Safe, Accessible, Connected to the Community


Kansas City, MO


York Region, ON

Vehicles

Low Floor, Accessible, Comfortable Interior, High Capacity, Advanced Information, Unique Identity, Advanced Technology

Kansas City, MO

San Bernardino, CA

Running Way

Exclusive Busways, Dedicated Lanes, Mixed Traffic with Priority

Washington, DC

Technology

Off Board Fare Collection, Real Time Information, Traffic Signal Priority,


New York, NY

Brisbane, AUS

Distinct Identity

Service, Vehicles, Stations, Branding, Image

BRT

Swiftway Bus Rapid Transit

Dublin, IRE

rapidtransit

Winnipeg, MB

Brampton züm See you sooner.

Brampton, ON

Why Bus Rapid Transit?

This Bus Rapid Transit Feasibility Study is being undertaken because higher order transit is a fundamental component of City's Regional and Transportation Plans.

Halifax Regional Municipality Municipal Planning Strategy *(section 4.2.3)* - "Halifax Transit will continue to investigate the potential demand and feasibility of new services such as rail, **bus rapid transit** and expanded ferry service."

Integrated Mobility Plan *(section 3.2.5 d, action 97)* - "Increase the priority of transit in the transportation network by implementing a BRT system in Halifax with dedicated bus lanes."

Halifax Transit Moving Forward Together Plan *(section 2.4)* - "Give transit increased priority in the Transportation Network."

Why do communities implement Bus Rapid Transit?

- **Desire for higher quality service than can be offered conventional transit in mixed-traffic;**
- **Desire for various integrated transportation options for the community;**
- **The ability to implement rapid transit incrementally;**
- **Can be quicker and less expensive to implement than other rapid transit choices;**
- **The opportunity to encourage higher density intensification around important corridors and nodes; and**
- **Provides more flexibility than other forms of higher order transit, such as rail.**

Transit Demand

To identify travel corridors with sufficient ridership to support Bus Rapid Transit service we reviewed transit travel patterns and future land use plans.

Weekday Bus Stop Activity (Boardings and Alightings)

Weekday Daily Ridership Levels:

- *At least one stop-to-stop link (passengers on board between stops) >4,000 passengers*
- *Average ridership for all stop-to-stop links in corridor > 2,000 passengers*

Weekday AM Peak Ridership Levels:

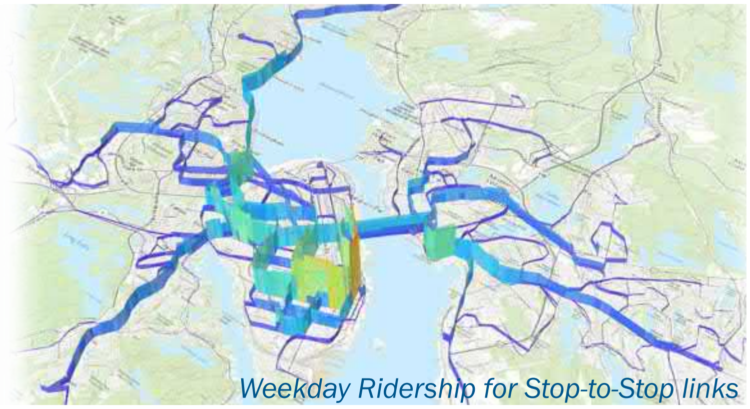
- *At least one stop-to-stop link >2,000 passengers*

Total Weekday Ridership Activity

- *> 12,500 boardings and alightings (full length of corridor)*

Existing Travel Demand Source: *Halifax Transit, 2016 Fall Service (all time periods).*

Future Travel Demand Source: *Regional Transportation Demand Model (VISUM); average growth 2011-2031 (AM peak hourly only).*



Weekday Ridership for Stop-to-Stop links

CRITERIA	CORRIDOR	Barrington	Bedford	Oxford - Coburg – Spring Garden	Lacewood	Mumford – Chebucto - North	Portland	Robie	Bayers - Young	Dunbrack - Willet – Main	Gottingen	Herring Cove	South	South Park - Inglis	Windmill – Bedford Bypass	Pleasant	Victoria	Woodland	Wyse
Weekday - All Day	Ridership on Busiest Stop-to-Stop Link	5,100	1,800	4,100	2,000	2,750	2,800	3,350	2,500	1,950	3,350	1,400	1,200	2,200	1,650	1,400	1,350	1,150	1,450
	Average Ridership for All Stop-to-Stop Links	3,000	1,150	2,300	550	1,250	700	2,050	1,550	300	1,200	750	1,000	1,400	500	800	700	800	950
	Total Corridor Ridership (Boardings + Alightings)	28,550	13,300	44,650	14,900	26,550	6,150	17,800	8,500	6,150	5,050	6,600	1,900	10,550	650	2,100	1,550	2,100	3,100
Weekday - AM Peak	Ridership on Busiest Stop-to-Stop Link in Corridor	1,950	900	1,000	400	1,050	1,050	1,150	650	550	350	500	250	500	800	350	500	300	450
	Forecast Annual Ridership Growth in Corridor	5%	-3%	2%	7%	2%	2%	0%	10%	1%	4%	3%	0%	1%	2%	2%	2%	1%	2%
Demand Rating	🟢 High 🟠 Medium 🔴 Low	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟠	🟠🟢	🟠	🟠	🟠	🔴	🔴	🔴	🔴	🔴

Corridor Screening Criteria

We reviewed corridor characteristics and assessed implementation considerations to further assess suitability for Bus Rapid Transit.

Reviewed Corridor Characteristics:

Space Within Public Right-of-Way: *Is there available space for dedicated transit infrastructure (queue jumps, transit signal priority, reserved bus lanes, stations, etc.)?*

Connectivity: *Does the corridor connect to key destinations and align with the Integrated Mobility Plan?*

Visibility: *Does this increase the profile of transit? Will there be opportunities for Transit Oriented Development?*

🟢 High Potential 🟠 Med 🔴 Low Potential ⚪ Not Applicable

	Barrington	Bedford	Oxford - Coburg Spring Garden	Lacewood	Mumford – Chebucto North	Portland	Robie	Bayers - Young	Dunbrak - Willet - Main	Gottingen	Herring Cove	South	South Park - Inglis	Windmill	Pleasant	Victoria	Woodland	Wyse
Transit Ridership	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟠/🟢	🟠	🟠/🟢	🟠	🟠	🟠	🔴	🔴	🔴	🔴	🔴
Space for Infrastructure	🔴	🔴	🟠	🟢	🟠	🟢	🟢	🟢	🟢	🟠	🟢	🟠	🟢	⚪	⚪	⚪	⚪	⚪
Connectivity	🟢	🔴	🟢	🟠	🟢	🟠	🟢	🟠	🟠	🟢	🟠	🟠	🟠	⚪	⚪	⚪	⚪	⚪
Visibility	🟢	🟠	🟢	🟠	🟢	🟢	🟢	🟠	🔴	🟢	🟠	🔴	🔴	⚪	⚪	⚪	⚪	⚪

Assessed Implementation Considerations:

- *Are there opportunities to coordinate Bus Rapid Transit construction with other projects (transit priority projects, road/sewer works projects)?*
- *Are provincial and federal approvals required?*

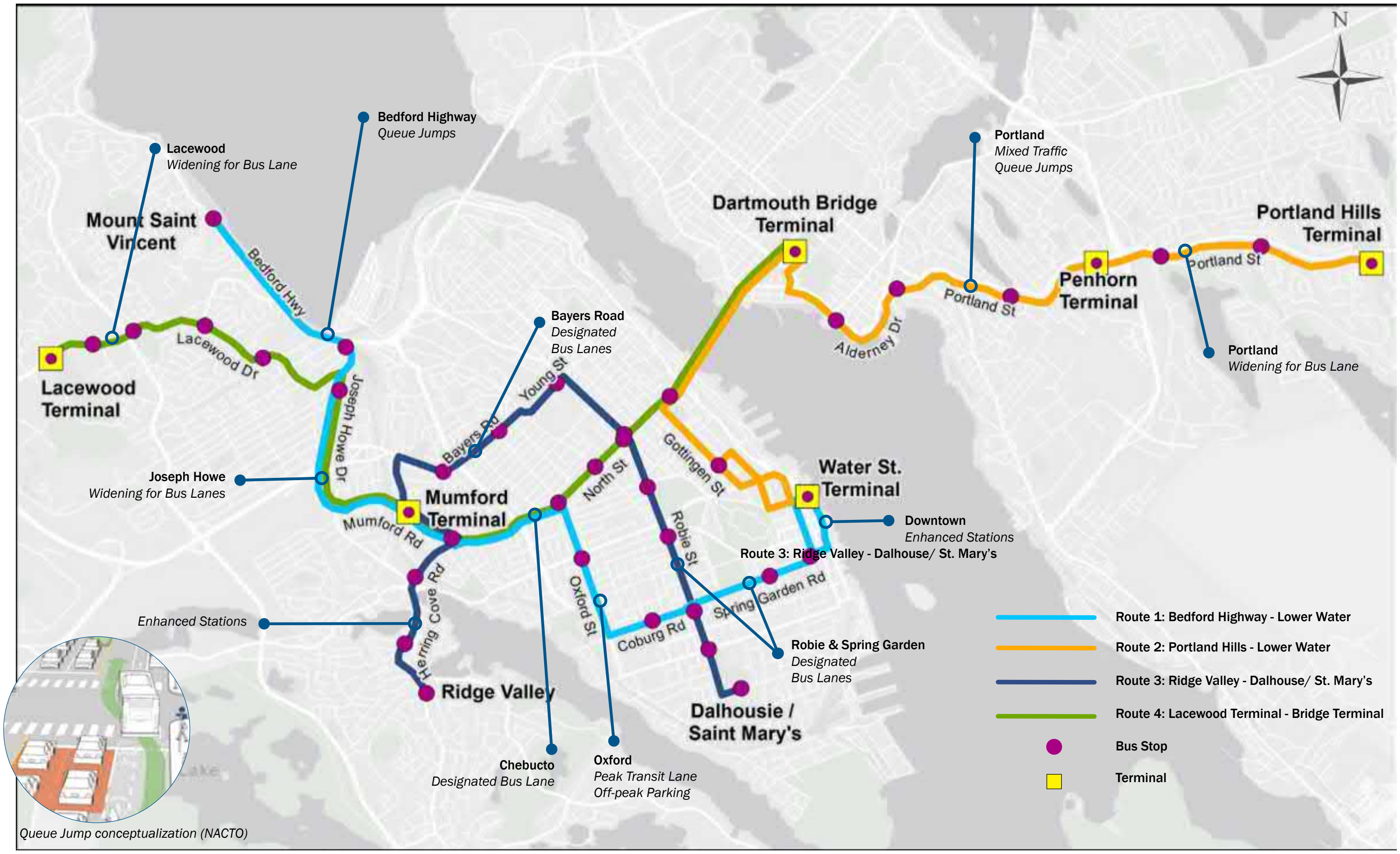
🟢 Easier to Implement 🟠 Med 🔴 More Complex ⚪ Not Applicable

	Barrington	Bedford	Oxford - Coburg - Spring Garden	Lacewood	Mumford - Chebucto - North	Portland	Robie	Bayers - Young	Dunbrak - Willet - Main	Gottingen	Herring Cove	South	South Park - Inglis	Windmill	Pleasant	Victoria	Woodland	Wyse
Implementation	🟠	🟠	🟠	🔴	🟠	🔴	🟢	🟢	🔴	🟢	🔴	🟠	🟠	⚪	⚪	⚪	⚪	⚪

Bus Rapid Transit Feasibility Study

HALIFAX TRANSIT

Proposed Bus Rapid Transit Network



Queue Jump conceptualization (NACTO)

Bus Rapid Transit Elements

Potential infrastructure upgrades will need to be explored to make Bus Rapid Transit feasible in Halifax. These could impact properties, traffic patterns, and parking/ loading. Example enhancements are conceptualized below.

Street Widening

E.g. Lacewood Avenue
Portland Street

New Alignment

E.g. Joseph Howe Drive

Designated Lanes for Transit

E.g. Chebucto Road

Peak Period Transit Off-Peak Parking

E.g. Oxford Street

We want your Feedback!

Do you think Bus Rapid Transit is a good initiative for Halifax?

Yes	No

Comments

Bus Rapid Transit Feasibility Study

HALIFAX
TRANSIT

We want your Feedback!

Do you have any comments on the proposed network of BRT routes and stations?

We want your Feedback!

Which Bus Rapid Transit route should be implemented first?

Route 1: Bedford Highway to Lower Water

Route 2: Portland Hills to Lower Water

Route 3: Ridge Valley to Dalhousie/ Saint Mary's

Route 4: Lacewood to Bridge Terminal

We want your Feedback!

What else should Halifax Transit consider when developing Bus Rapid Transit services?

Appendix D

Briefing Note: Stations and Stops

DILLON
CONSULTING

DILLON
CONSULTING

HALIFAX REGIONAL MUNICIPALITY

Bus Rapid Transit Study

Task 8: Briefing Note on Station and Stop Guidelines

December 2017 – 17-5956

Table of Contents

Figures

1.0 Introduction

One of the most important elements of Bus Rapid Transit (BRT) is the design, layout, and operation of stations and stops. Transit users access the service at these locations and, consequently, stations and stops must function in a manner that meets user needs, that fits with the adjacent environment, and that attracts users to the system.

Having a comprehensive set of guidelines that describe the requirements for effective stations and stops is necessary to create an attractive BRT system. This document outlines station and stop guidelines to support the development of Bus Rapid Transit in Halifax, and is organized into the following sections:

- Types of Stations and Stops – This section introduces three kinds of stations and stops that could be expected to be developed in a Halifax BRT system;
- Planning and Design Considerations – Topics such as the station platform, shelter requirements, seating, urban design, customer information and intermodal connections as they relate to the three kinds of stations and stops are discussed in this section;
- Other Considerations – A number of additional general considerations such as property needs, utility requirements, security, maintenance and interaction with adjacent land use are discussed in this section.

2.0 Types of Stations and Stops

Bus Rapid Transit station and stop types can range from relatively simple bus stops to large-scale stations with multiple stop locations that are fully integrated with adjacent land uses. The arrangements developed for any particular potential stop location depend on site factors such as passenger demand, available right-of-way, surrounding land use, and available budget. Different types of stops are typically used along each individual BRT corridor in accordance with variations in site factors.

The following is an overview of the specific stop types recommended for application in Halifax. Details about dimensions, amenities and other characteristics and requirements are provided in later sections of this report.

2.1 BRT Enhanced On-Street Stop

The most basic type of bus stop is one where a bus stop sign is attached to a post at a safe and appropriate location at the side of a road. BRT stops must be more than this. They need to reflect the branding of the BRT service and provide for an enhanced set of amenities designed to improve the experience for the customer. Ideally, each stop location includes a distinctive marker or kiosk highlighting that it is a BRT stop, an appropriately sized shelter and seating for customers, and information about the available transit service. An example of an enhanced on-street BRT stop is illustrated in Figure 1.

Figure 1: On-Street BRT Stop (Kansas City - Troost Corridor)

2.2 BRT Separate Right-Of-Way Station Stop

Some BRT corridors or portions of corridors may be able to accommodate a separate right-of-way for the BRT service. This could take the form of a separate busway operating on its own alignment or physically separated lanes operating in an existing right-of-way. These facilities can be developed when there is property available, the number of transit users supports greater levels of priority, and the corridor is a key piece of the system. Stops on these facilities have all of the same basic requirements as the enhanced on-street stop, but tend to be larger to accommodate greater numbers of customers and stopping buses than might typically be expected at an on-street stop. Examples of separate right-of-way station stops are provided in Figure 2 and Figure 2.

Figure 3: Transit Station in Separate Right-of-Way (Ottawa)

Figure 2: BRT Station in Median of Arterial Roadway (York Region)

2.3 BRT Off-Street Station Stop

Multi-stop transit stations or transit centres are focal points in many transit networks. They are the places where transit routes meet to allow transit users to transfer between services and they are usually part of or adjacent to significant developments such as shopping centres, commercial, and mixed-use areas. The importance of these locations means that they are often part of a BRT system, whether or not the system is connecting to an existing transit centre, or a new centre is being constructed as part the BRT network. All of the primary components of the other types of BRT stops are included in an off-street station stop, with the added challenge of integrating these elements into the rest of the transit centre. Examples of off street station stops are shown in Figure 4 and Figure 5.

Figure 4: Transit Centre (Mississauga)

Figure 5: Transit Centre (Brampton)

3.0 Planning and Design Considerations

This section examines the key components to include in the Halifax BRT station and stop areas and outlines what requirements and considerations are necessary to provide appropriate facilities for the users of the BRT service.

3.1 Running Way

The running way is the roadway or traveled way where the buses will actually be operating through the station. While the running way may look like a conventional roadway between stations, there are specific items that should be considered within and near stations to provide the best experience for the transit user.

3.1.1 Lanes

Most BRT facilities provide for one lane of operation in each direction between stations. Within station areas, it is often desirable to provide two lanes in each direction, one adjacent to the platform for buses to stop and service customers, and a second lane for express or out of service buses to bypass the station.

The two lanes per direction are common on separate BRT facilities operating in their own corridor. These facilities often accommodate larger volumes of in-service buses, employ a service plan that incorporates routes that may not serve all stations, and use the corridor for moving out of service buses quickly to where they are needed. If property is available to accommodate this, then two lanes in each direction are often built. Sometimes there is insufficient property or there are other constraints in place that limit one or both directions to a single lane, however, this should be avoided if possible.

Separate BRT facilities within an existing roadway right of way often do not have the property available to accommodate two lanes in each direction. One lane in each direction is then provided.

Figure 6 and Figure 7 provide examples of lane arrangements for BRT facilities.

Figure 6: Median BRT Facility with One Lane

Figure 7: Separate Bus Transit Lanes Carrying BRT Services (New York City)

BRT stops in off-street transit terminals should always have a lane for the buses to stop and serve customers and a second lane for other buses to bypass. The other, non-BRT stops within the terminal should also have the two-lane arrangement so that the BRT vehicles can enter and exit the facility efficiently.

On-street BRT services typically operate in mixed traffic or in a designated bus lane. Buses will stop in the lane to serve customers at stops. Bus bays are not recommended in mixed traffic environments. If property is available and the volume of bypassing buses warrants it, then bus bays adjacent to a bus lane can be considered.

3.1.2 Drainage

The cross-section of conventional urban roadways is normally designed to be higher in the centre of the road and slope slightly to the curbs. This allows rain and melting snow to drain towards the curb and then travel to catch basins and into sewers. Water and slush that accumulates next to the curb can be splashed onto customers waiting at adjacent bus stops.

For BRT facilities, it is desirable to 'reverse' the drainage by sloping the road surface away from the curb. This is common at transit centres and in separate busways where drainage that moves water away from the platforms can be designed from the start and then constructed. Figure 8 illustrates this concept.

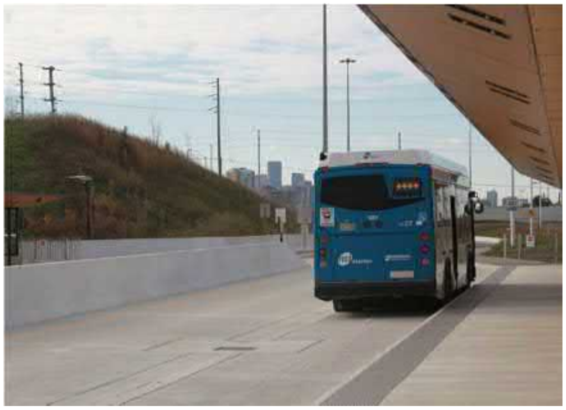


Figure 8: Example of Reverse Drainage (Mississauga)

Where BRT stops are being fit into existing road facilities and the opportunity to slope the road away from the platform cannot be accommodated, effort should be made to keep catch basins away from the platform area to avoid accumulation of water at lower points along the curb.

3.1.3 Pedestrian Arrangements

BRT stations and stops are usually some of the busiest stops in a transit system. The high volume of customer access/egress at stations necessitates specific arrangements to provide a safe pedestrian environment.

With separate busway stations that have one or two lanes in each direction, it is common to provide a centre median with a railing or barrier to prevent transit users from crossing directly between platforms on opposite sides of the running way. Passengers that wish to cross are directed to either a grade separated crossing of the busway, or to one or more at-grade pedestrian crossings that are separate from the passenger waiting and bus stopping areas.

Figure 9: Median Barrier, Platform Railing between Bus Stop and Crosswalk (Winnipeg - Harkness Station)

Separate BRT facilities that are incorporated into existing rights-of-way require similar consideration. In the case of median facilities, there may or may not be a median dividing travel directions. If there is, then a median railing should be incorporated. With median platforms having general traffic lanes between them and the roadway edge, it is common to have railings at the back of the platforms to prevent pedestrians from crossing anywhere except at designated locations. Figure 9 shows an example of a median barrier and guide railing.

On-street BRT stops will generally not require railings to guide pedestrians to crossings because the arrangements are similar to conventional streets. Curb-side railings can be used to define the platform area and to prevent passenger boardings or alightings at locations that would otherwise interfere with transit or traffic operations.

3.2 Platforms

Platforms are the areas where transit users wait for, board, and alight buses. The platform areas should be designed to meet the needs of the volume of transit users using them and the volume of buses accessing them.

3.2.1 Platform Length and Width

The first rule of designing a transit platform is that it must be built on a tangent. This means that the platform curb must be a straight line for its full length. This is important for buses serving the platform to be able to get all of their doors as close as possible to the platform.

Standard transit buses are 12 metres (40 feet) in length. Articulated transit buses are 18 metres (60 feet) in length. These are the primary bus styles that Halifax anticipates using for the foreseeable future.

The minimum length of the BRT platforms will depend on the amount of transit service and types of buses. As such, this minimum distance may vary from corridor to corridor. A corridor using only standard buses operating at a frequency such that only two buses serve the stop simultaneously will require a minimum platform length of 24 metres. A busier corridor may require two articulated buses to be accommodated at one time, requiring a minimum platform length of 36 metres. Each planned corridor should be studied separately to identify the appropriate minimum platform length.

The desirable width or depth of the platform depends on several factors:

- Number of Waiting Passengers – The platform needs to be large enough to accommodate the number of transit users that are expected to accumulate between buses during the busiest time of usage for that stop. There is information in the *Transit Capacity and Quality of Service Manual* (Transportation Research Board Transit Cooperative Research Program Report 165) on how to calculate the size of platform necessary to accommodate a certain number of waiting passengers;

- Boarding and Alighting Space – Even with all of the waiting transit users, there needs to be space for people getting on and off of buses and then entering and leaving the platform area;
- Need for Through Circulation – Particularly with on-street stops, the platform area may be integrated with sidewalks;
- Shelters and Furniture – There needs to be space for shelters, benches, passenger information kiosks, litter containers, fare vending machines, bike racks, and other items that are required at a particular stop.

While some station and stop locations will have sufficient space to accommodate all of the above requirements, in practice many locations will be constrained. The minimum platform width adjacent to the curb is 2 metres (although 3 metres is desirable). This accommodates boarding, alighting and basic circulation, and meets all common accessibility requirements. Beyond this 2-metre zone is where shelters, seating and other furniture is accommodated and where additional space for waiting transit users is provided.

Figure 10: VIVANext Station Platform (York Region)

The narrowest width of shelter that can be fully enclosed is 1.6 metres and requires somewhat more than 2 metres of space for installation. Thus, the minimum width of platform that can accommodate all likely needs is 4 metres. Narrower widths are only possible if some desired amenities are not included at the stop.

If a canopy is installed over the platform, the supporting columns for the canopy should be located so as not to view the sightlines to oncoming buses for waiting customers.

An example of a good platform layout is illustrated in Figure 10.

3.2.2 Curb Height

There are three curb height options that can be considered for BRT services:

1. Normal Height – With this option, the standard curb height that is used for roadways (usually 180 mm) is constructed. This requires passengers to step up into the bus and the passenger ramp to be deployed to accommodate passengers with mobility devices, strollers, or who may otherwise appreciate the elimination of the step.
2. Level Boarding – This arrangement raises the curb so that the platform is equal in height to the floor of the bus. This allows all passengers to walk or roll directly on and off of the bus without the need for a ramp. It can speed up boarding and alighting activity because no steps are required. Special curb cross-sections are sometimes required with this arrangement to prevent the bus wheels and curbs from contacting each other and being damaged. An example of level boarding is shown in Figure 11
3. Near-Level Boarding – This is part way between the normal height curb and fully level boarding. With this option, the curb height (usually 250 mm) is set so that a kneeling bus will bring its front door sill almost even with the platform, allowing easier boarding at this location. Figure 12 illustrates near-level boarding.


Figure 11: Level Boarding (Eugene, Oregon)


Figure 12: Near-Level Boarding (Winnipeg)

For separate BRT facilities and transit centres, it is usually possible to build the curb height that is desired. For on-street stops, factors such as adjacent property and grading may prevent near-level or level boarding options – each stop location will need to be assessed individually.

3.2.3 Layout

The edge of the platform adjacent to the travel lanes should have a different coloured and textured strip (compared to the main platform) that meets all appropriate accessibility requirements. This strip can be included in the minimum 2 metre platform width described previously.

The minimum 2 metre width of platform for boarding, alighting and circulation should be clear of obstructions. This means that signs, poles, hydrants, planters, canopy support columns, and other items should not be located within this area of the platform. Shelters, benches and other items should be positioned 2 metres or farther from the platform edge.

Beyond the ends of the platform, space can be provided for maintenance activities (e.g. a place to park a maintenance vehicle without blocking the bus lanes) and access for people walking to and from the primary platform.

These layout arrangements are illustrated in several of the previous figures.

3.2.4 Pedestrian Arrangements

Access to and from the platform for transit users requires the following considerations:

- Safety – Pathways need to guide transit users to appropriate locations for crossing roadways, possibly using railings or landscaping. Appropriate traffic control may be required. Consider sightlines between vehicles and pedestrians, as well as visibility and sightlines for pedestrians themselves;
- Accessibility – Sidewalks or pathways connecting to the platform need to meet appropriate accessibility requirements in terms of slope, width, railings, seating and surface material;

This is illustrated in Figure 13.

Figure 13: Pedestrian Access to VIVANext Station (York Region)

3.3 Weather Protection

As BRT stations are some of the most important stops in a transit network, they should have appropriate weather protection for transit users. This can include both enclosed shelters as well as overhead canopies covering other areas of the platform. Both of these are discussed in this section.

3.3.1 Shelters

Every BRT station or stop should have enclosed shelter space for transit users that is sized to suit the number of people using the stop. While the *Transit Capacity and Quality of Service Manual* referred to previously can assist with estimating the appropriate size of shelter space, the minimum size of shelter should be approximately 1.6 to 2.0 metres by 3.0 to 3.5 metres in size. This size is sufficient to accommodate a small two person bench, room for people to stand, and room for the turning circle of a wheelchair or similar mobility device. Larger shelter space should be provided at stops with larger numbers of waiting transit users.

The shelter design used should be unique from conventional shelters used at regular bus stops and should be a component of the visual branding identity for BRT. It can be designed and fabricated locally, or unique designs from shelter suppliers can be used. At some locations, it may be possible to build custom shelter spaces within adjacent buildings or place BRT shelters immediately adjacent to buildings

The vertical panels of the shelters should be mostly glass and provide visibility for transit users to clearly see approaching buses and to be seen by passing traffic. Any customer information panels should be located to maintain these key sightlines. Orientation of the vertical panels can be flexible depending on the stop location – place entrances where they make sense and consider the prevailing wind direction.

Examples of BRT shelter designs are shown in Figure 15 and Figure 15.

Figure 14: BRT Station Shelter (Grand Rapids, Michigan)

Figure 15: BRT Station Shelter (Kansas City)

3.3.2 Canopies

Overhead canopies can be used to enhance the amount of shelter space while maintaining circulation on the platform and providing a better environment for transit users. Canopies can be used to connect multiple small shelters to provide additional waiting space, to cover the area between shelters and the curb, and to connect the platform to adjacent buildings.

Canopies should be designed as part of the distinctive shelter design approach being used for the BRT service. While they provide shelter from falling rain and snow, the canopy roof panels should be translucent to allow the platform to remain as bright and light as possible. It is important that the column structures supporting the canopy be located so as not to block the sightlines to oncoming buses for waiting customers.

Figure 17: Station Canopy (Chicago)

Figure 16: Station Canopy (Winnipeg)

3.4 Seating

Seating can be provided with benches both inside and outside of shelters, on retaining walls and planters if appropriately designed and located, and through leaning rails or other structures in high volume locations with frequent service.

Ideally, the smallest BRT stop will provide for a two seat bench inside the shelter and a small two or three seat bench outside on the platform. At larger and busier stop locations, more seating can be provided. Positioning outside seating under canopies is ideal.

Benches that provide individual seating locations are preferred because they discourage people from using the benches for sleeping. Some of the seating should be designed in a way that includes supports to assist people as they sit down or stand up.

Seating examples for BRT stations are shown in Figure 18 and Figure 19.

Figure 18: Shelter Seating (Grand Rapids)

Figure 19: Platform Seating (Winnipeg)

3.5 Customer Information

This section considers the elements within a station that a customer may interact with to understand and use the BRT service.

3.5.1 Signage

Both static and dynamic signage should be considered for BRT stations. Static signage is printed material that provides the customer with information about the routes that serve the station, their schedule and frequency, and where at the station they stop. Other signage about fares, rules of conduct on the transit system, and upcoming plans or changes is also common. Static signage is most commonly posted in an information display case and/or on bus stop poles in the station.

Figure 20: Dynamic Signage (Brisbane, Australia)

Dynamic signage refers to electronic variable message signage that can provide real time information about the arrival times for the next buses. These signs are most often located on poles or under canopies close to where the buses are stopping, or in a central location inside a larger shelter area. Figure 20 illustrates this.

3.5.2 Poles

Sign poles should be minimized on the platform. Ideally, there are no poles present on the primary first two metres of platform in order to accommodate free mobility and circulation of transit users. Shelter and canopy structures can provide locations for mounting signs rather than adding poles. Poles that are necessary should be designed as part of the design language of the BRT program.

3.5.3 Kiosks

Freestanding kiosks, markers, or other types of information displays are often provided as part of a BRT program. They can be designed to provide a combination of both static and dynamic information and, if designed to be placed where buses stop, provide a strong visual presence for the BRT system. Other styles of kiosks may be located at the back of the platform, or near the main pedestrian entrances to the platform. Regardless of the purpose of the kiosk, it should be designed as part of the design language of the BRT program.

An example of a multi-use BRT marker is shown in Figure 21.

Figure 21: Kiosk with Static and Dynamic Information (Kansas City)

3.5.4 Wayfinding

Maps and other wayfinding signage help people enter and exit the station areas, and orient themselves with surrounding land use. Maps are typically found within the station areas while signage will be found both within the station as well as on the access pathways to and from the station.

While there may be some common wayfinding elements within the stations such as a map of the surrounding area, each of these maps will, or course, be unique. Wayfinding signage for circulation and access will need to be custom designed for each station, but should be drawn from a set of signs, images and a design language that have been developed specifically for the BRT program.

3.5.5 Fare Vending

Consideration needs to be given to whether or not there will be a need for fare vending equipment on the platforms. This will be necessary if there is to be off-board fare collection for BRT services. This means that all customers must have a pass or purchase their fare from a vending machine on the platform prior to boarding the bus, and the bus operator will not be collecting fares. This approach can allow for all-door boarding which can speed up passenger boarding and alighting and make the service faster and more reliable.

Even if on board fare collection is maintained, if may be appropriate to provide some fare vending equipment at some of the BRT stations in order to allow transit users to purchase their tickets prior to boarding. While not as effective as full off-board fare collection, it can help to speed up the boarding process.


Figure 22: Fare Vending Machines at BRT Stop (New York City)

If off-board fare vending is desired, the equipment should be placed near locations where people are accessing the platforms, and should be at the back of the platform, away from the boarding and alighting area.

Figure 22 demonstrates one example of fare vending equipment appropriately located at a BRT Station.

3.6 Urban Design

In the context of a BRT station, urban design refers to developing a strong visual identity for a BRT program through the design of the physical elements within and around the station areas. In addition to the shelters, canopies, kiosks and other platform elements described above, it includes the elements described below.

3.6.1 Surfaces


Figure 23: Use of Various Surfaces (Chicago)

The colours and textures of walking surfaces on and around the platform areas of BRT stations are an important element in providing a safe and attractive environment for transit users. The surface materials must be easy to walk on yet not slippery. At the same time, they must be easy to maintain. Colour and/or texture can be used to show the platform edge, the primary circulation areas of the platform, areas for waiting, and to enhance wayfinding. In addition to the platform areas and access pathways, different colours and materials can be used on the running ways to help confirm priority over other traffic. Locally available materials and proven construction techniques should be used whenever possible.

Figure 23 shows an example of the use of various types of surfaces at a BRT station.

3.6.2 Landscaping

Landscaping adds visual interest to both the station and the area around the station. It can soften the aesthetic impacts of hard BRT infrastructure and help to define station areas. Quality landscape design can enhance the appeal of the station for new riders, the community, and potential developers near the station. Landscape features can also be used to guide customers through natural wayfinding and to provide platform elements such as seating. Native landscape material should be used whenever possible. Figure 24 demonstrates an effective use of landscaping in a BRT project.

Figure 24: BRT Landscaping (Cleveland)

3.6.3 Lighting

Lighting can serve several functions at BRT stations. It provides general illumination, assists in station location and identification, and makes station features visible during periods of darkness. In addition, it aids bus operators in identifying stations and determining if there are passengers waiting to board. Lighting also provides a sense of security for waiting transit users. Attractive station lighting can highlight architectural and design elements of the station, enhancing the rider experience and the appeal of the station for the community. Lighting can also communicate when the station is closed by changing the colour or intensity of the lighting when the station is out of service. This is illustrated in Figure 25.

Figure 25: BRT Station Lighting (Winnipeg)

3.6.4 Furniture

In addition to shelters and seating, there is other furniture that can commonly be found in BRT stations. These can include waste and recycling containers, newspaper vending boxes, and food or drink vending machines. Discussion about whether or not all of these items will be accommodated should be undertaken.

Waste and recycling containers are common and desirable in stations, but can sometimes be a security concern. This can sometimes be overcome with specially designed containers.

Free or pay vending machines can improve the customer experience, but can also generate litter and maintenance challenges. Depending on the local context, there may be an opportunity to charge a fee for the provision of these items in station areas.

Whatever furniture elements are approved, care must be taken to locate them in places where they will not interfere with the free flow of people boarding, alighting, and circulating within the platform area. It may be possible to enclose some of the elements in material that is integrated with the BRT design language.

3.7 Intermodal Connections

This section summarizes the key requirements for ensuring that a BRT facility is fully integrated with other forms of mobility in the community. This is important because any trip a person takes on the BRT service will require them to access the BRT station using one or more other modes and then to travel from where they get off of the BRT service by one or more modes to their final destination.

3.7.1 Pedestrian

Appropriate sidewalks and pathways connecting a BRT station with all of the adjacent land uses is necessary to ensure that each station serves the largest possible area. As part of station planning, pedestrian access routes should be examined to ensure that there are appropriate pedestrian routes for all land uses and areas within at least 400 metres of the station, that the sidewalks and pathways are complete and in good condition, and that appropriate pedestrian crossing arrangements are in place at all crossing points.

3.7.2 Bicycle

Providing bicycle parking at BRT stations provides another option for transit users to access the BRT system, and extends the area of influence of the station well beyond the range of pedestrians. Ideally, bicycle parking is provided at all BRT stations. All BRT stations that are connected to dedicated cycling facilities such as bike lanes and bike paths must have bicycle parking provided.

Bicycle parking can include various styles of bike racks, lockers and shelter. An example of this is provided in Figure 26.

Figure 26: BRT Bicycle Parking (Winnipeg)

Parking facilities need to be located as close as possible to the platform, but not on the platform or interfering with clear pedestrian access paths to and from the platform. The amount of parking provided will depend on the expected demand and should be assessed by considering the location of the station relative to dedicated cycling facilities and the nature of the area the station serves. If space is available, shelters for the bike racks should be considered at stations where higher bicycle activity is anticipated.

3.7.3 Transit

BRT stops at transit centres are naturally well integrated with other transit services that connect to the transit centre. If a BRT stop is being created at an existing transit centre, it should be located centrally within the centre in order to minimize transfer distances between the BRT service and the other transit services.

For on-street and separate right-of-way BRT stops, the location of the BRT stops relative to any cross street regular bus stops should be carefully assessed at each site to ensure that the arrangements work best for transit user transfers between routes and for transit service operational requirements.

3.7.4 Vehicles & New Mobility

In general, it should be possible for people to be dropped off or picked up at a BRT station by a taxi or a private vehicle driven by a family member or a rideshare service (such as Uber or Lyft).

Accommodating passenger drop off zones for private vehicles at large BRT stations and at BRT stops in more suburban locations should be a priority. BRT stops in more central areas of the community may be less of a priority for this as the connections for pedestrians, bicycles and other transit services are more important.

Figure 27: Passenger Drop Off / Pick Up Zone (Halifax)

Potential passenger drop off arrangements should be identified for all BRT stops and stations. As demonstrated in Figure 27, directions for drivers of drop off vehicles may be required and shelter for people waiting to be picked up may be appropriate.

Integrating the BRT system with car share services should be considered to extend the area of influence of a station. This can be done by establishing dedicated car share service parking areas at appropriate BRT stations.

Parking for private vehicles should be considered at BRT stations as part of a comprehensive park and ride program in the community. The larger and more suburban BRT stations, as well as those that intercept significant commute roadways, are the best locations for this. Each park and ride facility will require a custom design to suit the needs of the particular station within the constraints of available property.

4.0 Other Considerations

The previous sections reviewed the requirements for BRT stations that make them functional, effective and attractive for transit users and neighbourhoods adjacent to the stations. This section addresses other items that must be considered to allow stations to operate efficiently and effectively.

4.1 Utilities

Utility servicing needs must be identified in the planning stage of BRT station development. The key areas to focus on are discussed below.

4.1.1 Electrical

Determine what power is needed to support all of the identified station requirements at each location. Evaluate the utilities to determine whether existing power is compatible with the station's needs. If providing lighting, then consider opportunities to rely on existing street or area lighting rather than assume that all-new lighting must be installed. At the time of initial construction, consider running conduit to various locations for possible future power needs such as lit signage, security cameras, vending equipment, fare equipment, and landscape lighting that may not be part of the initial station plan.

4.1.2 Water and Sewer

The need to have access to water and sewer will depend on the design decisions and the amenities being provided at each station. Washroom facilities for transit staff and/or the public may be a part of larger stations or transit centres and will clearly require water and sewer arrangements. Water access may also be desirable for landscaping maintenance or cleaning of the station area, although low-water or native plants in landscaping and the use of a truck-mounted, self-contained pressure washer for routing cleaning may overcome this requirement.

4.1.3 Electronic Communications

Determine the requirements for the communications infrastructure needed to support the amenities at each station location. These will include the bandwidth, protocols, physical requirements and security measures. A combination of wired and wireless solutions will likely need to be designed to accommodate all requirements.

Planning for appropriate enclosures for all utility related equipment and their locations within the station areas will need to be undertaken in order to keep them accessible for servicing while not interfering with the primary purpose of the station – serving transit users.

4.2 Property

An important consideration in planning and design is the amount of property required for the station or stop and supporting infrastructure such as pedestrian access. Available property must be identified at each station location and any issues identified early in the planning process. If private property is required for the desired station or stop arrangement, then the cost of purchasing the necessary property or establishing an easement must be balanced against the impact on transit users of less than ideal space and amenities in the station.

4.3 Safety and Security

BRT stations and stops should be planned and designed using a “crime prevention through environmental design (CPTED)” approach. This can include the following points:

- Having no entrapment areas;
- Providing clear escape routes;
- Creating clear and unobstructed sight lines and using convex mirrors where necessary;
- Ensuring that platforms and access linkages are well lit and highly visible;
- If the station or stop is not attended, consider provision of remote video monitoring and a call box that connects directly with the system operator and/or the police;
- Creating relevant signage and announcements;
- Choosing plant species to prevent screening issues and ensure proper sightlines;
- Removing ice and snow quickly;
- Conducting regular inspections and maintenance to deal with hazards.

Care must be taken to balance the requirements of CPTED with the provision of a station or stop that is attractive and comfortable for users. This means that platforms, amenities, and access linkages to and from the area around stations must find a middle ground between being user friendly / attractive and an overly sterile environment.

Other safety and security considerations include the following:

- Secure all benches, bike racks, waste containers and other items in the station areas;
- Consider platform elements and furniture that can prevent the concealment of foreign objects and consider materials that are less damaging if they become projectiles;
- Facility design should be reviewed by safety and security staff;
- Implement routine maintenance programs to minimize downtime and quickly respond to equipment and facility failures;
- Implement a routine graffiti removal program;

- Identify a civic address for each BRT stop or station for emergency response;
- Implement a proactive safety and security review program including training for all relevant staff, patrols, threat assessments, and incident tracking system to identify trends.

4.4 Maintenance and Life-Cycle Cost

BRT systems should be planned and designed with life-cycle maintenance procedures and costs in mind, along with initial construction and regular operating costs. For example, design should include elements that help to reduce maintenance. This could include using stainless steel railings and furniture that is self-polishing and does not require any maintenance of the finish, and minimizing vertical surfaces and using graffiti resistant materials for those that are needed.

Planning should also consider how stations and stops will operate during exceptions, such as when there is repair work underway. For example, building in redundancy by providing two shelters instead of a single larger one will allow the station to continue to operate effectively for transit users if one shelter needs to be repaired. Without thought to this type redundancy, it may be necessary to close the station completely, inconveniencing customers.

Space for maintenance activity, maintenance vehicles, materials and snow storage should be considered in planning and designing the BRT stations and stops. Identifying where maintenance vehicles should park while the station area is operational, how and where to remove snow, where to place a bin of ice melting material, and how to access power, communications and water infrastructure must all be planned ahead of time.

4.5 Adjacent Community

The adjacent community should be considered when identifying potential BRT stops and stations and in designing them once the locations have been selected.

When locating potential BRT station sites, local zoning should be reviewed to ensure that existing regulations allow for stations and related facilities. The zoning should also be reviewed to determine what uses are permitted in the area around the station and if they are compatible with an effective BRT system. If the uses are not transit friendly, then an assessment of the potential to change the zoning should be undertaken, or a different station location should be considered.

At a more detailed level, the transition area immediately around the station should be carefully examined. The transition area should coordinate the station with surrounding street-level functions and elements such as intersections, building entrances, vehicular movements, pedestrian circulation patterns, and existing street furniture and landscape elements. The transition area should allow the station to fit easily into the immediately adjacent community, and for those using the area to see and understand the function of the station.

Appendix E

Representative Transit Priority Measures: Drawings and Cross-Sections

◇ P	"BUS RAPID TRANSIT/PARKING" LANE
↱ ↑ ↰	RED ARROWS INDICATE LANE DESIGNATION CHANGE
●	LARGE–SCALE BRT STATION
◎	MEDIUM–SCALE BRT STATION
●	ENHANCED ON–STREET BRT STOP
⫯	BRT OVERHEAD SIGNAGE

No.	DESCRIPTION	Date (mm/dd/yy)	By
A	ISSUED FOR REVIEW	01/10/18	MM

ISSUE or REVISION

Client

HALIFAX

DILLON CONSULTING

HARBOURSIDE
Transportation Consultants

Project

BRT STUDY

Title

OXFORD STREET BRT

Scale 11x17: 1:375
22x24: 1:750

Date JANUARY 2018

Drawn B. FORBES

Designed

Checked

Approved

Contract No. 172042

Drawing No.

C-01

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◇	"BUS RAPID TRANSIT" LANE
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●	LARGE-SCALE BRT STATION
◎	MEDIUM-SCALE BRT STATION
●	ENHANCED ON-STREET BRT STOP
⍿	BRT OVERHEAD SIGNAGE

A	ISSUED FOR REVIEW	01/10/18	MM
No.	DESCRIPTION	Date (mm/dd/yy)	By

ISSUE or REVISION

HALIFAX

Client

DILLON CONSULTING

HARBOURSIDE Transportation Consultants

Project

BRT STUDY

Title

CHEBUCTO ROAD BRT

Scale 11x17: 1:500
22x24: 1:1000

Date JANUARY 2018

Drawn B. FORBES

Designed

Checked

Approved

Contract No. 172042

Drawing No.

C-02

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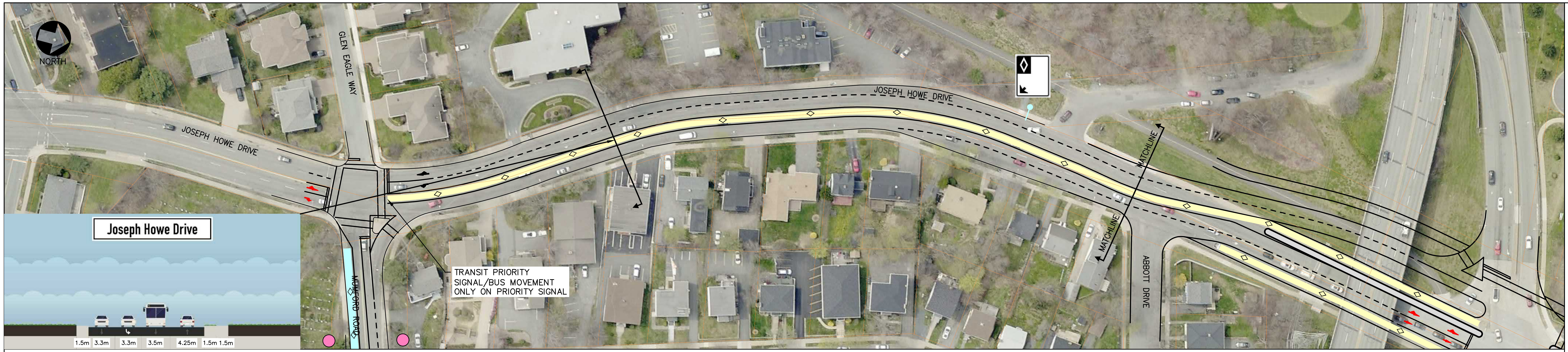

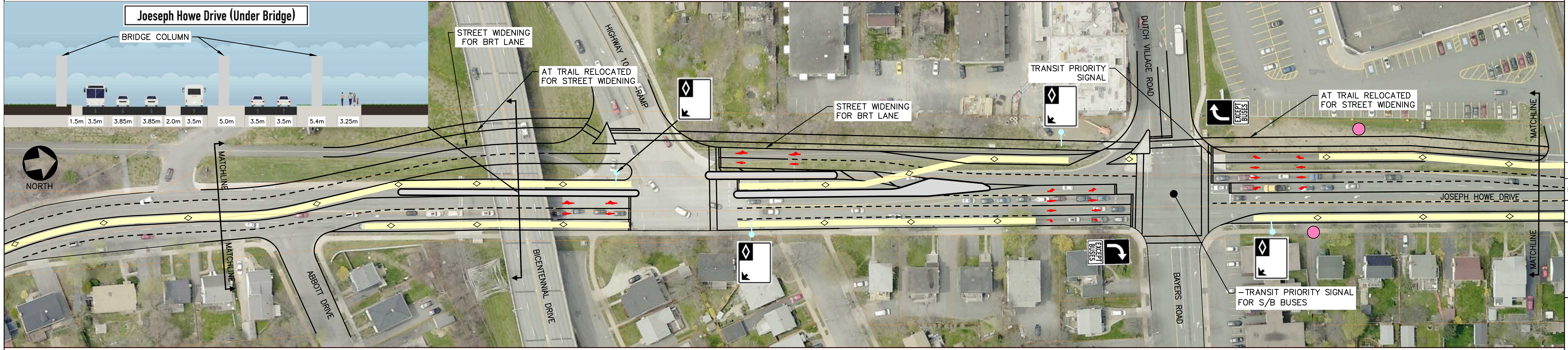

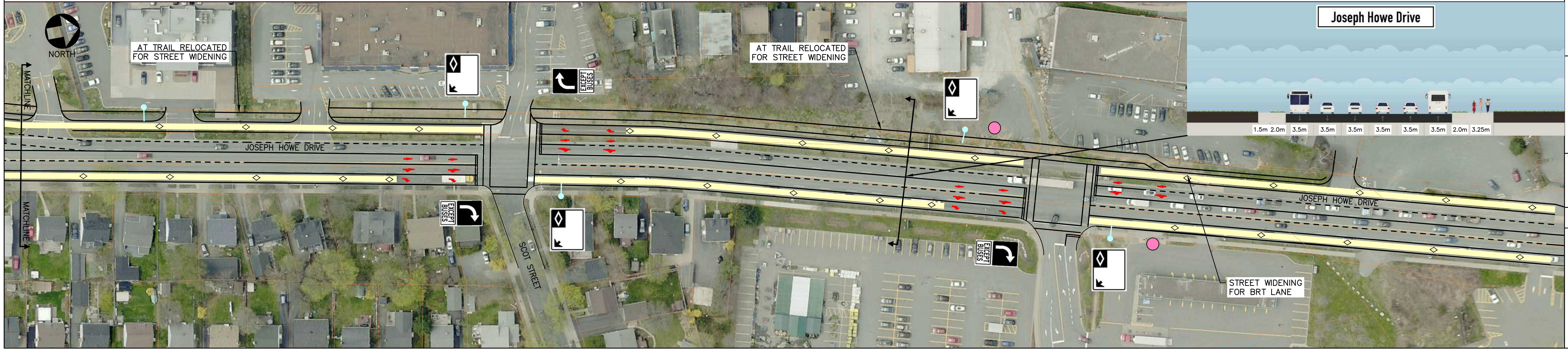

◇	"BUS RAPID TRANSIT" LANE
↑	RED ARROWS INDICATE LANE DESIGNATION CHANGE
●	LARGE–SCALE BRT STATION
◎	MEDIUM–SCALE BRT STATION
●	ENHANCED ON–STREET BRT STOP
↓	BRT OVERHEAD SIGNAGE

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Client

HALIFAX

DILLON CONSULTING

HARBOURSIDE Transportation Consultants

Project

BRT STUDY

Title

JOSEPH HOWE DRIVE BRT

Scale	11x17: 1:375 22x24: 1:750	Date	JANUARY 2018
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		Checked	Approved
		Contract No.	172042

Drawing No.

C-03

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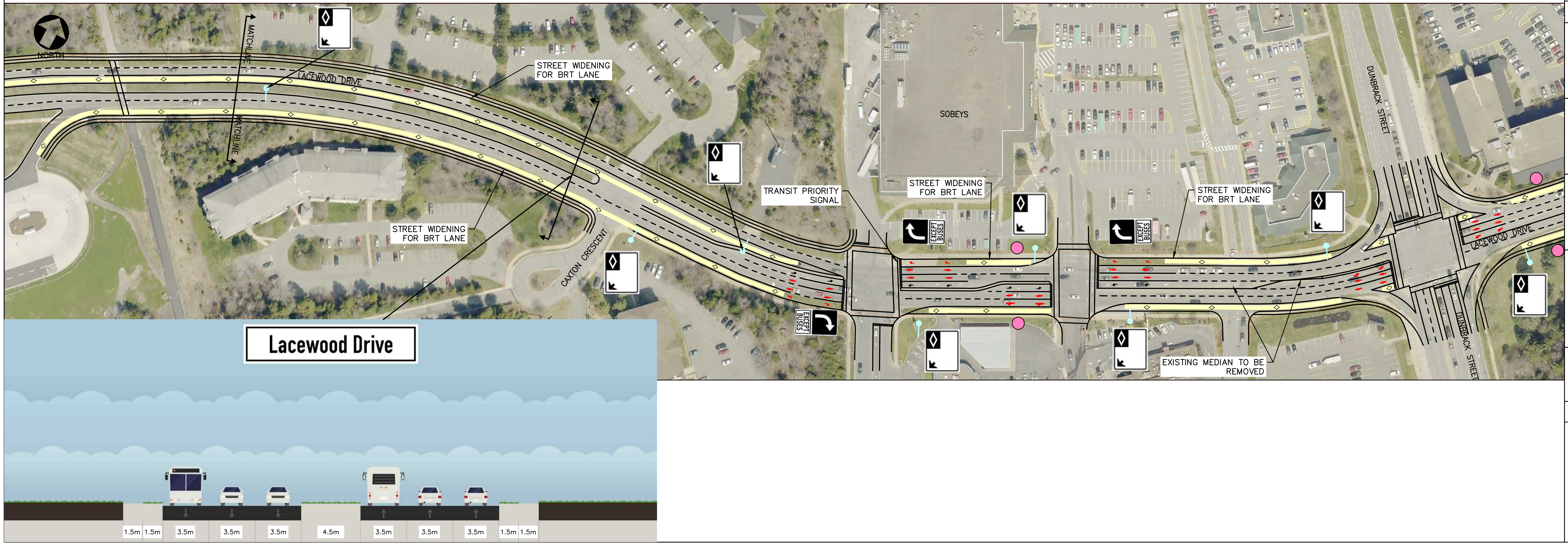

◇	"BUS RAPID TRANSIT" LANE
↑	RED ARROWS INDICATE LANE DESIGNATION CHANGE
●	LARGE–SCALE BRT STATION
◉	MEDIUM–SCALE BRT STATION
●	ENHANCED ON–STREET BRT STOP
⍿	BRT OVERHEAD SIGNAGE

No.	DESCRIPTION	Date (mm/dd/yy)	By
A	ISSUED FOR REVIEW	01/10/18	MM

ISSUE or REVISION

Client

HALIFAX

DILLON CONSULTING

HARBOURSIDE Transportation Consultants

Project

BRT STUDY

Title

LACEWOOD DRIVE BRT

Scale 11x17: 1:500
22x24: 1:1000

Date JANUARY 2018

Drawn B. FORBES

Designed

Checked

Approved

Contract No. 172042

Drawing No.

C-05

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◇ "BUS RAPID TRANSIT" LANE

RED ARROWS INDICATE LANE DESIGNATION CHANGE

● LARGE–SCALE BRT STATION

◎ MEDIUM–SCALE BRT STATION

● ENHANCED ON–STREET BRT STOP

BRT OVERHEAD SIGNAGE

A	ISSUED FOR REVIEW	01/10/18	MM
No.	DESCRIPTION	Date (mm/dd/yy)	By

ISSUE or REVISION

Client
HALIFAX

DILLON CONSULTING

HARBOURSIDE
Transportation Consultants

Project
BRT STUDY

Title
PORTLAND STREET BRT

Scale 11x17: 1:625
22x24: 1:1250

Date JANUARY 2018

Drawn B. FORBES

Designed

Checked

Approved

Contract No. 172042

Drawing No. C-06

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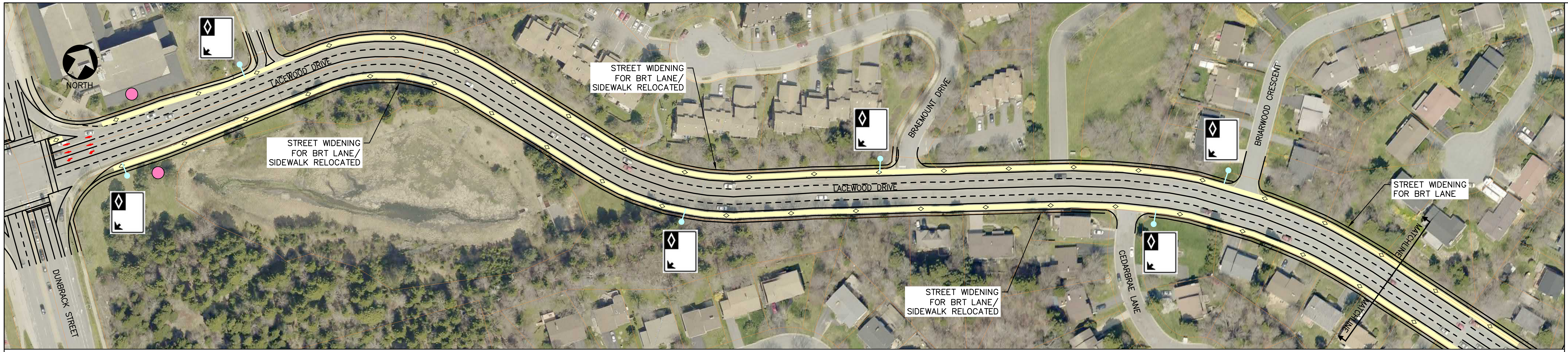

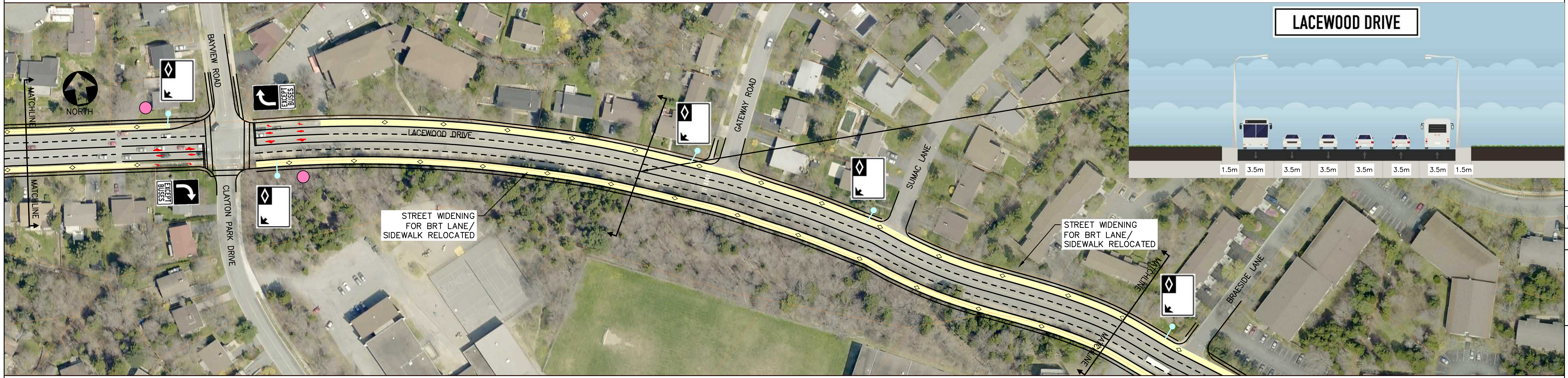

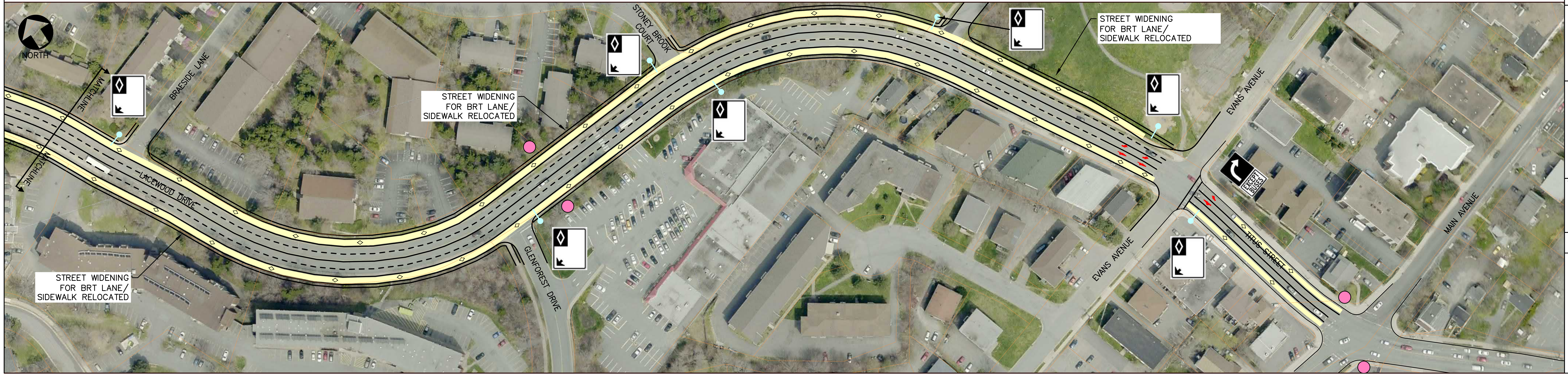

◇ "BUS RAPID TRANSIT" LANE

RED ARROWS INDICATE LANE DESIGNATION CHANGE

● LARGE-SCALE BRT STATION

◎ MEDIUM-SCALE BRT STATION

● ENHANCED ON-STREET BRT STOP

BRT OVERHEAD SIGNAGE

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No.	DESCRIPTION	Date (mm/dd/yy)	By

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Client

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DILLON CONSULTING

HARBOURSIDE Transportation Consultants

Project

BRT STUDY

Title

LACEWOOD DRIVE BRT

Scale	11x17: 1:500 22x24: 1:1000	Date	JANUARY 2018
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		Checked	Approved
		Contract No.	172042
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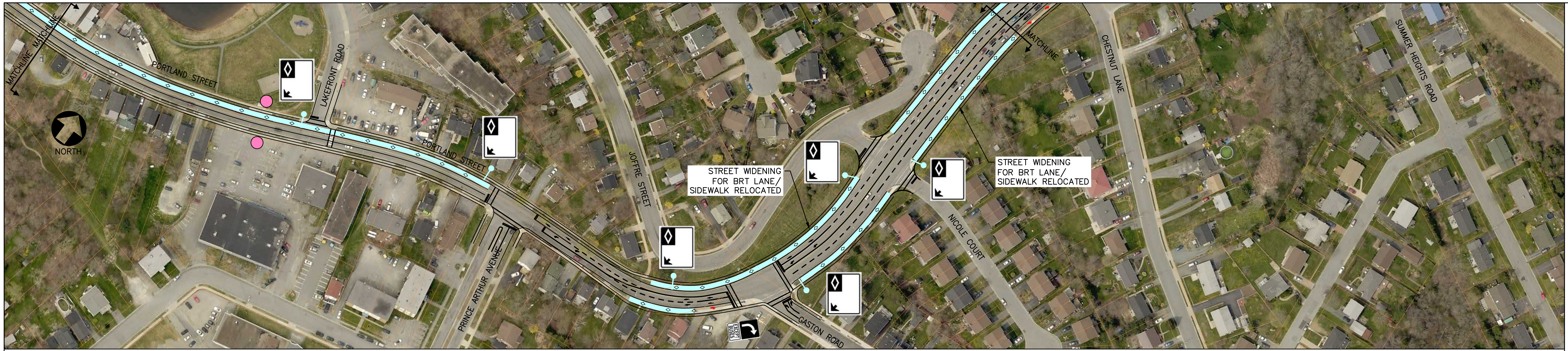

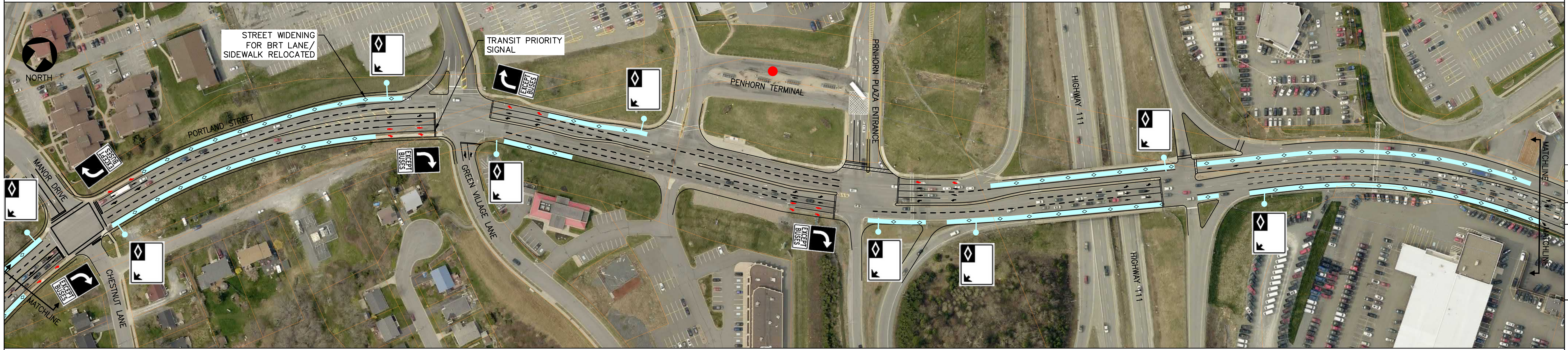

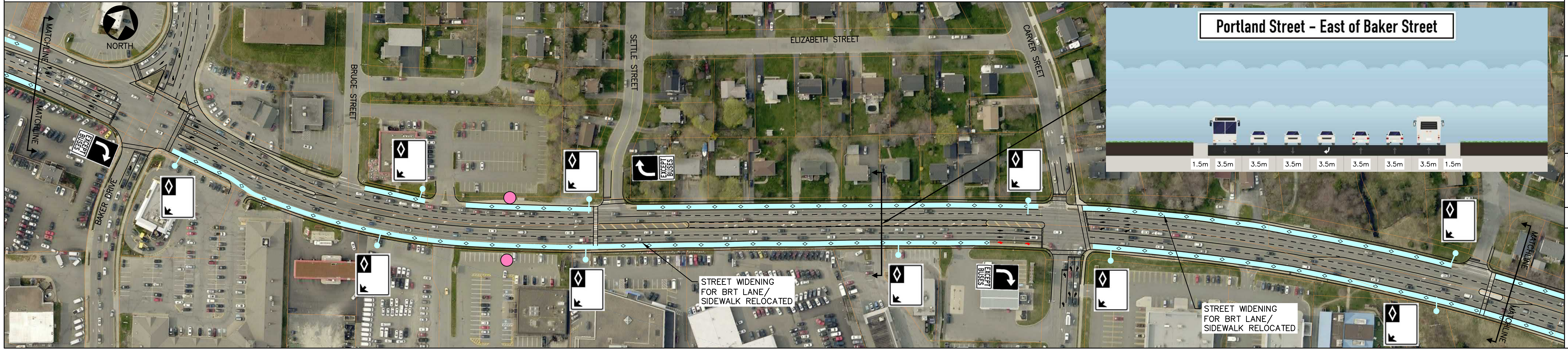

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●	LARGE-SCALE BRT STATION
◎	MEDIUM-SCALE BRT STATION
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No.	DESCRIPTION	Date (mm/dd/yy)	By

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Project

BRT STUDY

Title

PORTLAND STREET BRT

Scale 11x17: 1:625
22x24: 1:1250

Date JANUARY 2018

Drawn B. FORBES

Designed

Checked

Approved

Contract No. 172042

Drawing No.

C-07

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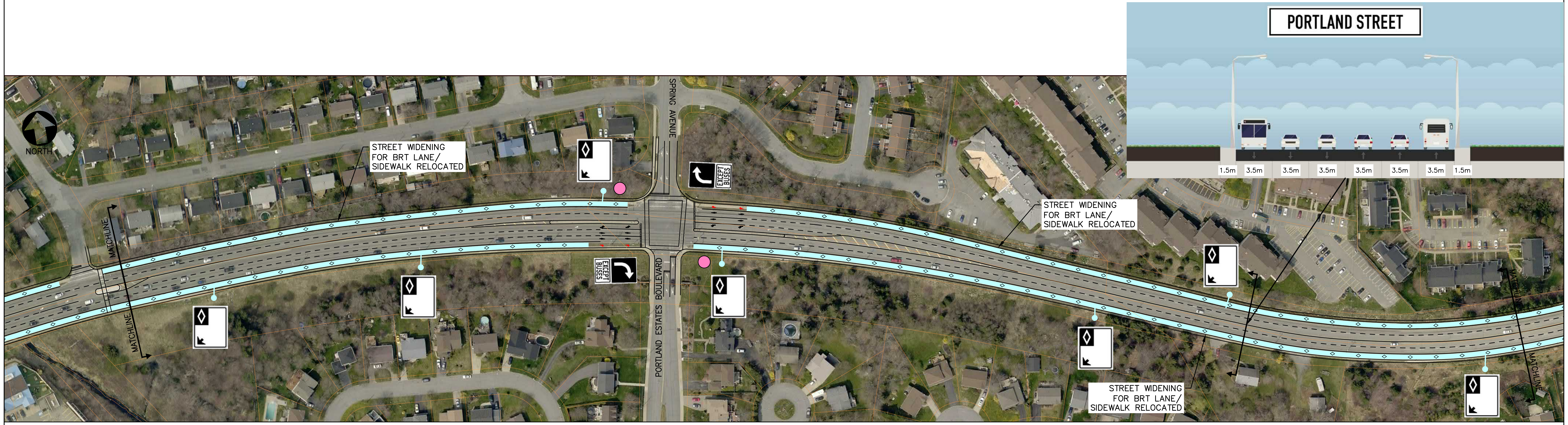

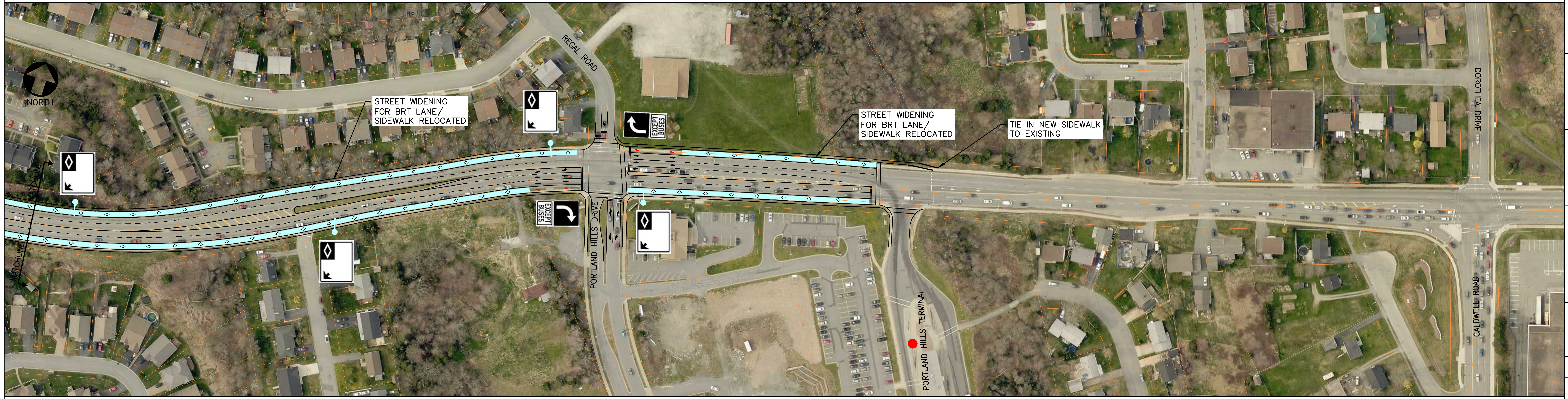

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↑	RED ARROWS INDICATE LANE DESIGNATION CHANGE
●	LARGE–SCALE BRT STATION
◉	MEDIUM–SCALE BRT STATION
●	ENHANCED ON–STREET BRT STOP
⫯	BRT OVERHEAD SIGNAGE

No.	DESCRIPTION	Date (mm/dd/yy)	By
A	ISSUED FOR REVIEW	01/10/18	MM

ISSUE or REVISION

Client

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HARBOURSIDE
Transportation Consultants

Project

BRT STUDY

Title

PORTLAND STREET BRT

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		Contract No.	172042
		Drawing No.	C-08

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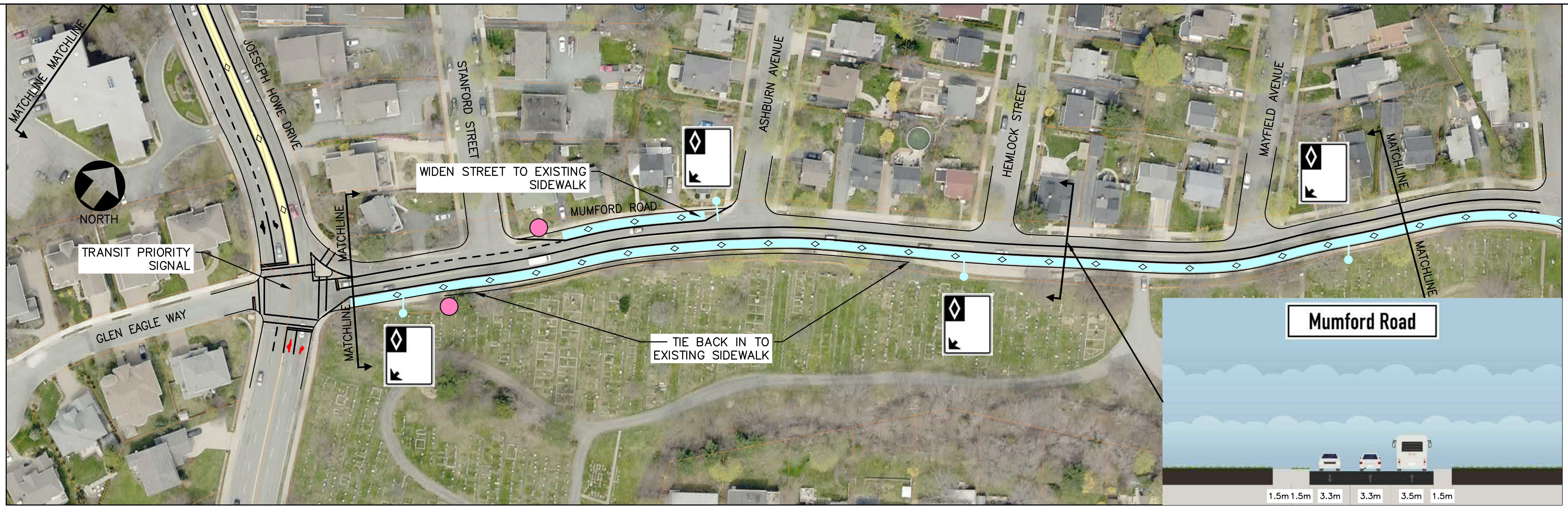

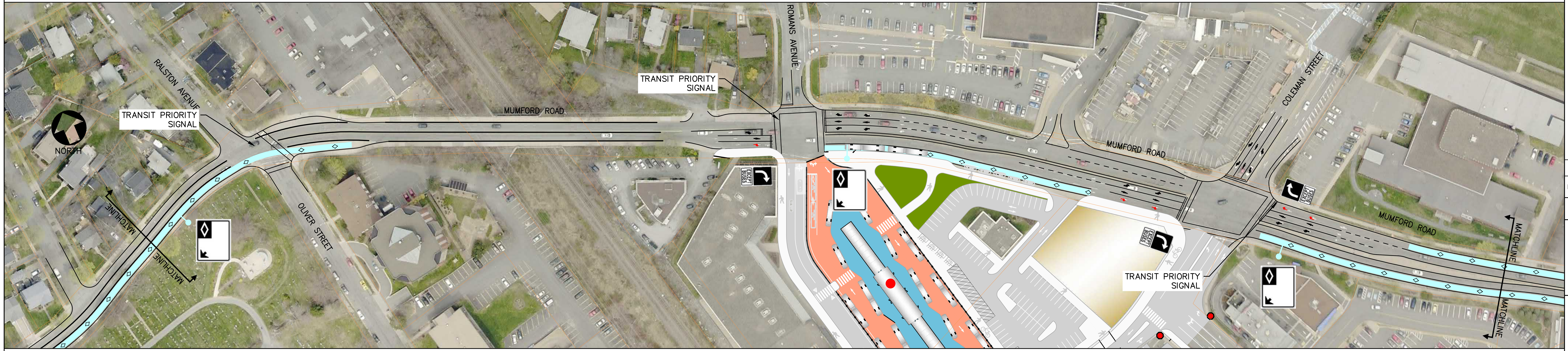

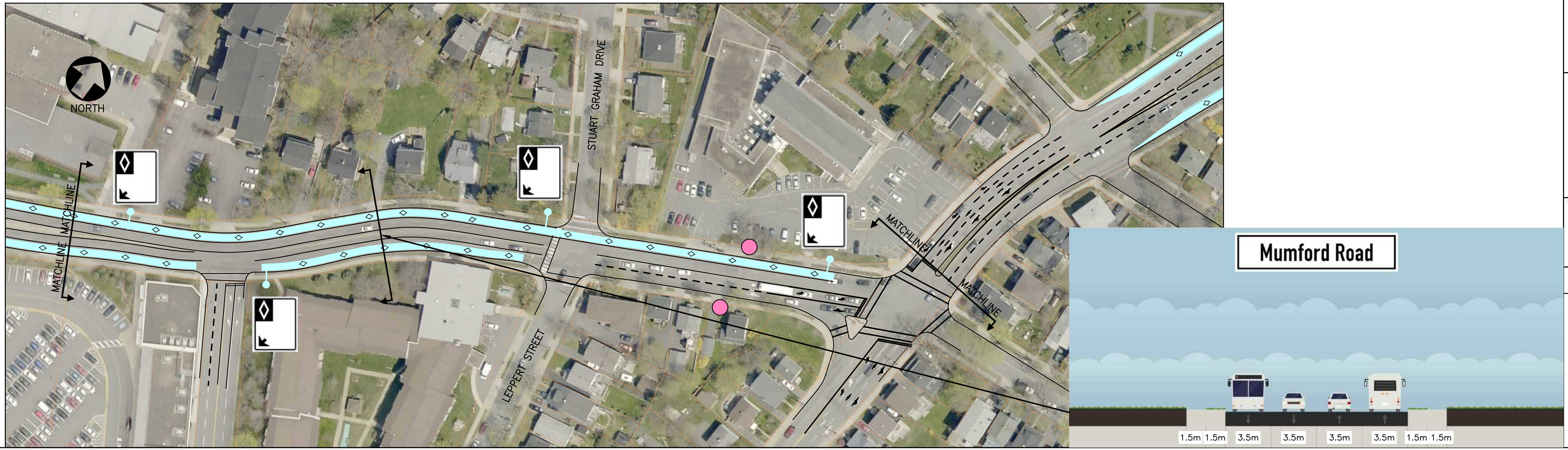

◇	"BUS RAPID TRANSIT" LANE
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●	LARGE-SCALE BRT STATION
◎	MEDIUM-SCALE BRT STATION
●	ENHANCED ON-STREET BRT STOP
↓	BRT OVERHEAD SIGNAGE

No.	DESCRIPTION	Date (mm/dd/yy)	By
A	ISSUED FOR REVIEW	05/14/18	MM

ISSUE or REVISION

Client

HALIFAX

DILLON CONSULTING

HARBOURSIDE
Transportation Consultants

Project

BRT STUDY

Title

MUMFORD ROAD BRT

Scale 11x17: 1:500
22x24: 1:1000

Date MAY 2018

Drawn B. FORBES

Designed

Checked

Approved

Contract No. 172042

Drawing No. C-09

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Appendix F

Station Development Costs - By Station Type

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COST ESTIMATE: ENHANCED ON-STREET STOP

ITEM	DESCRIPTION	QTY.	UNITS	PRICE	TOTAL
	Excavation and Rough Grading				
1	Excavate and remove concrete sidewalk and rough grading	85	sq.m	$70.00	$5,950.00
	Concrete Foundations				
2	Concrete base for Station ID Sign Structure	1	ls	$5,000.00	$5,000.00
3	Concrete base for Bus Stop Flag	1	ls	$1,500.00	$1,500.00
	Electrical and Communications				
4	Electrical work	1	l.s.	$30,000.00	$30,000.00
5	Communication Supply (wireless receiver and connections to signage)	1	l.s.	$10,000.00	$10,000.00
	Concrete Paving				
6	Concrete base for 8x20 heated shelter	20	sq.m	$500.00	$10,000.00
7	Concrete sidewalk paving for 2mx 30m platform and amenities areas	65	sq.m	$120.00	$7,800.00
8	Unit Paving for accessible path of travel to shelter doors and head of platform	10	sq.m	$350.00	$3,500.00
9	Detectable Warning Surface Tiles (based on length of platform from head of stop)	24	ea	$600.00	$14,400.00
	Shelter, Signage & Site Furniture				
10	8x20 heated shelter with integrated benches, and lighting including door openers, including shipping and installation	1	ea.	$52,500.00	$52,500.00
11	Station ID Sign Structure (including illuminated sign and information display cabinet)	1	ea.	$25,000.00	$25,000.00
12	Real-Time Electronic Display (current OLED outdoor multifunction display screen technology)	1	ea.	$30,000.00	$30,000.00
13	Bus stop flag with 20 route tiles and detectable panels	1	ea.	$6,500.00	$6,500.00
14	Bench with Back	1	ea.	$4,500.00	$4,500.00
15	Recycling Centre with integrated cigarette butt receptacle	1	ea.	$4,500.00	$4,500.00
	Landscaping				
16	Sod repair and tree replacement allowance	1	allow	$5,000.00	$5,000.00
	Sub-total				$216,150.00
	Contingency (30%)				$64,845.00
	Total - Enhanced On-Street Stop				**$280,995.00**

COST ESTIMATE: MEDIUM SCALE BRT STATION

ITEM	DESCRIPTION	QTY.	UNITS	UNIT PRICE	TOTAL
	Excavation and Rough Grading				
1	Excavate and remove concrete sidewalk and rough grading	180	sq.m	$70.00	$12,600.00
	Concrete Foundations				
2	Concrete base for Station ID Sign Structure	1	ls	$8,000.00	$8,000.00
3	Concrete base for Bus Stop Flag	1	ls	$1,500.00	$1,500.00
	Electrical and Communications				
4	Electrical work	1	l.s.	$45,000.00	$45,000.00
5	Site Lighting Allowance	1	allow.	$25,000.00	$25,000.00
6	Communication Supply (wireless receiver and connections to signage)	1	l.s.	$10,000.00	$10,000.00
	Concrete Paving				
7	Concrete base for 8x40 heated shelter	40	sq.m	$500.00	$20,000.00
8	Concrete base for 5x20 canopy and bike canopy	15	sq.m	$500.00	$7,500.00
9	200mm thick reinforced concrete paving for 3mx 40m platform	120	sq.m	$200.00	$24,000.00
10	Concrete sidewalk for amenities areas	120	sq.m	$120.00	$14,400.00
11	Unit Paving for accessible path of travel to shelter doors and head of platform	20	sq.m	$350.00	$7,000.00
12	Detectable Warning Surface Tiles (based on length of platform from head of stop)	32	ea	$600.00	$19,200.00
	Shelter, Signage & Site Furniture				
13	8x40 heated shelter with integrated benches, and lighting including door openers including shipping and installation	1	ea.	$87,500.00	$87,500.00
14	5x20 canopy with integrated lighting and space for information kiosk	1	ea.	$45,000.00	$45,000.00
15	5x10 canopy with integrated lighting for bicycle racks	1	ea.	$25,000.00	$25,000.00
16	Station ID Sign Structure (including illuminated sign and information display cabinet)	1	ea.	$30,000.00	$30,000.00
17	Transit information kiosk	1	ea.	$8,500.00	$8,500.00
18	Real-Time Electronic Display (current OLED outdoor multifunction display screen technology)	1	ea.	$30,000.00	$30,000.00
19	Bus stop flag with 20 route tiles and detectable panels	1	ea.	$6,500.00	$6,500.00
20	Bench with Back	1	ea.	$4,500.00	$4,500.00
21	Backless Bench	1	ea.	$4,000.00	$4,000.00
22	Bicycle racks	4	ea.	$500.00	$2,000.00
23	Recycling Centre with integrated cigarette butt receptacle	1	ea.	$4,500.00	$4,500.00
	Landscaping				
24	Landscape allowance (sod, trees, planting bed, shrubs)	1	allow	$55,000.00	$55,000.00
	Sub-total				$496,700.00
	Contingency (30%)				$149,010.00
	Total - Medium-Scale BRT Station				**$645,710.00**

COST ESTIMATE: LARGE SCALE BRT STATION

ITEM	DESCRIPTION	QTY.	UNITS	UNIT PRICE	TOTAL
	Excavation and Rough Grading				
1	Excavate and remove concrete sidewalk and rough grading	240	sq.m	$70.00	$16,800.00
	Concrete Foundations				
2	Piles(20) and slab foundation for heated shelter and large canopy including knee walls	1	ea	$145,000.00	$145,000.00
3	Concrete pile and pile cap for Station ID Sign Structure	1	ea	$15,000.00	$15,000.00
4	Concrete base for median fence	60	m	$750.00	$45,000.00
4	Concrete base for Bus Stop Flag	1	ls	$1,500.00	$1,500.00
	Electrical and Communications				
5	Electrical work	1	l.s.	$45,000.00	$45,000.00
6	Site Lighting Allowance	1	allow.	$50,000.00	$50,000.00
7	Communication Supply (wireless receiver and connections to signage)	1	l.s.	$10,000.00	$10,000.00
	Concrete Paving				
8	Concrete bases for 5x20 canopy and bike canopy	25	sq.m	$500.00	$12,500.00
9	200mm thick reinforced concrete paving for 3mx 60m platform	180	sq.m	$200.00	$36,000.00
10	Concrete sidewalk for amenities areas	60	sq.m	$120.00	$7,200.00
11	Unit Paving for accessible path of travel to shelter doors and head of platform	35	sq.m	$350.00	$12,250.00
12	Detectable Warning Surface Tiles (based on length of platform from head of stop)	48	ea	$600.00	$28,800.00
	Shelter, Signage & Site Furniture				
13	30x60 large canopy with integrated lighting, signage and aesthetics	1	ea.	$650,000.00	$650,000.00
14	8x40 heated shelter with integrated benches, and lighting including door openers and aesthetics	1	ea.	$87,500.00	$87,500.00
15	5x20 canopy with integrated lighting	2	ea.	$45,000.00	$90,000.00
16	5x10 canopy with integrated lighting for bicycle racks	1	ea.	$25,000.00	$25,000.00
17	Station ID Sign Structure (including illuminated sign and information display cabinet)	1	ea.	$40,000.00	$40,000.00
18	Transit information kiosk	2	ea.	$8,500.00	$17,000.00
19	Real-Time Electronic Display (current OLED outdoor multifunction display screen technology)	1	ea.	$30,000.00	$30,000.00
20	Bus stop flag with 20 route tiles and detectable panels	1	ea.	$6,500.00	$6,500.00
21	Bench with Back	1	ea.	$4,500.00	$4,500.00
22	Backless Bench	2	ea.	$4,000.00	$8,000.00
23	Bicycle racks	4	ea.	$500.00	$2,000.00
24	Bicycle lockers	8	ea.	$500.00	$4,000.00
25	Decorative median fencing	60	m	$2,200.00	$132,000.00
26	Warning and regulatory signage	1	allow	$1,500.00	$1,500.00
27	Recycling Centre with integrated cigarette butt receptacle	2	ea.	$4,500.00	$9,000.00

	Landscaping				
28	Landscape allowance (sod, trees, planting bed, shrubs)	1	allow	$55,000.00	$55,000.00
	Sub-total				$1,587,050.00
	Contingency (30%)				$476,115.00
	Total - Large-Scale BRT Station				**$2,063,165.00**

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Bus Rapid Transit Study

Briefing Note: Ridership Impacts of BRT in Other Jurisdictions
Potential Funding Options for BRT

February 2019 – 17-5956

Table of Contents

Tables

1.0 Introduction

This briefing note provides a brief summary of:

- Estimated ridership impacts of BRT initiatives in other jurisdictions; and
- Potential funding options for consideration in the development of BRT in Halifax Regional Municipality.

2.0 BRT Ridership in Other Jurisdictions

2.1 Factors Affecting Ridership

In corridors in which BRT initiatives are implemented, ridership levels are influenced by a combination of factors. Some are directly related to the characteristics of the transit service, while several others are not. Consequently, it is often challenging for cities to isolate the ridership impacts attributed solely to a specific BRT project.

Factors affecting BRT ridership levels can be generally categorized as shown in Table 1:

Table 1: Factors Affecting BRT Ridership

Category	Factor	Comments
Transit-Related	Speed and Reliability	• Transitways that use separate roadways and grade separations to minimize interaction with other traffic offer significantly higher reliability and speeds, and generally have a higher impact on ridership growth. • In-street BRT, utilizing reserved lanes, queue jumps, and traffic signal priority, offer moderate improvements in reliability and speed, and have a more moderate impact on ridership growth.
	Span of Service	• BRT services typically operate throughout the day on all days of the week. • BRT service with a span of service significantly lengthier than that previously offered by conventional transit has a positive impact on ridership.
	Service Frequency	• A BRT service offering a significantly more frequent service in comparison to that previously offered by conventional transit in mixed traffic has a positive impact on ridership. • If service frequencies remain relatively unchanged with the introduction of BRT, ridership impacts are minor.
	Comfort, Ease of Use	• BRT projects with major investments in stations, new buses, and passenger information systems tend to have a more positive impact on ridership than those that do not.

Category	Factor	Comments
	Fares	- A BRT fare structure (types and values of fares) that is fully integrated with the rest of the transit system has a more positive impact on ridership than those that are not. - Systems that use off-board fare payment at busy stations realize some improvements in speed and reliability that, in turn, can have a positive impact on ridership.
Non-Transit Related	Development Density	- Corridors in which significant growth in development density occurs in conjunction with BRT realize significantly higher ridership growth than in corridors where little change in development density occurs.
	Land Use Patterns	- BRT corridors in which there is a mix of land uses (e.g. residential, commercial, educational, employment, etc.) realize higher ridership levels throughout the day than corridors in which land use is more homogeneous.
	Pedestrian Facilities	- The arrangement of sidewalks and paths and the quality and safety of the pedestrian environment directly affect passenger access to BRT stations. - A pedestrian network that provides convenient access to BRT service has a more positive impact on BRT ridership than when pedestrian connections are poor or lacking.
	Economic Conditions	- Urban areas experiencing strong growth in population and employment will realized higher levels of ridership growth (including BRT ridership) than will cities with lower levels of economic growth.
	Demographics	- BRT corridors that serve a diverse mix of demographic groups, especially those that already use transit (e.g. workers, students, new immigrants, seniors), tend to realize high ridership growth.
	Alternative Transportation Options	- Ridership growth for BRT in areas with high rates of vehicle ownership amongst households is less than in areas with lower levels of vehicle ownership. - Ridership growth in BRT corridors with higher levels of traffic congestion and/or limited parking tends to be higher than in corridors with moderate congestion and abundant parking.

While estimates of ridership changes associated with BRT projects in other jurisdictions are reported in the next section, it is important to note that the conditions for the above factors are not fully known (or readily available) for any of the projects. The reported ridership impacts are for BRT initiatives with which the consulting team has some familiarity or from information reported on internet sites. Consequently, caution should be used in extrapolating these estimates to the conceptual BRT plan proposed for HRM.

During the future planning stages for any of the proposed BRT lines, it is recommended that an estimate of ridership impacts be undertaken that is based on a methodology that models the BRT improvements, regional growth in population/employment/post-secondary enrollments, and land use intensification scenarios along the BRT corridors.

2.2 Ridership Impacts in Other Jurisdictions

Based on the consulting team's knowledge of other systems and from information reported on internet sites, Table 2 summarizes the estimates of ridership impacts of selected BRT projects.

Table 2: Ridership Impacts of Selected BRT Projects

Type	Jurisdiction	BRT	Features	Ridership Impact
Transitway BRT	Ottawa, ON	Transitway	• 59 kms, 38 stations • 5 branches (East, Southeast, Central, West, Southwest)	~70% to 80% of system's weekday ridership
	Mississauga, ON	Mississauga Transitway	• 18 kms, 12 stations • 12 routes	+107%
	Winnipeg, MB	Southwest Transitway	• Stage 1 (2012) - 4 kms, 4 stations, 13 routes • Stage 2 (2020) - 7 kms, 9 stations	+14% (Stage 1)
	Miami, USA	South Miami-Dade Busway	• 21 kms, 28 stations • Parallel to major highway	+50%
In-Street BRT	Vancouver, BC	96 B-line	• 11 kms, 12 stations • Mixed Traffic with Traffic Signal Priority, limited reserved lanes	+30%
	Brampton, ON	Züm	• 4 corridors, ~90 stops • Mixed Traffic with Traffic Signal Priority	Queen (2010-18) +133% Main (2011-18) +174% Steeles (2012-18) +117% Bovaird (2014-18) +62%
	York Region, ON	Viva	• 6 routes • Mixed Traffic with Traffic Signal Priority, Sections of Median Bus Lanes	+20% to 50%
	Boston, USA	Silver Line	• Multiple routes, 21 stations • Tunnel, Reserved Lanes, Mixed Traffic	+84%
	Kansas City, USA	MAX	• 2 lines, ~40 stations • Mixed Traffic with Traffic Signal Priority, limited reserved lanes	+9% to +50%
	Los Angeles, USA	Metro Rapid	• Network of 20 express lines • Mixed traffic, with Traffic Signal Priority	+27 to 42%
	Las Vegas, USA	MAX	• Operated 2004 – 2016 • 11 kms, 22 stations • Sections of reserved lanes • Special Vehicles (Civis)	+35 to 40 %

3.0 Potential Funding Mechanisms for BRT

Investing in Canada Plan

Building on the *Public Transit Infrastructure Fund (PTIF)* approved in Budget 2016 to accelerate federal investment in the rehabilitation, repair, and modernization of public transit infrastructure, the Government of Canada approved the *Investing in Canada Plan* in Budget 2017 to provide additional funding across five priority infrastructure streams: public transit, green, social, trade and transportation, and rural and northern communities' infrastructure.

The *Public Transit Stream* of the *Investing in Canada Plan* includes $20.1 billion over 10 years, delivered by Infrastructure Canada. This stream provides funding to address the construction, expansion, and improvement of public transit infrastructure. An agreement is signed with each province and territory regarding cost-sharing for agreed-to projects. Provincial/territorial allocations of the funding are determined by a formula based on ridership (70%) and population (30%). The allocated amount for the *Public Transit Stream* in Nova Scotia is $289,589,324. Within each jurisdiction, funding is allocated to existing public transit systems based on their respective ridership, with some flexibility possible to address regional requirements.

Web link: https://www.infrastructure.gc.ca/plan/icp-publication-pic-eng.html#4.1

User Fees

These include non-transit fees used to influence individual travel decisions to encourage modal shift, reduce congestion, and reduce GHG emissions. Examples include carbon taxes, gasoline taxes, cordon charges, car rental levies, and highway tolls.

Vehicle Ownership and User Fees

These fees are designed to recover some of the externalities that result from automobile use (e.g. pollution, accidents, injuries, etc.). Examples include vehicle registration fees, new vehicle sales levy, vehicle insurance taxes, and a driver's license tax.

Parking Charges

These include charges, other than property taxes, on lands predominantly used for automobile parking and are designed to recover some of the externalities that result from automobile use (e.g. pollution, accidents, injuries, etc.). Typical examples include a sales tax on paid parking transactions and parking levies to owners of non-residential, off-street parking spaces within designated areas.

Special Purpose Taxes

These generally apply to all individuals and/or employers and the revenues raised are used to fund dedicated projects or services. Examples include an employer payroll tax (e.g. *Versement de Transport* in France) and a utility fee on electricity, natural gas or water/sewer accounts.

Development Charges

Development charges are levied by municipalities on the construction of new residences and commercial developments, with the revenues used to offset all or a portion of the cost of new infrastructure required to support new development growth. Development charges typically vary by the type and location of new development. They are used by several Canadian municipalities as a revenue source and have been used to fund such transit infrastructure as bus fleet expansions, garages, and rapid transit construction.

Land Value Capture

Land value capture is an approach that enables a municipality to recover and invest land value increases generated by the improved accessibility created by a public investment in transportation infrastructure. While the uplift in value due to improved accessibility depends on local circumstances, the rationale is that the uplift should be shared between the benefitting property owners and the municipality that makes the transit investment. Opportunities for land value capture are highest when developable properties with restricted access are located near planned transit stations and the public sector transit investment is yet to be finalized. In such situations, the land value capture can be an important factor in moving the project forward.

Approaches to land value capture include:

- Special property tax within a defined district that benefits from the transit investment;
- Sale of air rights for development above or below a station;
- Tax increment financing that leverages future tax revenue increases to fund the transit investment;
- Negotiated agreements in which the property owners provide funding or in-kind contributions in return for development approval.

Public-Private Partnerships (P3)

A P3 involves a contract between the municipality and a private consortium in which the private partner designs, builds, finances, maintains (and optionally operates) a major transit project over a defined period (often 30 years) at a fixed cost on a fixed schedule. In return, the municipality makes a series of service payments to the private partner over the term of the agreement. A major objective of P3's is to transfer cost and schedule risk to the private partner. A P3 (DBFM) was used for the Southwest Transitway (Stage 2) project in Winnipeg.

Private Sector Contributions

In some instances, land developers have partnered with municipalities to partially fund components of new public transit infrastructure that directly benefit their developments. This approach has been used to fund new transit stations in cases where a station (and the transit service that stops there) is viewed as a catalyst to build and market a new development or to obtain approval to increase density on the lands adjacent to the station. For example, the developer of lands adjacent to the Southwest Transitway in Winnipeg partially funded the construction of the new Jubilee Station on the transitway.