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1. Study 1: On-Demand Transit
2. Study 2: Bus Lifecycle Analysis
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Transit Service Efficiency

Executive Summary

December 2019
Executive Summary

Brampton Transit Overview

1300+ Staff (900+ Operators)  $79 Million Revenue  450 Buses

31,2 Million Riders  57 Routes

Growing Service Needs

Brampton Transit has experienced significant growth* over the past few years
- 154% total trip growth
- 100% rides/capita growth
- 25% population growth
- Continued ridership growth is expected in the future with population growth and attracting new businesses

Focused on Service Efficiency

Brampton Transit has diligently worked on service efficiency
- Maximizing route performance
- Ensuring safety and minimizing risk
- Preventative maintenance to maximize vehicle lifecycles
- Extending shifts to not impact service levels
- Reducing costs where possible

Resulted in Four Specific Transit Service Efficiency Studies

*2009-2018
Executive Summary

Study Focus Areas

Brampton Transit Service Efficiency Studies

**Study #1**
On-Demand Transit Assessment
- Analyze opportunities to use on demand at a lower cost
- Recommend conditions for successful implementation

**Study #2**
Bus Lifecycle Analysis
- Assess optimal bus retention years by fleet type
- Adjust lifecycle targets as needed
- Recommend optimal maintenance program

**Study #3**
Snow Removal for Transit Facilities
- Analyse costs of in outsourced versus in-house snow removal (Facilities only)
- Identify cost efficient service model that maintains service levels

**Study #4**
Service Reliability
- Analyse costs of long-term absenteeism
- Assess potential cost savings by assigning contingent resources
Executive Summary

Study 1: On-Demand Transit Assessment

Current State Findings

Types of On-Demand Transit

- Curb to Curb Transit
- First/Last-mile Connections
- Shuttle Services
- Flexible Routing

Overall Findings

- Modern On-Demand Transit is enabled by new technologies, advanced algorithms and automated scheduling, routing and dispatching of vehicles
- On-Demand Transit most suitable for low-demand scenario with many benefits such as cost saving, route rationalization and network optimization

Peer Review Findings

Overall Findings

- Peers in Ontario are already exploring On-Demand options (Innisfil, Belleville, York Region)
- When used for late night route deviation, ridership on the on-demand alternative has grown significantly, necessitating additional service
- In urbanized areas, the service tends to operate on weekends and/or during evenings when demand for fixed route decreases
- In rural zones it operates as a first/last mile service to commuter and/or rapid transit

Key Analysis Findings

- Existing Brampton Transit services operate at a high-degree of productivity, with 99% of all hours of service operating beyond the practical maximum of on-demand transit
- Brampton Transit services would not be able to be replaced by On-Demand Transit at a broad scale without incurring significant costs
- On-Demand Transit presents an opportunity to manage and control costs resulting from future service expansion

Exploring On-Demand now will position Brampton Transit for lower cost options in the future
Executive Summary

Recommendation 1: Conduct a strategic pilot of On-Demand Transit on deliberately selected route(s) to evaluate the precise cost and customer service impacts.

- Possible opportunities for a strategic pilot program include:
  - Late-evening on-demand/shuttle service within the central industrial and commercial parks
  - Late-evening flexible routing along routes 3 and 15 to supplement and/or replace service on 24 and 32 respectively
  - Late-evening on-demand service south of Brampton Gateway to replace routes 53, 54 and 56
- Considering the expected growth in service and ridership, On-Demand Transit is a valuable tool to manage and avoid future costs that should be investigated now
- On Demand would position Brampton Transit to grow transit services strategically as demand continues to rise
- The sooner the exploration of On-Demand begins, the better positioned Brampton Transit will be to offset growth costs in the future
Executive Summary

Study 2: Bus Lifecycle Analysis

Current State Findings

<table>
<thead>
<tr>
<th>Current Fleet</th>
<th>Current Fleet Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>450 Buses</td>
<td>Brampton Transit manages a fleet of <strong>450 buses</strong>, with the vast majority being 40-ft Diesel models</td>
</tr>
<tr>
<td>18 yr. Avg. Retention</td>
<td>High retention target of <strong>18 years</strong> on fleet</td>
</tr>
<tr>
<td>19K Avg. MBDF</td>
<td>Brampton Transit currently operates overhauls, replacements, inspections, and preventative maintenance</td>
</tr>
<tr>
<td></td>
<td>Overall, Brampton Transits current maintenance program is <strong>highly effective</strong>, and underpins the successful operations of a <strong>highly reliable fleet</strong> (high MDBF)</td>
</tr>
</tbody>
</table>

Peer Review Findings

<table>
<thead>
<tr>
<th>Agencies Reviewed (6)</th>
<th>Peer Review Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halifax Transit, Winnipeg Transit, Toronto Transit Commission, Mississauga MiWay &amp; York Region Transit</td>
<td>Brampton’s current target bus retention policy is <strong>at the high end of peers reviewed</strong></td>
</tr>
<tr>
<td></td>
<td>Agencies have a mixed approach to overhaul programs and maintenance intervals</td>
</tr>
<tr>
<td></td>
<td>Bus retention policy and preventative maintenance programs are not formally documented among peer agencies</td>
</tr>
<tr>
<td></td>
<td>Most agencies are starting to look at <strong>expanding/formalizing Preventive Maintenance programs</strong> for individual components</td>
</tr>
</tbody>
</table>

Overall Findings

<table>
<thead>
<tr>
<th>Overall Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Mean Distance Between Failures (MBDF) of <strong>12,000 km</strong> is optimal for Brampton Transit Buses, buses that fall below this should be <strong>retired early</strong></td>
</tr>
<tr>
<td>Bus retention policy (age) that provides the lowest lifecycle cost and a minimum standard of service reliability - <strong>18 years</strong> for a 40-ft diesel bus, <strong>15 years</strong> for a 40-ft hybrid bus, and <strong>9 years</strong> for a 60-ft hybrid bus.</td>
</tr>
<tr>
<td>Achieving the City’s emissions goal is directly linked to the retention age established for the diesel buses in the fleet</td>
</tr>
</tbody>
</table>

Retiring buses at the MDBF 12,000 target is aligned with the city’s emissions targets
Executive Summary

Study 2: Bus Lifecycle Analysis

The following is an overview of the recommendations related to Bus Lifecycle analysis

**12,000 Km**

**Recommendation 1:**
Maintain a minimum MDBF of 12,000 kilometers for all buses and implement ongoing condition-based assessment to ensure that the quality of service is maintained.

**Recommendation 2:**
Maintain a bus retention policy that provides the lowest lifecycle cost and a minimum standard of service reliability.

**Recommendation 3:**
Implement the recommended maintenance program based on the bus retention policy.

**Recommendation 4:**
Implement maintenance related recommendations to obtain maximum value from fleet investments including: mobile mechanic; top 10 mechanical issues; predictive maintenance; warranty tracking; warranty programs; battery check program; and, update bus lifecycle model.
Executive Summary

Study 3: Snow Removal for Transit Facilities

Current State Findings

<table>
<thead>
<tr>
<th>Current Infrastructure</th>
<th>2</th>
<th>5</th>
<th>8</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSP</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Peer Review Findings

Overall Findings

- Majority of other transit services use contractors
- Lack of staff capacity is the primary reason most transit systems do not switch fully to in-house services
- Contractor issues are common across the industry, with response times being the primary source of tension
- TTC uses a hybrid approach, which only contracts secondary areas to contract workers

Key Analysis Findings

- In all aspects of operational metrics, in-house snow removal would be more beneficial for riders and employees of Brampton transit
- Current equipment is adequate, and staff capacity is sufficient to conduct in-house snow removal
- Overall, internal service delivery costs are significantly lower than outsourcing snow removal
- Potential costs savings of up to 50% (Approximately $130k)

Managing facilities snow removal in house will have a potential cost savings of up to 50%
Executive Summary

Study 3: Snow Removal for Transit Facilities

The following is an overview of the recommendations related to Snow Removal for Transit Facilities

**Recommendation 1:**
Bring snow removal for transit facilities in-house to reduce cost, minimize service disruption and enhance service efficiency.

**Recommendation 2:**
Implement a data driven approach that focuses on enhance documentation of data and analysis to proactively plan for future needs with clear defined strategy supported by data and insights.
Study 4: Service Reliability

Executive Summary

Current State Findings

<table>
<thead>
<tr>
<th>Key Facts</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTAs</td>
<td>53</td>
</tr>
<tr>
<td>Ave. Work Time</td>
<td>8:22</td>
</tr>
<tr>
<td>Cancelled Service Hrs</td>
<td>5%</td>
</tr>
<tr>
<td>LTAs over 2 years</td>
<td>20</td>
</tr>
</tbody>
</table>

Overall Findings

- Brampton Transit has been experiencing increasing staff absenteeism and mounting pressures for service delivery
- Operating cost at the same time is also increasing in order to maintain the service level
- Significant upward trend on lost service hours and increasing overtime

Peer Review Findings

Overall Findings

- Long-Term Absenteeism (LTA) is prevalent throughout the industry and is dealt with by bringing on additional resources and implementing prevention and back-to-work programs

Key Analysis Findings

- Increasing number of LTAs and the tenure of LTAs creates pressure on current operators and supervisors
- Operator shortage and lack of appetite to take on additional work increasing service cancellations
- Operating costs increasing more than anticipated, largely due to costs allocated to cover overtime
- Adding additional resources can reduce the cost over time by up to $400k (approximately)

Adding resources to fill gaps left long term absenteeism could provide cost savings of up to $400k
Executive Summary

Study 4: Service Reliability

The following is an overview of the recommendations related to service reliability

**Recommendation 1:**
Supplement the operators group gradually through an increase in headcount by 12-15 FTEs as phase 1 to evaluate the impact of additional staff. Follow up with additional hires as required based on the need versus cost of overtime (with anticipated savings between $169K-$212K/year)

**Recommendation 2:**
Consider addressing increasing LTA tenures through a review of LTA staff person at the 2 year mark, and “deactivate” the employee if deemed to be away for longer than 2 years

**Recommendation 3:**
Set crew hours back to target with the aim to shorten the average work time back to the target of 8:00 hours to boost operators’ productivity

**Recommendation 4:**
Gather Operator feedback to uncover deeper insights into the workforce’s well-being and how it may impact service reliability
# Executive Summary

## Summary of Inputs

### On-Demand Transit Assessment

#### Current State of On-Demand Transit
- Benefits
- Success Factors
- Peer Implementation

#### On-Demand Transit Analysis
- Evaluation of Testing Conditions
- Scenario Modeling and Analysis
  - Parameters
  - Scenario Identification
  - Cost Savings Analysis

#### Planning and Implementation Strategy
- Tailored implementation approach

### Bus Lifecycle Analysis

#### Benchmarking on Preventative Maintenance & Bus Retention Practices
- Industry Scan
- Peer Review of Maintenance

#### Current Fleet Analysis
- Age, Make/Model, Propulsion
- Mileage
- Purchase Costs

#### Scheduled Maintenance Programs & Costs
- Major overhauls and rebuilds
- Transit Preventative Maintenance
- Annual Maintenance
- Semi-Annual Maintenance

#### Unscheduled Maintenance Frequency & Costs
- Frequency of breakdowns
- Cost of breakdowns

### Snow Removal

#### Current Pain Point of Outsourcing
- Safety
- Reputation
- Service

#### Operation Metrics Comparison
- Safety, service level and flexibility
- Staff satisfaction
- Cost

#### In-house model enablers
- Staff capacity
- Equipment
- Strategy to deployment

#### Benchmarking on snow removal practice
- Peer Review of snow removal service model

### Service Reliability

#### Operators & Supervisors
- Long Term Absenteeism Drivers and Trends
- Bidding Trends
- Supervisors Pressures

#### Service Delivery Composition
- Workforce Delivering Services Trends
- Cancellations

#### Costs
- Employee Cost Composition
- Overtime Costs
- Potential Savings

#### Others
- Collective Agreements
- Crews’ Times (shift lengths)
City of Brampton: Transit Service Efficiency Study 1: On-Demand Transit Final Report

December 2019
Executive Summary

Transit Service Efficiency:
On-Demand Transit Analysis
Executive Summary

Current State Findings:
- New trends in Transit reflect the need to incorporate new technologies, advanced algorithms and automated scheduling, routing and dispatching of vehicles into their operations.
- On-Demand Transit most suitable for low-demand scenario with many benefits such as cost saving, route rationalization and network optimization.

Analysis Conclusions:
- Extensive analysis of Brampton’s detailed data indicates that existing Brampton Transit services operate at a high-degree of productivity, with 99% of all hours of service operating beyond the practical maximum of on-demand transit.
- Brampton Transit services would not be able to be replaced by On-Demand Transit at a broad scale without incurring significant costs.
- Although no immediate savings were identified, On-Demand Transit presents an opportunity to manage and control costs resulting from future service expansion under certain circumstances.

Recommendation:
- Conduct a strategic pilot of On-Demand Transit on deliberately selected areas and time of day to evaluate the precise cost and customer service impacts.
- Conduct the pilot as soon as possible given the continued expected growth of ridership.
Context

Transit Service Efficiency: On-Demand Transit

Section 1-2
Purpose of This Study

The purpose of the study for the On-Demand Transit Analysis is described below

<table>
<thead>
<tr>
<th>Context Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Various forms of technologically advanced on-demand transit currently exist</td>
</tr>
<tr>
<td>o Other regions in Ontario have begun developing their own models of on-demand transit</td>
</tr>
<tr>
<td>o Not all environments or conditions within a City are conducive to introducing forms of on-demand transit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Mission</th>
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</thead>
<tbody>
<tr>
<td>o To partner with Brampton Transit to identify opportunities for improving service using on-demand transit and reducing costs over the long-term</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Desired Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To define the conditions necessary for the implementation of on demand transit to be successful</td>
</tr>
<tr>
<td>2. To demonstrate how Brampton Transit could serve better and at a lower cost</td>
</tr>
<tr>
<td>3. Make recommendations for an on-demand transit strategy that considers all factors needed for success</td>
</tr>
</tbody>
</table>
Approach & Methodology

Through focused research and stakeholder interviews, a strong understanding of Brampton’s bus retention and maintenance program was established, then leveraging the following methodology to complete the review and develop recommendations:

1. **Identify evaluation parameters**
   - Average Waiting Time (headway)
   - Vehicles (type and quantity)
   - Service Hours
   - Utilization
   - Trips Completed

2. **Identify evaluation scenarios**
   - Existing Services and Demand Scenarios
   - Future Growth Scenarios

3. **Apply developed model to evaluation scenarios**

4. **Compare scenarios on evaluation parameters and examine cost comparisons**
Areas Investigated

Current State of On-Demand Transit
- Benefits
- Success Factors
- Peer Implementation

On-Demand Transit Analysis
- Evaluation of Testing Conditions
- Scenario Modeling and Analysis
  - Parameters
  - Scenario Identification
  - Cost Savings Analysis

Planning and Implementation Strategy
- Tailored implementation approach
Current State Findings

Transit Service Efficiency:
On-Demand Transit
Current State Findings

Definition of On-Demand Transit

On-Demand Transit is experiencing a renaissance thanks to advances in technology

- On-Demand Transit evolves from an older concept of demand-responsive transit, a model that was labour intensive and suboptimal in providing passenger satisfaction
- Modern On-Demand Transit is enabled by new technologies, advanced algorithms and automated scheduling, routing and dispatching of vehicles
- Different from ride-hailing, On-Demand Transit is an extension of public transit that provides shared ride services to passengers in areas that may not be practical or cost-effective for fixed-route transit
- It is useful in lower demand areas where fixed-route services would not be practical or cost-effective, hence providing better levels of transit service for these areas
- It isn’t always the better alternative to fixed-route transit, particularly when there is a frequent fixed-route service nearby; sometimes it’s better to walk to a bus stop to catch a frequent fixed-route service than to wait for an On-Demand service
- On-Demand Transit does not automatically mean door-to-door
Current State Findings

Types of On-Demand Transit

Modern On-Demand Transit takes on numerous forms, enabled by advanced technologies

- **Curb to Curb Transit**
  - Provide shared rides for **disparate areas**
  - Frequently leverage **smaller vehicles** to navigate more challenging road geometry
  - Useful in **lower demand areas** where fixed-route services would not be practical or cost-effective

- **First/Last-mile Connections**
  - Shared rides to/from key **transfer points** such as Bus Rapid Transit or commuter rail
  - Frequently leverage **smaller vehicles** to navigate more challenging road geometry
  - Useful in **lower demand areas** where fixed-route services would not be practical or cost-effective

- **Shuttle Services**
  - Connect riders to **employment or commercial zones**
  - Most effective in contained zones **close to higher order transit** to cover periodic demand
  - Vehicle size depends on demand, and number of drops-off

- **Flexible Routing**
  - **Increases** the service areas
  - Often **effective** when demand along the corridor drops off at extremities of a route
  - Tend to use **conventional transit vehicles** to meet the demand along the corridor
On-Demand Transit requires additional technical and implementation considerations

- Not a replacement for successful fixed-route transit services
- Cost-saving potential is directly tied to a reduction in total service-hours to serve customers
- Requires advanced planning, procurement and contract administration for technology, fleet, service providers and others
- On-Demand Transit requires extensive rider communication and education prior to and during the initial weeks of service
- As demand increases, the transition to fixed-route transit services must be carefully considered in the context of customer experience
Benefits of On-Demand Transit

On-Demand Transit can support four important goals and provide specific operational benefits:

**Cost savings and financial sustainability**
- More financially efficient than conventional transit in very low demand scenarios
- Can be more cost-effective alternative to introduce transit service in growth areas along the fringes of urban centers and in rural areas

**Improved Route Performance**
- May boost ridership by improving service quality in underperforming areas
- Improve service quality while reducing service-delivery costs in very low-demand scenarios

**Network Rationalization**
- Maintain or improve coverage while realigning routes and reallocating resources to busy corridors
- Increase service area in areas where traditional transit service may not be feasible

**Improved Customer Service**
- Can reduce waiting time for infrequent transit routes*
- Can provide greater certainty on the vehicle arrival than relying on a schedule alone

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*There is a trade off of shorter wait time and possible longer journey time associated with On-Demand Transit due to in-vehicle route deviations. Preference may be given to On-Demand or Fixed Route depending on customer’s travel needs.*
Success Factors for On-Demand Transit

The following conditions were identified based on industry best practices and are used to assess whether existing and potential future transit services are candidates for On-Demand Transit.

**Demand Conditions**
- Low demand for existing service
- Low predicted demand for new services
- Predicted demand is spread across the service area
- Latent demand for service during periods with no transit operations

**Geographic Conditions**
- Unfavorable route network and condition for conventional transit
- Poor pedestrian connections to transit corridors
- Walking distances to reasonable transit stops in excess of standard

Minimum boarding threshold is defined for per service hour and/or per km (e.g. less than 10 – 12) to determine if the demand condition is met.

Geographic condition, connectivity, and specific walking distance needs to be at required conditions to warrant On-Demand Services.
Peer Review

Transit Service Efficiency:
On-Demand Transit
Peers in Ontario are already exploring it

Innisfil, Belleville and York Region are operating on-demand transit alternatives

**Innisfil-Uber Partnership**
- Began in 2017 as a pilot for introducing a conventional-transit alternative
- Plan was to subsidize rides taken using the Uber application
- The program was considerably more successful at attracting riders than anticipated
- The cost of the program ballooned beyond initial estimates to $1.2 Million
- The town has since had to impose ride caps (30 per person per month) and increase the fare paid by the customer (capping the discount per ride to $4) in order to maintain the service
- Underscores that in high-demand situations, On-Demand Transit can cost more to deliver

**Belleville Late Night Route Deviation**
- Began in 2018 as a pilot of the Pantonium route deviation algorithm, replacing late night service with an on-demand alternative
- Operating between 9:30pm and midnight on weekdays, and starting at 7pm and 6pm on Saturday and Sunday respectively
- Ridership on initial circulator route was approx. 35 total riders per night and did not service major trip generators
- Ridership on the on-demand alternative has grown to over 300 total riders per night, necessitating additional service

**York Region Transit Mobility On Request**
- Rebranding and expansion of the previous Dial-a-Ride service
- Currently operates a mix of stop-to-stop, shuttle, hub-to-hub, and first/last mile services
- Service in six zones can be requested via the Mobility On Request Application or by phone
- Ten additional zones must be booked via phone
- In urbanized areas, the service tends to operate on weekends and/or during evenings when demand for fixed route decreases
- In rural zones it operates as a first/last mile service to commuter and/or rapid transit
- Pilot project serving Aurora GO operates to connect commuters to GO Train services in the AM and PM hours

2. [https://pantonium.com/initial-results-from-belleville-on-demand-transit/](https://pantonium.com/initial-results-from-belleville-on-demand-transit/)
On-Demand Transit Analysis

Transit Service Efficiency:
On-Demand Transit

Section 1-5
Testing Conditions for On-Demand Transit

Conditions for On-Demand Transit in Brampton have been reviewed in the areas of route performance, route network and potential expanded services for underserved areas and time periods.

### Conditions Favourable for On-Demand Transit

#### Routes and areas that perform poorly
- Routes and areas with low utilization
- Small areas paralleled by frequent, higher-performing routes
- Opportunities to leverage first/last mile connections or route deviations

#### Road and route networks
- Road networks prohibit effective conventional transit
- Narrow, winding roads, cul-de-sacs, lack of sidewalks and efficient pedestrian connections
- Existing route networks are winding and deviate or completely lack directness

#### Expanded Services Required
- Area with low or no service during some or all time periods
- New areas that are presently not served by transit
- Considered as lower-cost opportunity to provide service overnight and during other service periods
On-Demand Transit Analysis

Testing Condition Evaluation in Brampton

Given Brampton's Transit performance, there are no savings opportunities for On-Demand service.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing transit demand is less than 10 boarding per hour</td>
<td>Low*</td>
</tr>
<tr>
<td>Demand density within zone is less than 5 boarding per hour per square kilometer</td>
<td>Low*</td>
</tr>
<tr>
<td>Road network design does not allow efficient routing of fixed-route services</td>
<td>Low*</td>
</tr>
<tr>
<td>Percentage of built-up area within walking distance</td>
<td>Low*</td>
</tr>
<tr>
<td>Demand for transit between 1am and 6am</td>
<td>Low*</td>
</tr>
</tbody>
</table>

*Low indicates that Brampton does not meet the criteria; High indicates that Brampton likely does meet the criteria

**Key Insights**

- There is no immediate opportunity to replace Brampton Transit services with On-Demand Transit.
- A targeted service and cost comparison is beneficial to uncover On-Demand opportunity for specific City areas and associated routes.
- In the foreseeable future, and given the current ridership trends, growth will be based on approved budget for service increase.
On-Demand Transit Analysis

Evaluation Parameters

To compare the effectiveness and cost efficiencies between current model and On-Demand, five parameters were evaluated assuming that existing demand must be served.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>On-Demand Scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Waiting Time (Headway)</td>
<td>Endeavor to reduce the waiting time without increasing costs</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Vehicle type and quantity must meet demand</td>
</tr>
<tr>
<td>Service Hours</td>
<td>Endeavor to reduce the total service-hours required</td>
</tr>
<tr>
<td>Utilization</td>
<td>Endeavor to improve utilization where possible</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>Endeavor to target to meet, at a minimum, the existing demand</td>
</tr>
</tbody>
</table>

Note: Specific parameter assumptions used in modelling are contained in the Appendix.
On-Demand Transit Analysis

Evaluation Scenario Overview

Nine scenarios were modeled and evaluated against the parameters for service efficiency and cost-savings and cost-avoidance comparison.

Existing Services and Demand

Goal: Cost Reduction
1. Late Evening on-demand services in North Brampton
2. Late Evening on-demand services in East Brampton
3. Late Evening on-demand services in West Brampton
4. Late-night flexible routing of existing transit services
5. PM Peak-period on-demand around Brampton Gateway
6. Late Evening on-demand around Brampton Gateway

Future Growth Scenarios

Goal: Cost Avoidance
7. Late Evening period on-demand service in industrial and commercial zones within Brampton
8. Future expansion of overnight services to support Airport Employees with On-Demand Transit
9. Future expansion of overnight services to support Airport Employees with flexible routing
On-Demand Transit Analysis

Parameter 1 – Headway / Average Waiting Time

Waiting time will increase from On-Demand service in nearly all scenarios, with average waiting time longer than ~40%, 6 minutes

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Average Waiting Time Existing Services</th>
<th>Average Waiting Time On-Demand Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>10-21</td>
<td>20</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>7.5-14</td>
<td>20-23</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>10</td>
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<td>Scenario 6</td>
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<td>20</td>
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<tr>
<td>Scenario 8</td>
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<td>20</td>
</tr>
<tr>
<td>Scenario 9</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

Ave. Exiting Services: 15
Ave. On-Demand Services: 21
On-Demand Transit Analysis

Parameter 2 – Vehicles

On-Demand Services will require the same number of vehicles as existing services for scenarios 2, 3 and 4; however, taking future growth into consideration in scenario 7-9, On-Demand Services will only require nearly half of the vehicles of current model to meet the same demand.
On-Demand Transit Analysis

Parameter 3 – Service Hours

Similarly On-Demand services will not reduce total service hours for current demand; but under the right conditions it may be a better option to meet future growth.
On-Demand Transit Analysis

Parameter 4 – Utilization

On-Demand Services for current demand will reduce the ridership per service hour significantly, impacting the service utilization and efficiency.

![Utilization Chart]

- **Existing Services**
  - Ave. Exiting Services: 32.7
  - Ave. On-Demand Services: 18.7

- **On-Demand Services**
  - Scenarios 1 to 9 show a reduction in ridership compared to existing services.
On-Demand Transit Analysis

Parameter 5 – Trips Completed

On-Demand Service will result in lower ridership since it will not be able to provide for all of the required trips in high-demand situations.
Cost Saving Comparison - Existing Demand

As the current demand is well met in Brampton through fixed route service, On-Demand Service model will not enhance the efficiency and achieve cost savings due to high operating cost.
Cost Comparison – Planning for Future

In the future growth scenarios for cost avoidance, in particular situations, it showcases a significant opportunity for On-Demand Transit to control costs of future expansion.
Key Takeaways

1. Immediate cost-savings relative to existing service are unlikely
   - Brampton transit service operates at a high level of productivity
   - This productivity cannot reliably be served by On-Demand Transit at a lower cost
     - Possible impacts include service quality degradation and a loss of ridership
   - On-Demand has the potential to use operating resources more efficiently in situations that may not be efficient for fixed-route service delivery – such as overnight services
   - Is resource-intensive and provide a low return on service implemented in undeveloped areas
   - While operating costs (cost of providing service on the road) may be marginally lower with On-Demand Transit in some cases, technology implementation and licensing fees would result in increased overall costs
     - In order to conduct a pilot, Brampton Transit will need budget support to incorporate the necessary technology implementation and licensing.

2. On-demand can help control costs of future growth
   - Brampton Transit has experienced unprecedented continuous growth in service and ridership over the past few years – this growth is expected to continue in the years ahead
   - Future service expansion into overnight periods or in zones with no service at certain time periods could be provided using On-Demand Transit at a lower cost than conventional fixed-route services
   - Expansion opportunities could include
     - Service expansion into the central industrial areas to meet shift workers in the late evening when conventional service is not operating
     - Overnight feeder services with a backbone of one or two fixed-routes (e.g., Airport Express)
Recommendations

Transit Service Efficiency: On-Demand Transit Analysis

Section 1-6
Recommendation Overview

The following is an overview of our recommendation related to On-Demand Transit, the details as well as implementation considerations are provided in the following slides.

**Recommendation 1:** Conduct a strategic pilot of On-Demand Transit on deliberately selected route(s) to evaluate the precise cost and customer service impacts.

- As Brampton continues to grow in service and ridership, On-Demand Transit is a valuable tool to manage and avoid future costs. This would position Brampton Transit to grow transit services strategically as demand continues to rise.

- Possible opportunities for a strategic pilot program include:
  - Late-evening on-demand/shuttle service within the central industrial and commercial parks.
  - Late-evening flexible routing along routes 3 and 15 to supplement and/or replace service on 24 and 32 respectively.
  - Late-evening on-demand service south of Brampton Gateway to replace routes 53, 54 and 56.

- Considering the expected growth in service and ridership, On-Demand Transit is a valuable tool to manage and avoid future costs that should be investigated now.

- On Demand would position Brampton Transit to grow transit services strategically as demand continues to rise.

- The sooner the exploration of On-Demand begins, the better positioned Brampton Transit will be to offset growth costs in the future.
## Strategic Pilot of On-Demand Transit

### Recommendation 1: Conduct a strategic pilot of On-Demand Transit on deliberately selected City areas and time of the day to evaluate the precise cost and customer service impacts

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Although On-Demand Transit is not anticipated to be an effective strategy for reducing costs related to existing services and demand, it may help the City manage/avoid costs associated with demands for future service growth. As showcased by analyzed scenarios, if routes selected properly, On-Demand Transit can reduce vehicle needs and annual service hours compared to a more traditional service expansion approach.</td>
<td>Conducting a strategic pilot of On-Demand Transit will provide:</td>
</tr>
<tr>
<td></td>
<td>o An opportunity to further test and validate feasibility</td>
</tr>
<tr>
<td></td>
<td>o Insights for future decision-making including specific costing parameters based on local experience and implementation</td>
</tr>
<tr>
<td></td>
<td>o Feedback on community interest and the impact on customer experience</td>
</tr>
</tbody>
</table>

Piloting is a frequently leveraged tactic by other jurisdictions considering the feasibility of On-Demand Transit, and a strategic pilot provides the opportunity to evaluate the precise cost impact, internal operational impacts, community interest and customer experience.

Possible opportunities for a strategic pilot program include:
- Late-evening on-demand/shuttle service within the central industrial and commercial parks
- Late-evening flexible routing along select routes to supplement and/or replace service on other applicable routs
- Late-evening on-demand service south of Brampton Gateway for select routes

Some of the selection criteria are:
- Transit demand is less than 10 boarding per hour
- Demand density within zone is less than 5 boarding per hour per square kilometer
- Walking distances to reasonable transit stops are in excess of standard
- Opportunity to feed core transit stops and routes
### Recommendations

**High-Level Planning and Implementation Strategy**

To guide implementing a strategic pilot of On-Demand Transit, a tailored 6-step approach is proposed.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identify Location Conditions</td>
</tr>
<tr>
<td>2</td>
<td>Determine service Concept</td>
</tr>
<tr>
<td>3</td>
<td>Develop Service Parameters</td>
</tr>
<tr>
<td>4</td>
<td>Procurement and Implement</td>
</tr>
<tr>
<td>5</td>
<td>Rider Evaluation and Customer/Employee Engagement</td>
</tr>
<tr>
<td>6</td>
<td>Delivery Transition and Change Management</td>
</tr>
</tbody>
</table>

1. **Identify Location Conditions**
   - Access new service areas and existing areas
   - Evaluate demand patterns

2. **Determine service Concept**
   - Flexible routing
   - Shuttle service
   - First/last mile service
   - Curb to Curb service
   - Minimum advanced request time
   - Target and max trip fulfillment time
   - Max travel time
   - Allowable stop locations
   - Allowable roadways

3. **Develop Service Parameters**
   - Technology
   - Fleet
   - Service
   - Accessibility and fairness

4. **Procurement and Implement**
   - Extensive public engagement
   - Education campaigns
   - Accessibility and fairness

5. **Rider Evaluation and Customer/Employee Engagement**
   - Investment in technology
   - Develop change management strategy
   - Staff training and develop know-how

6. **Delivery Transition and Change Management**
   - Set up performance metrics
   - Ongoing monitoring
   - Be prepared to respond for the change demand

*Note: Additional implementation planning detail is included in the Appendix*
Brampton Transit Service
Review
→ Study Area 2: Bus Lifecycle Analysis
Final Report

December 2019

Contents

1. Executive Summary
2. Context Setting
3. Current State Findings
4. Peer Review
   1. Key Findings
   2. Key Takeaways
5. Analysis & Recommendations
   1. Analysis Approach
   2. Key Recommendations
Purpose of This Study

The purpose of the study for the Bus Lifecycle Analysis is described below

Context

- Some transit agencies are revising their bus retention policy and choosing to replace them sooner.
- Depending on maintenance practices, there might be potential opportunities to reduce the total cost of bus ownership by reducing a bus lifecycle and accelerating its replacement.
- Brampton’s goal towards a green zero emissions fleet will be affected by the rate at which current diesel fleet is replaced by electric buses.

Project Mission

- To partner with Brampton Transit to review and recommend an optimal bus retention and maintenance program for the organization

Study Objectives

1. Identify whether Brampton Transit bus retention and maintenance practices are aligned with the industry
2. Identify an optimal maintenance program based on minimum standard of reliability and lowest annualized cost
3. Make recommendations regarding overall maintenance practices to improve efficiencies

Note: electric buses were not analyzed in this study due to lack of data.
Executive Summary

Transit Service Efficiency:
Bus Lifecycle Analysis

Section 2-1
Executive Summary

Current State Findings:
- Overall, Brampton Transits current maintenance program is highly effective and outperforming its peers, and underpins the successful operations of a highly reliable fleet (high MDBF).
- Mean Distance Between Failures (MDBF) is an ideal metric to measure vehicle reliability and a better metric to decide bus replacement than age of a bus.
- Brampton Transit manages a fleet of 450 buses, with 2/3 being 40-ft diesel models.
- MDBF for 40-ft diesel bus is 15,000 km; 60-ft/hybrid buses are yet to experience a full lifecycle.
- Current retention target of 18 years on fleet.
- Brampton Transit currently operates overhauls, replacements, inspections, and preventative maintenance (PM) programs to manage their fleet.
- Achieving the City’s emissions goal is directly linked to the retention age established for the diesel buses in the fleet.

Peer Review Key Takeaways:
- Brampton’s current target bus retention policy is at the top end of peers reviewed.
- Agencies have a mixed approach to overhaul programs and maintenance intervals.
- Bus retention policy and preventative maintenance programs are not formally documented among peer agencies.
- Most agencies are starting to look at expanding/formalizing Preventative Maintenance programs for individual components.

Recommendations:
- Maintain a bus retention policy that provides the lowest lifecycle cost and a minimum standard of service reliability.
- Maintain a minimum MDBF of 12,000 kilometers for all buses and implement ongoing condition-based assessment to ensure that the quality of service is maintained.
- Implement recommended maintenance program based on the bus retention policy.
- Evaluate additional maintenance tactics and programs to obtain maximum value from fleet investments and ensure sufficient budget resources to sustain a minimum MDBF of 12,000 km.
Context

Transit Service Efficiency: Bus Lifecycle Analysis
Approach & Methodology

Through focused research and stakeholder interviews, a strong understanding of Brampton’s bus retention and maintenance program was established, then leveraging the following methodology to complete the review and develop recommendations:

1. Develop model to calculate total lifecycle cost for existing bus types:
   - 40-ft hybrid
   - 40-ft diesel
   - 60-ft hybrid

2. Identify cost parameters and intervals by bus type:
   - Purchase
   - Maintenance (scheduled)
   - Maintenance (unscheduled)
   - End of life value

3. Apply developed model for various scenarios

4. Compare total annualized lifecycle cost for various scenarios of retention years
   - Ranging from 5 to 18 years

Note: Operating costs (i.e. fuel costs) were not taken into consideration because a change in bus retention years will not affect fuel costs.
### Areas Investigated

#### Benchmarking on Preventative Maintenance & Bus Retention Practices
- Industry Scan
- Peer Review of Maintenance

#### Current Fleet Analysis
- Age, Make/Model, Propulsion
- Mileage
- Purchase Costs

#### Scheduled Maintenance Programs & Costs
- Major overhauls and rebuilds
- Transit Preventative Maintenance
- Annual Maintenance
- Semi-Annual Maintenance

#### Unscheduled Maintenance Frequency & Costs
- Frequency of breakdowns
- Cost of breakdowns

---

Data received and **EXCLUDED** from the study to eliminate noise:

- Revenue, Ridership, Service Requests
Current State Findings

Transit Service Efficiency: Bus Lifecycle Analysis
Current State Summary

Brampton Transit currently operates a highly reliable fleet (high MDBF) driven by a highly effective maintenance program

Current State Overview

- **Retention** – Target of 18 years on fleet
- **Overhaul Program** – for structure and body at 9 year intervals for all buses
  - Frame is a mix of steel/composite and stainless steel
- **Replacement** – Engine and emission controls is replaced every 6 years, transmission replaced at midlife (9 years)
  - Articulated joint maintenance is planned to be replaced every 6-7 years starting in 2020
- **Inspections** – Perform legislated monthly, annual & semi-annual inspections
- **Preventative Maintenance** – PM inspection and repairs at every 15,000 km

Key Statistics

<table>
<thead>
<tr>
<th>Fleet Size &amp; Composition</th>
<th>Key Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-ft Hybrid</td>
<td>18 yr.</td>
</tr>
<tr>
<td>40-ft Hybrid</td>
<td>19K</td>
</tr>
<tr>
<td>40-ft Diesel</td>
<td></td>
</tr>
<tr>
<td>Total Buses – 450</td>
<td></td>
</tr>
</tbody>
</table>

1. Mean Distance Between Failures (MDBF) is the standard metric for reliability of vehicles; there may be variations across agencies as to how it is collected
### Key Findings (1 of 2)

<table>
<thead>
<tr>
<th>Areas of Review</th>
<th>Brampton</th>
<th>Toronto</th>
<th>Mississauga</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Buses</strong></td>
<td>450</td>
<td>2,100</td>
<td>500</td>
</tr>
<tr>
<td><strong>Spare Ratio</strong></td>
<td>24%</td>
<td>22%</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Target Retention</strong></td>
<td>18 yrs</td>
<td>12 yrs</td>
<td>14 yrs</td>
</tr>
<tr>
<td><strong>Avg. MBDF</strong></td>
<td>&gt;15,000 km</td>
<td>&gt;15,000 km</td>
<td>&lt;5,000 km</td>
</tr>
<tr>
<td><strong>Retention</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Target retention of 18 years on fleet</td>
<td></td>
<td></td>
<td>o Transitioned from 18 to 15 years retention for 40ft &amp; 18 to 12 years for 60ft</td>
</tr>
<tr>
<td>o Overhaul program for structure and body at 9 year intervals for all buses</td>
<td>o Transitioned from 18 to 13 years retention for 40ft diesel, 18 to 11 years for 40ft hybrid (last year) and 12 years for 60ft diesel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Engine is replaced every 6 years</td>
<td>o Stainless steel frame refurbishment done every 6 years</td>
<td>o No overhaul program for structure and body, engine, transmission or emission</td>
<td></td>
</tr>
<tr>
<td><strong>Overhaul Program</strong></td>
<td>o Transmission replaced at midlife (9 years)</td>
<td>o Engine and transmission replaced at midlife</td>
<td>o Electrical components for hybrids replaced every 6 years</td>
</tr>
<tr>
<td>o Emission controls replaced every 6 years</td>
<td>o Emission controls replaced at midlife or at failure</td>
<td>o Implementing a “battery health check” script to check charge capacity of module</td>
<td></td>
</tr>
<tr>
<td>o Articulated joint maintenance is planned to be replaced every 6-7 years starting in 2020</td>
<td>o Electrical components for hybrids replaced at failure</td>
<td>o Articulated joints are replaced at failure, looking to develop a program</td>
<td></td>
</tr>
<tr>
<td><strong>Replacement</strong></td>
<td></td>
<td>o Articulated joints are replaced at failure, looking to develop a program</td>
<td></td>
</tr>
<tr>
<td><strong>Inspections</strong></td>
<td>o Legislated monthly, annual and semi-annual inspections</td>
<td>o Annual (wheels-off) and semi-annual inspections</td>
<td>o Annual (wheels-off) and semi-annual inspections</td>
</tr>
<tr>
<td><strong>Preventative Maintenance</strong></td>
<td>o PM inspection and repairs completed at every 15,000 km</td>
<td>o PM inspection &amp; repairs at every 10K km</td>
<td>o Do not have any preventative maintenance programs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Developed a coolant hose replacement program every 3 years after observing trends in coolant leaks and have not yet measured cost savings</td>
<td>o Looking to address increased trends of coolant leak and frozen air dryer issues</td>
</tr>
</tbody>
</table>
## Key Findings (2 of 2)

<table>
<thead>
<tr>
<th>Areas of Review</th>
<th>Halifax</th>
<th>York Region</th>
<th>Winnipeg</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Buses</strong></td>
<td>328</td>
<td>541</td>
<td>630</td>
</tr>
<tr>
<td><strong>Spare Ratio</strong></td>
<td>22%</td>
<td>20%</td>
<td>19.5%</td>
</tr>
<tr>
<td><strong>Target Retention</strong></td>
<td>14 yrs</td>
<td>18 yrs</td>
<td>18 yrs</td>
</tr>
<tr>
<td><strong>Avg. MBDF</strong></td>
<td>5,000 – 10,000 km</td>
<td>10,000 - 15,000 km</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Retention
- Halifax:
  - Transitioned from 18 to 14 year retention 3 years ago
  - Analysis highlighted an operational cost increase beyond 14 years
- York Region:
  - Transitioned to 12 year retention, then back to 18 years last year
  - 12-year retention was not financially supported upon elimination of Ontario Bus Replacement Program funding.
- Winnipeg:
  - Target retention of 18 years, with some buses retired at 21 years
  - No hybrid buses
  - All maintenance is done in-house

### Overhaul Program
- Halifax:
  - No program for structure and body refurbishment
  - Stainless steel frames inspections done every 6 months
- York Region:
  - Overhaul program for structure and body at 10 years interval for 40ft diesel buses and 6 years for 60ft diesel buses.
  - Carbon steel frames are not inspected
- Winnipeg:
  - Overhaul program for structure and body ranges at 10-15 year intervals
  - Inspections done at 6 months for steel frames with coating

### Replacement
- Halifax:
  - Emission controls replaced at 125K km
  - Developing program to replace engines & transmissions at midlife
  - Discovered optimal PMI for engine overhaul is 7-8 yrs
  - Electrical serviced by vendors
  - Articulated joints refurbished every 2yrs
  - Hybrid battery replacements have not been made after 10 years of use
- York Region:
  - Engine is replaced every 6 years or at 400,000-500,000 km
  - Transmission replaced at 9-14 years and emission controls replaced at midlife
  - Articulated joint maintenance is contracted out but there is no overhaul program
- Winnipeg:
  - Engine is replaced at failure
  - Transmission is replaced at midlife and emission controls replaced at around 100,000 km
  - Articulated joint is maintained every year, but there is no overhaul program

### Inspections
- Halifax:
  - Legislated semi-annual inspections
- York Region:
  - Legislated annual and semi-annual inspections
- Winnipeg:
  - 200+ PM programs scheduled in maintenance software; various intervals

### Preventative Maintenance
- Halifax:
  - 4 PM inspections and repairs
  - Coolant hose replacement program every 150,000 km, resulting in significant increase in MDBF
- York Region:
  - PM inspection and repairs at every 5,000 km
  - Developed a one-time coolant hose replacement program after observing trends in coolant leaks
- Winnipeg:
  - N/A
### Key Takeaways

Amongst peer agencies, Brampton Transit is a leader with respect to its bus retention, reliability and maintenance program.

| 1 | Brampton runs a highly reliable fleet (high MDBF) & effective maintenance program |
| 2 | Brampton’s current target bus retention policy is at the higher end of peers reviewed (older retirement age)  
  - Three agencies recently reduced targets to improve service reliability |
| 3 | Agencies have a mixed approach to overhaul programs and preventative maintenance intervals  
  - Brampton has a well built preventative program, resulting in a longer overhaul cycle |
| 4 | Bus retention policy and preventative maintenance program not formally documented among peer agencies  
  - Referenced indirectly in some documentation and/or PM is scheduled into software |
| 5 | Most agencies are starting to look at expanding/formalizing PM programs for individual components  
  - Created from observing trends in breakdowns and failures (E.g. issues with coolant leaks) |
Analysis & Recommendations

Transit Service Efficiency: Bus Lifecycle Analysis

Section 2-5
Bus Lifecycle Analysis Approach

The following approach was followed to conduct the analysis:

- Bus purchase cost
- Fare Collection equipment
- TSP - ITS Components
- Automated Vehicle Monitoring (AVM)
- BOSS - Safety Shields

**Total Lifecycle Costs:**
are a combination of procurement, scheduled and unscheduled maintenance costs, and end of life value

- Mid-life full structural & body bus refurbishment
- Engine overhaul
- First ESS replacement
- Second ESS replacement
- Hybrid drive overhaul
- DPIM (dual power inverted module)
- Joint Refurbishment for articulated buses
- Transmission replacement
- Emission control system repairs/overhaul
- Preventative Maintenance repairs/replacements costs (triggered by inspections)

*Recommended schedule see Recommendation #3

- Repairs/Replacements from unexpected breakdowns and failures
- Bus resale or scrap value

**Data Sources:**
- Maintenance SME Interviews
- Industry Scan
- Work Orders
- MDBF and Cost Data
Recommendation Overview

The following is an overview of the recommendation, the details are provided in the following slides.

12,000 Km

Recommendation 1:
Maintain a minimum MDBF of 12,000 kilometers for all buses and implement ongoing condition-based assessment to ensure that the quality of service is maintained.

Recommendation 2:
Maintain a bus retention policy that provides the lowest lifecycle cost and defines a minimum standard of service reliability.

Recommendation 3:
Implement the recommended maintenance program based on the bus retention policy.

Recommendation 4:
Evaluate additional maintenance tactics and programs to obtain maximum value from fleet investments and ensure sufficient budget resources to sustain a minimum MDBF of 12,000 km.
Recommendations

Minimum MDBF

**12,000 Km**

**Recommendation 1:** Maintain a minimum MDBF of 12,000 kilometers for all buses and implement ongoing condition-based assessment to ensure that the quality of service is maintained.

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall, Brampton Transit’s current maintenance program is highly effective and outperforming its peers, and underpins the successful operations of a highly reliable fleet (high MDBF). Based on the industry peer review and vehicle reliability assessment (see below) it was determined that the City maintain a minimum MDBF of 12,000 kilometers for all their buses. In addition, the City should implement on-going condition-based assessments to early retire any bus whose MDBF falls below 12,000 kilometers. Bus reliability data was analyzed to determine the projected MDBF over the life of a vehicle.</td>
<td>○ Maintaining a minimum MDBF will ensure the quality of service for customers and minimize inefficiencies to service delivery.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MDBF (km/Failure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Distance Between Failures</td>
</tr>
<tr>
<td>12,000.00</td>
</tr>
<tr>
<td>24,000.00</td>
</tr>
<tr>
<td>36,000.00</td>
</tr>
</tbody>
</table>

Bus Age (Years)
**Recommendation 2:** Maintain a bus retention policy that provides the lowest lifecycle cost and defines a minimum standard of service reliability

Using the Brampton Transit data, a financial model of bus lifecycle cost was developed to test various scenarios that considered bus retention age, major overhaul frequencies, and capital subsidies. The analysis identified that the bus retention policy (age) that provides the lowest lifecycle cost and a minimum standard of service reliability for different fleet type are: 18 years for a 40-ft diesel bus, 15 years* for a 40-ft hybrid bus, and 9 years* for a 60-ft hybrid bus. Some of Brampton’s fleet has yet to experience a full lifecycle, particularly the hybrid buses are relatively new and have yet to experience the higher maintenance cost of their lifecycle. A monitoring model is to be updated over time as data for hybrid buses become available.

The graph below provides annualized bus lifecycle costs by fleet type:

- **Benefits:**
  - Having a bus retention policy allows for an overall decision making around fleet retention and maintenance
  - The bus retention policy ensures that assets are protected and maintained so that buses are replaced at an optimal point in lifecycle, and that they reach maximum useful life at least cost

* Subject to condition-based assessment of vehicles resulting in MDBF falling below 12,000 km
Recommendation 3: Implement the recommended maintenance program based on the bus retention policy

Based on the defined bus retention policy and industry best practices, the following maintenance program is recommended for the different types of fleet. In addition to the legislated inspections on a monthly, semi-annual and annual basis, preventative maintenance programs allow an acceptable MDBF in a cost effective manner. The recommended maintenance program is described in the table below:

<table>
<thead>
<tr>
<th>Bus Type</th>
<th>Preventative Maintenance Program and Intervals</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-ft Diesel</td>
<td>o Chassis/Body – 9 years (midlife) &lt;br&gt;o Engine – 6 years</td>
<td>Transmission – 9 years (midlife) &lt;br&gt;Emission Controls – 6 years</td>
</tr>
<tr>
<td>40-ft Hybrid</td>
<td>o Chassis/Body – 7-8 years (midlife) &lt;br&gt;o Engine – 6 years &lt;br&gt;o Transmission – 7-8 years (midlife)</td>
<td>Emission Controls – 6 years &lt;br&gt;ESS Replacements – 6 years &lt;br&gt;Hybrid Drive Overhaul – 7-8 years (midlife)</td>
</tr>
<tr>
<td>60-ft Hybrid</td>
<td>o Chassis/Body – N/A, repair upon failure &lt;br&gt;o Engine – 6 years &lt;br&gt;o Transmission – N/A, repair upon failure &lt;br&gt;o Engine Controls – 6 years</td>
<td>ESS Replacements – 6 years &lt;br&gt;Hybrid Drive Overhaul – N/A, repair upon failure &lt;br&gt;Articulated Joints – 6 years</td>
</tr>
</tbody>
</table>
Recommendations

Additional Maintenance Recommendations

**Recommendation 4:** Evaluate additional maintenance tactics and programs to obtain maximum value from fleet investments and ensure sufficient budget resources to support the MDBF goal

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Mobile Mechanic: Assess the cost/benefit (financial and customer service) of introducing an on-road mobile mechanic to do small repairs on road in lieu of a change-off</td>
<td>a) Mobile Mechanic: Fewer change-offs, less service interruptions (better customer service), less time spent doing change-offs</td>
</tr>
<tr>
<td>b) Top 10 Maintenance Issues: Formalize continued review of top 10 mechanical fault issues on a minimum semi-annual basis and review potential intervention methods to reduce same</td>
<td>b) Top 10 Maintenance Issues: Fewer service interruptions (customer service) and reduced repair costs</td>
</tr>
<tr>
<td>c) Predictive Maintenance: Improved utilization of Clever Device Automatic Vehicle Maintenance data to potentially predict recurring maintenance issues and proactively address same; explore emerging technologies that leverage AI to predict failures</td>
<td>c) Predictive Maintenance: Fewer service interruptions, better scheduling of maintenance prior to issue creating an unscheduled fault issue</td>
</tr>
<tr>
<td>d) Warranty Tracking: Assess value of increased staffing to support warranty tracking and utilization</td>
<td>d) Warranty Tracking: Potential reduced maintenance costs</td>
</tr>
<tr>
<td>e) Warranty Programs: Continue to include extended warranty options in bus procurement process to assess value to fault experience</td>
<td>e) Warranty Programs: Potential reduced maintenance costs</td>
</tr>
<tr>
<td>f) Battery Check program: Undertake regular battery checks on hybrid buses to predict necessary battery replacement schedule</td>
<td>f) Battery Check Program: Reduced faults, determine battery replacement schedule for hybrid buses</td>
</tr>
<tr>
<td>g) Update Model: The average age of the hybrid vehicles is low, and hence the bus lifecycle model loses accuracy for older hybrid vehicles. Furthermore, there is no data available regarding electric bus performance. Brampton Transit should update and review the model in 3 years to reflect data from new electric buses and older hybrid buses</td>
<td>g) Update Model: Potential reduced maintenance costs; reduced faults</td>
</tr>
<tr>
<td>h) Resource and budget allocation: ensure sufficient budget resources to deliver the minimum MDBF goal</td>
<td>h) Resource and Budgets: success in implementation</td>
</tr>
</tbody>
</table>
Brampton Transit Service Review

Study Area 3: Snow Removal for Transit Facilities

Final Report
December 2019
Executive Summary

Current State Findings:
- Brampton Transit contracted out snow removal service in 3 of their service areas in 2016 via a RFP process
- Challenges and issues have been subsequently experienced that impacted service, reputation and health & safety
- Quick response time across multiple locations is required to maintain scheduled service and overall service efficiency

Analysis:
- In all aspects of operational metrics, in-house snow removal would be more beneficial for riders and employees of Brampton transit
- Current equipment is adequate, and staff capacity is sufficient to conduct in-house snow removal
- Overall, internal service delivery costs are significantly lower than outsourcing snow removal
- Potential costs savings of up to 50% (Approximately $130k)

Recommendations:
- Bring snow removal for transit facilities in-house to reduce cost, minimize service disruption and enhance service efficiency.
- Implement a data driven approach that focuses on enhance documentation of data and analysis to proactively plan for future needs with clear defined strategy supported by data and insights
Context Setting

Section 3-2
Purpose of This Study

To provide snow removal services at the right service level and most cost efficient way.

Context Setting

- Contractor services for snow removal only took place as of 2016, prior to that, all snow removal was done in-house
- Safety, reputation and service play a large role in determining the optimal model for snow removal services
- Maintaining safety is a critical component to Brampton Transit choosing the correct avenue for snow removal

Project Mission

- To identify and recommend opportunities for Brampton Transit that will deliver the required service level at the maximum efficiency savings for Transit Facilities

Desired Outcomes

1. Identify and gain clarity on the optimal level of service and quality
2. Assess options for contracting out versus in-house service and the impacts on cost and safety
3. Make recommendations for snow removal level of service and communicating work plans to staff
The Importance of Snow Removal

Current snow removal efficiency review was requested because of growing concerns with contractor services and their negative impact on Brampton transit service, reputation, and the health and safety of both riders and staff.

Impact to Health & Safety
Unclear roads are dangerous for transit drivers and their passengers. Pedestrian walkways need to be maintained to avoid injury.

Impact to Service
Unclear driveways for transit buses impacts quality and efficiency of service. Delays also incur overtime requests to accommodate.

Impact to Reputation
Service disruption due to unclear driving paths and unsafe bus terminals will severely impact the City's reputation.

Lack of adequate snow removal severely impacts operations on various organizational levels. Quick response time across multiple locations is required to maintain scheduled service and overall service efficiency.
## Areas Investigated

### Current Pain Point of Outsourcing
- Safety
- Reputation
- Service

### Operation Metrics Comparison
- Safety, service level and flexibility
- Staff satisfaction
- Cost

### In-house model enablers
- Staff capacity
- Equipment
- Strategy to deployment

### Benchmarking on snow removal practice
- Peer Review of snow removal service model
Study 3 – Snow Removal Assessment
History of Snow Removal Services

Prior to 2016, Brampton Transit has managed snow removal responsibilities within the organization. Based on city recommendations, they have transitioned to using contractor services for snow removal in 3 of their service areas. A new RFP was issued because of contractor issues between 2017 and 2018.

1Exact cost from 2016-2018 and cost estimations for 2019 were provided by Brampton Transit
Outsourcing & Pain Points

Outlined is the reason for outsourcing snow removal services from 2017-2019 and the pain points subsequently felt by transit staff that directly impacted service, reputation and health & safety.

Historical Reason for Outsourcing

Prior to 2016, Brampton transit managed their own snow removal services at bus terminals and garages. The service has since been contracted.

Pain Points

Safety
- Higher likelihood of slips and falls
- Riskier driving conditions

Reputation
- Missed SLAs
- Employees having to step in for snow removal

Service
- Delayed departures
- Inaccessible terminals
### Scenarios

Scenarios created through the use of actual issues and events that occurred between Brampton transit and their contractors. The below illustrates that in all aspects, in-house snow removal would be more beneficial for riders and employees of Brampton transit.

<table>
<thead>
<tr>
<th>In-House</th>
<th>Contract</th>
</tr>
</thead>
</table>
| Busses require **fuelling** between 5pm -3am.  
- If driveways are not cleared busses will not be fuelled. This impacts services.  
- FSP are on site to immediately clear snow if required | **Response Times**  
- SLA stated 1 hour response time.  
- Contractors often showed up between 3-5 hours after request was sent for service impacting bus departures |
|  
- FSP were **available** for unexpected snowfall which occurred outside of contract start and end date | **Readiness & Ability to Pivot**  
- Contractors do not start until early December.  
- **Snowfall on November 11, 2019** put Brampton transit at risk of **cancelling** service because no contract was established for that timeframe |
|  
- **Constant monitoring** and quick responses ensure that there is minimal impact to regular service for riders.  
- FSP are able to prioritize job duties if snowfall occurs. FSP are also close to facility and terminal areas | **Service Impacts**  
- Contractors who balance multiple contracts can prioritize other areas over service routes and terminals.  
- Lack of quick response time has led to delayed bus departures from terminals because of snow pile up |
|  
- Areas are continuously salted because of FSP staff scheduling.  
- **Almost all hours are covered for immediate snow preparation.**  
- This readiness would reduce likelihood of slips and falls because of snow/ice. | **Prevention & Safety**  
- Delayed responses to inclement weather conditions increase the risk of slips and falls to employees and riders.  
- Slips and falls because of lack of Transit response time **heavily impacts City reputation** |
Study 3: Snow Removal Assessment

Maintaining Safety

Below are the key components to maintain safety. Not clearing the main areas to maintain ‘safe and passable’ spaces can cause staff and rider injury. This has negative effects on the Brampton transit experience, and it will directly affect the City's reputation.

Unsafe areas resulting from lack of snow removal can lead to:

- Bus skids that could injure passengers onboard and in the surrounding areas
- Collisions leaving terminals that could cause bodily harm and property damage
- Slips and falls at facilities could harm employees. Slips and falls at terminals could harm riders and become a liability issue

Clearing Driveways

Clearing driveways reduces likelihood of bus skids and employee car accidents. Bus skids resulting from unclear terminals can cause service delays.

Clearing Walkways

Unclear walkways could result in staff injuries, which would decrease staff satisfaction and could result in service disruption.

Removal of Snow Storage

Inadequate removal of snow storage could cause accidents such as large pieces of snow falling onto cars around snow areas, or pedestrians/employees.

Clearing Pedestrian areas in terminals

Lack of snow removal in pedestrian areas such as terminals would have increase changes of slips/falls and have the highest impact to reputation.
This reviews the decision criteria for 2019/2020 snow removal*. The most efficient and effective method of snow removal, with least cost impact, would be switching to in-house snow removal services. Areas affected would mostly have a positive impact.

<table>
<thead>
<tr>
<th></th>
<th>In House</th>
<th>Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Costs</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Maintaining Current ¹Service Level</td>
<td>←</td>
<td>↓</td>
</tr>
<tr>
<td>Adaptability to Increase in Ridership/ Service Demands</td>
<td>↑</td>
<td>←</td>
</tr>
<tr>
<td>Safety</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Staff Satisfaction</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>

¹Service level: Maintaining safe, clear and passable pathways, walkways and driveways in a quick and timely fashion to reduce any potential service impacts
Assumption: Current staffing for in-house snow removal would not be sufficient if there is a service increase. As ridership increases, FSP department will grow to maintain new service demands
*Costs were provided by Brampton transit
Costs Comparisons

The below cost model compares overall costs between contractors and in-house snow removal. Multiple contractors are used for different service areas. Overall, internal costs are significantly lower than outsourcing snow removal.

<table>
<thead>
<tr>
<th>Cost Items</th>
<th>Estimated In-House Cost For 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt</td>
<td>$16,000</td>
</tr>
<tr>
<td>Labour¹</td>
<td>$67,000</td>
</tr>
<tr>
<td>Equipment (Leasing fees)</td>
<td>$36,000</td>
</tr>
<tr>
<td>Maintenance</td>
<td>$10,000</td>
</tr>
<tr>
<td>Total</td>
<td>$129,000¹</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Areas</th>
<th>Estimated External Contractor for 2019</th>
<th>Cost for Contract 2017/2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area 1</td>
<td>$155,000</td>
<td>$167,000</td>
</tr>
<tr>
<td>Area 2</td>
<td>$58,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>Area 3</td>
<td>$85,000</td>
<td>$63,000</td>
</tr>
<tr>
<td>Total</td>
<td>$298,000¹</td>
<td>$290,500¹</td>
</tr>
</tbody>
</table>

¹Contractor costs are inclusive of salt, labour, equipment and maintenance. Exact cost for 2017/18 and cost estimations for 2019 were provided by Brampton Transit. Contract cost increase is due to higher cost of salt, maintenance, and labour year over year.

¹Labour costs included overtime accrued for facilities serviceperson.
Section 3-4

Peer Review
Models followed by peer organizations strengthen the case for Brampton transit to switch to in-house contracting.

<table>
<thead>
<tr>
<th>TTC</th>
<th>MiWay</th>
<th>London</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ridership: 533.2 million</td>
<td>Ridership: 36.6 million</td>
<td>Ridership: 24 million</td>
</tr>
<tr>
<td># of Facilities: 52</td>
<td># of Facilities: 11</td>
<td># of Facilities: 2</td>
</tr>
<tr>
<td>Contracted: Hybrid</td>
<td>Contracted: Y</td>
<td>Contracted: Y</td>
</tr>
</tbody>
</table>

- Will be using a hybrid method for 2019/2020 snow removal
- Current costs range from $500k-700k for in-house snow removal services
- Areas are divided by priority service areas, and secondary areas. Contracting services will only be used for secondary areas
- Priority locations are attended to immediately. Team of 35-40 are dispatched
- No KPI’s established because of nature of work – it is reactive
- Success is measured by hitting all areas within first 24 hours of snowfall
- City uses 5 year contracts for snow removal services
- Clearing of snow storage is included as part of the contract
- 10 of the 11 areas are with one contractor. Second contractor is only responsible for 1 service area
- Miway does a ‘pre-season review’ of service areas to identify safe places for snow storage until pick-up
- Previous Union concerns around unclear driveways/walkways as it has an impact to employee health and safety

- Contracting relationship extends to 20 years
- Contract cost is around $60k per year
- Only 2 service areas to maintain
- Contractor does not clear snow during working hours when cars are parked in the lot
- Internal staff take care of walkways during this time

The majority of other transit services use contractors. Contractor issues are common across the industry, with response times being the primary source of tension. Lack of staff capacity is the primary reason most transit systems do not switch fully to in-house services. TTC uses a hybrid approach, which only contracts secondary areas (low priority) to contract workers. All transit facilities maintain their own equipment for emergencies.

Summary of Findings
Recommendations

Recommendation Overview

The following is an overview of the recommendation, the details are provided in the following slides

**Recommendation 1:**
Bring snow removal for transit facilities in-house to reduce cost, minimize service disruption and enhance service efficiency.

**Recommendation 2:**
Implement a data driven approach that focuses on enhance documentation of data and analysis to proactively plan for future needs with clear defined strategy supported by data and insights.
# In-House Snow Removal

**Recommendation 1:** Bring snow removal for transit facilities in-house to reduce cost, minimize service disruption and enhance service efficiency.

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer review and the analysis of comparing in-house with contracting out on snow removal service indicated that in-houses snow removal is more beneficial to the City from both service delivery level and cost effectiveness perspective. The transition requires two key considerations: 1. Establish a Quality Assurance process to track and monitor the adequacy and quality of the work  o QA process in the form of a ‘winter road patrol’ as a means of ensuring safe public access to terminals and facilities 2. Maintain a performance scorecard to evaluate service levels against the targets  o 4 areas of focus: response time, effective prevention, cleaning time, and on-going QA monitoring</td>
<td>o Cost savings  o Consistent service level  o Enhanced public safety  o Increased accountability  o Proactive measurement and control</td>
</tr>
</tbody>
</table>

## Key Success Factors

1. Plan resource properly to adequately conduct the work  
2. Maintaining and replacing equipment if required  
3. Attending to unclear areas immediately if problem is identified  
4. Fulfilling legislative compliance for municipal snow removal
## Proactive Planning

### Recommendation 2: Implement a data driven approach to proactively plan for future needs with clear defined strategy supported by data and insights

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
</table>
| Implement a data driven approach that focuses on enhanced documentation of data and analysis to proactively plan for future needs with clear defined strategy supported by data and insights  
1. Establish strategies to keep in line with service growth  
   - Guaranteed FSP increase to match service increases  
   - Communications strategy to support quick response times  
   - Monitoring strategy for preparedness  
2. Better documentation of winter events aligned to request for snow removal and QA outcomes.  
   - Track bus delays  
   - Document deployment data and outcomes  
   - Expand injury report and review report periodically |  
  o Proactive measurement and control  
  o Consistent service level  
  o Public safety  
  o Better data insights for management decisions |

### Key Success Factors

1. A robust planning process to formulate strategies and tactics  
2. Thoroughly designed data collection templates and frameworks to capture data  
3. Process to quickly turn data into actionable insights
Key Success Factors for In-House Snow Removal Operations

The following 3 areas are important to maintain in order to have a successful in-house snow removal service.

1. **Staffing**
   Currently, Brampton transit has enough facilities service people to manage the service areas that are assigned to each garage (Clarke & Sandalwood). There is enough flexibility in the current work schedule to maintain a sequential deployment strategy. Overtime and shift changes can be used during a snow event, if required.

2. **Right Equipment**
   Each facility maintains the right snow equipment to manage each service area. Facilities are equipped with shovels, plows with salters, and loaders. Equipment need to be maintained and replaced if required.

3. **Strategy to Deployment**
   Quick communication of potential snow/winter events can lead to the development of deployment strategy and early preparation for schedule changes or request for overtime.
Services Efficiency at the City of Brampton

Study Area 4: Service Reliability

December 2019
Executive Summary

Current State Findings:
- Brampton Transit, like the rest of the industry, has been experiencing increasing staff absenteeism and mounting pressures for service delivery.
- Operating cost at the same time is also increasing in order to maintain the service level.
- Significant upward trend on lost service hours and increasing overtime.

Analysis:
- Increasing number of Long Term Absenteeism (LTA) and the tenure of LTAs creating pressure on current operators and supervisors.
- Operator shortage and lack of appetite to take on additional work increasing service cancellations.
- Operating cost increasing more than anticipated, largely due to costs allocated to cover Overtime.
- Adding additional resources can reduce the cost over time by up to $400k (approximately).

Recommendations:
- Supplement the operators group gradually.
- Address the tenure of LTAs.
- Aim to set the default crew work hour back to 8 hours.
- On-going monitoring and gathering feedback from staff.
Section 4-2

Context Setting
# Purpose of This Study

To devise a cost-effective approach to mitigate operators’ long-term absenteeism.

## Context Setting

- Long term absences are a significant contributor to open and unfilled pieces of work.
- Increases in cost are in large part a product of over-time hours and an increase in cancellation of services.
- An increase in unfilled hours puts pressure on crew hours.

## Project Mission

- To identity and recommend must cost effective way to fill open work resulting from long term absences.

## Desired Outcomes

1. To determine the full costs of long-term absenteeism looking at various factors related to service and cost.
2. To develop a costing model that calculates the most effective option to cover costs and inefficiencies.
3. To make recommendations to Brampton Transit regarding appropriate staffing levels and to outline areas for operational efficiencies.
## Areas Investigated

### Context Setting

#### Operators & Supervisors
- Long Term Absenteeism Drivers and Trends
- Bidding Trends
- Supervisors Pressures

#### Service Delivery Composition
- Workforce Delivering Services Trends
- Cancellations

#### Costs
- Employee Cost Composition
- Overtime Costs
- Potential Savings

#### Others
- Collective Agreements
- Crews’ Times (shifts lengths)

---

Data received and **EXCLUDED** from the study to eliminate noise:

- Revenue
- Ridership
- Service Requests
Study 4: Service Reliability Analysis
Study 4: Service Reliability Analysis

Key Data

Current operators levels create the need to increase the crew period.

- Hiring: ~20 per Year
- 40 Temp
- 887 Permanent
- 20 On Modified Work
- 33 On Long-term Absenteeism
- 53 or ~6% Total Unavailable Operators
- ~20 per Year Attrition
- 8:00 h Regular Shift Period (Crew Period)
- Average Overtime Added to Crew Periods by Default
Study 4: Service Reliability Analysis

Key Observations

- **Increasing Number of LTAs**
  - Started seeing absences of 5+ years
  - Pressure mounting on current operators

- **Increasing Overtime**
  - Significant upward trend of lost service hours from current year vs three years ago
  - Increased crew hours

- **Increasing Cancelled Service**
  - Increasing trend of cancelled services due to operator shortages
  - Reduced appetite to undertake additional work, leading to cancelations

- **Pressured Supervisors**
  - Increased amount of work to fill unfilled hours
  - Less operators to reach out to
  - Increasing SSDs absence

- **Increasing Operational Costs**
  - Increasing more than anticipated
  - More costs being allocated to OT
Study 4: Service Reliability Analysis

Long-Term Absenteeism’s Drivers

Five main absenteeism drivers (of 6+ months) contribute the most to operator shortages, overtime pay, and service cancellations.

Main Drivers
- Long-term Disability
- Paid Sick Leave
- Paid Sick WSIB
- Unpaid Sick Leave
- Unpaid WSIB

Create Operators Shortages
Increasing Overtime Hours Due to LTAs

The most significant drivers of overtime pay comes from Long-Term Absenteeism.

Overtime Hours Generated by LTA**

<table>
<thead>
<tr>
<th>Year</th>
<th>Long-term Disability</th>
<th>Sick</th>
<th>Sick WSIB</th>
<th>Sick Unpaid</th>
<th>WSIB Unpaid</th>
<th>Projected</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>32,582</td>
<td>7,568</td>
<td>13,484</td>
<td>3,545</td>
<td>7,368</td>
<td></td>
<td>58,6%</td>
</tr>
<tr>
<td>2017</td>
<td>51,683</td>
<td>9,751</td>
<td>5,546</td>
<td>14,515</td>
<td>8,208</td>
<td>15,248</td>
<td>57,279</td>
</tr>
<tr>
<td>2018</td>
<td>56,928</td>
<td>17,784</td>
<td>4,780</td>
<td>16,142</td>
<td>3,164</td>
<td>8,208</td>
<td></td>
</tr>
</tbody>
</table>

OT Hours Generated by LTA Increases Year over Year**

- 2017/2016: 58.6%
- 2018/2017: 10.1%
- 2019/2018: 0.6%

* 2019 is an annualized figure based on data from Jan - Sep
** Figures do not include the hours of operators on modified duty and are unable to drive
Increasing Number of LTAs & Modified Work

Number of LTAs and modified work, and the length of their absences, are increasing.

* Chart is based on available data for Jun and Jul of 2018, and Mar to Aug 2019.
Study 4: Service Reliability Analysis

Crew Pressures

The increase of unfulfilled hours added pressure on the crew hours.

Not bidding are Operators that have been off work for 6 months or more, with no medical to support return to work. Therefore they do not bid on work at the board bid times.

* 2019 data includes Jan-Sep inclusive
Increasing Cancelled Service

Lack of operators leave no options but to incur unscheduled overtime pay and cancel work hours.
Increasing Cancelled Service

Unscheduled OT (caused by both LTA and non-LTA) demanding more and more resources and costs.

![Graph showing Work Covered By Spareboard vs Unscheduled OT vs Cancellation Hours from Total Open Work to Cover Hours]

![Graph showing Cancellations vs Revenue Hours]

* 2019 is an annualized figure based on data from Jan - Sep
Operational Costs

Study 4: Service Reliability Analysis

Elements Included in the Fringe Rate

- Health Insurance (health, dental, vision)
- Group Life Insurance
- ADD
- Pension (OMERS)
- Employment Insurance
- Employer Portion of CPP*
- Employer Health Tax*

* Compensation amounts get affected when on LTA
Study 4: Service Reliability Analysis

Increasing Operational Costs

Total additional costs paid for overtime could have employed permanents and saved money.

* 2019 data includes Jan-Sep inclusive. Oct-Dec is trend based on annualized projection.
### Options Analysis – 2018 (Numbers Rounded to Nearest 100)

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
<th>0 Employees</th>
<th>5 Employees</th>
<th>10 Employees</th>
<th>15 Employees</th>
<th>20 Employees</th>
<th>28 Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line 1</td>
<td>Total Current Costs (Fully OT Pay)</td>
<td>$2,913,600</td>
<td>$2,913,600</td>
<td>$2,913,600</td>
<td>$2,913,600</td>
<td>$2,913,600</td>
<td>$2,913,600</td>
</tr>
<tr>
<td>Line 2</td>
<td>Scenarios: Had We Hired this Many New Operators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line 3</td>
<td>The Employee Costs (Salary + Fringe) Would Have Been</td>
<td>$-</td>
<td>$441,100</td>
<td>$882,200</td>
<td>$1,323,200</td>
<td>$1,764,300</td>
<td>$2,470,000</td>
</tr>
<tr>
<td>Line 4</td>
<td>The Remaining Hours to be Covered by OT</td>
<td>56,900</td>
<td>46,900</td>
<td>36,900</td>
<td>26,900</td>
<td>16,900</td>
<td>900</td>
</tr>
<tr>
<td>Line 5</td>
<td>Cost of Remainder of OT Hours</td>
<td>$2,913,600</td>
<td>$2,401,800</td>
<td>$1,890,000</td>
<td>$1,378,200</td>
<td>$866,400</td>
<td>$47,500</td>
</tr>
<tr>
<td>Line 6</td>
<td>Total Scenario Cost (Line 3 + Line 5)</td>
<td>$2,913,600</td>
<td>$2,842,900</td>
<td>$2,772,200</td>
<td>$2,701,400</td>
<td>$2,630,700</td>
<td>$2,517,500</td>
</tr>
<tr>
<td>Line 7</td>
<td>Savings (Line 1 - Line 6)</td>
<td>$-</td>
<td>$70,700</td>
<td>$141,400</td>
<td>$212,200</td>
<td>$282,900</td>
<td>$396,100</td>
</tr>
</tbody>
</table>

**Total Additional OT Pay vs Potential Savings After Hiring New Employees – 2018**

- **Base Pay + Fringe**
- **Potential Savings**
- **OT Pay**

<table>
<thead>
<tr>
<th>0 Employees</th>
<th>5 Employees</th>
<th>10 Employees</th>
<th>15 Employees</th>
<th>20 Employees</th>
<th>28 Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2,913,600</td>
<td>$2,401,800</td>
<td>$1,890,000</td>
<td>$1,378,200</td>
<td>$866,400</td>
<td>$47,500</td>
</tr>
<tr>
<td>$441,100</td>
<td>$70,700</td>
<td>$141,400</td>
<td>$212,200</td>
<td>$282,900</td>
<td>$396,100</td>
</tr>
<tr>
<td>$2,500,000</td>
<td>$3,500,000</td>
<td>$3,000,000</td>
<td>$2,500,000</td>
<td>$2,000,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>$2,000,000</td>
<td>$2,500,000</td>
<td>$2,000,000</td>
<td>$1,500,000</td>
<td>$1,000,000</td>
<td>$500,000</td>
</tr>
</tbody>
</table>
## Study 4: Service Reliability

### Peer Reviews

Long-Term Absenteeism (LTA) is noticed throughout the industry and dealt with by hiring new headcounts and implementing prevention and back-to-work programs.

<table>
<thead>
<tr>
<th>TTC</th>
<th>MiWay</th>
<th>London</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Operators:</strong> 5000</td>
<td><strong>Number of Operators:</strong> 950</td>
<td><strong>Number of Operators:</strong> 450</td>
</tr>
<tr>
<td>LTA Issues: N</td>
<td>LTA Issues: Y</td>
<td>LTA Issues: Y</td>
</tr>
</tbody>
</table>

- Operators are considered inactive as soon as they go on long-term disability.
- Benefit packages heavily impact operators motivation to come back.
  - Most operators come back after their short-term leave ends.
- Majority of operators who come back from short-term leave do go on modified duties.

- Problems with absenteeism, but they are trending lower.
- Noticed a rise in long-term absenteeism, particularly disability claims after changes to qualifications for long-term disability.
- Operators go from active to inactive after 2 year review. Miway chose 2 year timeframe because it is harder to qualify for LTD after 2 year mark.
- Relief pool has been enough to cover absenteeism without requesting operators to work overtime.

- Seeing an increase in mental health claims and leaves related to mental health.
- Operators are highest in long-term absenteeism; there has been no increase in management.
- HR reviews long-term at 9 month period and if operator is not coming back, their status is switched to inactive.
- Mitigation: Robust ‘Return to Work’ program with the insurance company.
- Also experiencing a problem with aging workforce.
Recommendation Overview

The following is an overview of the recommendation, the details are provided in the following slides

**Recommendation 1:**
Supplement the operators group gradually through an increase in headcount by 12-15 FTEs as phase 1 to evaluate the impact of additional staff. Follow up with additional hires as required based on the need versus cost of overtime (with anticipated savings between $169K-$212K/year)

**Recommendation 2:**
Consider addressing increasing LTA tenures through a review of LTA staff person at the 2 year mark, and “deactivate” the employee if deemed to be away for longer than 2 years

**Recommendation 3:**
Set crew hours back to target with the aim to shorten the default crew hours back to the target of 8:00 hours which can boost operators’ morale

**Recommendation 4:**
Gather Operator feedback to uncover deeper insights into the workforce’s well-being and how it may impact service reliability
### Supplement the Operators Group

**Recommendation 1:** Increase headcount by 12-15 FTEs as phase 1 to evaluate the impact of the additional staff. Follow up with additional hires as required based on the need versus cost of Overtime.

The cost benefit analysis indicates that sufficient staffing not only help relief the long term absenteeism, reduce overtime, and increase service level, it also provides tangible cost savings to the City of Brampton. It is recommended to take a phased approach. Increase headcount by 12-15 FTE as phase 1 to evaluate the impact and validate the benefit. Follow up with additional FTE if required.

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase headcount by 12-15 FTE as phase 1 to evaluate the impact and validate the benefit. Follow up with additional FTE if required.</td>
<td>Reduce LTAs</td>
</tr>
<tr>
<td></td>
<td>Reduce Overtime work and cost</td>
</tr>
<tr>
<td></td>
<td>Improve staff well-being</td>
</tr>
<tr>
<td></td>
<td>Reduce work cancellations</td>
</tr>
<tr>
<td></td>
<td>Cost savings of $169 - $212K annually</td>
</tr>
</tbody>
</table>

**Total Additional OT Pay vs Potential Savings After Hiring New Employees – 2018**
(Rounded to nearest 1000)

<table>
<thead>
<tr>
<th>Employees</th>
<th>Base Pay+Fringe</th>
<th>Potential Savings</th>
<th>OT Pay</th>
<th>Total Additional OT Pay vs Potential Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Employees</td>
<td>$3,300,000</td>
<td>$500,000</td>
<td>$2,917,000</td>
<td>$2917000</td>
</tr>
<tr>
<td>5 Employees</td>
<td>$3,890,000</td>
<td>$500,000</td>
<td>$2,405,000</td>
<td>$2405000</td>
</tr>
<tr>
<td>10 Employees</td>
<td>$4,410,000</td>
<td>$500,000</td>
<td>$1,382,000</td>
<td>$1382000</td>
</tr>
<tr>
<td>20 Employees</td>
<td>$5,100,000</td>
<td>$500,000</td>
<td>$870,000</td>
<td>$870000</td>
</tr>
<tr>
<td>28 Employees</td>
<td>$5,900,000</td>
<td>$500,000</td>
<td>$51,000</td>
<td>$51000</td>
</tr>
</tbody>
</table>

(Rounded to nearest 1000)
Recommendation 2: Review an LTA staff person at the 2 year mark, and “deactivate” the employee if deemed to be away for longer than 2 years.

Peer Review identified the practices of monitoring and managing the long-term absenteeism by limiting the period of time employees can be on LTA. Policies and programs are in place to address the issue. Similar practice is therefore recommended for the City of Brampton to review a LTA staff person at the 2 year mark, and “deactivate” the employee if deemed to be away for longer than 2 years. Below analysis indicates that it would address 20 resources in Brampton Transit.
Recommendation 3: Aim to shorten the averages working time per crew hours back to the target of 8:00 to boost productivity

Current state assessment indicated that the averages working time has been increasing in recent years and it is at 8 hours 13 minutes currently. This has created additional workload to already increased overtime some staff have to cover. In combination with staff shortage, this resulted in increasing non-bidding and lack of appetite to take on more work. It is recommended to shorten the default crew hours back to the target of 8 hours, in order to improve staff well-being, boost operators morale and ultimately improve service reliability.

Below graph shows the trend of default crew hours.

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve operators well-being</td>
<td></td>
</tr>
<tr>
<td>Help avoid long term absenteeism and inherent operating cost</td>
<td></td>
</tr>
<tr>
<td>Boost operators productivity</td>
<td></td>
</tr>
</tbody>
</table>
Gather Operator Feedback

**Recommendation 4:** Uncover deeper insights into the workforce’s well-being and how it may impact service reliability

<table>
<thead>
<tr>
<th>Details</th>
<th>Benefits</th>
</tr>
</thead>
</table>
| The assessment, combined with the peer review, uncovered that workforce long term absenteeism is not uncommon in Transit services, for various reasons. As service reliability is critically important for the municipality and residents, it is imperative that the workforce maintain healthy well-being in order to deliver the service. It is recommended to conduct regular check-in with operators and gather feedback from the staff to gain deeper insights into their well-being and proactively understand the impact on service reliability and plan accordingly. Below is a few suggested tactics in collecting feedback. | o Improve operators well-being  
|                                                                      | o Uncover any systemic issues                |
|                                                                      | o Better workforce plan and resourcing       |

- Informal Touch-base
- Pulse Check
- Virtual Focus Groups
- Suggestion Box
- Employee Well-being Survey
Appendix

Transit Service Efficiency
## Executive Summary

### Summary of Inputs

### On-Demand Transit Assessment

**Current State of On-Demand Transit**
- Benefits
- Success Factors
- Peer Implementation

**On-Demand Transit Analysis**
- Evaluation of Testing Conditions
- Scenario Modeling and Analysis
  - Parameters
  - Scenario Identification
  - Cost Savings Analysis

**Planning and Implementation Strategy**
- Tailored implementation approach

### Bus Lifecycle Analysis

**Benchmarking on Preventative Maintenance & Bus Retention Practices**
- Industry Scan
- Peer Review of Maintenance

**Current Fleet Analysis**
- Age, Make/Model, Propulsion
- Mileage
- Purchase Costs

**Scheduled Maintenance Programs & Costs**
- Major overhauls and rebuilds
- Transit Preventative Maintenance
- Annual Maintenance
- Semi-Annual Maintenance

**Unscheduled Maintenance Frequency & Costs**
- Frequency of breakdowns
- Cost of breakdowns

### Snow Removal

**Current Pain Point of Outsourcing**
- Safety
- Reputation
- Service

**Operation Metrics Comparison**
- Safety, service level and flexibility
- Staff satisfaction
- Cost

**In-house model enablers**
- Staff capacity
- Equipment
- Strategy to deployment

**Benchmarking on snow removal practice**
- Peer Review of snow removal service model

### Service Reliability

**Operators & Supervisors**
- Long Term Absenteeism Drivers and Trends
- Bidding Trends
- Supervisors Pressures

**Service Delivery Composition**
- Workforce Delivering Services Trends
- Cancellations

**Costs**
- Employee Cost Composition
- Overtime Costs
- Potential Savings

**Others**
- Collective Agreements
- Crews’ Times (shifts lengths)
Appendix A: Conditions Assessment

Quantitative evaluation of the current state of Brampton Transit

Brampton Transit’s services operate to a high-degree of productivity

- The following represents a summary of how Brampton Transit currently fairs against the conditions previously identified
- Each criterion is averaged over all weekday and weekend service periods

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing transit demand is less than 10 boardings per hour (BpH)</td>
<td>~ 1% of existing service</td>
</tr>
<tr>
<td>Demand density within zone* is less than 5 boardings per hour per square kilometer (BpH-km²)</td>
<td>18 of 167 zones 53 km² or 16%</td>
</tr>
<tr>
<td>Potential demand for transit in the overnight periods (1 am – 6 am) throughout the city is up to 5 boardings per hour per square kilometer (BpH-km²)</td>
<td>~ 0.5 BpH-km²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Evaluation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road network design within zone</td>
<td>Count and length of dead ends Does not include private roadways, driveways or motorways</td>
<td>1062 / 10935 130km or 7%</td>
</tr>
<tr>
<td>Road network within zone does not allow conventional transit operations</td>
<td>Qualitative by TTS zone</td>
<td>9 of 167 Zones 19 km² or 7%</td>
</tr>
<tr>
<td>Pedestrian connections and crosswalks along corridors</td>
<td>Could not be verified with available data</td>
<td></td>
</tr>
<tr>
<td>Walking distance to stops* (ave. 800m)</td>
<td>Percentage area within 400m for urban areas</td>
<td>53%</td>
</tr>
<tr>
<td></td>
<td>Percentage area with 1200m for rural/farm areas</td>
<td>78%</td>
</tr>
</tbody>
</table>

*Note that these values are reflective of Weekday Late Evening service
Appendix A: Conditions Assessment

Brampton On-Demand Transit Study

Existing Services
Appendix A: Conditions Assessment

Brampton On-Demand Transit Study

Late Evening Demand Density
Appendix A: Conditions Assessment

Brampton On-Demand Transit Study

Late Evening Walking Distance to Stops in Service

Legend

Walking Distance (metres)
- 400
- 800
- 1200

Brampton Transit Routes
- BRT
- Base Grid
- EXPRESS
- Local

Street Centerline
Traffic Zone within Brampton
Other Traffic Zone
## Appendix B: On-Demand Transit Analysis

### Cost factors for analysis

While the following table outlines the cost factors that were leveraged for this analysis, only through a pilot would it be possible to ascertain the true cost of on-demand options.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Brampton Transit* Conventional Vehicles</th>
<th>Brampton Transit* Vans</th>
<th>Third-party Partners** Vans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base operator wages (per hour)</td>
<td>$36</td>
<td>$36</td>
<td>$25</td>
</tr>
<tr>
<td>Indirect operating costs (per hour)</td>
<td>$44</td>
<td>$44</td>
<td>$20</td>
</tr>
<tr>
<td>Vehicle maintenance and fuel costs (per hour)</td>
<td>$35</td>
<td>$23</td>
<td>$23</td>
</tr>
<tr>
<td>Annual license costs (base, per year)</td>
<td>$50,000</td>
<td>$50,000</td>
<td>N/A Included in contract price</td>
</tr>
<tr>
<td>Annual license costs (per vehicle, per year)</td>
<td>$10,000 After 5 vehicles</td>
<td>$10,000 After 5 vehicles</td>
<td>$-</td>
</tr>
<tr>
<td>Vehicle purchase price</td>
<td>N/A Use existing fleet</td>
<td>$200,000</td>
<td>N/A Included in contract price</td>
</tr>
<tr>
<td>Annualized purchase price (7 years)</td>
<td>$-</td>
<td>$28,600</td>
<td>$-</td>
</tr>
<tr>
<td>Technology implementation cost</td>
<td>$150,000</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>Annualized implement’n cost (3 years)</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
</tbody>
</table>

*Brampton Transit operating costs derived from the 2018 CUTA Factbook

**Third-party operating costs leverage industry research from the Transportation Research Board and project team expertise
## Evaluation parameters for analysis

In order to compare the effectiveness and opportunity for cost efficiencies, the following parameters were evaluated assuming that existing demand must be served.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Existing / Traditional Service</th>
<th>Proposed On-Demand Service</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headway / Average waiting time</td>
<td>- Headway as scheduled&lt;br&gt;- Average Waiting Time&lt;br&gt;- ½ headway when headway &lt; 20min&lt;br&gt;- Otherwise, 1/3 headway</td>
<td>- Maximum headway defined&lt;br&gt;- Average waiting time derived from model</td>
<td>On-Demand scenarios will endeavor to reduce the waiting time without increasing costs</td>
</tr>
<tr>
<td>Average travel time</td>
<td>- Not evaluated</td>
<td>- Derived from model</td>
<td>For information only</td>
</tr>
<tr>
<td>Vehicles</td>
<td>- Number of vehicles assigned to provide service</td>
<td>- Number of type (capacity) of vehicles defined</td>
<td>Vehicle type and quantity must meet demand</td>
</tr>
<tr>
<td>Service Hours</td>
<td>- Service-hours per vehicle as scheduled</td>
<td>- Derived from model and influenced by vehicle parameters</td>
<td>On-Demand scenarios will endeavor to reduce the total service-hours required</td>
</tr>
<tr>
<td>Utilization</td>
<td>- Ridership / Service-hours</td>
<td>- Derived from model and influenced by vehicle parameters</td>
<td>On-Demand scenarios will endeavor to improve utilization where possible</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>- Based on Fall 2018 ridership counts</td>
<td>- Derived from model</td>
<td>On-Demand scenarios will target to meet, at a minimum, the existing demand</td>
</tr>
</tbody>
</table>
## Appendix B: On-Demand Transit Analysis

### Late-night On-Demand Service

**Scenario 1: Late evening on-demand in North Brampton replacing routes 24 and 32**

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing</th>
<th>On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>10pm – 1am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>20 min (60 min)</td>
<td>26 – 27 min</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>880</td>
<td>2,800</td>
</tr>
<tr>
<td>Utilization</td>
<td>13.4</td>
<td>3.7 – 5.0</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>47</td>
<td>42 – 56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>In-House On-Demand</th>
<th>Third-Party On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$ 101,200</td>
<td>$ 322,000</td>
<td>$ 196,000</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Fixed License Costs</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Added Per-vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Technology Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$ 101,200</td>
<td>$ 422,000</td>
<td>$ 246,000</td>
</tr>
</tbody>
</table>

### Opportunities
- Greater flexibility to travel east and west across northern Brampton without requiring a transfer
- Greater access to Base Grid and BRT services in late evening

### Challenges
- Demand within Zone One may quickly outpace the ability for On-Demand to remain cost-effective
- On-Demand service may cannibalize ridership from adjacent well-performing routes
- Rider communication during transition, since not all routes in area will be eliminated

Disclaimer: routes are mentioned as a means for analysis and no action or change is recommended
# Appendix B: On-Demand Transit Analysis

## Late-night On-Demand Service

### Scenario 2: Late evening on-demand in East Brampton replacing Route 31 and portions of Route 23

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing</th>
<th>On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>10pm – 1am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>10 – 21 min</td>
<td>20 – 23 min</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>~2</td>
<td>2</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>1,300</td>
<td>1,900</td>
</tr>
<tr>
<td>Utilization</td>
<td>13.5</td>
<td>8.4 – 9.6</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>~69</td>
<td>64 – 73</td>
</tr>
</tbody>
</table>

### Service Parameter (Existing Conventional Service vs. In-House On-Demand vs. Third-Party On-Demand)

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>In-House On-Demand</th>
<th>Third-Party On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$145,800</td>
<td>$219,000</td>
<td>$133,000</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td></td>
<td>$50,000</td>
<td></td>
</tr>
<tr>
<td>Fixed License Costs</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Added Per-vehicle Costs</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Technology Cost</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Vehicle Costs</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td><strong>Total Annual Costs</strong></td>
<td><strong>$145,800</strong></td>
<td><strong>$318,500</strong></td>
<td><strong>$183,000</strong></td>
</tr>
</tbody>
</table>

### Opportunities
- Improved service area coverage for residents in North-Eastern Brampton
- Greater access to Base Grid and BRT services in late evening

### Challenges
- Demand within Zone One may quickly outpace the ability for On-Demand to remain cost-effective
- On-Demand service may cannibalize ridership from adjacent well-performing routes
- Rider communication during transition, since not all routes in area will be eliminated

**Disclaimer:** routes are mentioned as a means for analysis and no action or change is recommended.
Appendix B: On-Demand Transit Analysis

Late-night On-Demand Service

Scenario 3: Late evening on-demand in West Brampton replacing Route 51

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing</th>
<th>On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>10 pm – 1 am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>20 min (60 min)</td>
<td>31 min</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>750</td>
<td>1,000</td>
</tr>
<tr>
<td>Utilization</td>
<td>51.7</td>
<td>28.6 – 31.0</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>155</td>
<td>120 – 130</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>In-House On-Demand</th>
<th>Third-Party On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$ 86,300</td>
<td>$ 115,000</td>
<td>$ 70,000</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Fixed License Costs</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Added Per-vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Technology Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$ 86,300</td>
<td>$ 215,000</td>
<td>$ 120,000</td>
</tr>
</tbody>
</table>

Opportunities:
- Testing an on-demand solution during this time period could support route rationalization in the area

Challenges:
- Demand outpaces the ability of On-Demand Transit to deliver quality service
- Possible for decreased ridership on account of service quality degradation

Disclaimer: routes are mentioned as a means for analysis and no action or change is recommended.
Late-night Flexible Routing

Scenario 4: Considering flexible routing to replace late evening service on Routes 24 and 32

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing</th>
<th>Flexible Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>10 pm – 1 am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>20 min (60 min)</td>
<td>10 min (30 min)</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td>&lt; 20 min added</td>
</tr>
<tr>
<td>Vehicles</td>
<td>2</td>
<td>2 additional</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>900</td>
<td>900</td>
</tr>
<tr>
<td>Utilization</td>
<td>13.4</td>
<td>8.3 – 12.3*</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>47</td>
<td>29 – 43</td>
</tr>
</tbody>
</table>

* Note that this only considers additional ridership relative to existing fixed-route ridership on these corridors

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>Flexible Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$101,200</td>
<td>$100,600</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$-</td>
<td>$-</td>
</tr>
<tr>
<td>Fixed License Costs</td>
<td>$-</td>
<td>$50,000</td>
</tr>
<tr>
<td>Added Per-vehicle Costs</td>
<td>$-</td>
<td>$30,000</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$-</td>
<td>$50,000</td>
</tr>
<tr>
<td>Technology Cost</td>
<td>$-</td>
<td>$50,000</td>
</tr>
<tr>
<td>Vehicle Costs</td>
<td>$-</td>
<td>$-</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$101,200</td>
<td>$246,000</td>
</tr>
</tbody>
</table>

Opportunities:
- Existing base grid routes in area can provide coverage for low additional travel time
- Leverages existing vehicles and stops
- Improves service for customers currently utilizing local routes

Challenges:
- Customer training will require specific and targeted messaging toward existing users of affected routes
- Policies around trip request time may result in lower quality of service for existing customers on base grid routes
- May result in additional complexities in procured technology

Disclaimer: routes are mentioned as a means for analysis and no action or change is recommended
Appendix B: On-Demand Transit Analysis

On-Demand in Brampton Gateway

Scenario 5: Replacing service on Routes 53, 54 and 56 near Brampton Gateway with an on-demand shuttle during the PM Peak

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing</th>
<th>On-Demand</th>
<th>Appendices B: On-Demand Transit Analysis</th>
<th>On-Demand</th>
<th>On-Demand</th>
<th>On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>3 pm – 7 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting Time</td>
<td>7.5 – 14 min</td>
<td>14 min</td>
<td></td>
<td>5 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>5</td>
<td>5</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>5,000</td>
<td>5,000</td>
<td></td>
<td>15,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilization</td>
<td>52</td>
<td>28 – 38</td>
<td></td>
<td>9 – 13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trips Completed</td>
<td>1045</td>
<td>800 – 1050</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>In-House On-Demand</th>
<th>Third-Party On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$ 575,000</td>
<td>$ 575,000</td>
<td>$ 1,050,000</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td></td>
<td>o Fixed License Costs</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td></td>
<td>o Added Per-vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td></td>
<td>o Technology Cost</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td></td>
<td>o Vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$ 575,000</td>
<td>$ 675,000</td>
<td>$ 1,100,000</td>
</tr>
</tbody>
</table>

Opportunities:
- Testing an on-demand solution during this time period could support route rationalization in the area

Challenges:
- Demand outpaces the ability of On-Demand Transit to deliver quality service
- Possible for decreased ridership on account of service quality degradation

Disclaimer: routes are mentioned as a means for analysis and no action or change is recommended.
Appendix B: On-Demand Transit Analysis

On-Demand in Brampton Gateway

Scenario 6: Replacing service on Routes 53, 54 and 56 near Brampton Gateway with an on-demand shuttle during the Late Evening

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing</th>
<th>On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>10 pm – 1 am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>10 min (30 min)</td>
<td>19 min</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>3.5</td>
<td>2</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>2,300</td>
<td>1,900</td>
</tr>
<tr>
<td>Utilization</td>
<td>52</td>
<td>18 - 33</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>242</td>
<td>210 - 260</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>In-House On-Demand</th>
<th>Third-Party On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$ 265,100</td>
<td>$ 218,500</td>
<td>$ 399,000</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Fixed License Costs</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Added Per-vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Technology Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$ 265,100</td>
<td>$ 318,500</td>
<td>$ 449,000</td>
</tr>
</tbody>
</table>

Opportunities:
- Annual Operating Cost offers possible savings
- High utilization allows use of existing fleet
- If grant funding is available to support implementation costs, this could be an effective opportunity to pilot On-Demand transit in Brampton

Challenges:
- Demand and utilization may quickly outpace ability to provide quality service
- Cost of implementation must be absorbed before cost savings materialize

Disclaimer: routes are mentioned as a means for analysis and no action or change is recommended.
Appendix B: On-Demand Transit Analysis

New Service Scenario: Late-night On-Demand Service

Scenario 7: Late evening on-demand in industrial areas, offsetting the costs of extending Routes 10, 20 and 40 during this period

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Conventional</th>
<th>On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>10pm – 1am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>20 min (60 min)</td>
<td>27 min</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>~4</td>
<td>1</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>3,000</td>
<td>825</td>
</tr>
<tr>
<td>Utilization</td>
<td>N/A</td>
<td>4.2 – 4.8</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>N/A</td>
<td>14 – 16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>In-House On-Demand</th>
<th>Third-Party On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$ 345,000</td>
<td>$ 94,900</td>
<td>$ 57,800</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Fixed License Costs</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ -</td>
</tr>
<tr>
<td>o Added Per-vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Technology Cost</td>
<td>$ -</td>
<td>$ 50,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>o Vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$ 345,000</td>
<td>$ 194,900</td>
<td>$ 107,800</td>
</tr>
</tbody>
</table>

Opportunities:
- Opportunity to provide frequently-requested transit service in an area and time period where low demand limits the effectiveness of conventional transit
- Significant cost savings relative to a conventional transit service are possible utilizing an on-demand solution

Challenges:
- Workers and employers in the areas served have long-since established travel habits, which may be difficult to change
- Technology and implementation costs are considerable for a relatively small program

Disclaimer: new services and routes are mentioned as a means for analysis and no action or change is recommended.
Appendix B: On-Demand Transit Analysis

New Service Scenario: Overnight Airport Express Feeder

Scenario 8: Providing overnight on-demand feeder service to connect with an extended Airport Express service

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Conventional</th>
<th>On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>1am – 5am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>10 min (30 min)</td>
<td>30 min</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td>17 + 2</td>
<td>6 + 2</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>17,000 + 2,000</td>
<td>6,200 + 2,000</td>
</tr>
<tr>
<td>Utilization</td>
<td>N/A</td>
<td>2.4 – 2.6</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>N/A</td>
<td>60 - 65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>In-House On-Demand</th>
<th>Third-Party On-Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$2,185,000</td>
<td>$943,000</td>
<td>$664,000</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$ -</td>
<td>$60,000</td>
<td>$ -</td>
</tr>
<tr>
<td></td>
<td>o Fixed License Costs</td>
<td>$50,000</td>
<td>$ -</td>
</tr>
<tr>
<td></td>
<td>o Added Per-vehicle Costs</td>
<td>$10,000</td>
<td>$ -</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$ -</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td></td>
<td>o Technology Cost</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td></td>
<td>o Vehicle Costs</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$2,185,000</td>
<td>$1,053,000</td>
<td>$714,000</td>
</tr>
</tbody>
</table>

Opportunities:
- Airport Express could form the backbone of overnight service in Brampton
- Bramalea Terminal offers a convenient hub to group passengers alighting from the Express by destination
- Potential to increase utilization by offering limited number of trips between stops in Brampton

Challenges:
- Low expected demand for the airport service
- Low utilization suggests a dedicated fleet of smaller-capacity vans will be required
- Demand is quite spread out across the northern part of Brampton

Disclaimer: new services and routes are mentioned as a means for analysis and no action or change is recommended.
New Service Scenario: Overnight Airport Express Flexible Route

Scenario 9: Providing overnight service on an extended Airport Express service modified with flexible routing in Brampton

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Conventional</th>
<th>Flexible Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Period</td>
<td>1 am – 5 am</td>
<td></td>
</tr>
<tr>
<td>Waiting Time (Headway)</td>
<td>10 min (30 min)</td>
<td>10 min (30 min)</td>
</tr>
<tr>
<td>Travel Time</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Vehicles</td>
<td>12 + 2</td>
<td>8</td>
</tr>
<tr>
<td>Annual Service-hours</td>
<td>12,000 + 2,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Utilization</td>
<td>N/A</td>
<td>1.3 – 1.6</td>
</tr>
<tr>
<td>Trips Completed</td>
<td>N/A</td>
<td>40 – 50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Parameter</th>
<th>Existing Conventional Service</th>
<th>Flexible Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Operating Cost</td>
<td>$1,610,000</td>
<td>$1,178,800</td>
</tr>
<tr>
<td>Annual Licensing Fees</td>
<td>$-</td>
<td>$80,000</td>
</tr>
<tr>
<td>o Fixed License Costs</td>
<td>$-</td>
<td>$50,000</td>
</tr>
<tr>
<td>o Added Per-vehicle Costs</td>
<td>$-</td>
<td>$30,000</td>
</tr>
<tr>
<td>Annualized Start-up Cost</td>
<td>$-</td>
<td>$50,000</td>
</tr>
<tr>
<td>o Technology Cost</td>
<td>$-</td>
<td>$50,000</td>
</tr>
<tr>
<td>o Vehicle Costs</td>
<td>$-</td>
<td>$-</td>
</tr>
<tr>
<td>Total Annual Costs</td>
<td>$1,610,000</td>
<td>$1,308,800</td>
</tr>
</tbody>
</table>

Opportunities:
- Airport Express could form the backbone of overnight service in Brampton
- Flexible routing provides a single-seat trip between the airport and the destination in Brampton
- Potential to increase utilization by offering limited number of trips between stops in Brampton

Challenges:
- Despite low-demand, service requires a conventional vehicle
- Round trip times will be long, since you cannot group passengers with like destinations to minimize travel
- Demand is quite spread out across the northern part of Brampton

Disclaimer: new services and routes are mentioned as a means for analysis and no action or change is recommended.
Appendix C: Planning and Implementation Strategy

Identifying local conditions

Ensuring that the local conditions are appropriate for On-Demand Transit

I. Identify the Local Conditions

New Service Area
- Assess the potential demand within the new service area
- Consider the impact of fixed-route deviation on travel time and coverage
- Develop an initial demand assessment based on this conceptual fixed-route network

Existing Service Area
- Determine if route or route-segments are performing below 10 BpH
- Determine the impact on service coverage if the route is eliminated, curtailed or realigned

Review Demand Patterns

Review the detailed boarding and alighting patterns throughout the study area for trends and demand patterns. If leveraging an initial demand assessment for a new service area, determine whether the service area supports defined criteria for On-Demand Transit.

Criteria

A. Demand: 2-10 BpH on average
B. Demand: 2 – 5 BpH-Km²
## Service delivery conceptualization

### Selecting an appropriate service delivery model

#### II. Determine the service delivery concept

- **A. Flexible Routing**
  - Requires existing fixed-route service
  - Requires street network accessible by standard transit vehicles
  - Requires layover facilities to recover time
  - Zone size is usually smaller than other on-demand formats
  - Consider consolidating very low frequency routes in similar directions with a single flexible route

- **B. Shuttle Service**
  - Requires nearby higher-order transit
  - Provides a wider catchment area and more spread-out and lower-demand trip generators
  - Zones are typically less than 15-20 square kilometers
  - Consider in residential or mixed-use areas nearby higher-order transit such as commuter rail or BRT, but beyond a comfortable walking distance

- **C. First/Last Mile Service**
  - Requires nearby higher-order transit
  - Provides a wider catchment area and more spread-out and lower-demand trip generators
  - Zones are typically less than 15-20 square kilometers
  - Consider in residential or mixed-use areas nearby higher-order transit such as commuter rail or BRT, but beyond a comfortable walking distance

- **D. Curb-to-Curb Service**
  - Requires nearby higher-order transit
  - Serves a limited number of trip generators within the zone, with service directed to higher-order transit
  - Service is traditionally short-distance
  - Consider in employment areas nearby higher-order transit such as commuter rail or BRT, but beyond a comfortable walking distance
  - Useful for providing large coverage of low-demand and widely-distributed trip generators
  - Zones are typically less than 15-20 square kilometers
  - Demand in zone is generally too low and consistent over the entire service period to warrant attractive fixed-route transit
  - Trips are localized within the zone
  - Useful when expanding service into new areas on the urban fringe

- **Note:** Service delivery concepts are not universally appropriate or inappropriate in all settings.
  - The following are four primary forms of On-Demand Transit:
    - A – Flexible Routing
    - B – Shuttle Service
    - C – First/Last Mile Service
    - D – Curb-to-Curb Service

- **Key considerations include:**
  - Expected ridership and demand patterns
  - Road, cycling and pedestrian network
  - Zone size
  - Trip generators and their locations within the zone
## Appendix C: Planning and Implementation Strategy

### Identifying appropriate service levels

Determining the level of service required to meet the demand

### Develop service parameters

<table>
<thead>
<tr>
<th>Flexible Routing</th>
<th>Shuttle Service</th>
<th>First/Last Mile Service</th>
<th>Curb-to-Curb Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum advanced request time</td>
<td>Based on round trip travel time</td>
<td>Based on distance to layover location</td>
<td>On-demand</td>
</tr>
<tr>
<td>Target and maximum trip fulfillment (waiting) time</td>
<td>Based on round trip travel time</td>
<td>Based on distance to layover location</td>
<td>&lt; 15 min (30 min maximum)</td>
</tr>
<tr>
<td>Maximum travel time</td>
<td>&lt; 20 min (deviation)</td>
<td>&lt; 20 min</td>
<td>&lt; 15 min</td>
</tr>
<tr>
<td>Allowable stop locations</td>
<td>Full-service transit stops Building entrances</td>
<td>Transit stops Intersections</td>
<td>Transit stops Intersections</td>
</tr>
<tr>
<td>Allowable roadways</td>
<td>Must allow standard transit vehicles</td>
<td>Vehicle-dependent</td>
<td>Public roadways</td>
</tr>
</tbody>
</table>

Timing is largely defined by the scheduled layover time
Must consider impact on service in the trunk/fixed-route segment of the route

A layover facility nearby higher-order transit stop(s) is required to stage vehicles
Round trip time should be kept as short as possible

A layover facility nearby major trip generators / higher order transit helps to stage vehicles
Service does not usually provide local curb-to-curb trips

Most flexible format of service allowing for greater variety in service parameters

Dependency on zone size

Most flexible format of service allowing for greater variety in service parameters

Based on distance to layover location

Minimum advanced request time

Curb-to-Curb Service

Full-service transit stops

Building entrances

Transit stops Intersections

Transit stops Intersections

Must allow standard transit vehicles

Vehicle-dependent

Public roadways

Public roadways

Timing is largely defined by the scheduled layover time
Must consider impact on service in the trunk/fixed-route segment of the route

A layover facility nearby higher-order transit stop(s) is required to stage vehicles
Round trip time should be kept as short as possible

A layover facility nearby major trip generators / higher order transit helps to stage vehicles
Service does not usually provide local curb-to-curb trips

Most flexible format of service allowing for greater variety in service parameters
Appendix C: Planning and Implementation Strategy

Procurement and Implementation

Considerations for procuring and implementing the service

IV

Determining the implementation strategy

A Technology
- An automated reservation, scheduling and dispatching system is the cornerstone of all On-Demand systems
- Fare payment and the complexity of PRESTO Integration could be a risk
- Technology should be procured to allow for flexibility in service design (i.e. all forms of On-Demand discussed previously)
- Consider ownership of the technology, versus leasing it as a service

B Fleet
- If the service requires maneuverability, then smaller vehicles (less than ~8m in length) are required
- Vendors include El Dorado, ARBOC, Starcraft and others

C Service
- Brampton Transit Operators may need a new Collective Bargaining Agreement in order to support the scheduling and work-selection process of in-house on-demand service
- Third-party contracts often have a fixed and a service-based pricing component, often charged per service-hour
- Management of service contracts with third-parties will require monitoring of key performance indicators, with targets built into the agreement

Considerations for implementation

Three major components factor in to procuring and implementing On-Demand Transit
- Technology, including reservation system and fare payment
- Fleet, particularly if a new vehicle-type is required
- Service, such as whether to outsource service delivery to a third-party contractor

These components could be procured together, or individually as the need requires

Accessibility and fairness must factor into the procurement and implementation of services
- Reservation system and vehicles must meet the AODA requirements
- Service must provide equal access, particularly to those with low income and/or seniors who may not have equal access to smart phone technology
## Communicating and educating customers

### Prior to start of service

- Extensive public engagement using multiple channels to support change management
- Current and potential future customers may find it challenging to understand the new service
- It may be wise to have 6-12 weeks of overlap between the on-demand service and the fixed-route service to help transition riders
- Ensure that existing customers are well-targeted in any marketing and education campaigns prior to the start of service
- Provide as many opportunities for customers and the public to learn about the new service prior to launch

### During regular operations

- Provide travel training and other ongoing educational opportunities for new customers to familiarize themselves with the service
- Provide as many mechanisms for trip booking as possible to ensure that all potential customers have equal access to the service
- Ensure that service alerts for any connecting services are reflected in the booking channel
- Service disruptions such as vehicle breakdowns or overcrowding that limit access to the on-demand service must be communicated promptly, and every effort to rebook passengers must be made to avoid creating a negative customer experience

---

**Successful On-Demand Transit** relies on frequent and effective customer communication. Customers using smart phones and other internet technologies often have access to the real-time location and predicted arrival of their vehicle natively within the booking application. This level of communication supports a positive customer experience, and should be echoed prior to service implementation and changes, as well as in times of service disruption.
During operations, Brampton should be aware of performance and be prepared to respond to changing demand.

### Ongoing service monitoring and transitioning

#### Performance Metrics and Monitoring

**Boardings per Service-Hour:**
- Target 7 BpH
- Review for service increase at 10 BpH
- Review for service decrease at 3 BpH

**Trips completed:**
- Target should be at least 95%
- Review service if trip denials over 5%

**Average waiting time:**
- Target should be equivalent to headway service standard (i.e. ½ headway for frequent routes, 1/3 headway for infrequent routes)
- Review service if waiting time exceeds equivalent for headway service standard

**Trip detour time:**
- Establish based on customer service
- Difference between direct route travel time and actual experienced travel time
- Review service if trip detour time increases above established targets

**Average cost per trip:**
- Establish based on minimum requirements for fixed-route service
- Determined by taking the cost per service hour and the average trip time

<table>
<thead>
<tr>
<th></th>
<th>Curb-to-Curb</th>
<th>First/Last Mile</th>
<th>Shuttle</th>
<th>Flexible Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>BpH &lt; 3</td>
<td>Eliminate</td>
<td>Eliminate</td>
<td>Eliminate</td>
<td>Curtail route</td>
</tr>
<tr>
<td>BpH &gt; 10</td>
<td>First/Last Shuttle</td>
<td>Shuttle</td>
<td>Flex-route Fixed route</td>
<td></td>
</tr>
<tr>
<td>Trip denials &gt; 5%</td>
<td>Review service area</td>
<td>Review service area</td>
<td>Review service area</td>
<td>Flex-route Fixed route</td>
</tr>
<tr>
<td>Waiting time &gt; 1/3 Hdwy</td>
<td>Review service area</td>
<td>Review service area</td>
<td>Review service area</td>
<td>Review service area</td>
</tr>
<tr>
<td>Excessive detour time</td>
<td>Review service area</td>
<td>Review service area</td>
<td>Review service area</td>
<td>Review service area</td>
</tr>
<tr>
<td>Excessive cost per trip</td>
<td>Eliminate Flex-route</td>
<td>Eliminate Flex-route</td>
<td>Eliminate Flex-route</td>
<td>Eliminate Fixed route</td>
</tr>
</tbody>
</table>

The following table represents possible considerations for transitioning between service models as the standards for the proposed performance metrics are exceeded.
Appendix

Transit Service Efficiency: Bus Lifecycle Analysis

Study #2
## Peer Agencies – Fleet size and make-up

<table>
<thead>
<tr>
<th></th>
<th>Brampton</th>
<th>TTC</th>
<th>Halifax</th>
<th>MiWay</th>
<th>Winnipeg</th>
<th>YRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-ft Diesel</td>
<td>327</td>
<td>~1200</td>
<td>281</td>
<td>409</td>
<td>575</td>
<td>403</td>
</tr>
<tr>
<td>40-ft Hybrid</td>
<td>43</td>
<td>~700</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-ft Electric</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>60-ft Diesel</td>
<td></td>
<td>152</td>
<td>45</td>
<td>66</td>
<td>40</td>
<td>86</td>
</tr>
<tr>
<td>60-ft Hybrid</td>
<td>80</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>450</td>
<td>2100</td>
<td>328</td>
<td>500</td>
<td>630</td>
<td>541</td>
</tr>
<tr>
<td>Spare Ratio</td>
<td>24%</td>
<td>22%</td>
<td>22%</td>
<td>25%</td>
<td>19.5%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Note: “✓” indicates the presence of a specific type of vehicle in a peer agency's fleet.
Peer Agencies – Target Bus Retention and Reliability

<table>
<thead>
<tr>
<th></th>
<th>Brampton Current</th>
<th>Brampton Recommended</th>
<th>Halifax</th>
<th>MiWay</th>
<th>TTC</th>
<th>Winnipeg</th>
<th>YRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-ft Diesel</td>
<td>18</td>
<td>18</td>
<td>14</td>
<td>15</td>
<td>13</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>40-ft Hybrid</td>
<td>18</td>
<td>15</td>
<td>15</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-ft Diesel</td>
<td></td>
<td></td>
<td>14</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>60-ft Hybrid</td>
<td>18</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Brampton</th>
<th>Halifax</th>
<th>MiWay</th>
<th>TTC</th>
<th>Winnipeg</th>
<th>YRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Average MBDF*)</td>
<td>&gt;15,000 km</td>
<td>5,000 - 10,000 km</td>
<td>&lt;5,000 km</td>
<td>&gt;15,000 km</td>
<td>Do not Track</td>
<td>10,000 - 15,000 km</td>
</tr>
</tbody>
</table>

- Mean Distance Between Failures (MBDF) is the standard metric for reliability of vehicles, but there may be variations across agencies as to how it is collected.
Appendix – Sensitivity Analysis

The following is a brief introduction of the graphs on the following slides

- Analysis showed that frequency of major overhauls did not impact optimal bus retention age
- Analysis showed that the target retirement age should be reduced if capital costs (purchase costs) are subsidized at 2/3 or greater
  - The following slides demonstrate impact on annualized costs at various levels of capital subsidy
Appendix

Annualized Bus Lifecycle Costs – No Capital Subsidy

<table>
<thead>
<tr>
<th>Bus Retention (Years)</th>
<th>Lowest Annualized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$75,000</td>
<td>5</td>
</tr>
<tr>
<td>$100,000</td>
<td>6</td>
</tr>
<tr>
<td>$125,000</td>
<td>7</td>
</tr>
<tr>
<td>$150,000</td>
<td>8</td>
</tr>
<tr>
<td>$175,000</td>
<td>9</td>
</tr>
<tr>
<td>$200,000</td>
<td>10</td>
</tr>
<tr>
<td>$225,000</td>
<td>11</td>
</tr>
<tr>
<td>$250,000</td>
<td>12</td>
</tr>
<tr>
<td>$275,000</td>
<td>13</td>
</tr>
<tr>
<td>$300,000</td>
<td>14</td>
</tr>
<tr>
<td>$325,000</td>
<td>15</td>
</tr>
<tr>
<td>$350,000</td>
<td>16</td>
</tr>
<tr>
<td>$375,000</td>
<td>17</td>
</tr>
<tr>
<td>$400,000</td>
<td>18</td>
</tr>
</tbody>
</table>

- 40 ft Diesel
- 40 ft Hybrid
- 60 ft Hybrid

MDBF = 12,000 km
MDBF = 15,000 km
Annualized Bus Lifecycle Costs – 33% Capital Subsidy

Bus Retention (Years)

Lowest Annualized Cost
Appendix

Annualized Bus Lifecycle Costs – 67% Capital Subsidy

![Graph showing annualized bus lifecycle costs for different bus types and maintenance intervals.]

- **MDBF = 12,000 km**
- **MDBF = 18,000 km**
- **MDBF = 15,000 km**

Lowest Annualized Cost

40 ft Diesel
40 ft Hybrid
60 ft Hybrid
Appendix

Annualized Bus Lifecycle Costs – 100% Capital Subsidy

Bus Retention (Years)

Lowest Annualized Cost

MDBF = 13,000 km
MDBF = 18,000 km
MDBF = 19,000 km

40 ft Diesel
40 ft Hybrid
60 ft Hybrid
Appendices

Snow Removal for Transit Facilities

Study #3
## Existing Infrastructure

Brampton transit has three primary service areas. Equipment has been designated to serve each area to ensure coverage. Currently, equipment on site is adequate for staff to clear service areas.

<table>
<thead>
<tr>
<th>Facility</th>
<th>FSP¹</th>
<th>Existing Equipment</th>
<th>Service Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandalwood Garage</td>
<td>![FSP Icon]</td>
<td>4×4 with Plow and Salter (×2)</td>
<td>1. Sandalwood Garage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volvo L70 Loader</td>
<td>2. Hurontario Transit Loop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WN WL32 Loader</td>
<td>3. Heart Lake Transit Terminal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Gateway Transit Terminal</td>
</tr>
<tr>
<td>Clarke Garage</td>
<td>![FSP Icon]</td>
<td>4×4 with Plow and Salter (×2)</td>
<td>1. Downtown Transit Terminal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4×4 Plow</td>
<td>2. Bramalea Transit Terminal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volvo L70 Loader</td>
<td>3. Clark Boulevard Garage</td>
</tr>
</tbody>
</table>

¹Facilities Services Person (FSP) are responsible for day to day maintenance of all transit facility assets.
## Scheduling - Clarke Facility

The below chart illustrates how many FSP are available at any given hour if snow removal services are required.

|       | 12:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|-------|-------|------|------|------|------|------|------|------|------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Monday|       | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 1      | 1      | 1      | 1      | 2      | 1     |
| Tuesday| 1     | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 2      | 1     |
| Wednesday | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| Thursday | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 1 |
| Friday | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| Saturday | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sunday | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |

**Findings:** All deployment strategies would be limited to sequential and not parallel for Clarke facility service areas on all weekdays except for Friday. Not enough FSP to attend to more than one service area at a time. No coverage on Friday and Saturday from 2am to 7am.
### Scheduling – Sandalwood Facility

The below chart illustrates how many FSP are available at any given hour if snow removal services are required.

|       | 12:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|-------|-------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| **Monday** | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| **Tuesday** | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| **Wednesday** | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| **Thursday** | 1     | 1    | 1    | 1    | 1    | 1    | 1    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 2    | 2    | 2    |
| **Friday** | 1     | 0    | 0    | 0    | 0    | 0    | 0    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 2    | 2    | 2    | 2    | 2    | 2    |
| **Saturday** | 1     | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    |
| **Sunday** | 2     | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 2    |

**Findings:** There are windows of time from Monday to Friday where parallel deployment could occur in the likelihood of heavy snow. Friday and Saturday have no coverage from 1 am to 7 am.
Below are examples of logged issues from Transit staff when communicating with contractors on their required duties. This illustrates various points of contention between Brampton transit and the contract services.

<table>
<thead>
<tr>
<th>Date</th>
<th>Logged Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 16</td>
<td>Humberview area was not pre-salted</td>
</tr>
<tr>
<td>November 27</td>
<td>Humberview area was not being monitored. Transit staff had to notify contractor for service. Contractor did not respond within one hour as specified in SLA.</td>
</tr>
<tr>
<td>December 12</td>
<td>Humberview area was not pre-salted. Property was not being monitored. Transit staff had to notify contractor for service.</td>
</tr>
<tr>
<td>December 24</td>
<td>Humberview area was not pre-salted. Property was not being monitored. Transit staff had to notify contractor for service. Contractor did not respond within one hour as specified in SLA.</td>
</tr>
<tr>
<td>December 30</td>
<td>Bramalea Transit Terminal was not being monitored. Transit staff had to notify contractor for service.</td>
</tr>
<tr>
<td>January 7</td>
<td>Sandalwood – Humberview area was not being monitored. Transit staff had to notify contractor for service.</td>
</tr>
<tr>
<td>January 19</td>
<td>Clarke Boulevard area was not being monitored. Transit staff had to notify contractor for service.</td>
</tr>
<tr>
<td>January 20</td>
<td>Gateway terminal was not kept safe and passable during winter event. Transit staff had to escalate situation</td>
</tr>
</tbody>
</table>
## Assessment: Service Level Agreement

<table>
<thead>
<tr>
<th>Current Service Level Requirement</th>
<th>Satisfactory</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Action</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Any winter event with the potential to freeze must be pre-salted</td>
<td>✔️</td>
<td>• To include areas that require pre-salting, i.e. driveways, roads surrounding bus route, bus terminals, stairways to terminals (if applicable).</td>
</tr>
<tr>
<td>• If an Environment Canada forecast shows a winter event issued for Brampton, a pre-salting of all sites must take place at least 1 hr before the winter event begins</td>
<td>✔️</td>
<td>• SLA pre-salting time requirements to be increased to 2 hours if service will be managed within the organization. This allots additional time</td>
</tr>
<tr>
<td><strong>During Winter events</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sites to be regularly monitored and treated as required to be maintained to a safe and passable condition</td>
<td>✔️</td>
<td>• Requires a more comprehensive definition of ‘safe and passable’ as there were disagreements with previous contractors as to what this looks like</td>
</tr>
<tr>
<td>• All overhead door and building entrances to be clear of snow or ice</td>
<td>✔️</td>
<td>• List which alternative ice melting products that would be acceptable</td>
</tr>
<tr>
<td>• Salting and Plowing needs to be performed as required for the duration of the winter event to ensure safe and passable conditions at all times</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>• All access doors are to be cleared, treated and regularly monitored as required for any drifting snow or related hazards.</td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>
## Assessment: Service Level Agreement

<table>
<thead>
<tr>
<th>Current Service Level Requirement</th>
<th>Satisfactory</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>After Winter Events</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- All facility and terminal roadways, parking areas, pedestrian walkways and platforms must be bare pavement 6 hrs after the conclusion of a winter event.</td>
<td></td>
<td>- Unrealistic expectation of bare pavement 6 hours after winter event. Timing should be decided based on cm of snowfall and amount of FSP designated for this service.</td>
</tr>
<tr>
<td>- Any excess snow that has been stored and could impact pedestrian or vehicular movements at any of the properties must be removed off site when requested. Transit will request this service on an as and when required basis.</td>
<td></td>
<td>- Snow storage removal is usually included as part of the contract duties per industry trend.</td>
</tr>
<tr>
<td>- If designated Snow Storage areas are full at the Garages, it must be removed off site when requested. Transit will request this service on an as and when required basis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Sites must be regularly monitored and serviced for drifting snow or other related hazards and cleared and treated as required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Sites must be regularly monitored and serviced for thaw/freeze conditions as required to ensure they are safe and passable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Downtown Terminal canopy (green roof) must be regularly monitored, snow that has accumulated on the top of the canopy needs to be removed during and after a winter event to ensure no hazard to pedestrians exists.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Final Report – Study 3

Deployment Strategy - Routes

This illustrates the current routes for in-house snow removal services.
# Quality Assurance

## Develop a Quality Assurance Process

Currently, there is no formalized method to verify that snow removal services were completed adequately. The implementation of a quality assurance process would formalize monitoring of snow removal operations, confirm service levels are met and identify and mitigate risks.

### Objective:
Design a quality assurance system in the form of a ‘winter road patrol’ as a means of ensuring safe public access to terminals and facilities.

### Key Components:
The quality assurance process is a continuous activity that covers the following areas:

- Driving record screening criteria for FSP to cover training for winter equipment
- Confirmation of completion of ‘scheduled activities’ (deployment strategy)
- Supervisor accountability – weather monitoring and notifications
- Quality check for equipment after snow removal is complete
- Quality check in service areas to confirm ‘safe and passable’

### Key Success Factors

1. Attending to unclear areas immediately if problem is identified
2. Fulfilling legislative compliance for municipal snow removal
3. Maintaining and replacing equipment if required
4. Scheduling overtime in advance, when necessary, to prepare for winter/snow event

### Benefits

- Confirmation of safe and passable terminals and facilities
- Accountability
- Opportunity to resolve any issues with snow clearing before negative impacts, i.e. safety concerns, service delays
- Opportunity to review state of equipment and mitigate when required
As snow removal services is a reactive service, maintaining a scorecard would be a good indicator of what service levels can be attained. Below is an example of areas that management can consider when creating a scorecard for in-house snow removal services.

<table>
<thead>
<tr>
<th>Areas of Focus</th>
<th>Measures of Success</th>
<th>Brampton Transit FSP</th>
<th>Target Reached</th>
<th>Contractor Snow Removal</th>
<th>Target Reached</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response times</td>
<td>Timeframe requested to begin snow removal</td>
<td>30 min</td>
<td></td>
<td>1 hour</td>
<td></td>
</tr>
<tr>
<td>Effective Prevention</td>
<td>100% of surfaces salted. Timeframe request: 12-24 hours before event</td>
<td>24 hours</td>
<td></td>
<td>24 hours</td>
<td></td>
</tr>
<tr>
<td>Clearing Time</td>
<td>100% of doors cleared</td>
<td>6 hours</td>
<td></td>
<td>12 hours</td>
<td></td>
</tr>
<tr>
<td>Ongoing Monitoring</td>
<td>QA process is maintained (notifications, QA check)</td>
<td>2 hours after clearing</td>
<td></td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

Target achieved: green, Target not achieved: red, Target at risk: yellow
Final Report – Study 3

Strategy: Monitoring & Execution

Continue and strengthen the monitoring and execution strategic to enable a smooth snow removal process.

1. Weather Monitoring
   • Facilities Foreperson is responsible for monitoring weather daily and checking for advisory weather reports.
   • Recommended approach would be to share weekly forecast at the beginning of the week and highlight days with high likelihood for snow.

2. Review Strategy
   • Once weekly weather forecast is communicated, facilities foreperson can begin strategizing snow removal tactics. Considerations should include:
     • Requesting overtime during ‘peak’ snow periods to ensure adequate staffing
     • Identify priority areas (i.e. clearing to occur before 5pm for bus fueling, and again before 3am before buses leave for service)

3. Notification
   • Notify Brampton Transit staff of potential weather, and advise the times areas will be cleared by staff.
   • Notify person in-charge of Quality Assurance to check properties once snow clearing is completed.

4. Property Monitoring
   • Quality Assurance person notifies Facilities foreperson of adequate snow removal. Foreperson requests Works to pick up snow storage (if applicable).
Data Management

Identified below are three areas that require either the creation and storage of documentation, or expansion of existing documents to include details relevant to snow removal services:

**Tracking Bus Delays**

- Currently bus delays are tracked and published for riders. Internally, bus delays should be tracked by reason for delay. This can help inform reasons for service delays/cancellations, and included as a scorecard measure. This will also help correlate delays with snow removal services.
- Formalize review of reports, particularly after known events, as a means to evaluate performance, confirm resources were sufficient and in general as a good risk management practice.

**Documenting Deployment Data and Outcomes**

- For the deployment strategy, Facilities foreperson should log how long each service area takes to clear, and how many FSP were on site for these duties. This will help inform future deployment strategies.
- The outcomes of the QA process should also be documented.

**Expanding Injury Reports**

- Currently, logged incidents cover date of incident, description and location.
- To include of a descriptor which indicates cause of slip/fall.
- Review information periodically for risk management and resources management.
Appendix

Service Reliability

Study #4
References

- **Key Data**
  - [2019 Operational Service Planner – 191007.xlsx](#)
  - [Comments on Service Reliability Study](#)
  - [Re Working time in crews increase consultant question](#)

- **Increasing Overtime Hours Due to LTAs**
  - [Payroll codes absence costing report](#)

- **Increasing Number of LTAs & Modified Work**
  - [Long Term Absences in years](#)

- **Crew Pressures**
  - [Not bidding as percentage of Total Operators](#)
  - [Re Working time in crews increase consultant question](#)

- **Increasing Cancelled Service**
  - [Cancx and OT Data](#)
  - [Cancellations and OT Data (Analysis)](#)

- **Pressured SSDs**
  - [Supervisor Service Delivery absences for Consultant's Data](#)

- **Increasing Operational Costs & Scenario Analysis**
  - [Service Reliability – Costing Model](#)