Existing System Evaluation and Choices Report

JULY 2017

Burlington Transit

Integrated Transit Mobility Plan

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Introduction and Executive Summary

This report is the first step in the Integrated Transit Mobility Plan for Burlington Transit. As a City agency, Burlington Transit is reconsidering the design of its transit system as the city rethinks its approach to growth, development and transportation. The city's potential shift in approach is reflected in the City's new Strategic Plan which calls for increased focus on transit, walking and biking as alternatives to driving.

Burlington Transit is the primary public transportation agency serving Burlington with service that connects to neighbouring Oakville and Hamilton. Figure 1 shows the existing transit network in the city, coloured by the frequency of the service.

- Purple lines (like Routes 10 and 20) operate every 20 minutes.
- Blue lines (like Routes 1 and 101) operate about every 30 minutes, though some blue routes operate about every 40 minutes.
- Green lines (like Routes 6 and 12) operate about every 60 minutes, though some green routes operate less frequently.
- Dashed lines operate only at peak hours and are coloured by their frequency at the peak hour.
- Dashed tan lines show service provided by neighbouring transit agencies.
- Solid tan lines show the Community Connector Routes (300, 301, and 302) that only operate mid-day on weekdays.

All routes, except the Community Connector Routes, connect to one or more of the GO Train stations (Aldershot, Burlington, or Appleby) connecting to the GO Lakeshore West line with service to and from Toronto.

Metrolinx is working to improve service on the Lakeshore West line by changing to electrified trains and increasing service to all-day, 15-minute frequency by 2020. This change presents a major opportunity for Burlington. When local bus trips connect to a regional train with minimal waiting, they become useful for vastly more destinations and therefore will attract more riders.

At the same time, the city is shifting its development focus. Having reached the greenbelt limit, the City's new Strategic Plan calls for the intensification of development in the city with a focus on key centers of activity like downtown and GO Stations.

Thus, the shifting approach to land use and coming changes to regional transit present a fertile opportunity for the City of Burlington to reconsider the design and focus of its transit system.

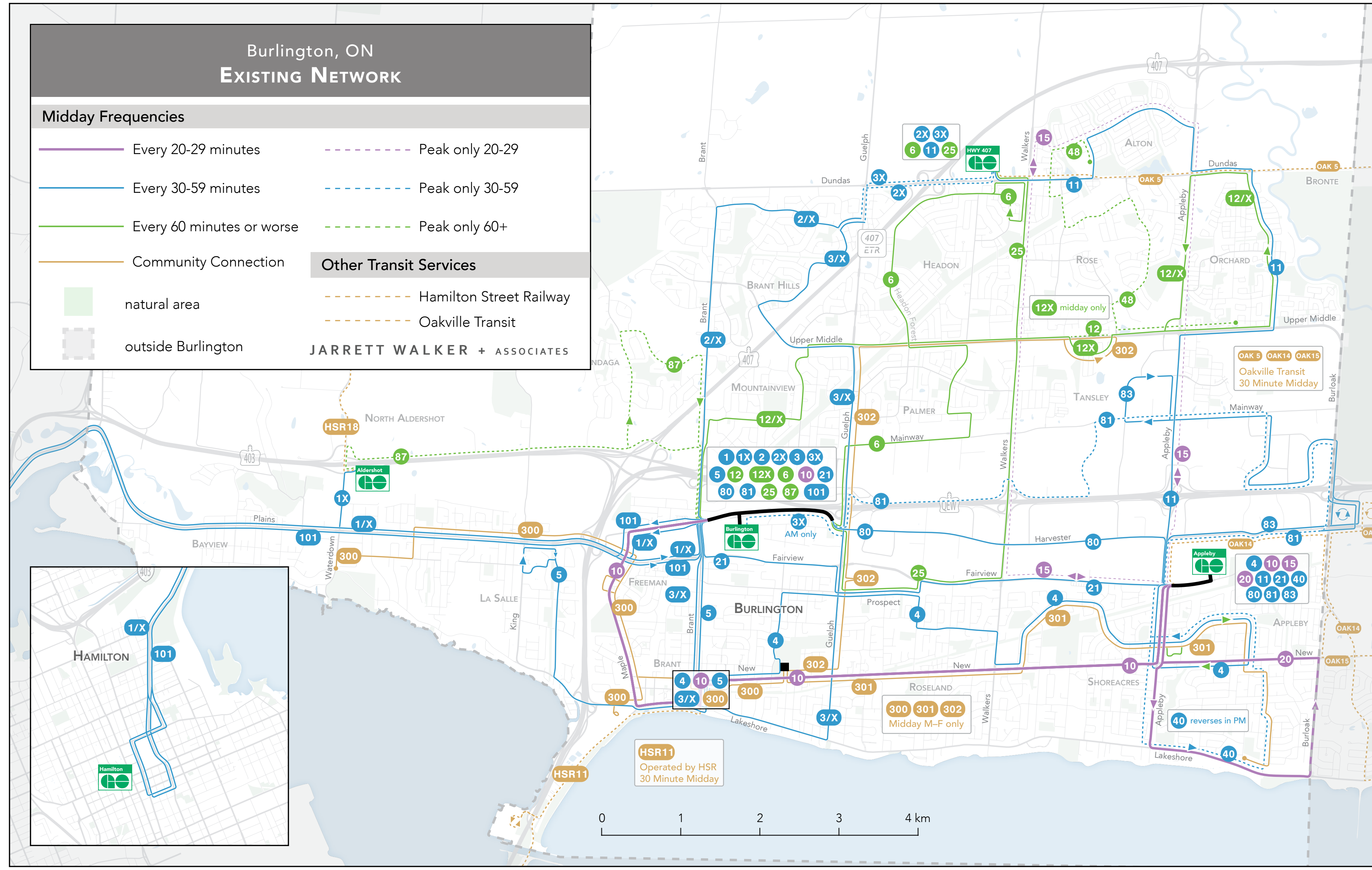


Figure 1: Existing Burlington Transit Network

Planning and the Public Conversation

The Integrated Transit Mobility Plan will design the future transit network for Burlington Transit. This plan will include:

- A redesigned bus network that can be implemented in 2018 or 2019.
- Recommendations for additional service in the future when 15-minute GO Train service arrives and as additional funding is available.

The first step in this plan is to describe the current state of the Burlington Transit's existing system, the existing conditions of the built environment in Burlington, and the trade-offs that will arise in planning the future transit network.

This report is the foundation for a conversation among the public, stakeholders and elected officials about how to make those choices.

Introduction and Executive Summary

Goals of Transit

Transit can serve many different goals. But different people and communities value these goals differently. And it's not usually possible to serve all of them well all the time.

Understanding which goals matter most in Burlington is a key step in developing the Integrated Transit Mobility Plan.

Possible goals for transit include:

- **Economic**: transit can give businesses access to more workers, and workers access to more jobs. Transit can also help attract certain industries, new residents, tourists, or other economic contributors.
- **Environmental**: increased transit use can reduce air pollution and greenhouse gas emissions. Transit can also support more compact development and help conserve land.
- **Social**: transit can help meet the needs of people who are in various situations of disadvantage, providing lifeline access to services and jobs.
- **Health**: transit can be a tool to support physical activity by walking. This is partly because most riders walk to their bus stop, but also because transit riders will tend to walk more in between their transit trips.
- **Personal Liberty**: By providing people the ability to reach more places than they otherwise would, a transit system can be a tool for personal liberty, empowering people to make choices and fulfill their individual goals.

Some of these purposes are served only when transit has high ridership. For example, the environmental benefits of transit only arise from many people riding the bus rather than driving, taking a taxi, or otherwise getting a ride in a private vehicle. And subsidy per rider is lower when ridership is maximized. We call these ridership goals.

Other purposes are served by the mere presence of transit. A bus route through a neighborhood provides residents insurance against isolation, even if the route is infrequent, not very useful, and few people ride it each day. Or that same route helps fulfill a political equity need; the desire to provide some service to all political wards within a city or town. We call these coverage goals.

If Burlington Transit wanted to maximize ridership, it would focus its service only on routes useful to many potential riders. Burlington Transit would be thinking like a business and targeting a market where its service is competitive.

Businesses are under no obligation to operate where they would spend a lot of money to reach few customers.

For example, Tim Hortons is under no obligation to provide a restaurant within 400 meters of everyone in Ontario. If it were, then the company would have to add hundreds of additional locations, some serving just one home and most operating at a loss because of the limited number of customers that each location served. The company would quickly go bankrupt.

People understand that suburban and rural areas have fewer Tim Hortons locations than urban areas. And in rural and suburban areas they may have to drive farther to reach a Tim Hortons because the company is only going to locate in places with enough likely customers to support a profitable business.

We don't describe this as Tim Hortons being unfair to rural or suburban areas; they are just acting like a business. It has no coverage obligation, only a goal of maximizing profit.

Transit agencies are often accused of failing to maximize ridership, as if that were their only goal. But as public agencies, they are intentionally providing coverage services that they know will not generate much ridership.

The elected officials who ultimately make public transit decisions hear their constituents say things like "We pay taxes too" and "If you cut this bus line, we will be stranded" and they decide that coverage, even in low-ridership places, is an important transit outcome.

Figure 2: Is an empty bus failing? That depends entirely on why you are running it in the first place.

Ridership and Coverage Goals are in Conflict

Ridership and coverage goals conflict. Within a fixed budget, if a transit agency wants to do more of one, it must do less of the other.

Consider the fictional town in Figure 3. The little dots indicate dwellings and commercial buildings and other land uses. The lines indicate roads. As in many towns, most activity is concentrated around a few roads.

A transit agency pursuing only ridership would run all its service on the main streets, since many people are nearby, and buses can run direct routes. A high ridership network is built around frequent service following favorable urban development patterns, forming a connected network, or what we call the Ridership Recipe, discussed further on page 11. This would result in a network like the one at bottom-left.

If the transit agency were pursuing only coverage, it would spread out so that every street had some service, as in the network at bottom-right. All routes would then be infrequent, even on the main roads.

These two scenarios require the same number of buses and cost the same amount to operate, but deliver very different outcomes. To run buses at higher frequency on the main roads, neighborhood streets will receive less coverage, and vice versa.

An agency can pursue ridership and provide coverage within the same budget, but not with the same dollar. The more it does of one, the less it does of the other.

These illustrations also show a relationship between coverage and complexity. Networks offering high levels of coverage – a bus running down every street – are naturally more complex.

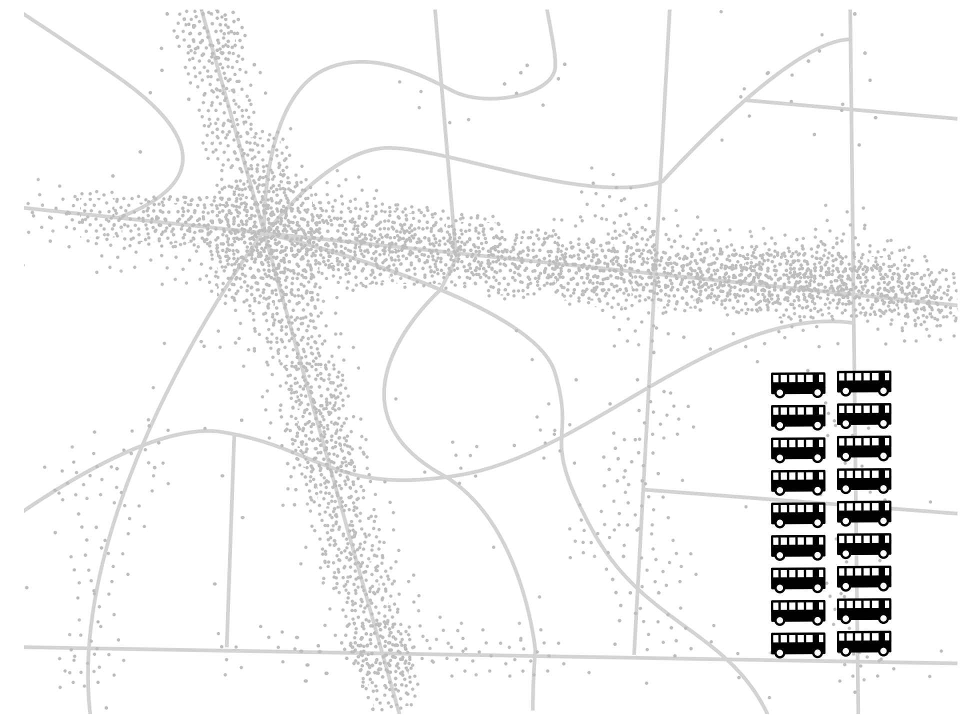
The choice between maximizing ridership and maximizing coverage is not binary. All transit agencies spend some portion of their budget pursuing each type of goal. A particularly clear way for transit agencies to set a policy balancing ridership and coverage goals is to decide what percentage of their service budget should be spent in pursuit of each.

The "right" balance of ridership and coverage goals is different in different communities. It can also change over time as the values and ambitions of a community change.

The choice to develop more intensely, to shift away from auto focused transportation, and the coming increase in GO Train frequency all combine to provide a key opportunity to rethink how Burlington Transit balances its transit goals.

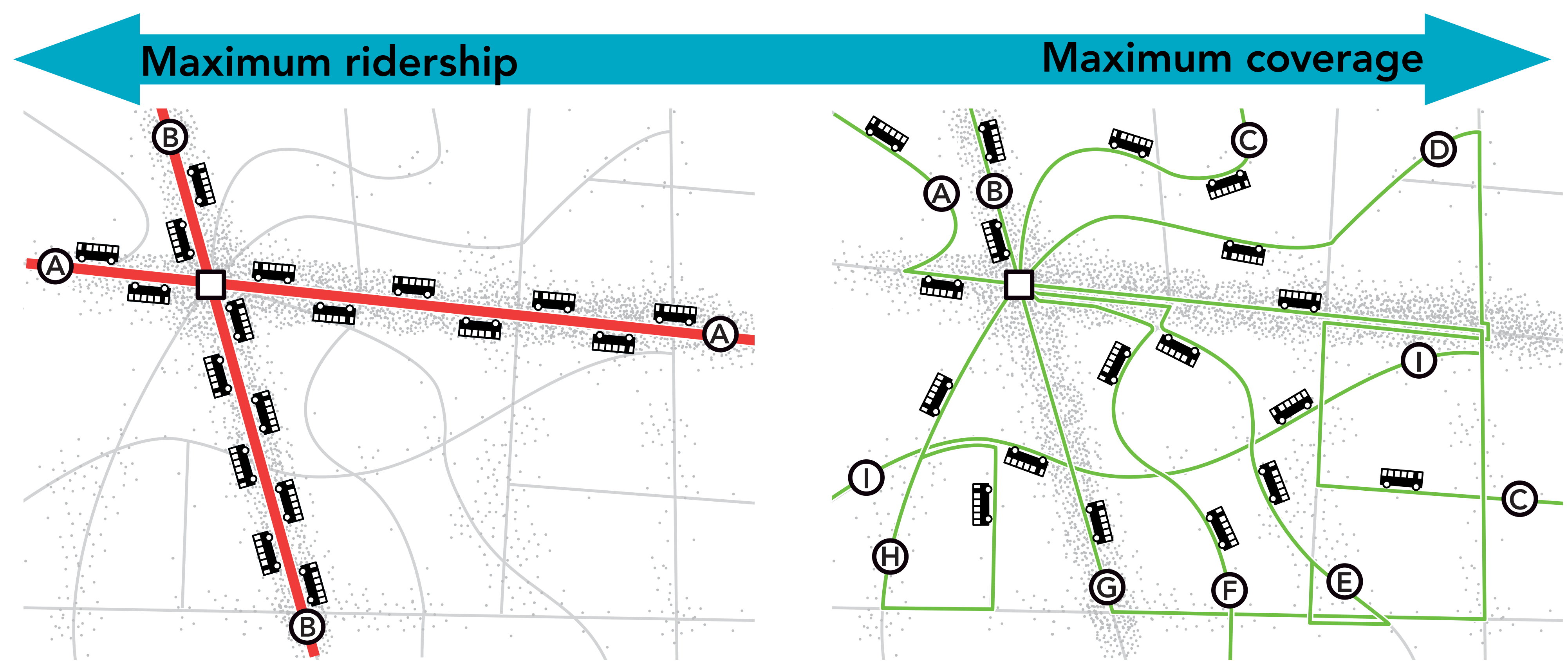
Figure 3: Fictional Ridership/Coverage Town

In this imaginary town, you have 18 buses to use to run transit routes. How will you distribute your service?



If you concentrate service in the busiest areas, your routes are very frequent, so waits are short. But people in less-populated areas have a much longer walk to service. You are maximizing total ridership, but some places have no service.

If you make sure every area is covered, everyone will have a bus stop nearby. But all routes are infrequent, requiring long waits, so very few people find them useful. Everyone has access to minimal service, but total ridership is low.



Introduction and Executive Summary

Key choices for the future of Burlington Transit

At the end of this report, we present three key choices that the public, stakeholders and elected officials may want to make as part of this transit plan. These choices are suggested by the existing conditions and performance of transit and land use in Burlington.

Balancing ridership and coverage goals

In every public transit system, a basic trade-off must be made between doing things that increase ridership (such as concentrating service into more frequent routes) and doing things that increase geographic coverage.

How should Burlington Transit balance ridership and coverage goals in its network? Is the current balance (which derives from the historical tweaks and changes to the network over the years) the right one, or should the balance be shifted? Within a fixed budget, a shift towards higher frequencies and higher ridership would require cutting coverage, and vice versa.

Peak vs. all day

Today, Burlington Transit operates some routes only during rush hours, and also offers higher frequencies during rush hours on all-day routes.

Rush-hour-only routes are sometimes designed to target the highest demand time of the day. Yet, as we discuss in this report, peak-only routes are often less productive than all-day routes and peak hour productivity is not much higher than productivity at other times of the day. Providing peak only service has costs over and above the typical cost of all day service. Thus, it is reasonable to assess if Burlington Transit should rebalance its service between all day and peak only.

Is our current level of service enough?

Burlington currently invests less in service per capita than many of its peers, and receives proportionally low ridership per capita as a result (as shown in Figures 4 and 5). Ridership and productivity have also declined since 2012.

While it is certainly possible to increase transit ridership without raising more money, doing so requires cutting low-ridership coverage services.

If Burlington does decide to shift resources from coverage services to higher-ridership services, there may still be an appetite in the city for higher levels of service overall. Given the city's plans for intensification and its stated desire to increase the share of trips using transit, a reassessment of the total amount of service provided is essential.

Many other Ontario cities invest heavily in transit and reap the benefits of having high ridership. There is nothing in Burlington's history, weather, economy or even sprawling development pattern to prevent it from enjoying a high-ridership, high-quality transit system that is central and powerful in the life of the city. The major hurdles between the existing system and that potential future are a set of easy-to-understand but difficult-to-make political choices, and a higher level of investment.

Chapter Summaries

Chapter 2: Transit Markets and Needs

The next chapter of this report is an assessment of the markets for transit in Burlington, or the potential for high ridership in Burlington, and the needs for transit in Burlington. The way of thinking about ridership described in Chapter 2 is similar to the way a private business thinks about its market for sales – how many potential riders are there, how useful will they find the service, and how well does the service compete for their ridership.

In this report, we refer to transit services that are not operated with the goal of high ridership as having a coverage goal. Coverage goals reflect concerns about equity, and they also reflect social-service objectives, such as meeting the needs of people who are especially reliant on transit, whether due to age, disability, poverty or some other condition.

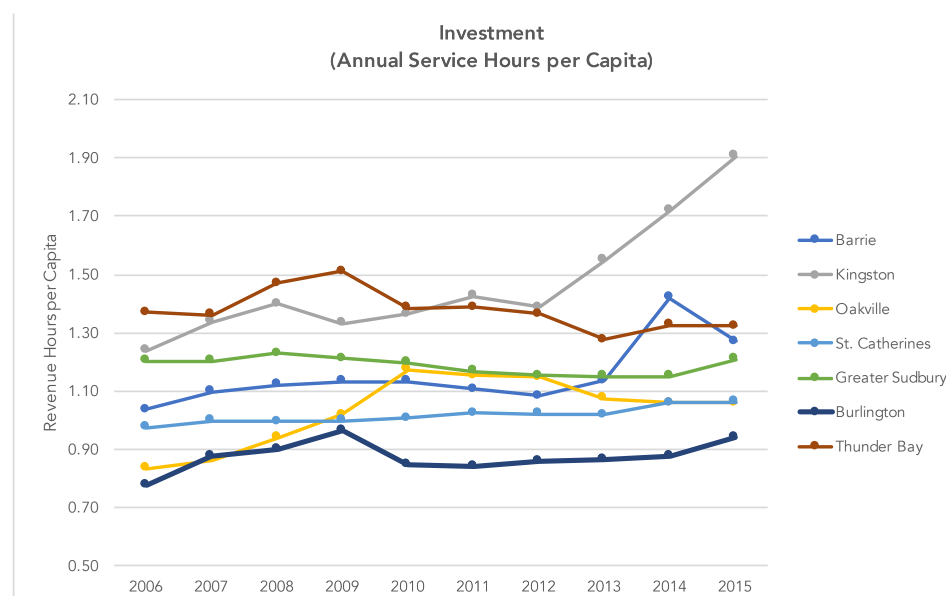


Figure 4: Graph of Investment per Capita Among Peer Cities (2006-2015)

Chapter 3: Recent Trends

In Chapter 3, we summarize the recent history of Burlington Transit and its performance.

Chapter 4: Transit Service Analysis

Chapter 4 presents an analysis of the fixed route transit network performance including comparisons to networks in peer cities, individual route-level performance, and key features of the network.

Chapter 5: Financial Analysis

Chapter 5 presents some insights about the financial conditions of Burlington Transit based on a review of current financial conditions and a comparison to peers.

Chapter 6: Key choices for the future

Chapter 6 summarizes a few key choices that Burlington may want to make as part of this Transit Mobility Plan. These choices will be part of public and stakeholder conversation over the next few months.

Chapter 7: Conceptual Alternatives

The final chapter of this report describes Conceptual Alternatives that clarify how the Burlington Transit network might look at extreme ends of the ridership-coverage spectrum. These concepts will be a key part of the stakeholder and public conversation over the next few months.

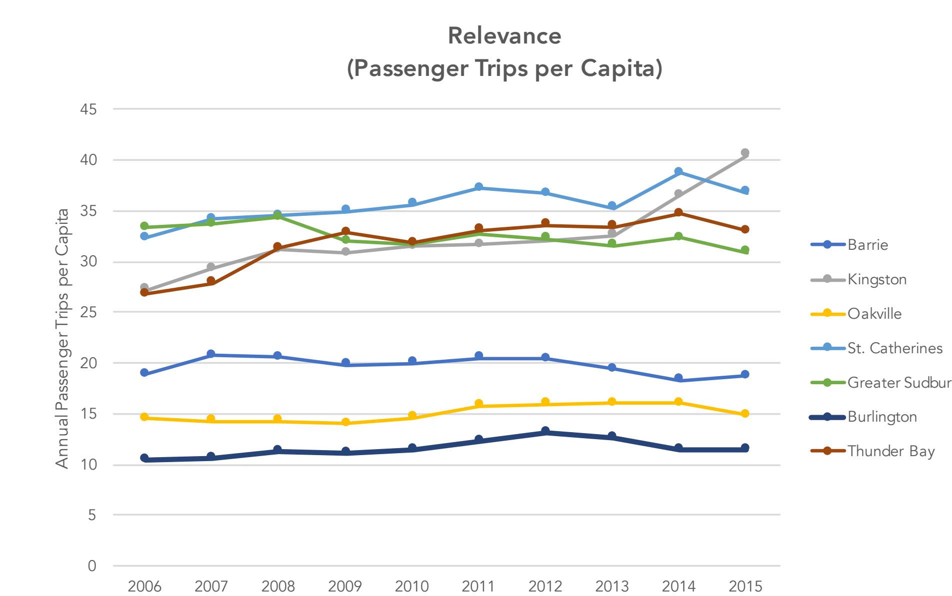


Figure 5: Graph of Trips Per Capita Among Peer Cities (2006-2015)

2 Transit Markets and Needs

Transit Markets and Needs

Development Patterns Affect Ridership

Attracting riders requires more than clean, courteous, comfortable or even frequent service. Many factors outside the control of Burlington Transit – land use, development, urban design, street networks – strongly affect transit's usefulness.

A good way to visualize how these factors impact ridership and costs is to ask: "How far does a bus need to go to serve 100 people or jobs?" The farther you have to go, the more expensive it is to provide service.

If a transit network is designed for high ridership, it will focus on places where ridership potential is high and cost is low, following the elements of what we call the Ridership Recipe:

- **Density**: How many people, jobs and activities are near each bus stop?
- **Walkability**: How many people can actually walk to the bus stop?
- **Linearity**: How far off a direct path does the bus travel to reach important destinations?
- **Proximity**: Does the bus traverse long, empty gaps to reach people and jobs?

These are geometric facts of the city and its design. Some people react strongly to the term "density" and infer moral or normative values that must come with it. Yet density describes a simple geometric and geographic fact that matters enormously for transit: the number of people close to any given transit stop.

All of these factors affect both the costs of providing transit in a particular place and how many people will find the service useful. Density and walkability tell us about the overall ridership potential: *"Are there are a lot of people around, and can they get to the transit stop?"*

Linearity and proximity tell us about both ridership potential and cost: *"Are we going to be able to serve the market with fast, direct lines, or will we have to run indirect or long routes, which cost more to operate (and cost riders time)?"*

A transit provider can influence the level of ridership their services generate, within their fixed budget, by targeting corridors and places where the "Ridership Recipe" is in effect. However, they cannot directly control the urban form of the places they serve.

The transit agency can try to provide a level of transit service that is as useful as possible, but the built environment has the power to limit transit ridership regardless of service.

Four Geographic Indicators of High Ridership Potential

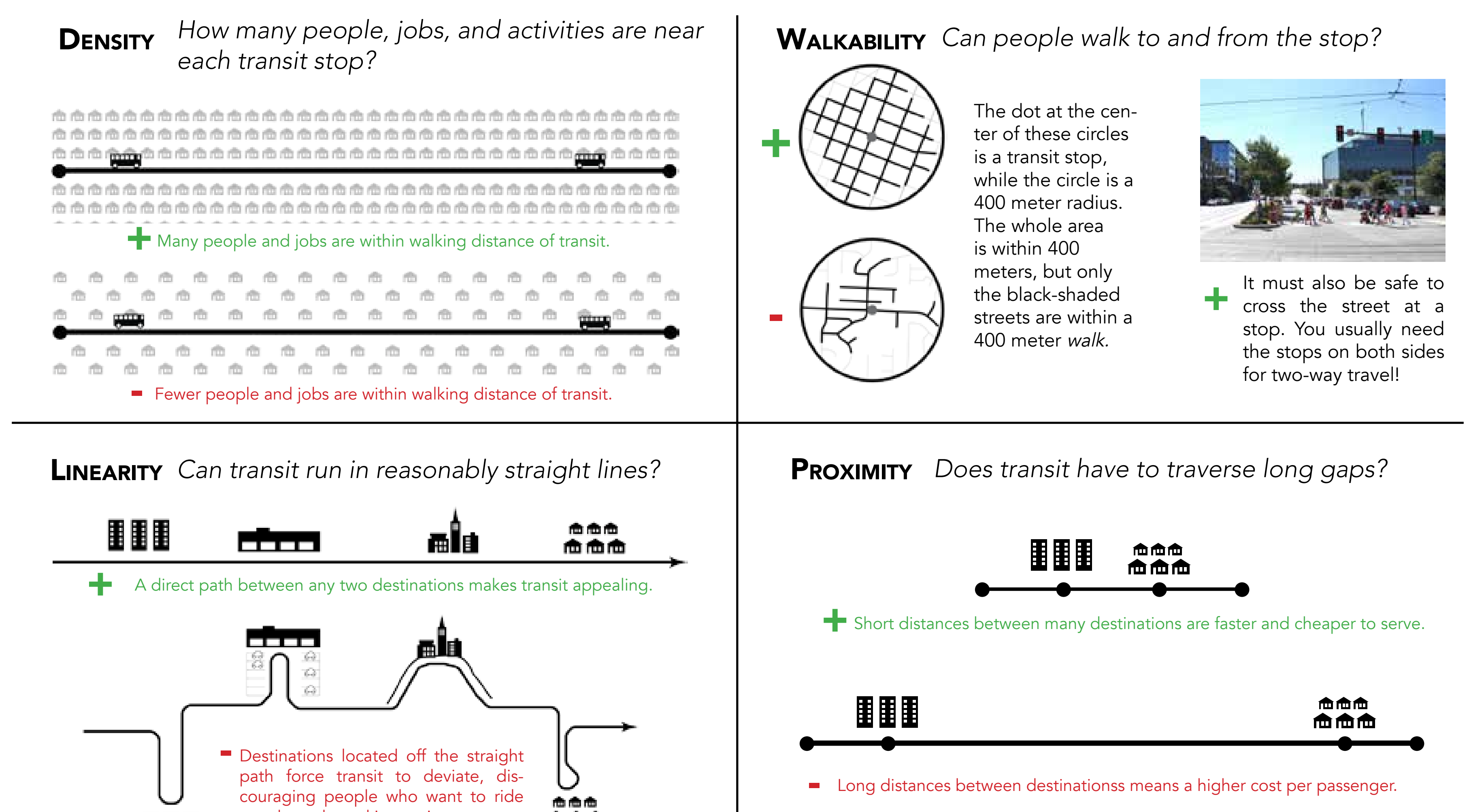


Figure 6: Illustration of the Ridership Recipe

In the short term, Burlington Transit could improve ridership by targeting service in areas where the Ridership Recipe is already in effect. In the long term, significant ridership gains could come from intensification of land use, improvements in the walkability of streets and redevelopment of suburban strip malls as recommended in the Strategic Plan.

In the following pages, we look at the data that illuminates potential markets and needs for transit in Burlington. We use these terms - "market" and "need" to describe opportunities to meet transit's competing goals of ridership and coverage.

Measures of Market

The market for local transit service is closely related to residential and job density. The more people live and work in an area, the more likely it is that a transit service to that area will achieve high ridership. However, as described above, density alone is not enough to deliver the Ridership Recipe for transit.

Measures of Need

Certain higher need populations are more likely to benefit from any nearby transit service. These include senior citizens, children under 18, and persons with limited incomes. Not everyone in these categories is a potential transit user, but concentrations of these groups usually indicate areas with higher needs.

Transit Markets and Needs

Density

The maps on this page and the following page show the densities of residents and jobs in Burlington.

In planning, people sometimes react strongly to the word "density" based on their emotional and cultural experiences. Yet density describes a simple geometric and geographic fact that matters enormously for transit: the number of people close to any given transit stop.

Residential density

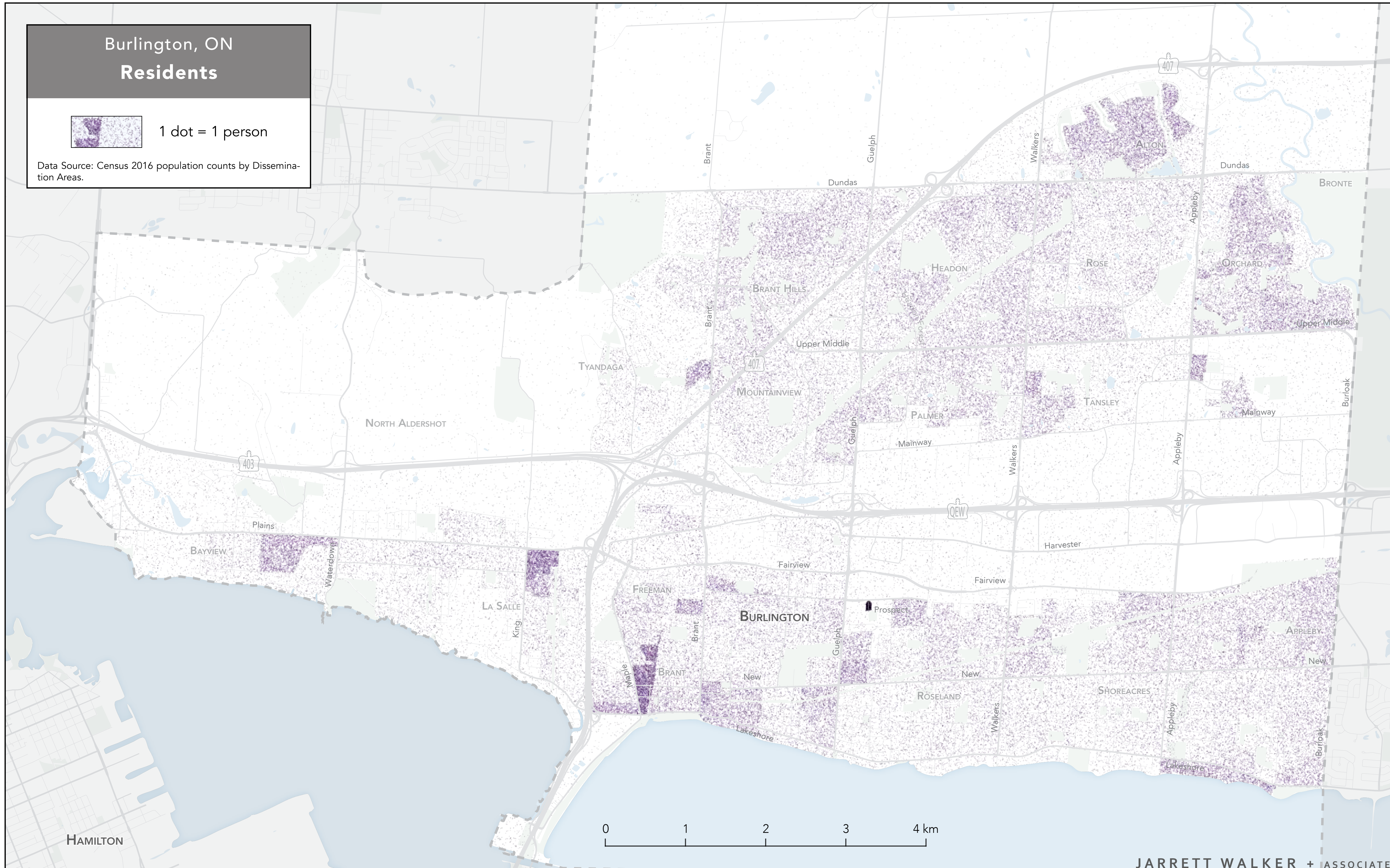
Residential density is the simplest measure of public transport's ridership potential. While not all trips start or end at home, nearly everybody makes at least one trip starting or ending at their place of residence every day.

The map to the right shows the estimated residential density for Burlington. In general, residential density tends to be higher in the southern part of Burlington, particularly south of Fairview Street and Plains Road.

A key challenge apparent from this map is that the highest density areas north of the QEW are in the most distant parts of the city, the Orchard and Alton Village neighbourhoods.

Also, the density of these neighbourhoods is focused inward, away from the main grid streets of the city. These two issues create a problem of linearity and proximity that complicates the creation of high ridership transit in the northern parts of Burlington.

Figure 7: Residential Density



Transit Markets and Needs

Employment density

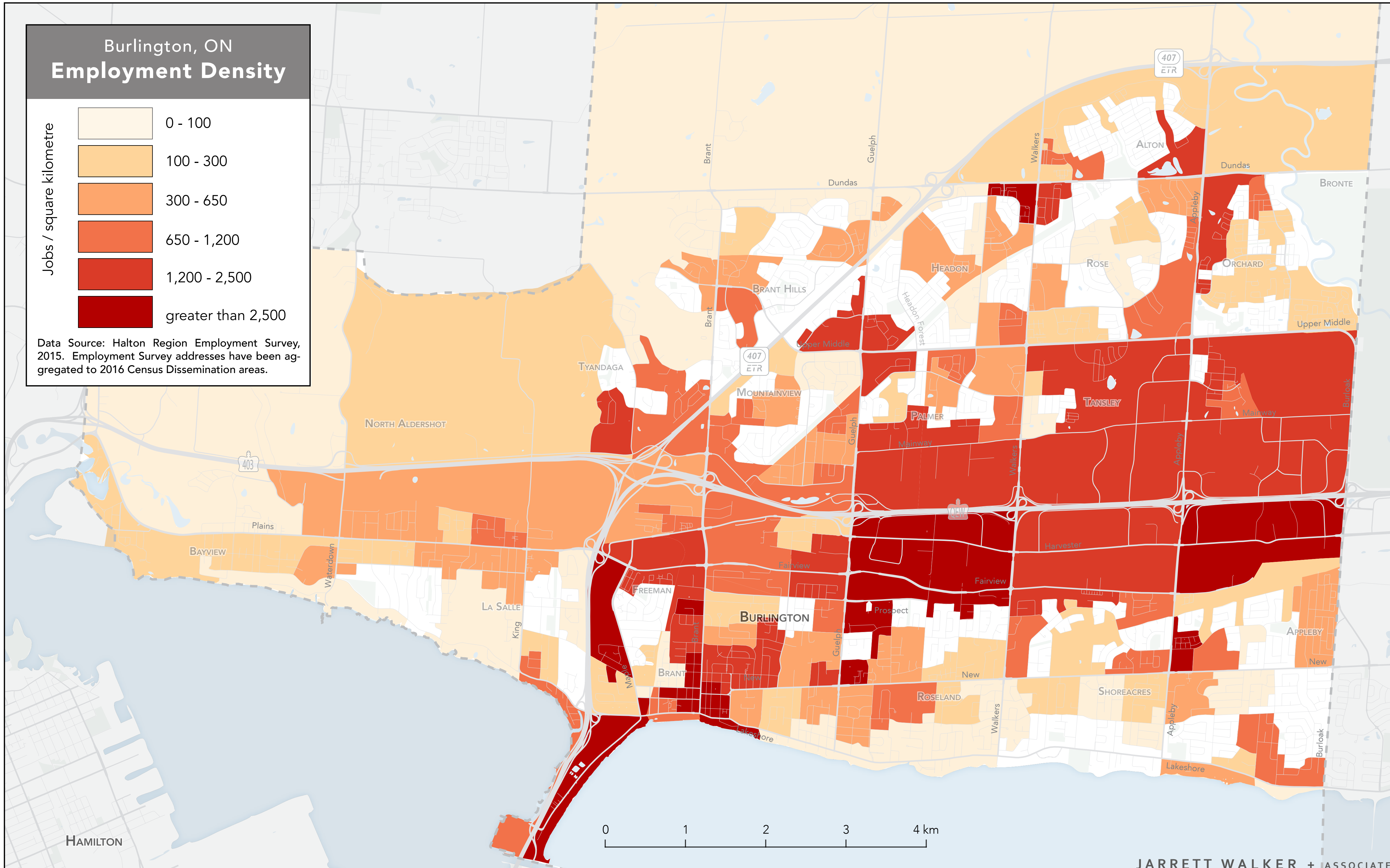
Employment density is an even better predictor of transit ridership than residential density. This is because it represents places people travel for work, but also places people go for services, shopping, culture, health care, and more. A person's workplace may be, throughout the day, a destination for dozens or even hundreds of people.

The map to the right shows the employment density for Burlington. Employment density is high in the traditional downtown core of Burlington and to the southeast of downtown, around the hospital.

Employment density is also high in a large swath of the city along the QEW, east of Guelph Line, between Fairview and Mainway.

A key limitation of employment density, however, is that we cannot differentiate between different types of employment. Trip patterns are very different for industrial and warehousing employment than they are for retail or health care. For retail or health care employment, many visitors are coming to the shops and offices which drives a high demand for all day transit service. For warehousing or industrial employment areas, there are far fewer non-work trips.

Figure 8: Employment Density



Activity density
Residential and job densities are combined into Activity Density in the map at right. This allows us to see how the total density of activities, the mix of uses, their proximity and their linearity could affect transit ridership across Burlington.

On this map, purple represents residential density and tan represents job density. Shades of dark purple and dark tan represent areas with a mix of uses, but the highest-density mixed use areas are shown in orange.

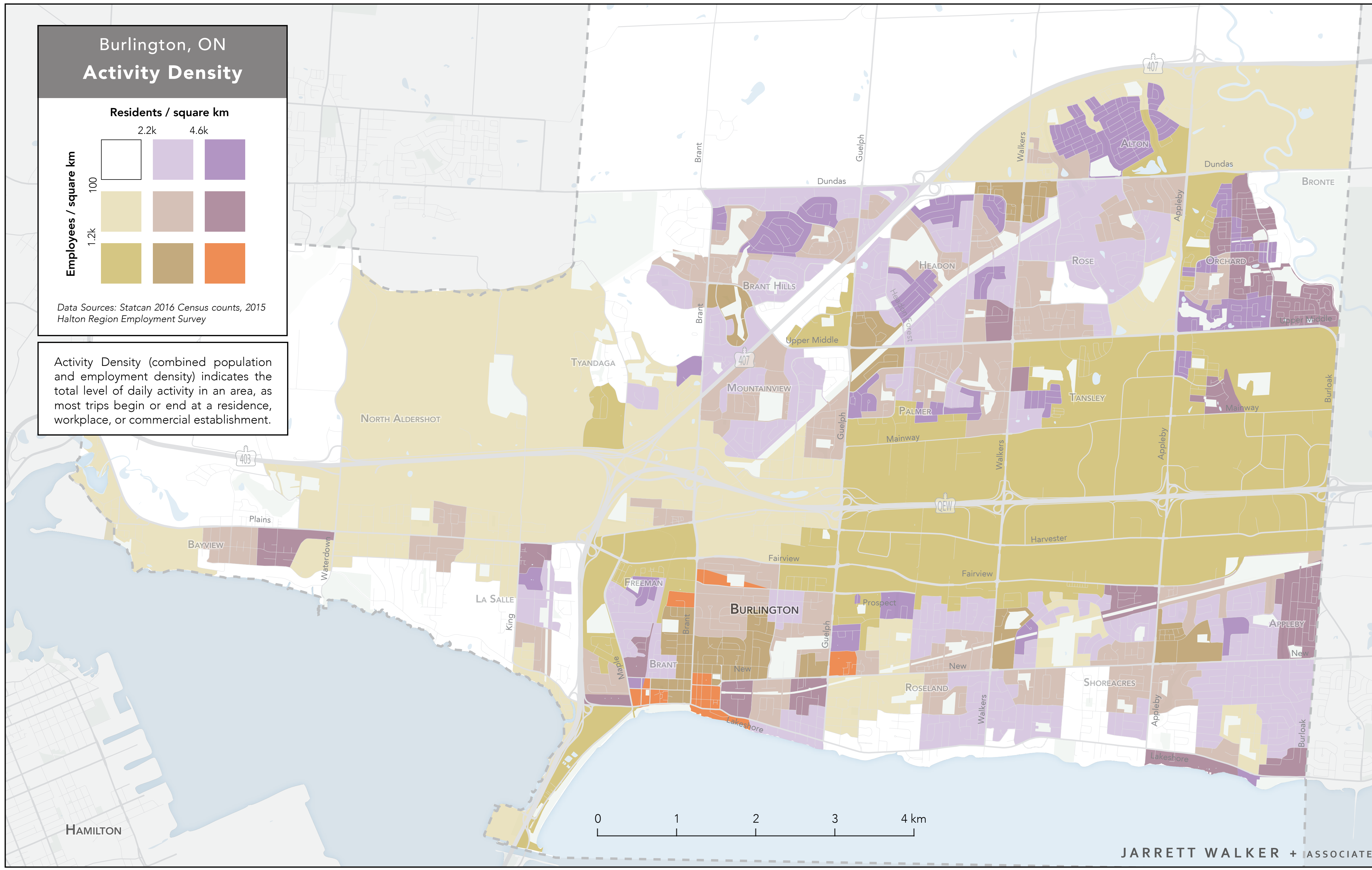
We can see that there are pockets of high activity density along Brant Street from Lakeshore to Fairview and along Maple from Lakeshore to Fairview.

There are also areas of higher density mixed uses along New Street, Plains Road East and Fairview Road. These three corridors stand out as the longest corridors with a mixture of uses across the city of Burlington.

Though it is not one of the four major factors named in the Ridership Recipe, the mix of residential and job density along a corridor affects how much ridership transit can achieve, relative to its cost.

This is because a mix of uses tends to generate demand for transit in both directions, at many times of day. Transit lines serving purely residential neighborhoods tend to be used in only one direction – away from the residential neighborhood, towards jobs and services.

Figure 9: Activity Density



Measures of Need

The maps on this page and the following pages show the densities of key populations with higher transit needs. These maps show the opposite of high demand areas. Instead they focus on groups that will generally have a higher need, but may not be very large in number overall.

Density of Seniors

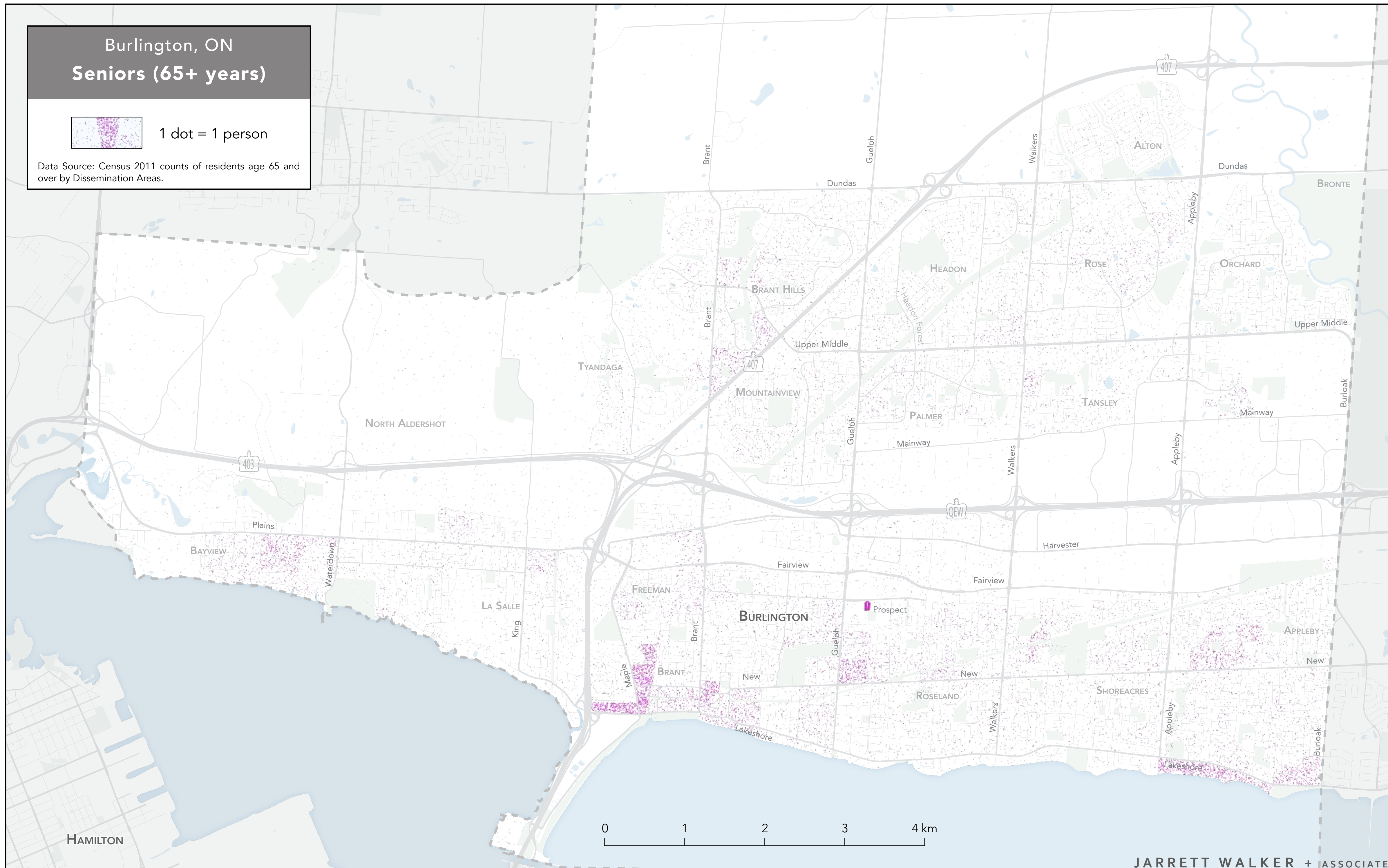
A major driver of transit coverage is the need for mobility among people who cannot drive. This need is particularly acute among seniors. The map at right shows the density of senior residents in Burlington.

Seniors' needs and preferences tend to be different from those of younger people. Seniors are more likely to be discouraged by long walks, because of limits on their physical ability, or concerns for their personal safety.

Seniors are much less likely to be discouraged by long waits for transit, because they are less likely to be employed. For the same reason, seniors are less likely to be discouraged by slow or indirect routes that take them out of their way.

Because of these factors, transit service designed primarily to meet the needs of seniors will struggle to attract other riders. Most riders that place higher value on their time will find service with long waits to be intolerable. Thus, the amount of focus that transit agencies place on meeting the needs of seniors should be carefully balanced with the needs and desires of the general population.

Figure 10: Density of Seniors



Transit Markets and Needs

Density of Youth
Just as transit coverage can meet the needs of seniors who cannot or choose not to drive, transit coverage can also meet the needs of children and teenagers who are too young to drive.

The map at right shows the density of residents under the age of 18 in Burlington.

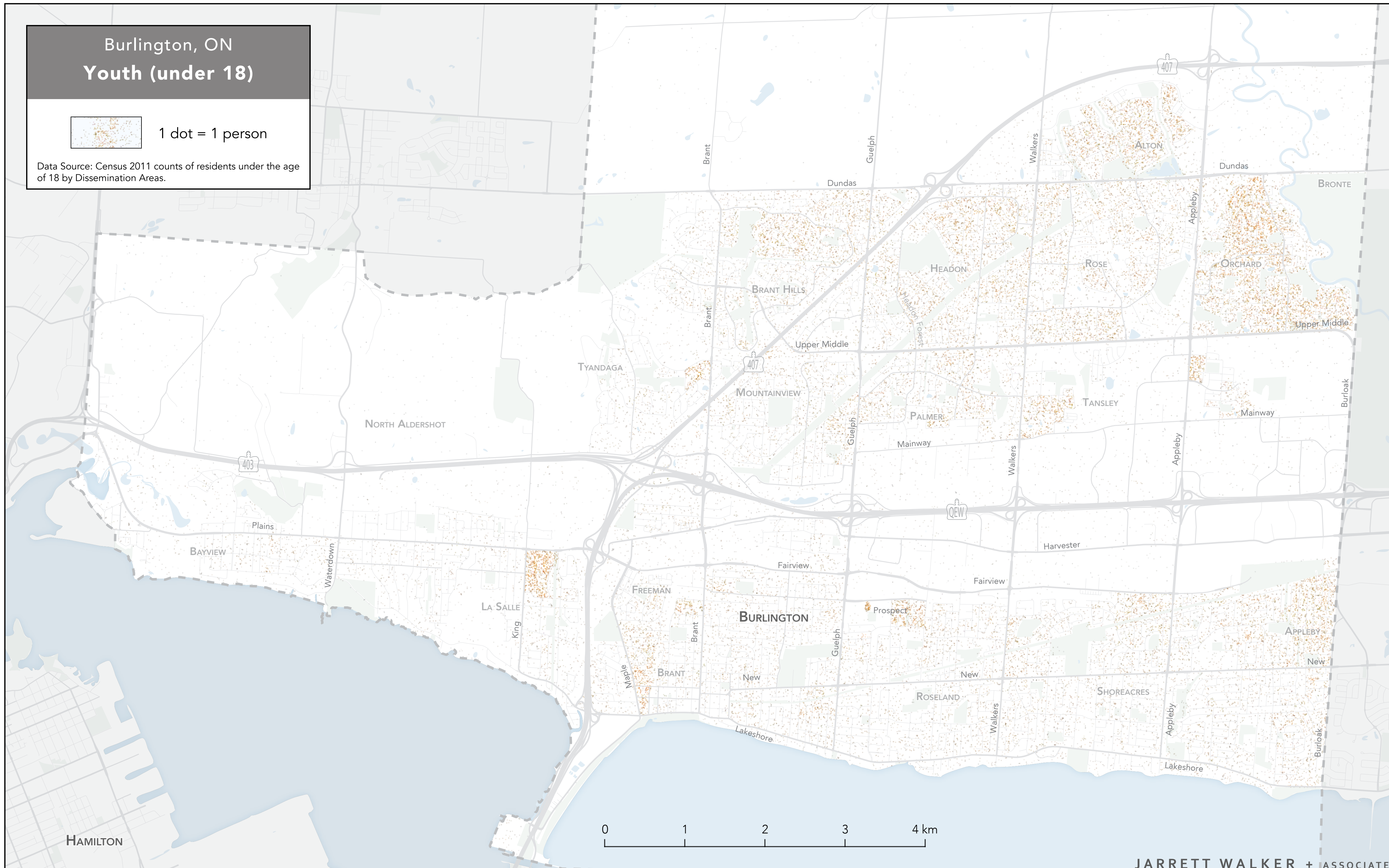
Youth are scattered all over the city, but there are clear concentrations near Plains and King, along Maple near Lakeshore, along Prospect near Burlington Mall, and in the Tansley neighborhood

Young people are like seniors in that they often live on a tighter budget than people of working age. For this reason, both are very sensitive to transit fares, and young people's parents are sensitive to paying a fare for each child.

However, young people and seniors are very different in their ability and willingness to walk to transit service. Most young people can and will walk farther to reach service than seniors.

Whatever effect an increase in price has on ridership among working age people, it will have an even stronger effect on ridership among young and old people. (This is why most transit agencies, along with movie theaters and other for-profit businesses, offer a discounted price for seniors and children.)

Figure 11: Density of Youth



Transit Markets and Needs

Residents with Limited Income

Transit is often tasked with providing affordable transportation for people on limited incomes. When this is done in the absence of high ridership, it represents a type of coverage goal.

The map to the right shows the density of people with limited incomes in Burlington. The areas that have the greatest concentration of people with limited incomes are generally close to downtown, along Plains Road or other main corridors to and from downtown. This makes it relatively easy to serve most limited income persons with transit service in a cost effective manner.

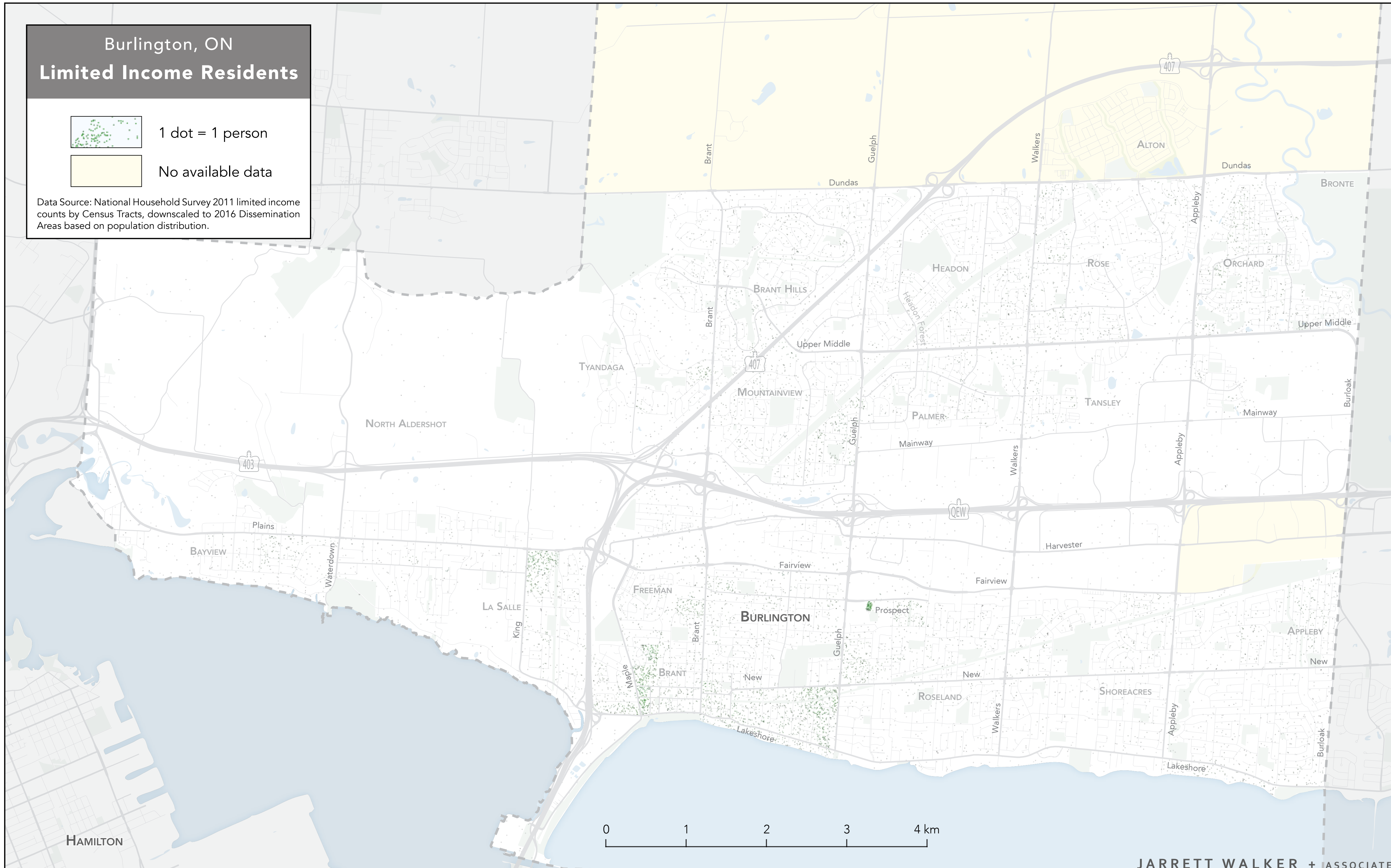
People who are living on limited incomes can represent either a strong market for transit or a need for coverage service (regardless of ridership), depending on the built environment around them.

A common misconception is that transit, especially all-day transit, is only useful to low income people who cannot afford a car. People at all points on the income spectrum make choices about how to travel, based on their evaluation of cost, time, safety, comfort and other factors.

People with fewer resources have an incentive to spend less on transportation. The more carefully a person must manage their money, the more attractive transit's value proposition may be.

This doesn't mean that lower-income people will automatically choose transit because it's the cheapest option. The service available to them must be useful and reliable for the kinds of trips they need to make. Nor does it mean that a person further up the income spectrum will not use the same transit services as low-income people, if they find those services sufficiently useful.

Figure 12: Density of Residents with Limited Incomes



Transit Markets and Needs

Access to a Vehicle
Not everybody has ready access to a personal automobile, and people who have less or no access will depend on other modes when they need to travel. This might include walking, cycling, getting a ride from a friend or family member, or, if it is reliable and available when they need to travel, transit.

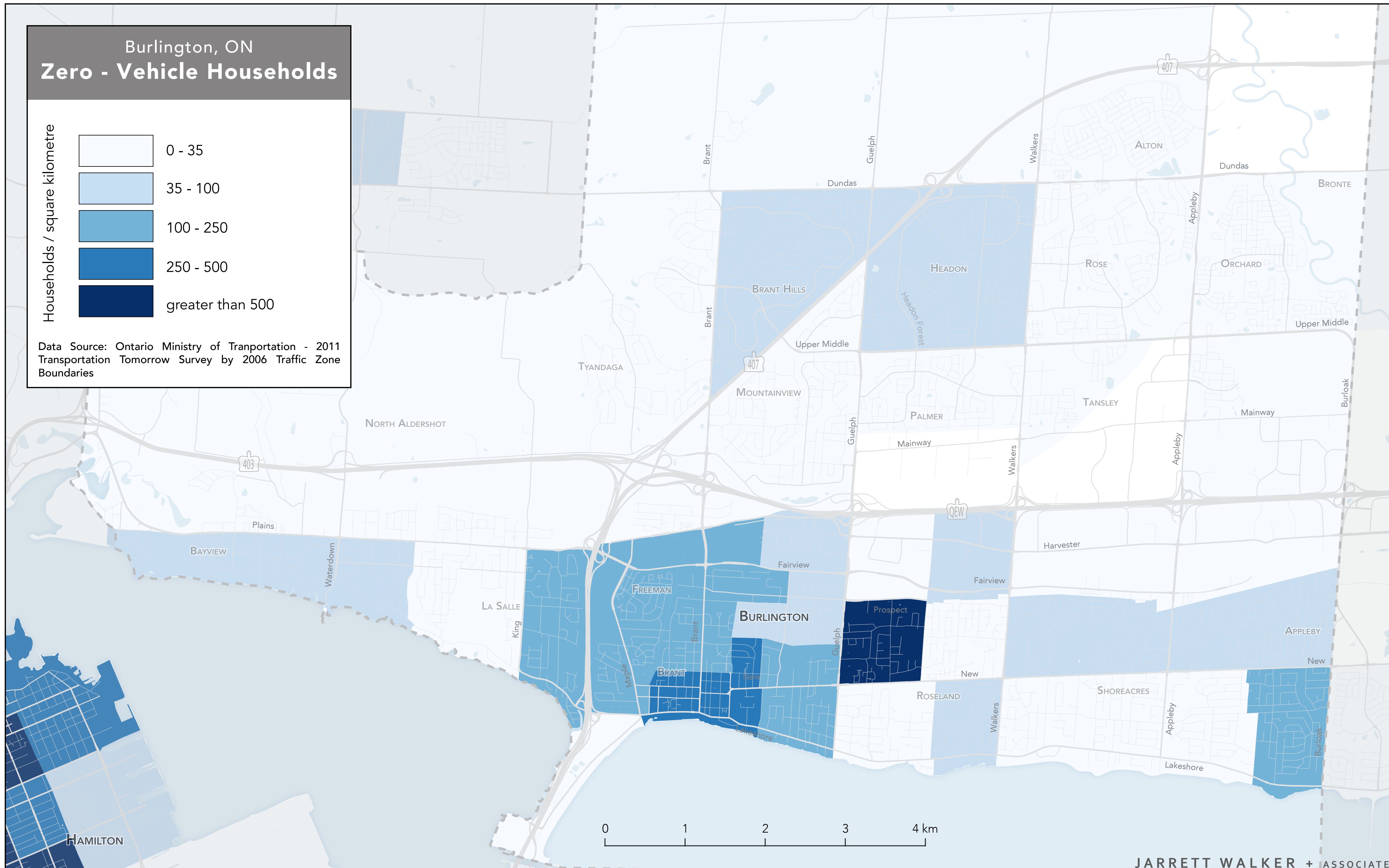
The map at right shows the number of households without any vehicles available in Burlington. Darker areas have more households without vehicles.

Most households without vehicles are in or near downtown with a large number in the area south of Prospect Street and east of Guelph Line. The large number of households without cars along Prospect is likely associated with the same pocket seen in the maps of Seniors, Limited Income, and Residential Density. This pocket of high need and high demand is likely to be a high ridership location.

Near Lakeshore and Burloak there is another pocket of households without vehicles. Comparing this map to the map of Seniors suggests that this pocket is likely a concentration of seniors in the towers along Lakeshore who do not have cars.

North of the QEW, there are few households without vehicles suggesting that the primary area of need for this population is south of the QEW.

Figure 13: Households without Vehicles



3 Recent Trends

Recent Trends

Service Levels, Ridership and Productivity

Ridership on Burlington Transit rose consistently from 2005 to 2012, but has declined consistently from 2012 to 2015.[1]

In 2012, Burlington made significant changes to its routes, adding Route 101, splitting Route 1, adding more weekend service but making cuts to many higher productivity routes and eliminating others. The general result of this change was to shift the system toward a more coverage oriented design.

The combination of a significant system changes in service in November 2013, combined with fare increases from 2009 to 2015 are major factors in declining ridership and declining productivity from 2012 to 2015.

Because so much of transit's operating cost relates to human labour, and humans are generally compensated based on their time, the bulk of transit operating cost arises from hours of service (rather than distance, or the size of vehicles, or other factors).

Thus "service hours" describes the sheer quantity of transit service provided, without consideration for how much it costs the agency to deliver each hour of service. The service hours required to operate any given route will increase if:

- route length increases,
- route frequency increases,
- or, span (hours of operation) of service increases.

The City of Burlington made investments in additional service hours consistently from 2005 to 2008. Service hours were flat from 2009 to 2012 and have increased slightly since 2012.

Productivity is a transit industry term for a type of service efficiency. If ridership is an outcome people care about, then ridership relative to cost describes how productive an agency is towards that outcome. The productivity ratio is:

Productivity = Ridership / Cost = Boardings or Trips / Service hour

Using the Canadian Urban Transit Association (CUTA) reports for 2005 to 2015 we can assess productivity over time. CUTA provides the number of passenger trips, not boardings. A boarding counts every time a person gets on a bus. If a person transfers from one bus to another to complete a trip, they would count as two boardings, but only one trip.

In 2005, an average of 12.5 people completed a trip on a Burlington Transit bus per service hour provided. In 2016, there were 12.2 trips per hour. Productivity peaked in 2012 at 15.2 trips per service hour.

Increasing transit fares is known to decrease ridership, even when service levels are held constant. The relationship is not perfectly consistent and a 10% increase in fare will not reduce ridership by 10%, but the relationship is well documented. Figure 17 shows the Burlington Transit cash fare per trip from 2006 to 2015. Over that time, the cash fare has increased by $1.00, or 40%, mostly from 2009 to 2015. This change alone would be expected to depress ridership.

1 All data in this analysis is from the Canadian Urban Transit Association (CUTA) Transit Fact Book reports for 2005 to 2015.

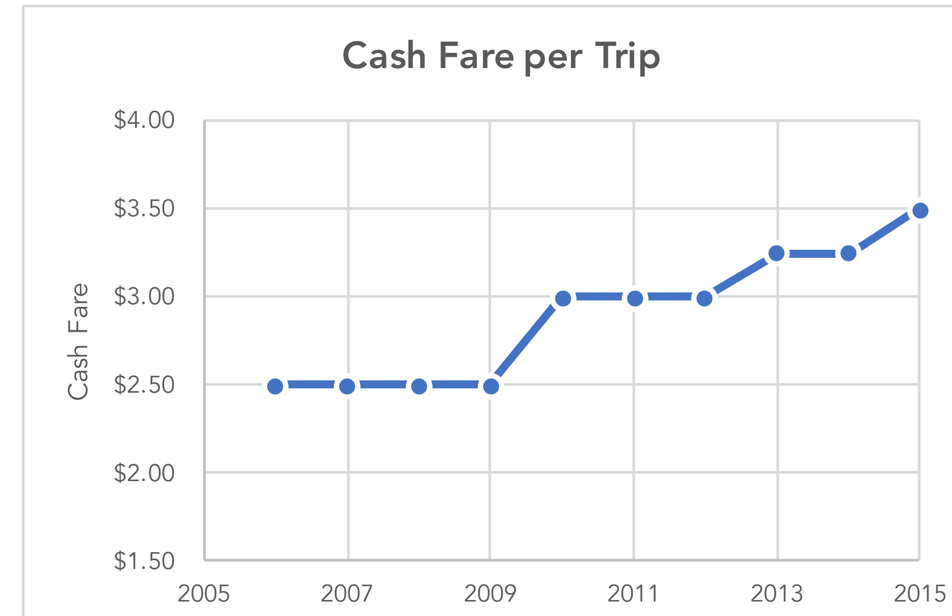


Figure 17: Graph of Cash Fare per Trip 2006-2015

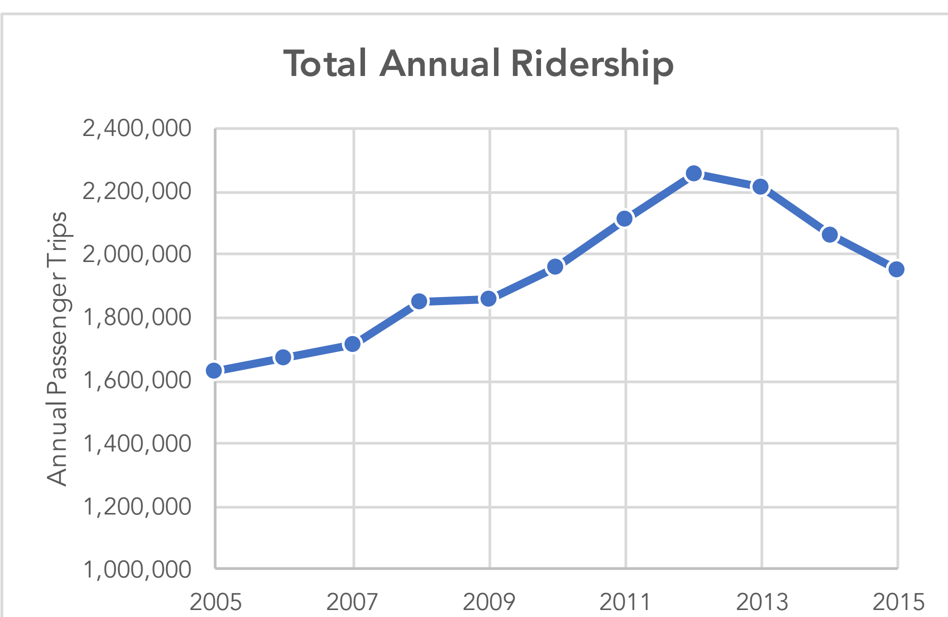


Figure 14: Graph of Total Annual Ridership 2005-2015

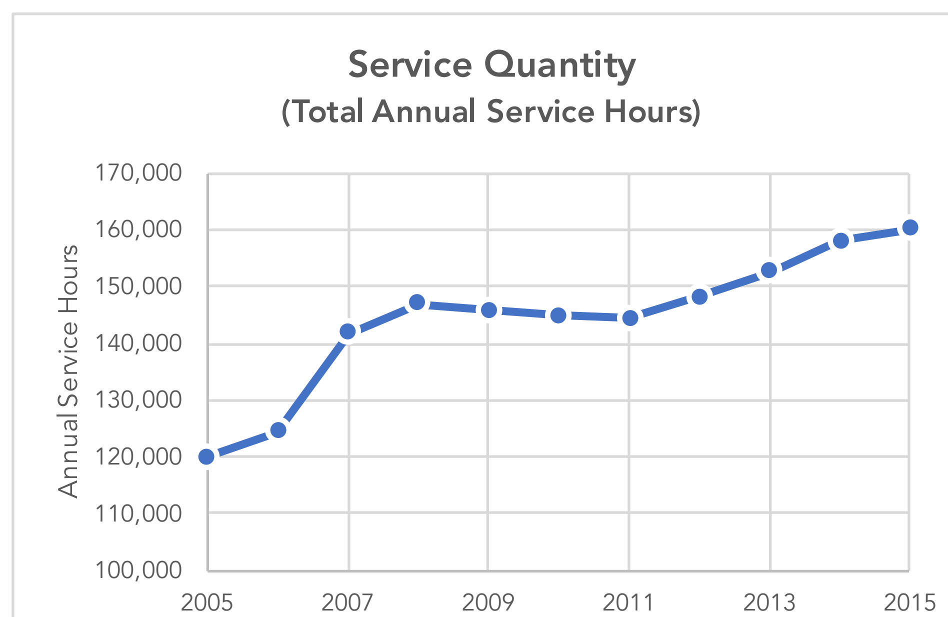


Figure 15: Graph of Total Annual Service Hours 2005-2015

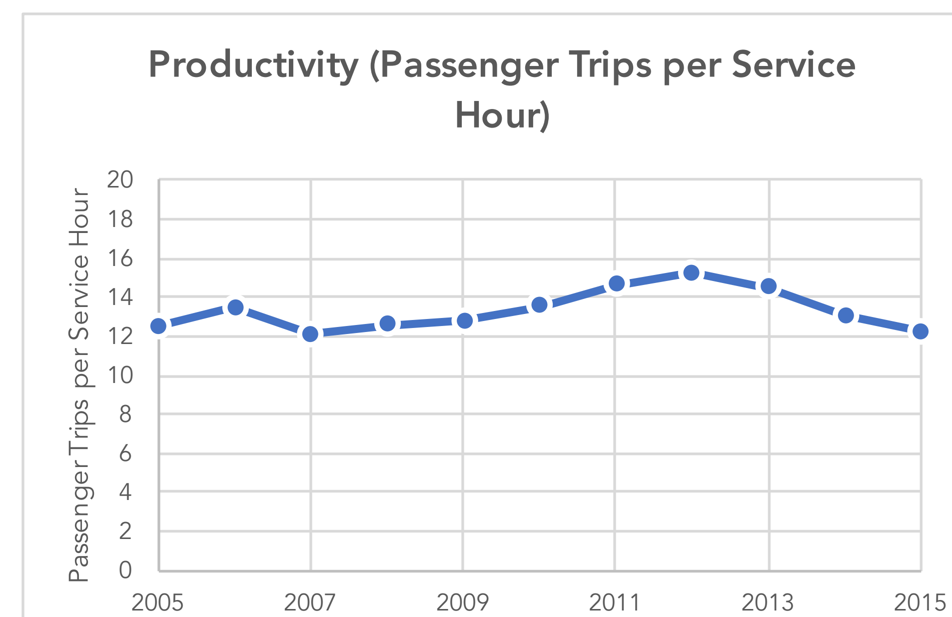


Figure 16: Graph of Annual Average Productivity 2005-2015

4 Transit Service Analysis

Transit Service Analysis

Peer Comparison

For performance of the entire network, and to aide in thinking about Burlington's particular transit choices, it helps to compare Burlington Transit to peers. Obviously, no place precisely replicates the economic, demographic, and geographic conditions of Burlington, so a group of peers provides a range rather than a prescriptive target.[1]

Also, these peer agencies may be making different choices on the spectrum between maximizing ridership and coverage. Each community has different values and therefore may be focusing their service on a different goal

The peers shown in the charts on this page and the next are all moderately sized cities in Ontario.

Investment and relevance

The pair of charts at right show how much a municipality invested in transit service (Figure 18) and how relevant transit was to the life of the community (Figure 19) in from 2006-2015. (2015 is the most recent fiscal year for which data is available.)

Burlington's level of investment in service, relative to its population, is lowest among these peers. The ridership its network attracts, relative to population, is the lowest among peers.

Direct comparisons to Oakville, the only peer in the Greater Toronto-Hamilton Area (GTHA), are particularly instructive. For the last six years, Oakville has invested about 20% more per capita than Burlington and has about 22% more trips per capita.

The City of Burlington Strategic Plan calls for the intensification of development in the city with a focus on key centers of activity like downtown and GO Stations. The City's Strategic Plan makes strong statements in support of increased transit service and more intense and transit-friendly development, including:

- "The city will shift a greater proportion of inbound and outbound traffic to public transportation."
- "Future development will be higher density, walkable and accessible, transit oriented with appealing streetscapes."
- "Growth is being achieved in mixed-use areas and along main roads with transit service, including mobility hubs, downtown and uptown."

Neighbouring Oakville does not have similar goals of land use intensification or increasing the mode share of transit, but it already invests more in transit. Given that Burlington has much stronger goals relative to intensifying land use and encouraging mode shift than its neighbour, the lower investment and relevance of transit in Burlington is stark. Burlington is aspiring to do better than its neighbour in terms of high-density, walkable and transit-supportive land use, but is well behind, by comparison, in the quantity of transit provided for existing development.

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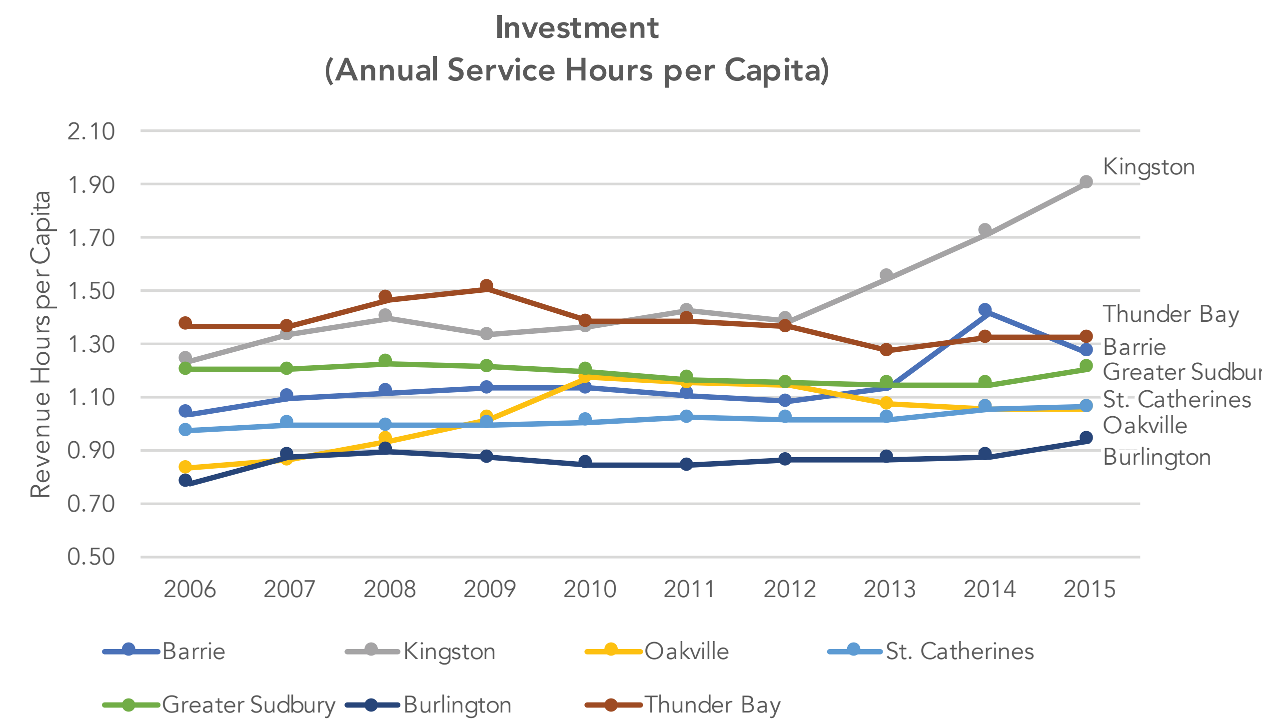


Figure 18: Graph of Investment per Capita Among Peer Cities (2006-2015)

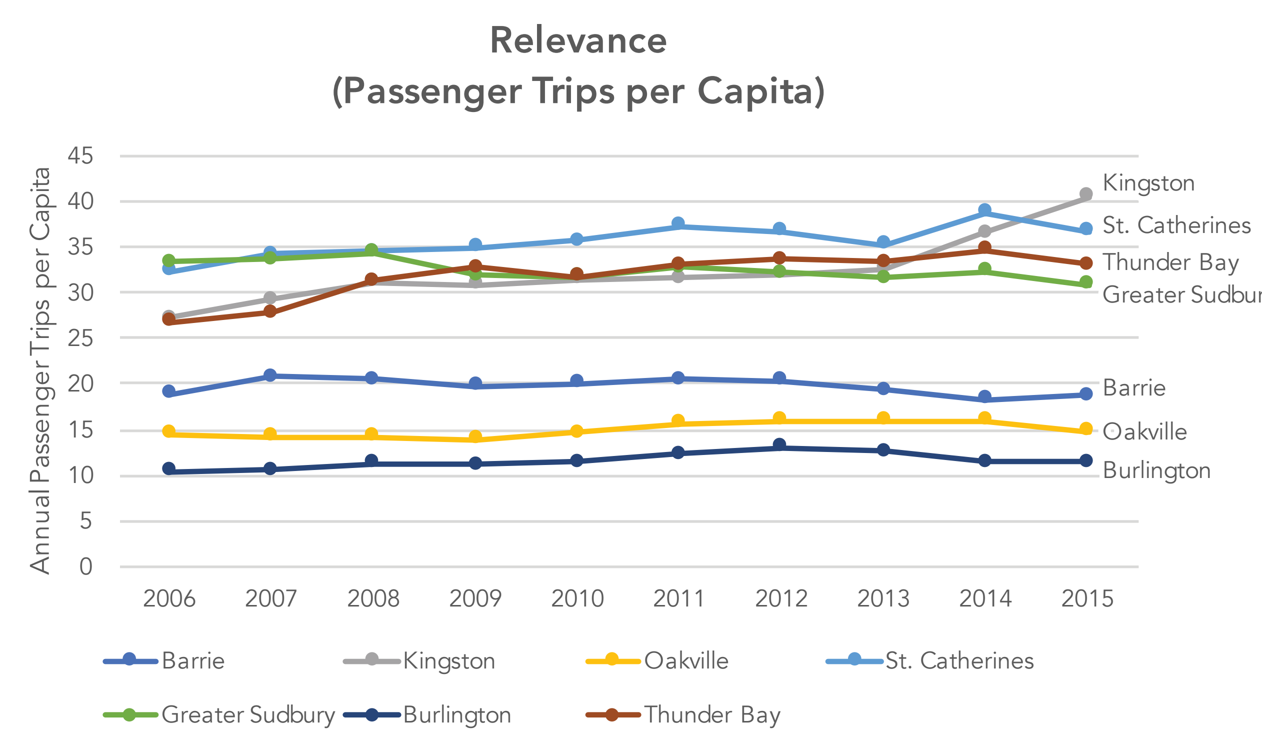


Figure 19: Graph of Trips Per Capita Among Peer Cities (2006-2015)

1 All data in this analysis is from the Canadian Urban Transit Association (CUTA) Transit Fact Book reports for 2005 to 2015 unless otherwise noted.

Transit Service Analysis

Productivity
The productivity of these peer systems (the ridership they achieve relative to cost) is compared in Figure 20.

Productivity is strictly a measure of achievement towards a ridership goal. Services that are designed for coverage goals will likely have low productivity. This does not mean that these services are failing or that the transit agency should cut them. It just means that the budget dedicated to those services is not being spent to maximize ridership.

As discussed on page 20, based on the CUTA data, there were on average 12.2 passenger trips per service hour in 2016. A boarding counts every time a person gets on a bus. If a person transfers from one bus to another to complete a trip, they would count as two boardings, but only one trip.

From 2005 to 2015, Burlington Transit has generally been the lowest in productivity among its peers. For a short time, from 2010 to 2013, the productivity of Burlington Transit was higher than in neighbouring Oakville. Of the remaining peers, only Thunder Bay has seen a significant increase in its productivity over the period of analysis. Most other peers have had a stable or declining productivity. Of particular note, however, is that to exceed the average of its peers, Burlington would need to nearly double its productivity.

Cost per unit of service
The graph in Figure 21 shows how much it cost each peer agency, in 2015, to operate each hour of service. Burlington has the second-lowest operating cost per service hour. This suggests that Burlington Transit has been doing a good job of keeping its operating costs low and would normally be a point of praise for the agency.

A closer inspection of Burlington Transit operations, however, suggests that this low operating cost per revenue hour may be the result of unsustainable operating practices.

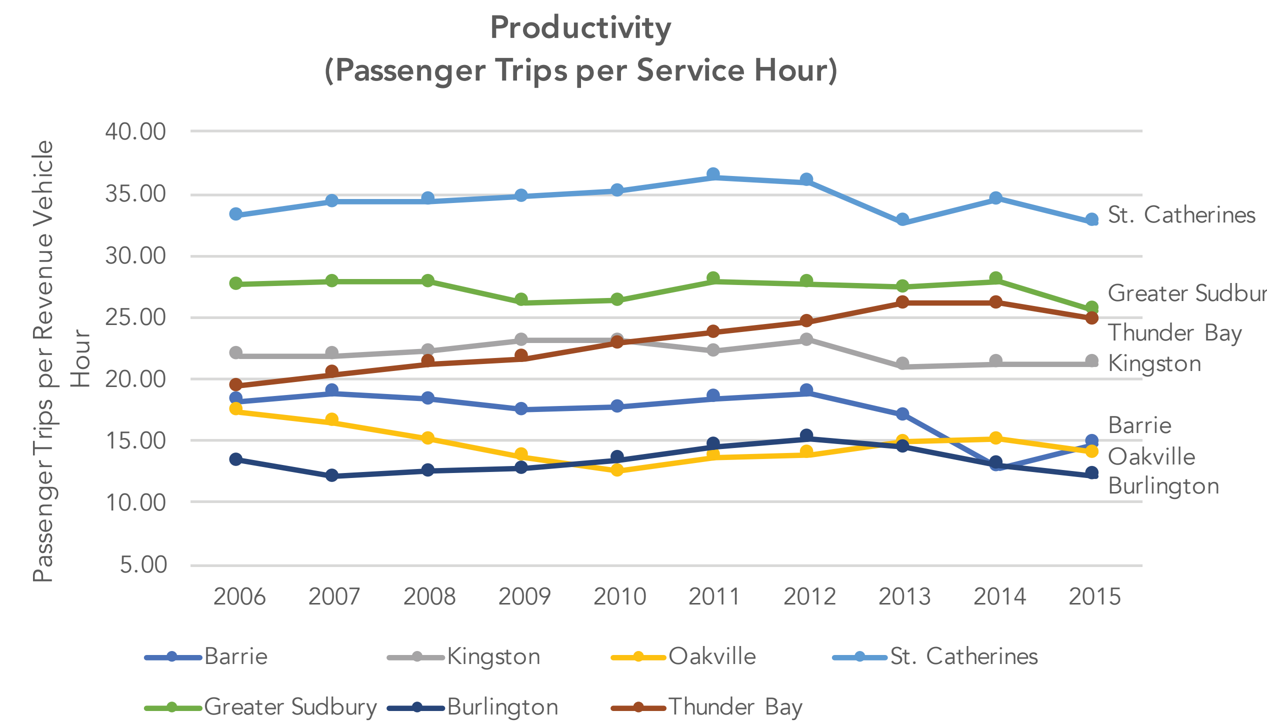


Figure 20: Graph of Productivity Among Peer Cities (2006-2015)

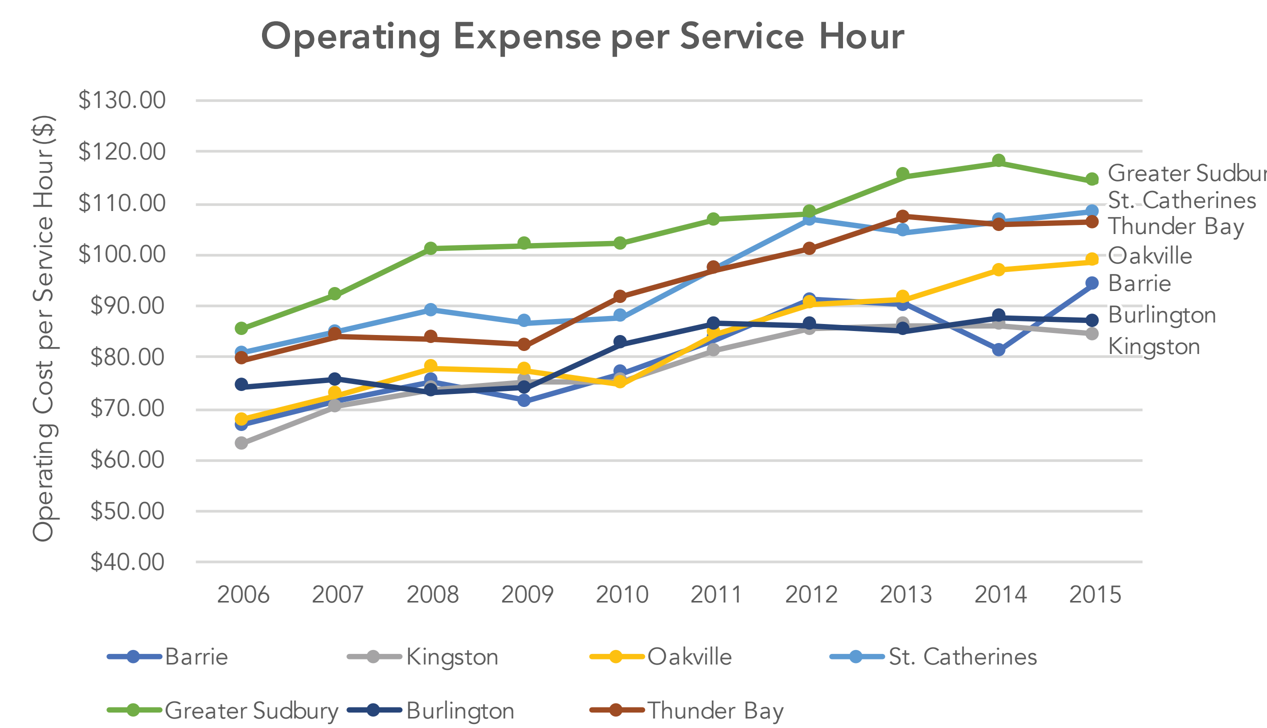


Figure 21: Graph of Operating Expenses per Service Hour Among Peer Cities (2006-2015)

Transit Service Analysis

Figure 22 shows the total service hours on an average weekday categorized by the percentage of layover and recovery time provided in the daily schedule. This estimate is derived from the vehicle schedule block, the scheduled time that a vehicle is in service to carry passengers. Drivers have less that 13% recovery and layover time during two-thirds of scheduled service on weekdays. And for more than one-third of the service hours, drivers have less than 10% layover and recovery time in their schedules.

Layover and recovery time is essential to maintaining reliable operations for a transit system. Drivers need breaks to operate their vehicles safely. And drivers need recovery time at the end of every trip to provide a buffer in the schedules. If a driver had no recovery time in their schedules, then one significant delay at the beginning of their shift would throw off their on-time performance for their entire shift and would frustrate passengers for hours after the original incident caused the original delay.

A typical planning standard is to keep 13% layover and recovery in the schedule, for driver breaks and to allow drivers to catch up in case they were delayed on any given trip. Limited layover and recovery time means that significant delays early in the day will cascade throughout the remainder of the day. This problem is compounded by the fact that Burlington Transit interlines many routes throughout the day. For example, Routes 1 and 101 are interlined during the mid-day, so a delay for a bus on Route 1 and 10 am could result in delays on Route 101 at 1 pm because the same bus might be serving both routes at different times. This suggests that the current low cost per revenue hour is unsustainable in the long term.

Fares

Figure 23 compares the cost of a single trip fare for the eight peers including Burlington Transit. The cost graphed is the single trip cost for a ticket. So for Burlington Transit, this cost is $2.75, or 1/10 the cost of a $27.50 10-ticket book. When using a PRESTO card, single trip fares are similarly priced at $2.70 per trip. The current cash fare for Burlington Transit is $3.50 per trip.

Compared to its peers, Burlington Transit has the second highest fares, behind only Oakville. It is not surprising that fares are lower among other peers, since the cost of living in the GTHA is higher than the rest of Ontario. But, fares in Burlington were closer to peer average as recently as 2009. And the pattern of lower investment, relevance and productivity that is common to both Burlington and Oakville is further reinforced by the higher than average fares.

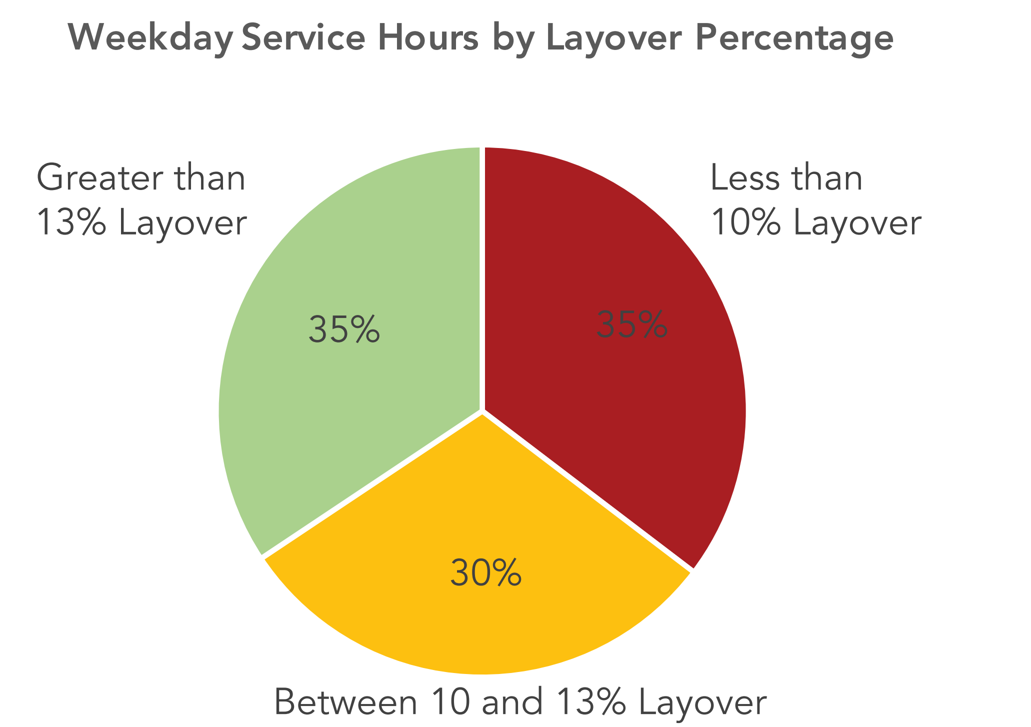


Figure 22: Graph of Estimated Layover by Weekday Service Hours on Burlington Transit

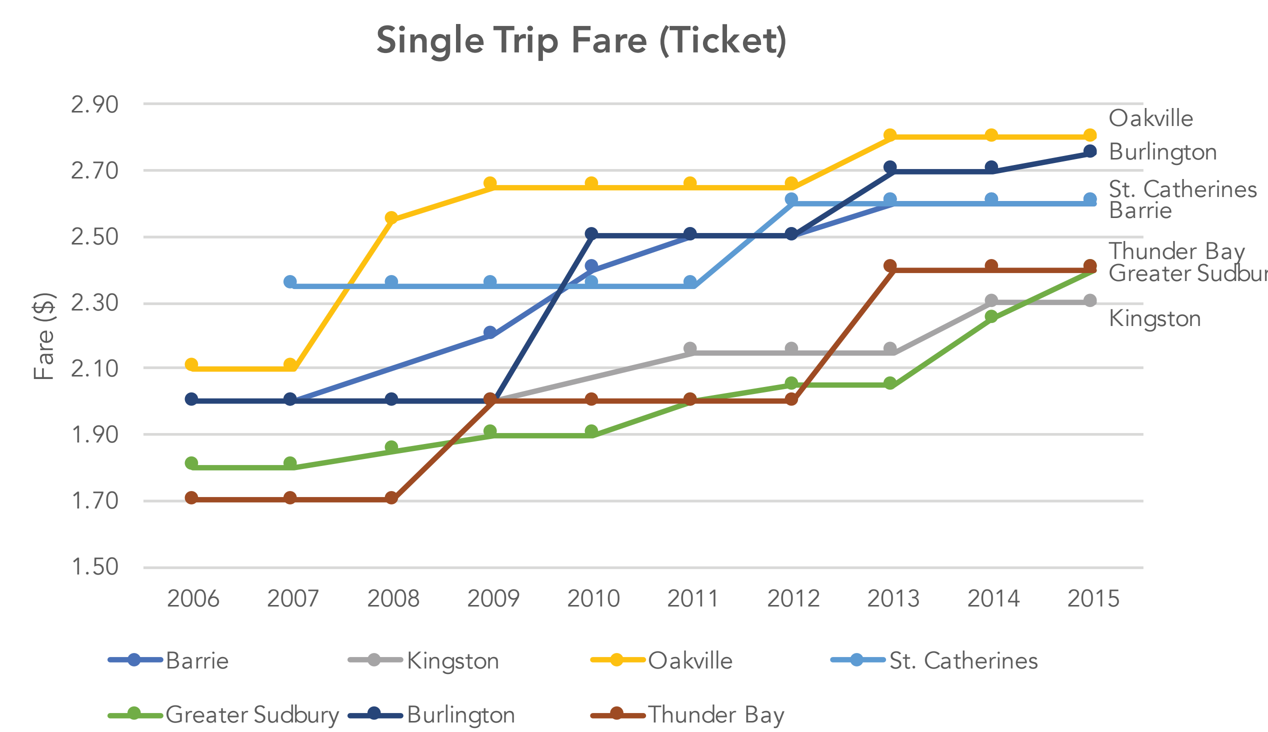


Figure 23: Graph of Single Trip Fares (Ticketed Fares) Among Peer Cities (2006-2015)

Transit Service Analysis

Frequency is Freedom

In transit conversations, there is always a great focus on where transit is provided, but unfortunately little concern about when it is provided. The "when" of transit service is described as frequency (how many minutes between each bus) and span (how many hours a day, and days a week, it runs).

Low frequencies and short spans are one of the main ways that transit fails to be useful, because it means service is simply not there when the customer needs to travel.

Even though Google Maps or trip planning tools can be consulted for directions, frequent transit service is effective at attracting ridership because it has the simplicity of a road: you can use it anytime you need to. Frequent service allows someone to maintain a map of the transit system that is much like a road map, in that no schedule is needed to know how to go places whenever you want to.

Burlington Transit does not currently offer any routes that meet this "no schedule needed" threshold all-day. The closest the system comes to providing this threshold is on Plains Road where Routes 1 and 101 provide nearly 15-minute service in the mid-day. Route 101 operates every 15 minutes, but only from 5 am to 10 am and 3 pm to 7 pm.

Routes 10 and 20 are nearly frequent routes as they provide consistent 20 minute frequencies from 5 am to 7 pm on weekdays.

Figure 25 on the following page shows the frequency and span of service for all routes in the Burlington Transit system.

Frequent service:

- Reduces waiting time (and thus overall travel time).
- Improves reliability for the customer, because if something happens to your bus, another one is always coming soon.
- Makes transit service more legible, by reducing the need to consult a schedule.

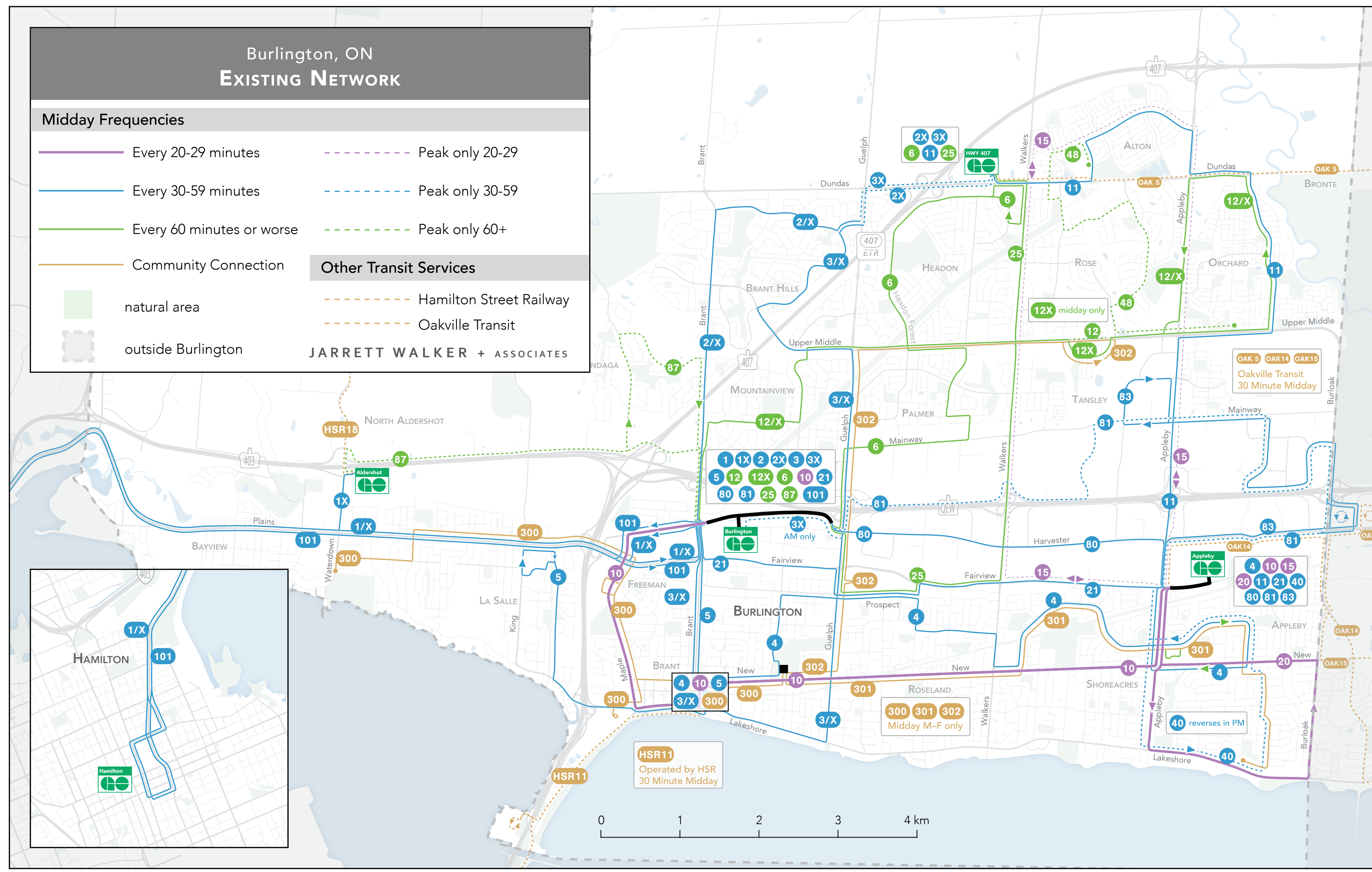
Many people assume that today, with real-time transit arrival information and smartphones, nobody needs to wait for a bus anymore, and frequency therefore doesn't matter. If a bus only comes once an hour, that's fine, because your phone will tell you when it is a few minutes away and you should start walking.

Despite all these new technologies, frequency still matters enormously, because:

- Waiting doesn't just happen at the start of your ride, it also happens at the end. You may not need to leave the house much before your departure, but if your bus is infrequent, you have to choose between being very early or too late.
- Many of the places we go don't let us hang out until our bus's arrival is imminent. We can easily do this when leaving home, but it is more awkward when leaving a restaurant or a workplace that is closing.
- Real-time arrival information doesn't make the bus more reliable, but frequency does. Your smartphone can tell you when your bus is arriving, but it cannot prevent your bus from having a problem and being severely delayed, or not showing up at all. Only frequency—which means that another bus is always coming soon—can offer this kind of reliability.

Routes 1 and 101 are Burlington Transit's most frequent, and longest-span routes (Route 1 runs until almost 1 am). They are also among the most productive in the network, attracting not just high ridership, but high ridership relative to their cost.

Figure 24: Map of Burlington Transit Existing Network by Mid-day Frequency



Span

The other element of the "when" of transit service is span: the hours of operation of a route each day, and the days of operation each week. If someone considers using a low-frequency service, they may be disappointed when it requires a long wait. With a short-span of service, someone may find that it isn't there at the time of day or on the day of the week they need it.

The chart to the right summarizes each route's frequencies and spans. Burlington Transit operates 26 routes, but only 14 of these operate all-day on weekdays. Five routes operate only at peak times and four routes operate only during mid-day.

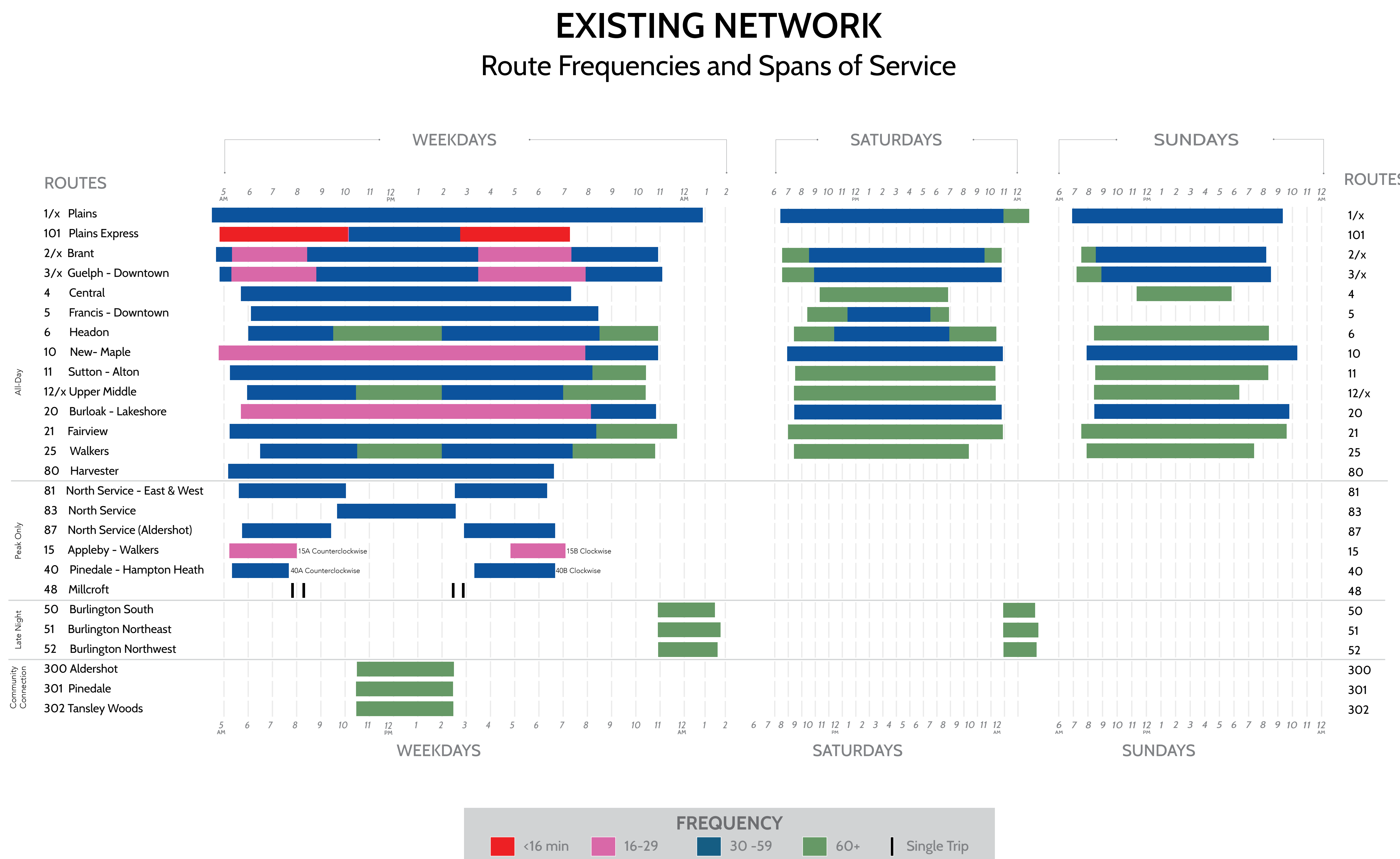
On weekdays, most Burlington Transit routes end before 11 pm. Three special late night routes (50, 51, 52) operate from 11 pm to 1:30 am and provide late night service on weeknights and Saturday nights.

Burlington Transit offers lower frequencies and shorter spans on Saturdays and Routes 101 and 80 don't run at all. On Sundays, spans are shorter on most routes and Route 5 doesn't run at all.

The transportation profession has long been focused on the weekday peaks, because those are the times when our road capacity is most-used and congested. Yet people need to travel at all times of day and week. If a travel option is only available during the weekday peaks, people are unlikely to rely on it.

Service workers tend to work from very early in the morning to midday, or from midday to late at night, and the service industry peaks on weekends. Anyone taking an evening class, pursuing a hobby, going to worship, or staying late at work to finish a report needs a bus ride home outside of the traditional 8-to-5 workday.

Figure 25: Existing Network Route Frequencies and Spans



JARRETT WALKER + ASSOCIATES

March 3, 2017

Ridership

We analyzed ridership data for September and October 2016. In that period, on an average weekday, about 13,200 people boarded a Burlington Transit bus. However, this ridership was not evenly distributed: about 30% of these boardings occur on Routes 1 or 101.

Ridership by stop

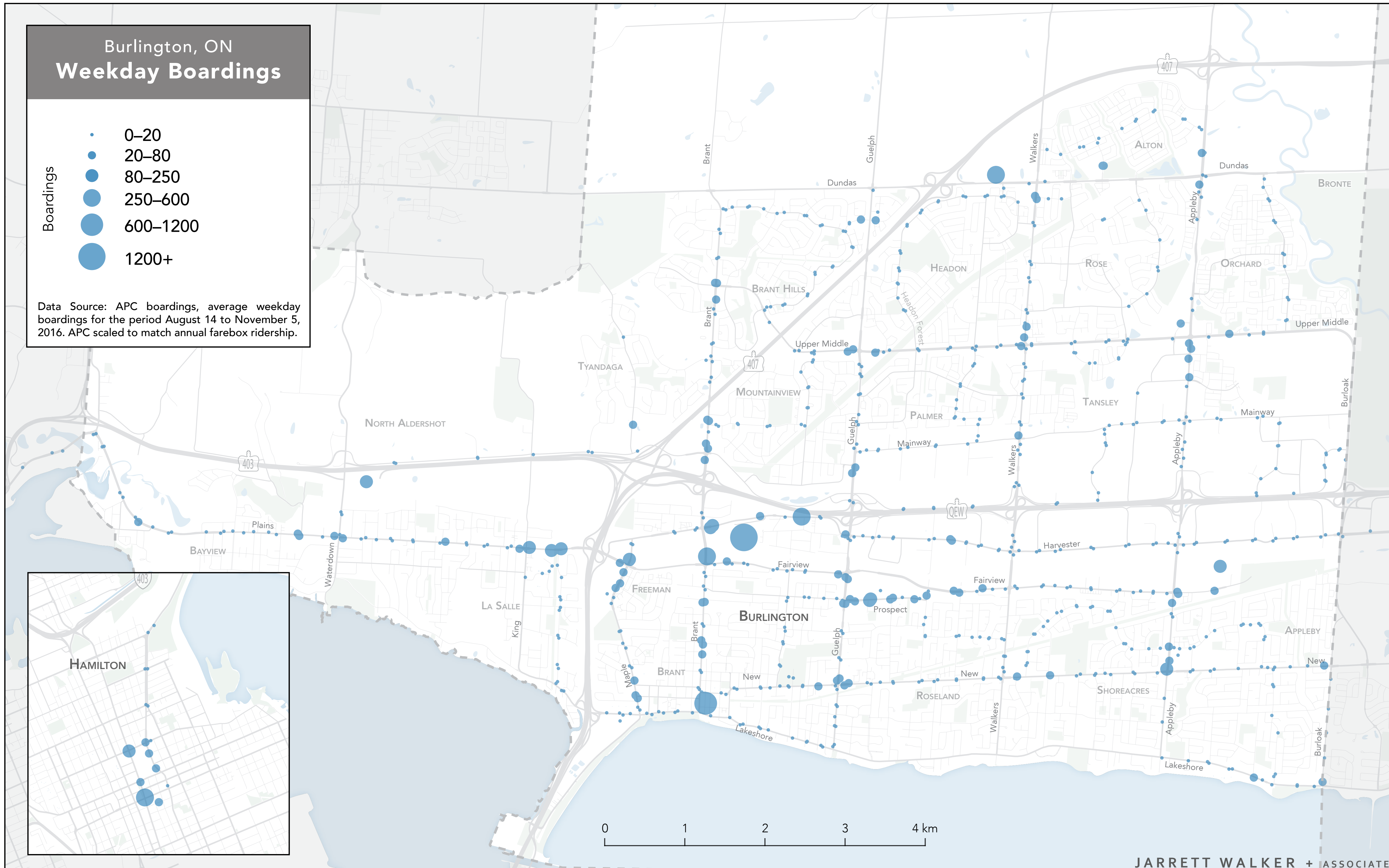
The map at right shows the average daily total boardings at each bus stop in the network on weekdays in September and October 2016.

A small dot on a very low-frequency route may simply be a reflection of the low level of service. A small dot on a frequent route, on the other hand, suggests other problems. Conversely, a large dot on an infrequent route means that ridership is high despite a low level of service, which suggests that underlying transit demand may be high.

From this map, we can observe that:

- The Burlington GO Station and the Downtown Terminal are the two busiest stops in the system.
- Most high ridership stops are on the main grid streets while there are few large dots on smaller neighborhood streets.
- Plains Road west of the QEW has a consistent string of high ridership stops. This is expected as this corridor has relatively high activity density and has the proximity and linearity to support high ridership.
- Fairview Road and Prospect Street (along Route 21) have many stops with high boarding activity which is

Figure 26: Map of Boardings by Stop



Transit Service Analysis

expected given the activity density, the density of people on limited-income, and the density of seniors.

- New Street and Maple Avenue (Route 10) have many clusters of high ridership stops. This is a function, in part, of the higher frequency service provided on Route 10 but also an outcome of the high activity density in the corridors combined with their linearity and proximity to other major centres of activity.
- Conversely, there are not many large boarding dots along Route 20, suggesting that the higher frequency service here is over serving this area.
- In the northern half of Burlington there is a strong pattern of high ridership stops at the commercial areas near major intersections (such as Walkers Line and Upper Middle Road).

Shopping centers often have high transit ridership, because they are important destinations for the many people who shop there, as well as job centers for retail employees.

Ridership by Hour

The average ridership in each hour of the day, totalled for all routes, is shown in the graph in Figure 27. Not all routes are running at all times of day, and people can't ride buses that aren't there. Thus the shape of demand shown in Figure 27 is as much a response to the service that is offered as it is an expression of underlying travel demand.

On weekdays, ridership peaked at the 7:00 am hour and then declined to between 600 and 800 boardings per hour in the mid-day. A large peak began at 2:00 pm hour and dropped off by 6:00 pm.

The AM rush hour was about 70% higher than the midday, likely reflecting the typical morning work commutes for workers within Burlington or connecting to GO Stations to reach jobs outside the city. In the early afternoon, there was a very large peak starting at 2:00 pm when schools let out. Ridership reached its highest peak in the 3:00 pm hour, likely from a combination of after school trips, early commuters leaving work, and afternoon or evening shift service workers heading to their jobs.

These shapes suggest that the traditional rush-hour commute is important, but is not entirely dominant. The early afternoon peak suggests a sizeable contingent of school aged children using transit for afternoon rides home or to reach afternoon activities. They may have gotten a ride with family in the morning, but they get themselves home in the afternoon when family members are at work. Ridership drops significantly after 6 pm but plateaus on weekdays from 7 pm to 9 pm at around 300 boardings per hour. It then declines rapidly in the late evening.

Figure 28 shows the pattern of boardings, bus trips and the resulting boardings per trip. Boarding peak both in the AM and PM, through the PM peak is much higher and longer than the AM Peak. This provides some context to the average boardings by hour in Figure 27.

Bus trips peak in the AM and PM with the highest peak in the PM. Boardings per trip are highest in the early AM and rise again in the PM peak, though the boardings per trip do not rise substantially above average, suggesting that buses are generally not crowded in the PM peak.

It's normal for buses to get fuller on the peak, but Burlington's don't,

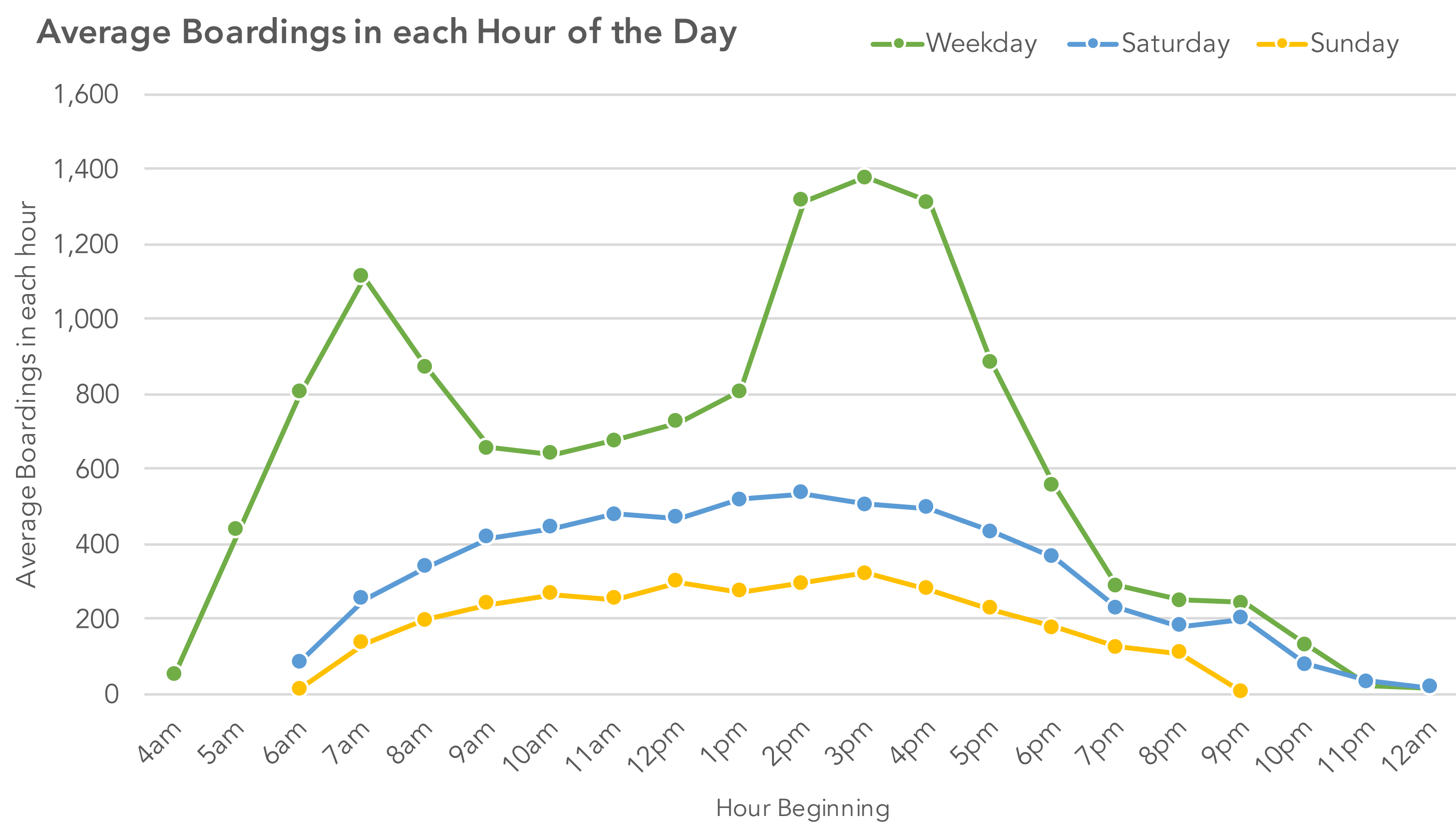


Figure 27: Graph of total Ridership By Hour, for Weekdays, Saturdays, and Sundays

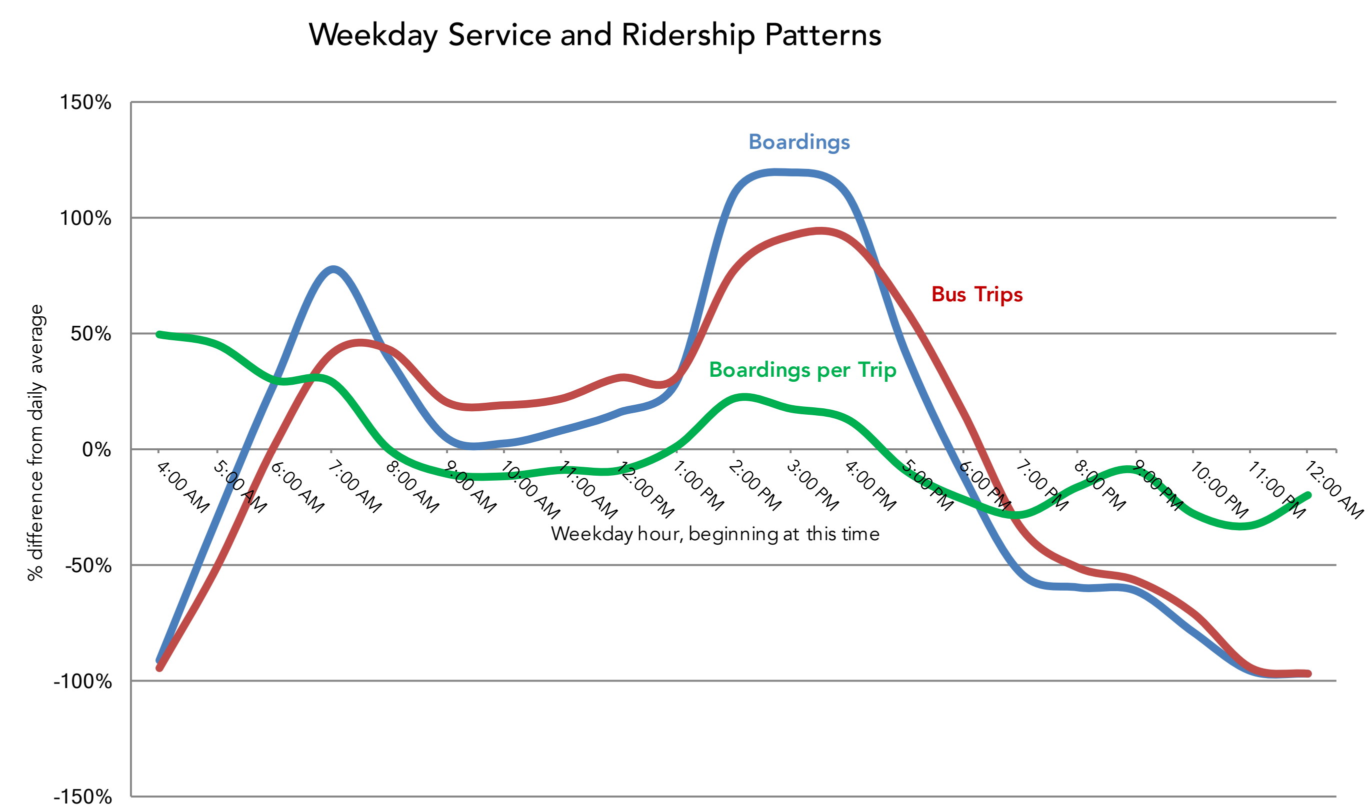


Figure 28: Graph of Boardings, Bus Trips and Boardings per Trip for an Average Weekday

Transit Service Analysis

because as much peak service is put out as there are peak riders. Burlington allows for increased crowding on the afternoon PM peak (1-4 pm) but not on the more traditional PM commute peak (4-6 pm), where loading actually goes down.

In many transit systems, the boardings per trip line would itself have strong peaks, and the fact that it doesn't suggests that there may be more peak service than needed.

Evening and Late Night Service

Some of the decline in evening ridership is a function of the decline in frequency and service after 7 pm. Route 80 stops running at 6:30 pm and Routes 101, 4 and 5 stop running between 7 and 8 pm. Frequencies on Routes 6, 11, 12, 21 and 25 drop from about every 30 minutes to every 60 minutes between 7 pm and 8 pm.

At 11 pm, Burlington Transit switches to a late night network of three routes (50, 51, 52) that operate primarily as long, one-way loops covering most of the city. Route 1 continues operating until 1 am in conjunction with these late night routes. The three late night routes get very low ridership and very low productivity. But, this late night service is valuable as a key insurance policy for riders and to help support afternoon ridership.

Buses running late at night, and very early in the morning, will always be much emptier than those running during the day. Yet the presence of those late buses is, in many transit systems, supporting higher productivity during the day.

This sometimes becomes clear when an agency cuts the last bus trip of the day, because few people ride it. Measured alone, the last trip of the day was the least productive, so it was cut. Very soon, however, the bus trip that is now the last of the day (and was the second-to-last, before) becomes equally unproductive.

No responsible person will plan their daily schedule, or their life, around the last bus of the day. The last bus is a sort of insurance policy, there if people need it, and it always looks unproductive when it is evaluated on its own.

Late night trips tend to support afternoon ridership, because people who work or study in the second half of the day head out in the afternoon and come back home at night. If the bus isn't there for them to return home at night, then they have a powerful incentive to get a car or find some other way to make their round-trip commute. For this reason, it is common for transit agencies to find that afternoon ridership drops after cuts to nighttime service.

It is rarely a good idea to measure the productivity of a route or a network by time of day, with an eye towards cutting trips and thereby increasing productivity. The ridership on a route is almost always arising from the day-long and week-long level of service.

So late night service is important, but a key question is whether the current approach to late night service in Burlington works for the city. The complexity of a separate late night system that operates different routes, in a different pattern just for the last two hours of service can be confusing for riders. Other peer agencies, like Oakville, Thunder Bay and Sudbury, operate their most productive routes until 11 pm or midnight.

Oakville runs a late night service that continues until 1:30 am, but it is an on-demand, drop off service from the Oakville GO Station. If Burlington is concerned about service after midnight, this model might be more appropriate to handle the night owl service needs of the community.

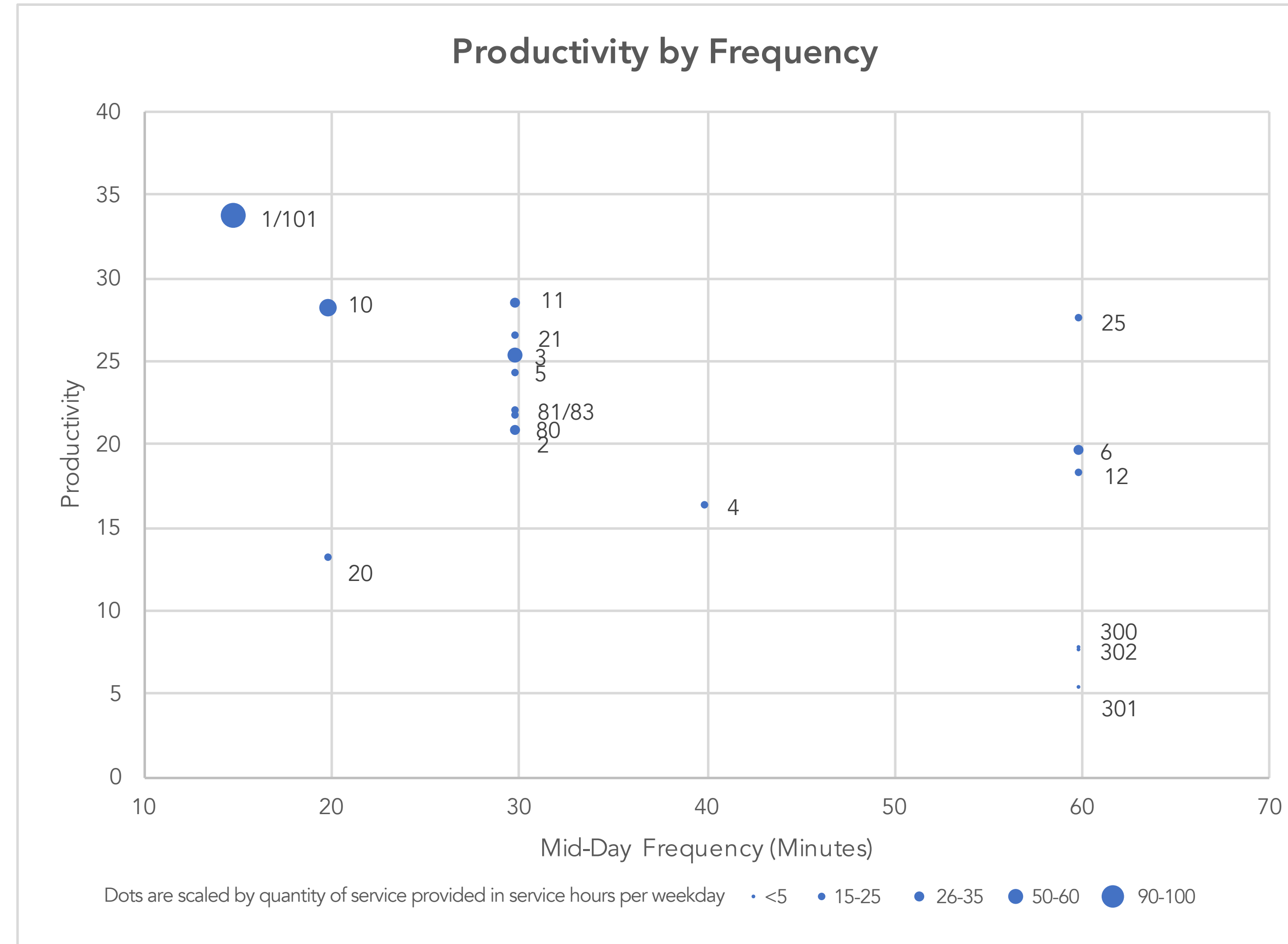


Figure 29: Graph of Productivity (Boardings per Hour) by Route for Burlington Transit

Productivity

The City, through its Strategic Plan, has expressed a desire to increase the percentage of trips that use public transit. It has also expressed a desire to have "efficient, greener, convenient and usable" public transit options. These expressed goals imply a desire to increase transit ridership in Burlington.

Implicit in any goal to increase ridership, or to achieve other outcomes that depend on increased ridership, is a constraint: there is a limited amount of funding available in any year. Burlington Transit cannot spend infinite amounts of money in pursuit of each additional rider to increase the percent of trips using transit.

Any goal that relates to higher ridership, then, actually arises from higher ridership *relative to cost*. If a transit agency wants to increase ridership within a fixed budget, it will examine where (or when) in its network ridership relative to cost is already high, and consider reallocating service to those routes or those times.

Because no transit agency has a limitless budget, someone who cares about maximizing ridership would not be satisfied simply by a large dot on the boardings map until they knew what it cost the transit agency to achieve that large dot.

The scatter plot in Figure 29 presents productivity by route. Each route is a dot, and it is plotted based on its midday frequency (on the horizontal axis) and its productivity (on the vertical axis). The size of each dot is scaled to the total amount of service provided on the route.

Unlike the CUTA data, which analyzes trips per service hour, route by route productivity analysis looks at boardings per hour. The average weekday productivity for the entire system is 24.2 boardings per hour.

The most frequent routes (1/101 and 10) are also the most productive. We are analyzing Routes 1 and 101 together because they operate along almost the exact same route and therefore each supports the other.

Route 20, despite being relatively frequent, is not very productive compared to lower frequency routes. This suggests that the area Route 20 serves may not justify that level of frequency, or that other issues are reducing the usefulness of Route 20.

Routes 6, 12, and 25, seem to be very productive for hourly frequency routes, but they are only hourly routes during the mid-day. In the AM and PM peak periods, they operate every 30 minutes.

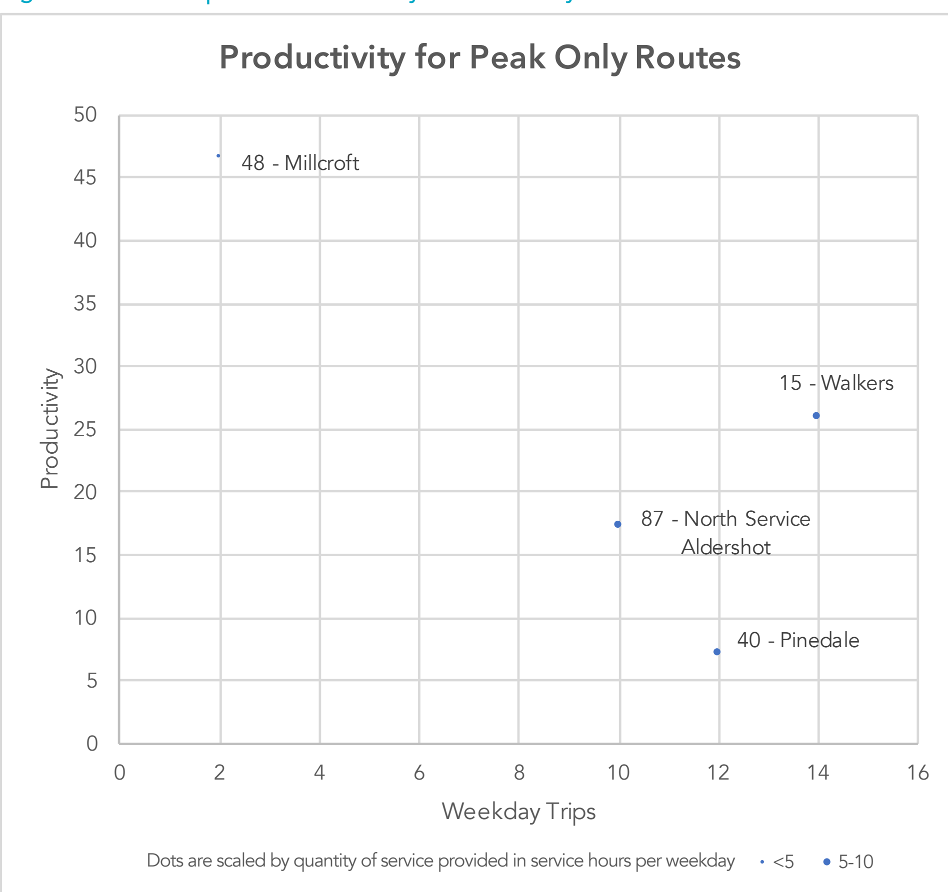
The Community Connector Routes (300, 301 and 302), achieve very low productivity levels, between 5 and 8 boardings per hour. This level of productivity is barely higher than a good dial-a-ride service would achieve, suggesting that the people using these routes might be more efficiently served with a different service type.

Peak Productivity

During the peak commute period, transit demand patterns change to a degree, and it's normal for service to change in response. Some agencies, Burlington Transit included, also offer certain routes only during the weekday peaks.

Peak-only routes are sometimes designed to target the highest-demand

Figure 30: Scatter plot of Productivity for Peak Only Routes



time of the day. Two peak only routes (15 and 40) are clearly oriented toward commuters going to and from GO Stations. Other routes have additional peak trips to serve commuters going to and from GO Stations.

Peaking has some high costs that are often invisible to the public:

- The agency must maintain a large fleet of buses for the peaks, a fleet that sits idle at all other times. For each extra bus that is run during peak times, the agency had to purchase the bus, find land to store it on, and pay people to maintain it.
- Peak hour services have a slightly higher average labor cost than service at other hours. This is because Burlington Transit must pay extra for drivers who work swing shifts targeted at providing peak hour service.
- Sending buses out and back in the AM peak and then again in the PM peak creates additional deadhead time and cost that would not be incurred if buses were out providing service all day.

Transit agencies increase frequencies of all-day routes during the peaks for a number of reasons:

- To reduce crowding, if the peaks are the highest-demand periods of the day.
- To attract more affluent riders, who have more choices in how they travel and therefore less tolerance of waiting, and who are more likely to work professional jobs and commute on the peaks.
- To reduce auto congestion on the peaks, when roads are most strained.

Figure 30 illustrates the productivity of the four peak only routes in the Burlington Transit system. Route 48 is an outlier because it only operates two trips per day, specifically timed to serve two high schools.

Of the other three, Route 40 stands out as a particularly low productivity route, with only seven boardings per hour.

Given the high costs of running peak-only services and higher frequencies during the peak, it would be reasonable to expect higher productivity, and more crowded buses, on the peaks (particularly the PM peak) than at other (less expensive) times of day.

Similarly, thinking back to Figure 28, where the boardings per trip data are plotted per hour, we must ask whether the investment in additional frequency and service, particularly in the afternoon, is valuable and effective for Burlington Transit given the additional costs of the service.

Transit Service Analysis

Frequency and Productivity

One of the biggest components of operating cost is frequency. (It is not the only component – route length and span of service also matter.) In examining over 24 transit systems, we have found a statistically significant correlation between transit route frequency and productivity (as have scores of academic researchers).

The scatter plot at right shows the individual routes from 24 transit networks, each plotted according to their midday frequency (on the horizontal axis) and their productivity (on the vertical axis).

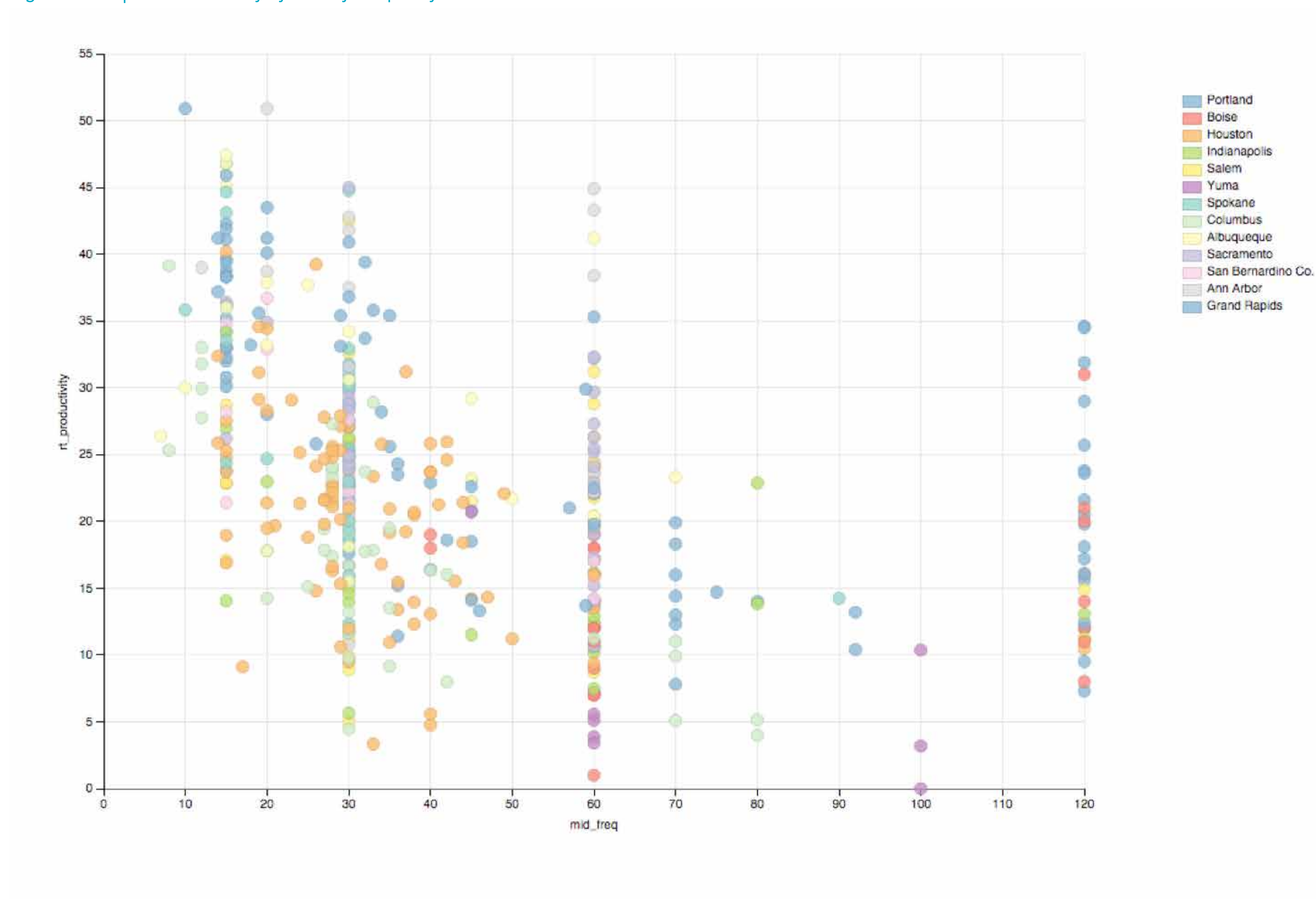
Among all of the dots in this chart, there is a clear curve detectable, up and to the left. More frequent services tend to have higher productivity (ridership per service hour), even though providing high frequency requires spending more service hours.

While a higher frequency increases the denominator of the productivity ratio, the higher ridership more than makes up for it.

This is how we know that high frequency contributes to high ridership, rather than simply representing an investment proportional to ridership. If higher frequencies were not causing higher ridership, then the dots on this chart would be a flat horizontal cloud, instead of a curve upward to the left. When a transit agency increased the frequency on a route, its ridership would increase proportionally, *and its productivity would remain unchanged.* Instead, higher frequencies are associated with higher productivity.

This happens because frequent service is the most useful and convenient service for riders; thus, transit agencies typically target this most expensive service towards their strongest markets. When frequent service is available to people in a suitably dense, walkable environment, high ridership is a common result.

Figure 31: Graph of Productivity by Midday Frequency in 24 Cities



Transit Service Analysis

Case Studies

A few routes offer intriguing, sometimes surprising productivity and patterns of boardings. They are “outliers” from the trend, and in this section we explore why.

Route 20

As noted above, Route 20 has lower productivity than we might expect given its frequency. Two key features help explain why Route 20 is not as productive as expected.

Route 20 is interlined with Route 10, meaning a bus and driver will do them in series throughout the day. Without this interlining, neither route would be nearly as productive, because buses would have to spend more time (and therefore cost) on each of them. Interlining is a way to operate short routes efficiently. Thus, Route 20 has a higher frequency than we might expect because it is interlined with Route 10 to increase the efficiency of both routes.

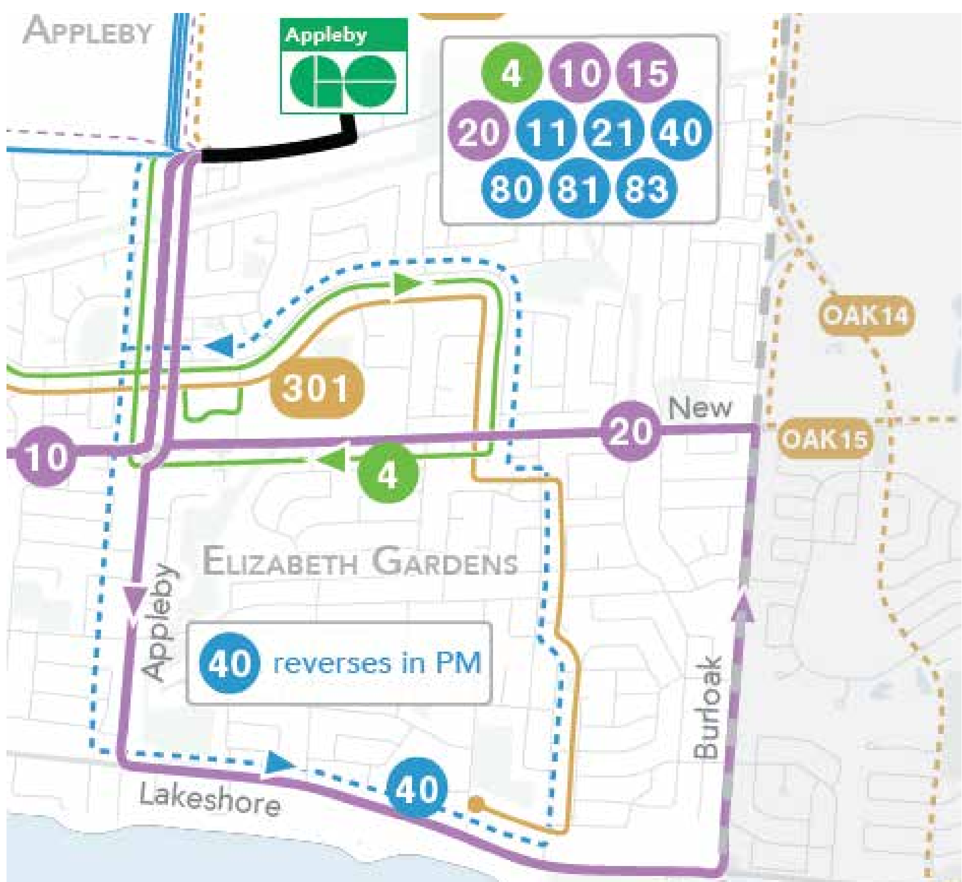


Figure 32: Frequency Map of Route 20 and Elisabeth Gardens Areas

The more significant issue with Route 20 is that it is primarily a long one-way loop. Route 20 operates from the Appleby GO station to Lakeshore Drive via Appleby Line and makes a one-way loop counter-clockwise on Appleby, Lakeshore, Burloak and New Street and then returns to the Appleby GO Station.

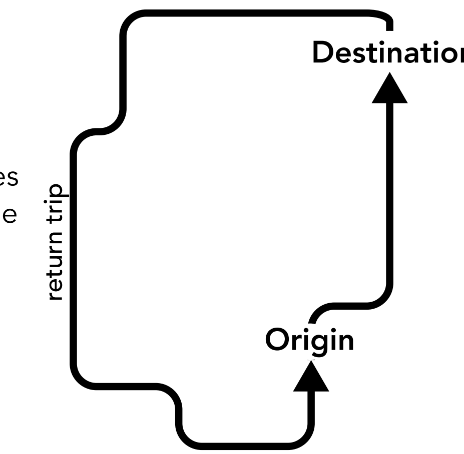
While this provides service for this entire area to and from the Appleby GO Station, it does not provide useful service for a lot of trips. In Figure 33 below, if someone on Lakeshore near White Pines Drive wants to go to the Food Basics to grocery shop, it’s an easy and short ride on Route 20 to reach the shopping center. And it’s frequent enough that they might be willing to wait, instead of walking a kilometer.

But to get home, you can’t ride Route 20 back. As a one-way loop, if you get back on a Route 20 bus with your groceries, you have to ride all the way around the loop to Appleby GO before you can get home.

Worse still, you can’t even ride all the way around the loop and home. Because Route 20 is interlined with Route 10, once you reach Appleby GO the bus you are on will continue as Route 10 toward Burlington GO. To get home, you would have to transfer to a different Route 20 bus.

Obviously, most people will not use transit for this kind of trip. So even though Route 20 looks like it provides high frequency service for this area, in reality its usefulness for many trips is limited by its design.

One-way loops

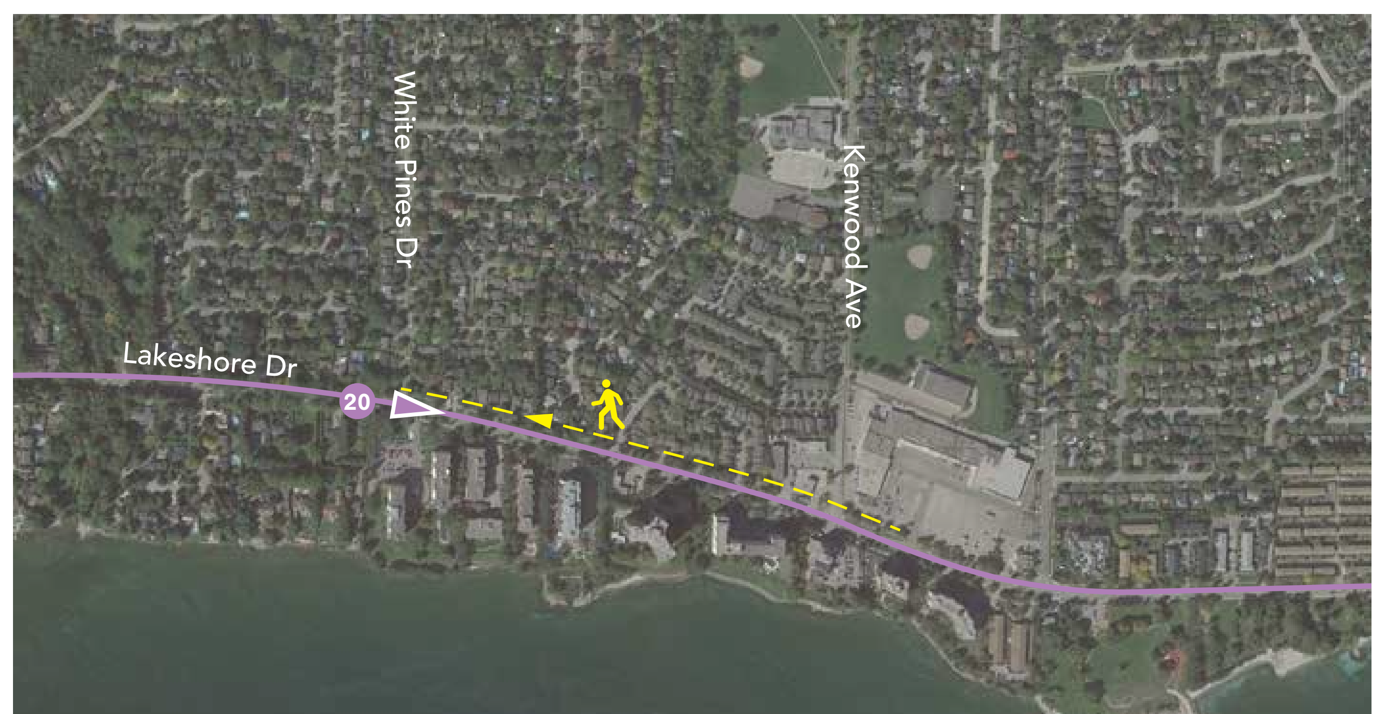


One-way loops are sometimes put at the ends of long routes, because they are easy ways to turn-around a bus. At the end of a long route, buses tend to be empty, so very few people end up riding around the loop.

But sometimes one-way loops are used to provide coverage: access to service that doesn’t result in much ridership. One-way loops sacrifice directness and travel time in order to cover a larger geographic area.

How does a passenger experience this sacrifice? It may be that on their way out, they can get on the bus and it goes in the direction they are traveling, so the trip feels fairly direct. But on their way home, they must ride around the loop the long way, out of direction, to get back to where they started.

Like hourly service, a one-way loop cannot attract a passenger whose time is scarce and valuable (and that person may be rich or poor) because it guarantees that in one direction or another, the trip will be long and circuitous.



Getting *to* the Food Basics from White Pines Drive is easy on Route 20. Getting *back*, however, requires a long ride around the loop and a transfer. It would be much easier to just walk. Most people will not make that trip by bus because of the inconvenience of the return trip.

Figure 33: Example of One-Way Loop on Lakeshore

Transit Service Analysis

Route 4 and Route 10

As noted above, Route 4 has the lowest productivity among routes that run all day. Clearly a major reason for that low productivity is its relatively low frequency, it operates on a 40-minute headway most of the day. But Route 4 also suffers from two other key issues that limit its potential ridership.

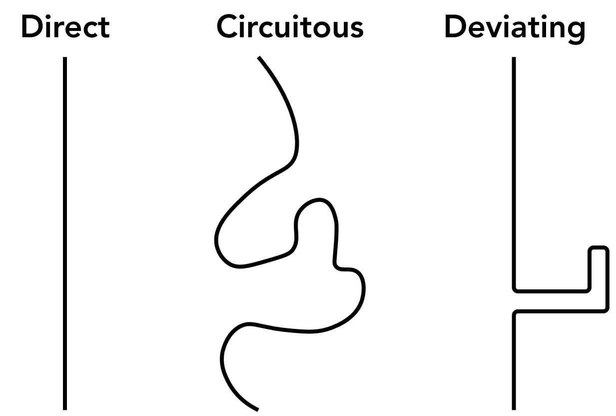
First, Route 4 is an indirect route. From downtown, it heads east on New, then turns north to Prospect to go by the Burlington Mall. It then turns south and snakes back toward New Street before turning north again on Longmoore Drive. It has a one-way loop along Pinedale and New at its eastern end before turning north to reach Appleby GO. We would call Route 4 a circuitous route.

By comparison, Route 10 goes directly from downtown to Appleby GO via New Street. Even if both routes operated at the same frequency, many riders would choose Route 10 over Route 4 because it would be a faster trip.

The other challenge for Route 4 is that even where it's not competing with Route 10, it's competing with Route 21. It is rarely less than 800 metres from a competing route at a higher frequency, either Route 10 or 21. Thus, many riders will naturally choose to walk to either of the more frequent options.

And the pattern of boardings on Routes 4 and 10 make clear that many are choosing the higher frequency route. Where Route 4 and 10 overlap, boardings on Route 10 tend to be much higher, as one can see when comparing Figures 35 and 36 to the right.

The primary trips for which Route 4 is more useful than Route 10 is to access Burlington Mall from New Street. Without Route 4, people who live along New Street or downtown would have to take Route 10 to Route 3 to get to Burlington Mall.



With the existing frequency of service, a trip like that would require an average wait of 10 minutes for Route 10, then an average wait of 15 minutes to transfer to Route 3. Thus, Route 4 provides a useful one-seat ride for some riders because of the excessive wait times for a transfer between low frequency routes.

Figure 35: Boardings on Route 4

Figure 36: Boardings on Route 10

Figure 34: Frequency of Routes in Southern Burlington

Transit Service Analysis

Route 21 and Route 80

Routes 21 and 80 both operate from Burlington GO to Appleby GO. Route 21 operates via Fairview Road and Brant Street. Route 80 operates via Harvester Road and Appleby Line. The routing for both can be seen in Figure 37 below.

Both operate at the same frequency. And they are only about 600 metres apart, but are separated by the main rail line through Burlington. Therefore, it is hard to walk from one to the other. Route 80 covers a shorter distance and runs a shorter span, which would suggest that it might have a higher productivity because it has lower costs. Route 80 gets an average of 368 boardings per weekday with a weekday productivity of 21.6 boardings per service hour.

Nevertheless, Route 21 gets higher ridership and higher productivity. It gets on average of 578 daily boardings and a weekday productivity of 26.3 boardings per service hour.

What accounts for the difference? By the ridership recipe linearity and proximity are effectively the same. Here the difference is density and walkability. In particular, the diversity of the density makes a significant difference.

Figure 38 shows a snapshot of the activity density of the two corridors. Harvester Road is full of employment and only employment. While the density is high, it is single use. Along the Fairview Road corridor there is a high density of both employment and residents. This provides a mixture of trips all day long.

Figure 39 further reinforces the differences in the two corridors. While Fairview Road is a relatively wide road with auto-oriented commercial, it has many shops and residences near the street and a number of connections to neighborhoods to the south.

Harvester Road is dominated by large-lot land uses, set far back from the street and with large distances between business. Most have large parking lots out front, putting bus riders far from their destinations when they get off the bus.

Figure 39: Aerial image of Fairview and Harvester Road Corridors

Figure 37: Frequency of Routes in Fairview and Harvester Road Corridors

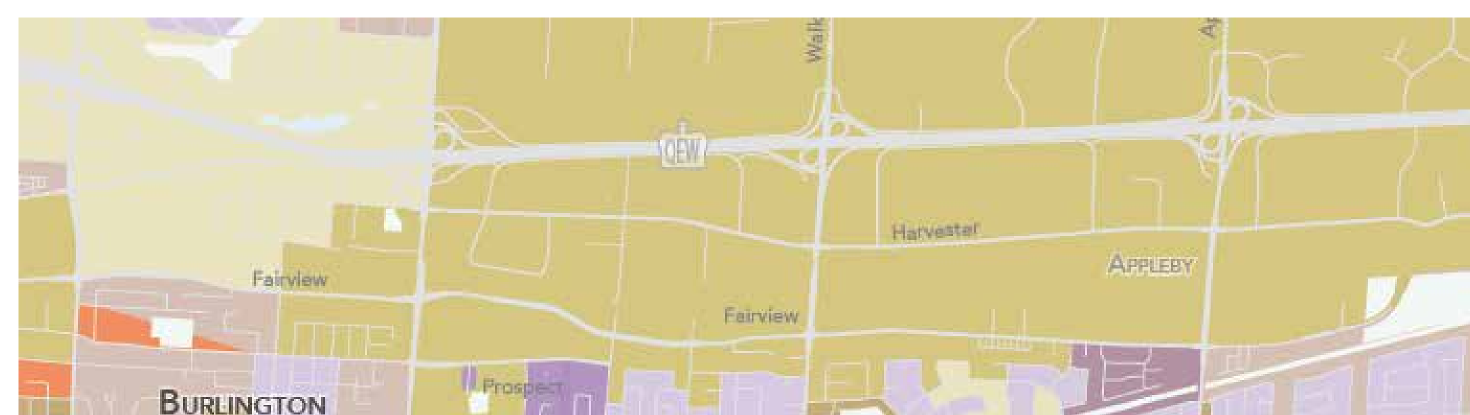


Figure 38: Activity Density in Fairview and Harvester Road Corridors

Transit Service Analysis

Routes 1 and 101

Routes 1 and 101 both operate from Burlington GO to downtown Hamilton via Plains Road. Route 1 has an extension to Aldershot GO from 5 am to 8 pm. Individually and together they are two of the highest ridership and highest productivity routes in the Burlington Transit network. The routing for both can be seen in Figure 40 below. Their ridership and productivity are unsurprising given the activity density along the Plains Road corridor and the strong anchors of activity at each end.

Route 1 runs every 30 minutes all day, seven days a week. Route 101 (the Plains Express) only operates on weekdays and runs every 15 minutes from 5 am to 10 am and again from 3 pm to 7 pm. During the mid-day, it runs every 30 minutes. Route 101 skips about two-thirds of stops along Plains Road along its route. In effect Route 1 is the local bus and Route 101 is the “rapid bus”.

A “rapid bus” is a common branding for services where a local bus makes stops about every 400 metres and a rapid bus only stops about every 800 metres (or even farther apart). This pattern is commonly found on some of the busiest corridors in large transit systems where travel distances are long and boardings are high throughout the day. The combination of these factors leads to very long travel times when only local service is provided. It is also a common pattern where local bus frequency is already very high (headways of less than every 15 minutes).

For example, the Valley Transit Authority in San Jose, California uses this pattern on El Camino Real where the combined local Route 22 and Route 522 achieve 21,000 boardings per weekday on a route that is 38 kilometres long. The combined Routes 1 and 101 get about 3,000 boardings per weekday on a route that is 15 kilometres long.

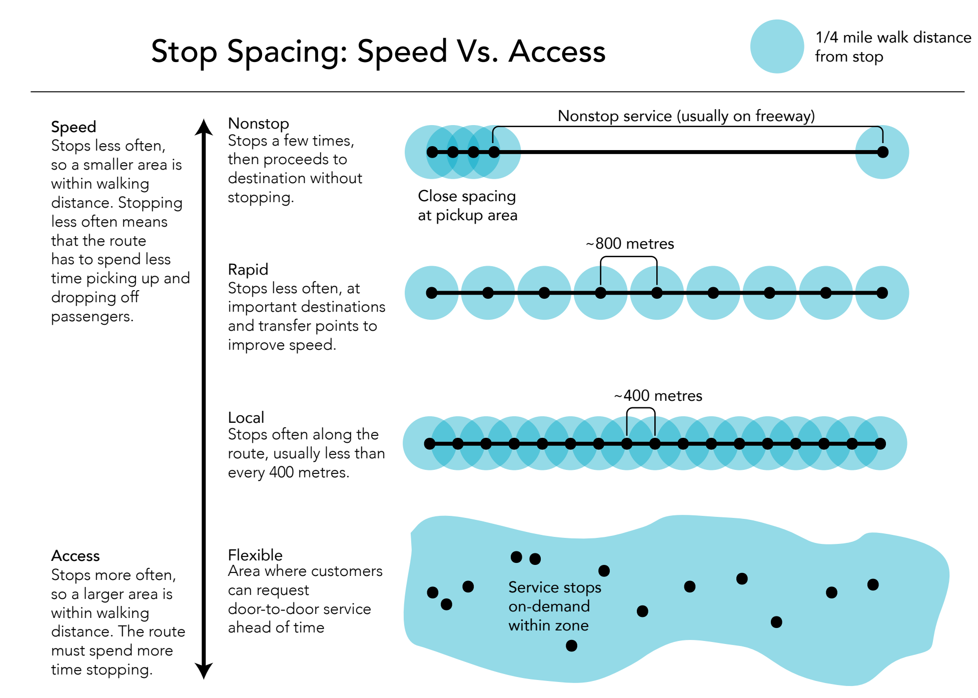
The splitting of service along Plains Road raises questions about the proper balance of speed versus access along this corridor. Figure 41 shows the range of different service types that bus services can provide on a range from maximum access to maximum speed.

The current arrangement of service on Plains Road is faster for riders going from Hamilton to Burlington GO or vice versa during the day. Total trip time on Route 101 is only 29 minutes between the end points during the mid-day, versus 39 minutes on Route 1. Part of this difference is attributable to the deviation by Route 1 to serve Aldershot GO but part is also attributable to Route 101 making fewer stops. In the mid-day, both routes operate at 30 minute frequencies. Therefore the average wait for each is 15 minutes. If the services were combined and operated at a 15-minute frequency, then the average wait would be 7.5 minutes, which would make up for 75% of the travel time savings of Route 101.

The relatively small time savings between the local and rapid service on this corridor and the fact that neither the local nor the rapid service operates at 15-minute frequency all day suggests that this splitting of service on Plains Road may be adding more complexity than it adds in value to riders or the overall system.

Figure 40: Frequency of Routes in Plains Road Corridor

Figure 41: Graphic of Different Service Types by Access and Speed



Transit Service Analysis

Network Characteristics

This section describes some characteristics of the Burlington Transit network that may not be immediately apparent to the reader. Some of these characteristics are deliberate techniques used to turn a collection of lines into a network covering an area. Which of these techniques are suitable for Burlington in the future will depend on the frequency of routes in the network and the geography of the city.

One of the Key Choices we are presenting to Burlington in this report is between higher frequencies and higher geographic coverage. The outcome of this choice in particular will influence which of these techniques we recommend for Burlington's transit network.

For example, a "pulse" is essential for a low-frequency, high coverage network, but becomes less important as routes' frequencies get better.

In another example, a "grid" network only works well if most routes are frequent, allowing easy transfers at every grid intersection. Some of the characteristics of the Burlington Transit network described below are not intentional techniques, but rather side-effects of other network design decisions, or artifacts of history.

Radial vs Grid networks

If a city has only one area where jobs and other activities are concentrated, then all routes can simply go from outlying neighbourhoods into that center.

In small and mid-sized cities, there is often only one activity center, and a radial network can easily provide one-seat rides for most people to their activities. Few trips require a connection at all, but for those that do, all connections happen downtown.

Most larger cities, however, do not have only one center of activity. Some very large metropolitan areas – such as Vancouver – are so dense across such a large area that they truly have everywhere-to-everywhere travel demand.

Burlington is not such an extreme case, but has at least five obvious areas of concentration based on the land use density and boarding activity: downtown, Burlington Mall, Appleby Mall, Mapleview Shopping Centre and the area around Plains Rd and King Road.

In addition to these, the GO stations are key destinations and major boarding and transfer locations for riders, particularly the Burlington GO station. Aldershot GO is also expected to develop into a bigger destination as new development grows around the station.

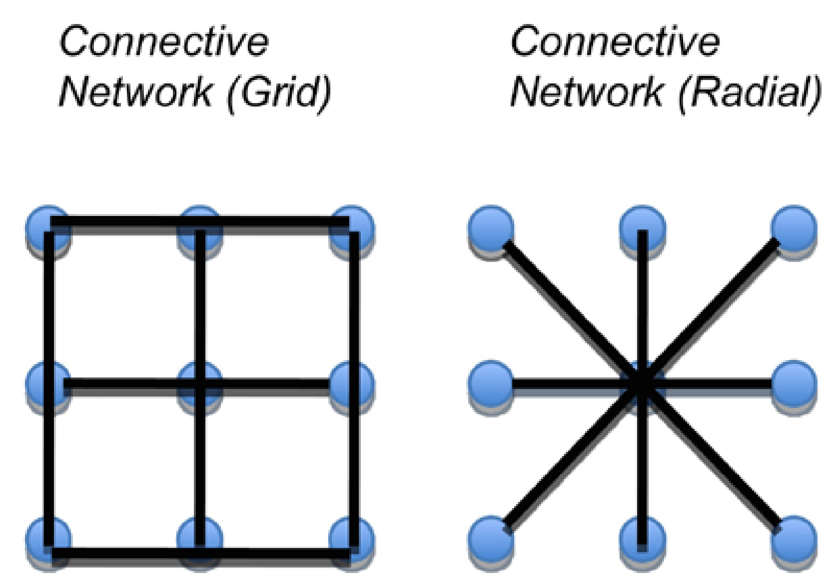


Figure 42: Graphic Example of Different Network Designs

In a "perfect" grid or a "perfect" radial network (neither of which, of course, exists) every place in the city is at most one transfer away from every other place in the city. These two shapes have naturally developed in cities because they allow a set of lines to function together as a network, on which people can travel from anywhere to anywhere.

For Burlington, the challenging of operating a radial network is the natural design of the city's two-kilometre grid road network, the dispersed activity centres, and the three GO stations spread across the city.

The existing Burlington Transit network is a hybrid of a grid and radial network. Most routes radiate from Burlington GO, and then follow major grid streets in a primarily east-west or north-south orientation. Some routes radiate from Appleby GO (such as Routes 4, 10, 11, 15, 20 and 40). Key routes connect both Burlington GO and Appleby GO, including Routes 10, 21, and 80. A few key routes (3, 4, 5 and 10) connect to the downtown terminal on John Street.

Pulsing

This hybrid style of Burlington's transit network introduces complexity and creates a number of challenges. Since most Burlington Transit routes are low frequency (less than 15-minute frequency), they would benefit from having a central point to transfer between them.

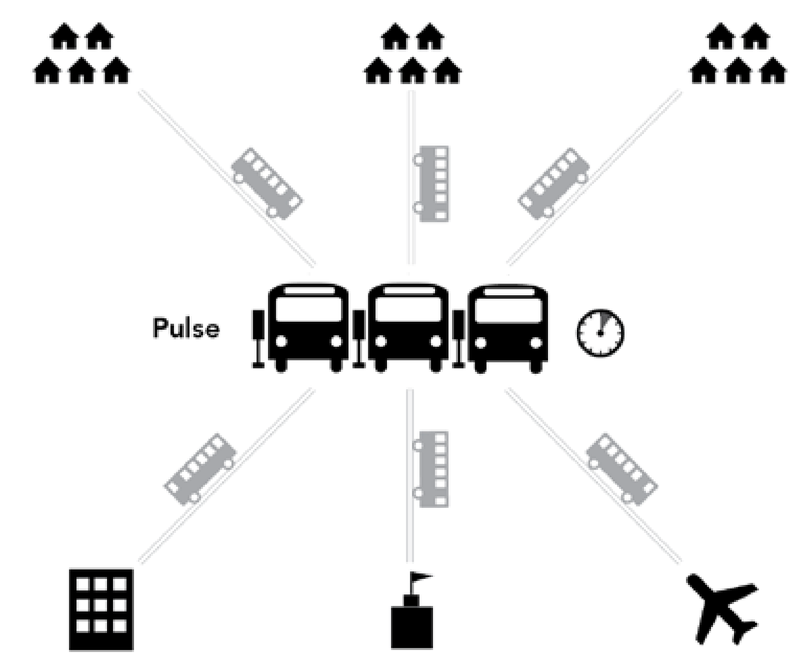
Many transit networks in small and mid-size cities are operated with a "pulse" at a central location like downtown. In the case of Burlington, the more likely location would be at the Burlington GO Station.

To offer a pulse, an agency must design its routes to be a certain length so that buses can all arrive at the pulse point at the same time, each hour, or half hour. The buses dwell together for a few minutes, passengers connect among them, and then they depart again. (This can happen at any regular interval, though half-hourly and hourly pulses are common.)

A pulse is an excellent way to create a network out of a set of routes, because it makes transfers less onerous and risky than they would be if they happened at random. This is especially important for low-frequency routes. If two 30-minute routes cross someplace in the city, and someone wants to transfer between them, their average wait will be 1/2 of the frequency, i.e. 15 minutes. (Sometimes they will get lucky, and wait 1 minute; sometimes they will get unlucky, and just miss their connection, and wait 29 minutes. On average, they will wait 15 minutes.) This amount of waiting time, and degree of variability in trip time, is intolerable to most people, so hardly anyone will rely on such a connection.

Instead, if the transit agency designs the network so that those two 30-minute routes pulse together at a Transfer Center, people's wait at the connection point will be reliably just a few minutes long. Many more people will be willing to transfer between low-frequency routes if the connection is quick and reliable.

Figure 43: Graphic Example of Radial Network with a Central Pulse Location



Transit Service Analysis

There is a cost to pulsing, however. First, the routes must be designed so that they can make a round trip in the right amount of time to get back to the pulse with all of the other routes. This makes it hard for Burlington Transit to lengthen a route just a tiny bit in response to requests. It also means that any reduction in the speed of the bus can be threatening to the pulse, since that bus may not be able to do its round trip in the required amount of time.

Second, the routes must be given enough spare time to protect them against all of the predictable or unpredictable delays that happen on the roads. If two 30-minute routes are meant to pulse together, and one of them is often late and misses the rendezvous, then the transferring passengers face waits even worse than if the routes were connecting at random – they may often be waiting 25 minutes! The spare time added to schedules to protect against delays is called "recovery time," and it is essential for the reliability of a pulse.

Radial networks are well-suited to pulsing, and vice versa. As discussed above, however, the city's grid road network and dispersed centres make a centralized pulse location difficult to fit within the Burlington Transit network. Therefore, the hybrid system that has developed over time lacks the positive benefit of a centralized pulse point for transferring between all low frequency routes. And as a hybrid grid with mostly low frequency routes, it lacks the consistency of a high frequency grid where all possible destinations are one, short wait transfer away.

One example of the challenges this creates is the difficulty of reaching Hamilton from Lakeshore and Burloak. In the current network, a person would board a Route 20 bus bound for Appleby GO. At Appleby GO you could transfer to Route 21 to Burlington GO where you could then transfer to Route 1 or Route 101. Alternatively, because Route 20 and Route 10 are interlined, you could remain on your bus and ride through downtown and up Maple Avenue to transfer to Route 1 or 101 at Maple Avenue and Fairview Road. While the second option requires only one transfer, it requires a circuitous path.

Prior to 2012, the Burlington Transit network featured a more grid-like design that facilitated easier connections across town. In that network, Route 10 and 20 were a single route and Route 1 and Route 21 were a single route. Thus, from Lakeshore and Burloak, you could ride in either direction on Route 10 and proceed directly to Maple and Fairview to connect to Route 1. Or you could ride the opposite direction on Route 10 to Appleby GO and transfer to Route 1 there. In either case the trip was more direct and it was faster.

Complexity

In addition to the complex mix of grid and radial structure of the Burlington Transit network, we can observe from the network map that the service offering is fairly complex. The Burlington Transit network is stretched very thin, trying to serve many places on a small budget.

Most of the sources of complexity, described below, arise from this tension. Some of these sources Burlington Transit has managed to keep to a minimum; others add a great deal of complexity.

Many routes relative to total service

The biggest source of complexity in most transit networks is the sheer number of routes. One way to think about this is to ask, "*How many different patterns is my transit agency dividing a fixed amount of service into?*"

Burlington Transit's resources are divided into a large number of routes, and this makes the network more spatially complex and hard to parse (and also means that most routes run infrequently). The complexity is visible on the weekday midday frequency map (Figure 24 on page 25), which is dominated by blue and green lines representing routes that run only once or twice per hour. Splitting service on Plains Road between Routes 1 and 101, as previously discussed, also adds complexity and reduces the frequency of each route.

Two additional sources of complexity are the separate routes that operate just at night and the separate schedule of service for holidays. Many other transit agencies operate a Sunday schedule on holidays to minimize complexity.

Special trips and extensions

Another source of complexity is special trips and branches. A transit agency may send certain buses on a different route, just a few times a day, to provide service to a place or an organization that particularly needs it. In the case of Burlington Transit, many of these special trips are called extensions and are marked with an "X" on the schedule and bus.

Special trips make the network look more complicated and harder to use without reference materials. Even the most experienced transit rider will sometimes get on the "wrong" bus on their route, failing to read the sign up top before they board or failing to understand that it means the bus will be skipping their usual stop, or following a different branch.

Burlington Transit makes some special trips, and they are shown in our weekday frequency map as dashed lines. Most commonly, special trips off of ordinary routes are simply adding a little extra length to the end of the route, or deviating to provide front-door access to a particular place. For example, Routes 2 and 3 makes special trips in the peak periods to reach the Highway 407 GO Carpool Lot (see Figure 44 below). Similarly, Route 3 deviates from Guelph Line in the AM peak to provide service to the Burlington GO Station. Route 12 deviates in the mid-day to provide more direct service to The Village of Tansely Woods, a senior home off Upper Middle Road.

In addition to these special extensions, Burlington Transit operates a separate type of service called Community Connection Routes. These routes operate only in the mid-day, Monday thru Friday. They operate completely different routes and they operate to the front door of major malls and other key destinations. These routes have been designed to meet at the Central Recreation Center and to connect to major senior centres around Burlington. These routes operate hourly and they are marketed and designed specifically towards riders who do not want to walk and who are not concerned about waiting.

Given that these routes are specifically designed to meet the needs of a small group of riders and they operate for less than 3 hours a day, it is not surprising that they get very low ridership and very low productivity. But they are obviously not designed to achieve a ridership objective. Nevertheless, the very low productivity level of these routes suggests that they may be served more effectively with some kind of on-demand transit option such as a dial-a-ride service.

Figure 44: Example of Route Extensions for Routes 2 and 3

Service Frequency

An additional source of complexity in the Burlington Transit system is the variety of service frequencies offered. Most Burlington Transit routes do operate on "clockface frequencies". Many transit agencies deliberately design routes, and write schedules, so that routes have "clockface frequencies." This means that the time between buses at any given stop is 15, 20, 30 or 60 minutes. This pattern in a schedule is far easier for most people to recognize than frequencies that don't relate to 60 minutes.

On an hourly route, for example, the schedule becomes vastly easier understand and remember if the bus leaves at the same time in each consecutive hour. If you know that the bus leaves at :15 after each hour, and you know when service begins and ends each day, then with just these three facts you know the entire day's timetable.

Clockface frequencies are especially important at low frequencies, such as hourly or half-hourly. At these frequencies, a trip must be planned around the limitations of the timetable, so a timetable that can be remembered makes it easier to plan a trip spontaneously.

While Burlington Transit uses clockface frequencies, it operates routes at five different frequencies (15, 20, 30, 40 and 60 minutes). Routes 10 and 20 operates every 20 minutes and Route 4 operates every 40 minutes. Most other routes operate every 30 minutes or every 60 minutes. This complicates any attempt to create a pulse or to create consistent timed connections between routes. It is impossible to create a pulse between Routes 4, 10, and 20 and the rest of the system because the operate at frequencies that do not align evenly with the rest of the system.

Walkability and deviations

In thinking about walkability, we are almost always focused on the existence and quality of sidewalks and safe crossings, and these are certainly necessary minimal features of a walkable place. In Burlington, maintaining sidewalks in winter is a known challenge, especially sidewalks that are directly adjacent to large roadways and become covered in snow and ice.

However, even when there are sidewalks and safe crossings, the design of the street network itself can severely limit walking, and in doing so can limit the ridership potential of a transit stop or route.

To understand how, compare the two street networks at the right (Figure 45), each with a single bus stop in the middle:

The street network at on the left side of the example has very high connectivity. This means that of the places around a transit stop, most of them will be within walking distance, because the street network offers such direct paths. This means that a single stop can serve a fairly large area.

The looping streets and cul-de-sacs in the network at on the right side of the example have low connectivity. This means that of the homes around the transit stop in that neighbourhood, only a few are within a short walk. The street network requires people to walk far out of their way. A single stop in a disconnected street network is actually serving a much smaller area.

A secondary effect of disconnected street networks is that they require those roads that do go through to be even larger, in order to handle all the traffic that is forced to use them. This means that neighbourhoods like the one at bottom are surrounded by wider roads and bigger intersections, which makes walking or accessing transit on those main roads less safe and less pleasant.

If a transit stop is only within walking distance of a small set of places, then a transit agency needs to run more circuitous and looping routes in order to get close to everyone. This effect is visible in the Orchard and Alton Village neighbourhoods, where there are pockets of high density housing (as seen in the map of residential density, on page 11). Unfortunately, the poorly connected street grid forces Burlington Transit to run routes off the main roads and into the neighbourhood streets service in the area, contributing to low ridership and high costs.

Walkability around major intersections may become a bigger challenge for Burlington if the City decides to add frequent routes that connect to the northern parts of the city. In cities with frequent transit networks, frequent routes cross at major intersections and people simply transfer at bus stops at the intersection.

The example of Appleby Line and Dundas Street in Figure 46 is instructive. The typical crossing distance for this intersection is about 43 metres, which is not terrible. But the additional challenge is that for frequent routes to make a good connection, they need to stop as close to the intersection as possible. In this example and as is common across much of Burlington, most development is not facing the intersection or even near it. Therefore, stop locations at this intersection would have to trade-off between making transfers easy and making access to surrounding businesses easy.

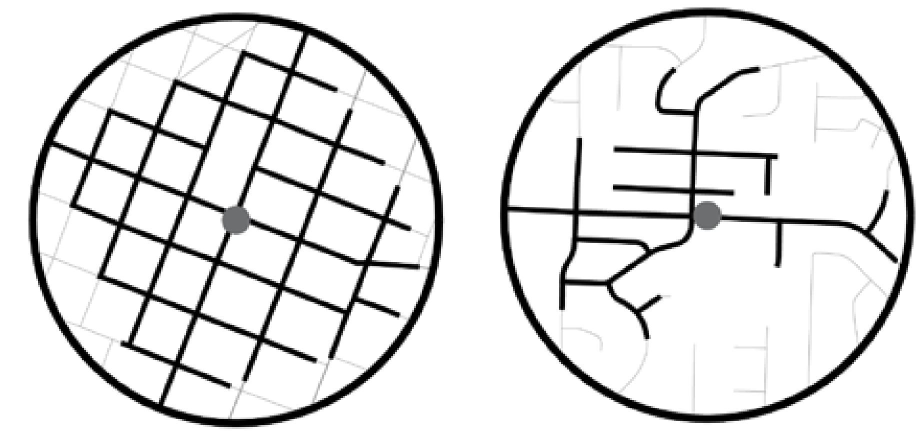


Figure 45: Example of Connected and Disconnected Road Networks

Figure 46: Intersection of Appleby Line and Dundas Street

5 Financial Analysis

Financial Analysis

Summary

Funding Sources

Burlington Transit's annual operating expenses are funded primarily from contributions from the City of Burlington. In 2015 about 57% of operating revenues came from the municipal contribution. Passenger revenues contributed another 37% and the provincial contribution provided 6% of operating revenues.

Operating Costs

The largest cost for Burlington Transit (based on 2015 reporting to CUTA) is the labour cost to pay drivers and supervisors to operate the buses. Called Transportation Operating expenses, these account for 55% of operating costs. The second highest cost is vehicle maintenance at 19%. Fuel is the third highest expense, at 13% of all costs. Plant (or building) maintenance and general and administrative expenses round out the remaining costs for Burlington Transit at 3% and 9% of costs, respectively.

These costs are in line with the typical for transit agencies. Labour costs to operate buses is almost always the largest expense for any transit agency.

Sources of Operating Revenue (2015)	Amount	Percent of Total
Passenger Revenue	$5,346,741	37%
Provincial Contribution	$842,100	6%
Municipal Contribution	$8,243,973	57%
Total Operating Revenue	$14,432,814	

Types of Operating Cost	Amount	Percent of Total
Transportation Operating	$7,943,508	55%
Fuel	$1,941,373	13%
Vehicle Maintenance	$2,788,885	19%
Plant Maintenance	$407,365	3%
General/Administrative	$1,351,683	9%
Total Operating Costs	$14,432,814	

Figure 49: Table of Revenues and Costs of Burlington Transit in 2015

Sustainability

A key question about financial condition is whether the current operations are sustainable given recent funding levels. As previously noted, one key issue with the current way Burlington Transit operates is that the current schedules do not allow sufficient layover and recovery to maintain adequate on-time performance. This suggests that current operations are not sustainable within current funding.

Another area of concern is the level of vehicle maintenance. Compared to Ontario peers[1], Burlington has fewer maintenance staff per vehicle and operates far more service kilometres per maintenance staff. This latter statistic is perhaps the most problematic. Vehicle wear and tear is generally most related the number of kilometres driven. Currently Burlington Transit operates about 50% more service kilometres per maintenance staff than peer agencies. These peer comparisons on maintenance suggest a lack of sufficient maintenance personnel to properly service vehicles.

The lack of sufficient maintenance staffing and the insufficient layover and recovery time in schedules both suggest a generally excessive parsimony by the city and the transit agency. The cost of narrow margins on schedules and maintenance is low reliability.

1 All data in this analysis is from the Canadian Urban Transit Association (CUTA) Transit Fact Book reports for 2005 to 2015.

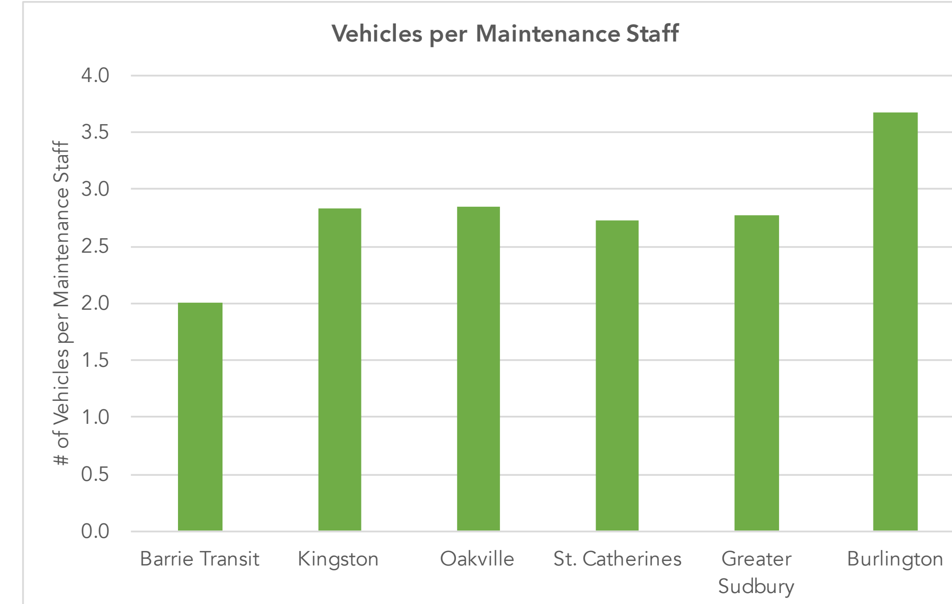


Figure 47: Graph of Vehicles per Maintenance Staff for Peer Agencies in 2015

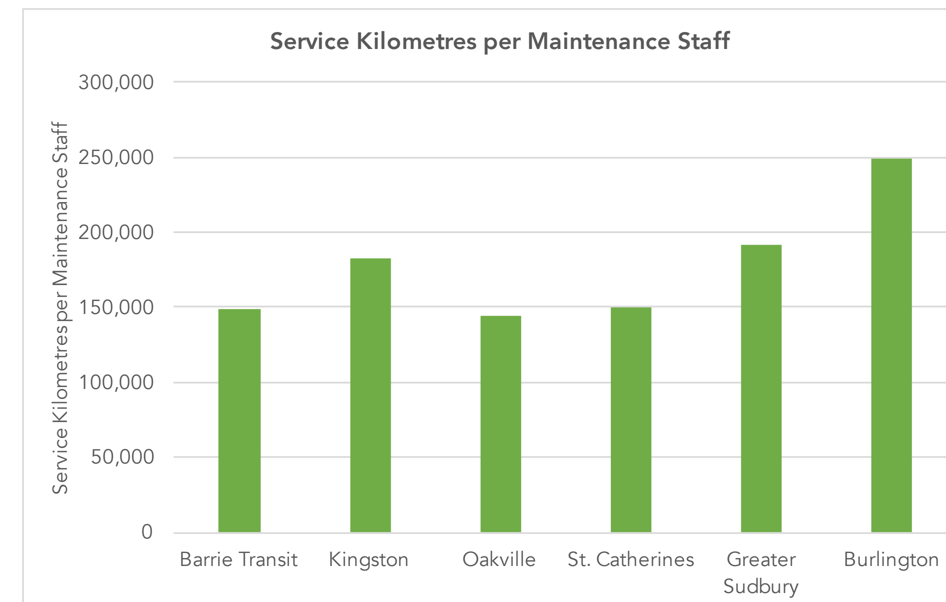


Figure 48: Graph of Service Kilometres per Maintenance Staff for Peer Agencies in 2015

Financial Analysis

Funding Levels

Burlington Transit has a Revenue/Cost Ratio of 37%, meaning that 37% of costs are recovered from passenger revenue. This ratio compares well to peer agencies in Ontario.

For many years, the City of Burlington set a goal of achieving a revenue/cost ratio of 50%. While there was no definitive reasoning for this specific level, it was likely set as a goal to meet a general business objective of being as "profitable" as possible. Of course, in the case of public transit, being profitable means minimizing the subsidy.

If the goal is to minimize the subsidy to transit, then on a per capita basis Burlington is doing quite well. Compared to peer agencies, the municipal contribution to transit is very low. Figure 51 shows the comparison of municipal contribution per capita across peer agencies in Ontario. Burlington contributes about $47 per capita to transit. Other peer agencies contribute $74 per capita, on average. Neighbouring Oakville spends approximately $76 per capita for transit. Given that Burlington has set highly ambitious goals for increasing the share of trips by transit and intensifying land use in mixed use communities, this difference in funding is stark.

These funding and cost recovery levels combined with the information on the apparently underfunding operations of the existing system raise essential questions about whether the current funding for the existing service level is adequate. It also raises the critical question about whether additional funding is needed to reach the goals that the City has set for transit.

Burlington is aspiring to do better than its neighbour Oakville and other peers in terms of increasing the percentage of trips by transit and other alternative means, but is well behind, by comparison, in its investment per capita in transit.

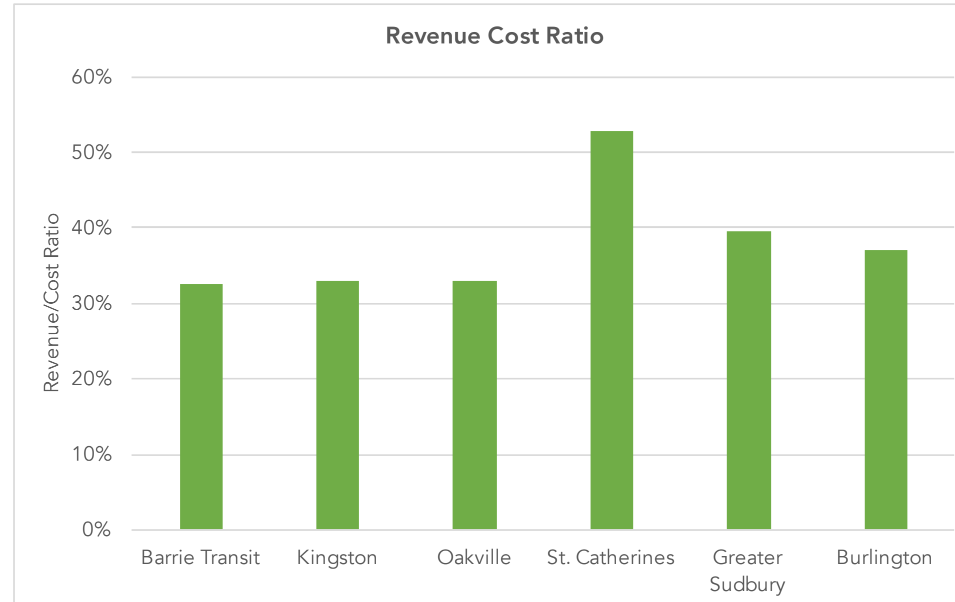


Figure 50: Graph of Revenue Cost Ratio for Peer Agencies 2015

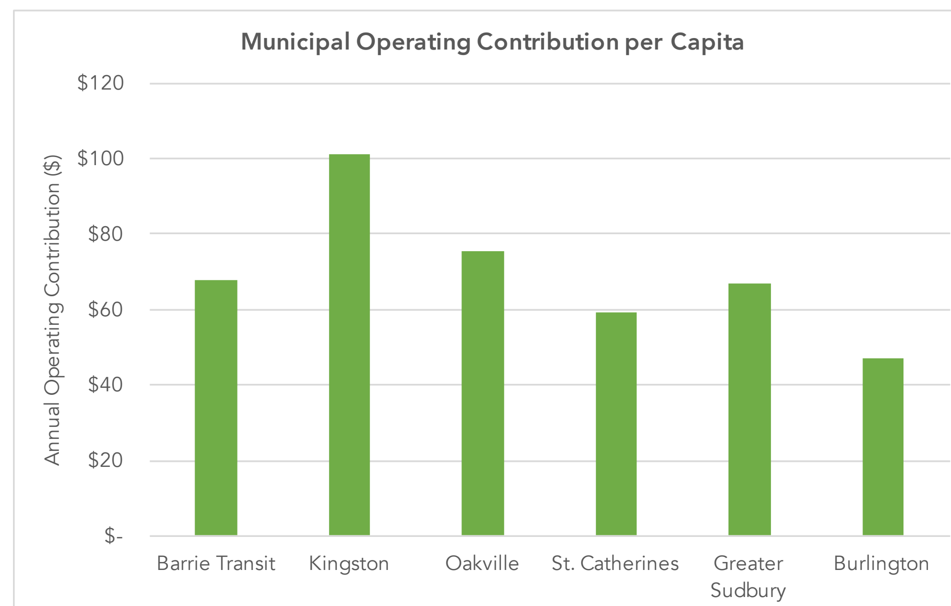


Figure 51: Graph of Municipal Operating Contribution per Capita in 2015

6 Key Choices

Key Choices

How to balance ridership and coverage goals?

The most fundamental choice before Burlington concerns ridership: How important is maximizing ridership within the Municipality's fixed budget for transit?

A goal of maximizing ridership serves several common intentions for transit, including:

- Low subsidy per ride.
- Vehicle trip reduction and emissions benefits.
- Support for denser urban development, where people can drive less and own fewer cars.

On the other hand, all sorts of other non-ridership transit goals also exist, and are also valid and important uses of transit resources. These include:

- Ensuring that everyone throughout the service area has access to some transit service.
- Providing lifeline access to critical services.
- Providing access for people with severe needs.

No transit agency focuses solely on either of these goals. Most transit agencies have routes that generate a lot of ridership very efficiently, and other which don't draw as much ridership but which have an important social purpose.

In its latest Strategic Plan the City of Burlington adopted goals and strategies related to both ridership and coverage.

The strongest statements of ridership goals were:

- "The city will shift a greater proportion of inbound and outbound traffic to public transportation."
- "Future development will be higher density, walkable and accessible, transit oriented with appealing streetscapes."
- "Growth is being achieved in mixed-use areas and along main roads with transit service, including mobility hubs, downtown and uptown."

The strongest statement of coverage goals was:

- "Employment lands are connected to the community and region through active transportation and public transit."
- "[A] public transit system that [is] all well-connected throughout the city."

There is a danger, with conflicting goals, that some people will accuse an agency of failing no matter what they do, because their adopted goals are in conflict. If a high-ridership bus line is crowded, they are scolded for not offering enough frequency there; yet if they remove buses from a low-ridership line to reallocate them to the high-ridership line, they are scolded for cutting access that some people rely on.

Only by acknowledging the conflict between these goals, and explicitly deciding how much effort to use pursuing each, can a transit agency succeed at both.

It is often said about public and private organizations alike that if you want to know what really matters, look at their budgets. High-level policies are valuable, but when they are vague or in conflict, the real evidence of what a community values is in the budget.

Thus we suggest that Burlington think about this choice not as black-and white, but as a sliding scale that the community can help to set:

> What percentage of the available budget for transit should be dedicated to generating as much ridership as possible, and what percentage should be spent providing transit where ridership is predictably low, but needs are high?

This is not a technical question, but one that relates to the values and needs of a community.

We estimate that about 50% of the existing Burlington Transit network is designed as it would be if maximizing ridership were its only goal. The other 50% has predictably low-ridership, suggesting that it is being provided for other, non-ridership purposes. This may be the right balance for Burlington in the future, or the community may wish for a shift in emphasis.

The direction of that shift – either towards higher ridership or towards wider coverage – and how fast Burlington Transit should make such a shift are both questions for stakeholders to discuss in this planning process.

One way to manage the perennial conflict between ridership and coverage goals is to define the percentage of a fixed route budget that should be spent in pursuit of each one. The City of Burlington could, as a result of this study, establish that it will continue to spend about 50% of its budget maximizing ridership, or it could decide to spend more or less towards that purpose.

The City could also decide to maintain the existing balance in the short term, but devote any new funding to either high ridership or wide coverage, and in that way shift the balance without cutting any existing riders' coverage or frequency.

Burlington's desired balance of ridership and coverage goals will determine how much of a role high-frequency routes play in its transit network. A high-ridership network would be made of fewer total routes, but with higher frequencies than most routes have today.

The frequency of service on routes in the Burlington Transit network will, in turn, affect some technical decisions about how the network is and managed:

- Is there a major pulse of low-frequency routes?
- Can connections between frequent routes be made outside of downtown or GO Stations?
- Is the network's shape primarily radial, or is it more like a grid?

The usefulness of each of these techniques will depend entirely on the frequency of the Burlington Transit network, and therefore on how ridership and coverage goals are traded-off against one another in the future.

Peak-Hour or All-Day Service?

Demand for transit service tends to be higher at peak periods during weekday mornings and evenings. These peak periods occur at similar times of day as peak traffic on a city's major streets and highways.

On a typical weekday in Burlington, the number of boardings is highest between 6 and 8 AM, and between 2 and 5 PM. At the same time, there is always some demand for transit service outside peak hours and on the weekend.

There are distinct advantages to focusing a transit network on peak-hour services. For example:

- Peak-hour services have the most potential to produce full buses.
- Peak-hour services have the highest potential for traffic congestion relief on regional streets and highways.

Peak-hour services have the highest potential to relieve individual riders

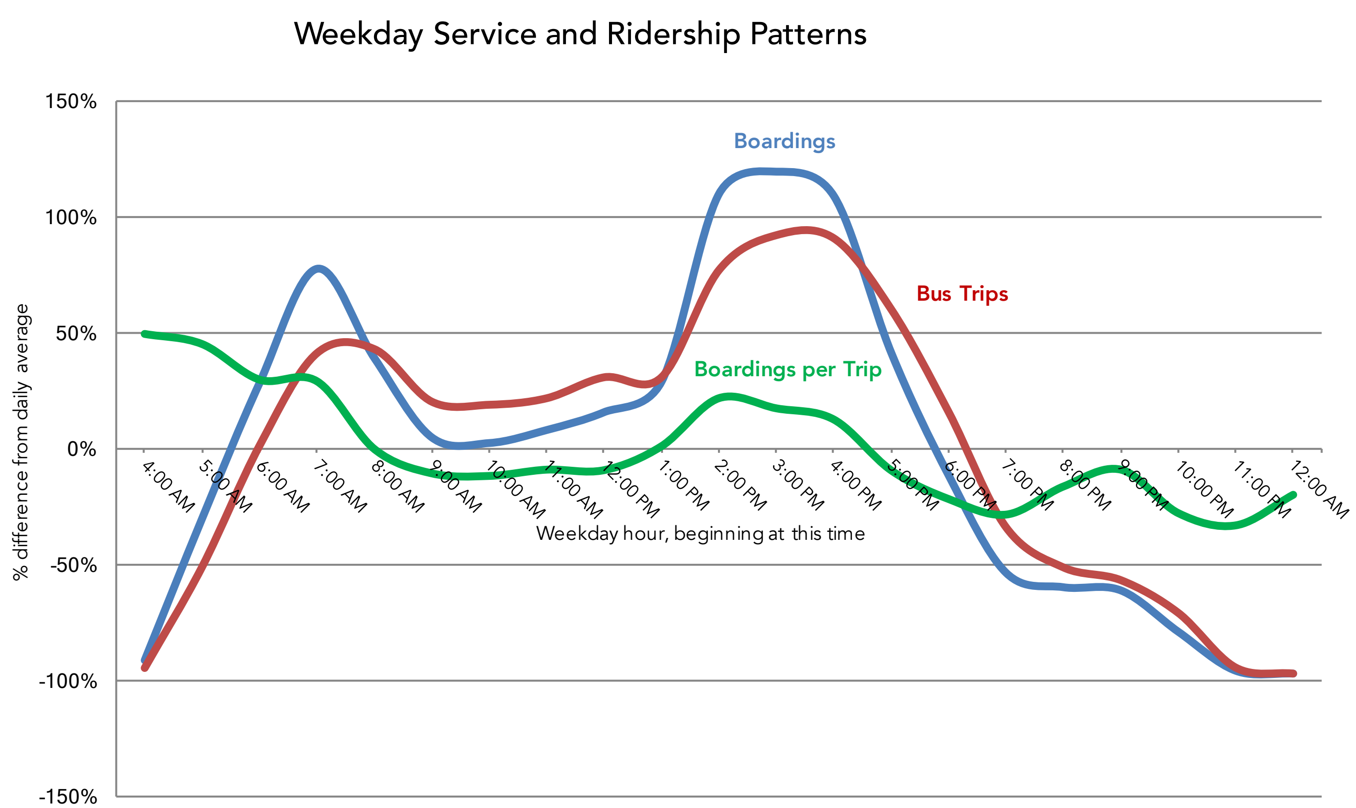


Figure 52: Graph of Boardings, Bus Trips and Boardings per Trip for an Average Weekday

of the stress of driving.

However, focusing on peak-hour services also has real disadvantages and costs, such as:

- Services focused on peak demand require transit agencies to maintain large fleets of buses that sit unused at most times. These buses must be purchased, maintained, stored and replaced on a regular basis.
- Peak-hour services tend to have a higher average labor cost than all-day services.
- Peak-hour services create extra deadhead costs from drivers and buses going to and from the bus garage multiple times per day.
- Peak-hour service tends to focus on the commuting needs of full-time office workers. But there are many other reasons to ride transit and many other types of potential riders. If service is only (or mostly) available at peak hours, many potential transit riders may find that they are able to make a trip in one direction but not in another.

Most transit agencies, including Burlington Transit, have networks that draw some compromise between meeting peak-hour demand and maintaining some level of service for the many transit rides that occur at other weekday times and on weekends. However, it is worth asking the questions:

> What is more important: fully serving higher demand at peak hours, or providing a useful level of transit service all day, everyday?

Resource Level: How Much Transit Do We Need?

The last question to consider in any planning process around transit is the simplest: Do we have enough transit service to support our goals?

The choice of what goals transit should serve is very separable from the choice of how much transit service to provide. The City could shift towards higher ridership, or higher coverage, within the existing transit budget. Transit outcomes would change as a result, even without a change in resources. This is a separate question from whether the sheer quantity of service in the City is appropriate.

The way that these two separate questions can become related, however, is if people's level of confidence in the City to deliver successful transit improves. If Burlington Transit's goals are not currently aligned with the goals of the community it serves, or if people do not understand what goals Burlington Transit is serving, then of course there will be a reluctance to increase investment in the transit system. Wrestling with the first choice – how to balance ridership and coverage – and altering the transit network to meet new, clearer goals, may improve people's sense that the transit network is delivering on their goals and is therefore worth further investment.

As mentioned earlier in this report, the City of Burlington provides less transit, relative to its population, than many of its peers. Transit is less relevant to the life of the city and its residents than it is in many of those peer cities.

On average across all cities, there is a simple relationship between the amount of service provided and the amount of transit ridership. Burlington could absolutely increase transit ridership without investing in more service. This would require cutting and reallocating low-ridership services, however, and while they may be low-ridership there are still small numbers of people who need them badly. The only way to substantially increase ridership without cutting coverage services is to provide more transit service. This almost always requires raising more funding.

> The only way to substantially increase ridership without cutting coverage services is to raise and spend more money on transit.

Another way to express this same idea is that wrestling with ridership vs. coverage is much harder in an austerity situation, when competing goals are fighting for a small fixed budget. When there is new revenue available for transit, ridership can be increased without cutting coverage. The growing resource pot protects the community from having to make painful trade-offs between competing, but closely-held, values.

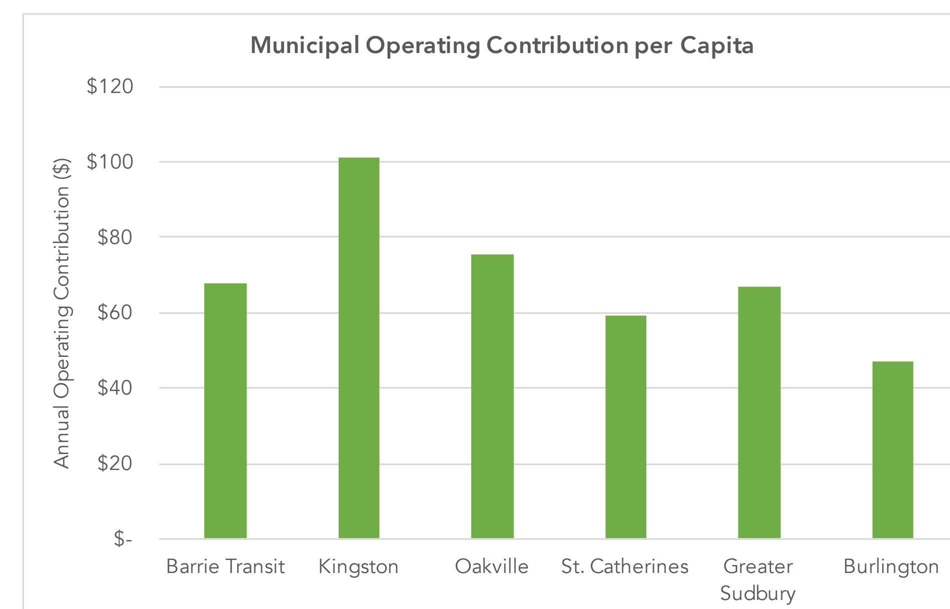


Figure 53: Graph of Municipal Operating Contribution per Capita in 2015

7 Conceptual Alternatives

Conceptual Alternatives

The trade-offs between ridership and coverage arises from the basic facts of how transit works, and from the reality of a limited budget for transit service.

Burlington Transit regularly hears from stakeholders that all of these additions would be valuable: frequency, coverage, later night and more weekend service. Within its existing budget, however, making any such improvements would require a cut somewhere else.

The trade-off between high ridership (and high frequency) on the one hand, and wide geographic coverage on the other hand, is particularly difficult to resolve. For this reason, Burlington Transit, the City and the consultant team have worked together to create three conceptual alternatives to illustrate the frequency-coverage trade-off in Burlington.

Conceptual Alternatives

The purpose of these conceptual alternatives is to help Burlington Transit's decision makers and stakeholders understand what would be possible within the existing transit budget. Understanding that everyone's preference would be for higher frequency *and* wider geographic coverage, both are simply not possible within the existing budget.

The existing budget is already being used effectively by the agency to deliver existing levels of frequency and coverage. There are no significant "inefficiencies" or "low-hanging fruit" that would allow Burlington Transit to meet such demands with existing resources. In fact, as noted in Chapters 4 and 5, the current system is operating on razor thin margins for its schedules and is likely underfunding its maintenance needs. Thus, additional funding may be needed just to maintain existing service. So any higher frequencies or coverage of new neighbourhoods would have to come at the expense of service elsewhere.

These alternatives assume the existing transit operating budget, we are not making any recommendation about the total quantity of service that should be offered. If the City chose to budget more operating resources for transit, this would make the trade-offs less difficult. The question of an appropriate level of investment should be considered after this exercise, once the limits of the existing budget, and the trade-offs it requires, has been clarified by these conceptual alternatives and the public response to them.

The three alternatives, then, represent three points on the spectrum of possible balance points between ridership goals and coverage goals. They are:

- **Coverage Concept** - 50% Ridership, 50% Coverage: This alternative matches the current split between ridership and coverage goals, but adjusts the current network to create consistency in frequency.
- **Midpoint Concept** - 70% Ridership, 30% Coverage
- **Ridership Concept** - 90% Ridership, 10% Coverage: This is the most extreme change from the current network, with the highest ridership potential but also the greatest reduction in low-ridership coverage services.

The spectrum graphic below illustrates how these three conceptual alternatives relate to each other and the ridership-coverage trade-off. As people think about their own reactions to the alternatives, and what kind of direction they would like to see Burlington Transit pursue in the future, they can locate their opinion along this spectrum.

Important Cautions

We are presenting three alternatives for public discussion in order to gain insight from the public as to how Burlington Transit should balance the competing goals of ridership and coverage, and also to get their feedback on service design ideas that are common to all alternatives. Because of this, the following cautions must be kept in mind.

The Concepts Are Not Proposals

A proposal is something that the proposer recommends. At this stage, neither Burlington Transit nor the consultant is proposing anything. The result of the public conversation about these conceptual alternatives will help guide us in developing the actual proposed network, which will be developed later in 2017 or 2018.

Some features are common to all conceptual networks, but even these are not proposals yet. In designing the concepts, we wanted to highlight the ridership-coverage trade-off, and to do this we tended to make a single choice about matters that were unrelated to that trade-off, and keep that choice constant across all alternatives. That does not mean that different choices could not have been made, and we welcome public comment about these features of the plan.

No Concept is Preferred at this Stage

Neither the consultant nor Burlington Transit staff has any preference among these concepts, and has no desire to steer the conversation to a particular result.

The most important word in this report is if. The Coverage Concept shows what might happen if Burlington Transit chooses to retain its current balance of ridership and coverage goals. At the other extreme, the Ridership Concept shows what might happen if Burlington Transit chooses to shift toward a great focus on ridership as the primary goal.

Because the Ridership and Midpoint Concepts are the most different from the existing system, this report puts greater focus on explaining them, including both the upsides and downsides. This can create the illusion that these concepts are being promoted.

The Big Picture Matters More than Details

When we sketch network alternatives for public discussion, we do so with less attention to detail than we would when developing a final proposal for implementation. Do not judge an entire concept solely based on some small routing detail that you like or dislike. The point of these concepts is the "big picture" contrast: Which of these networks, with its outcomes positive and negative, best reflects how you would balance the competing priorities?

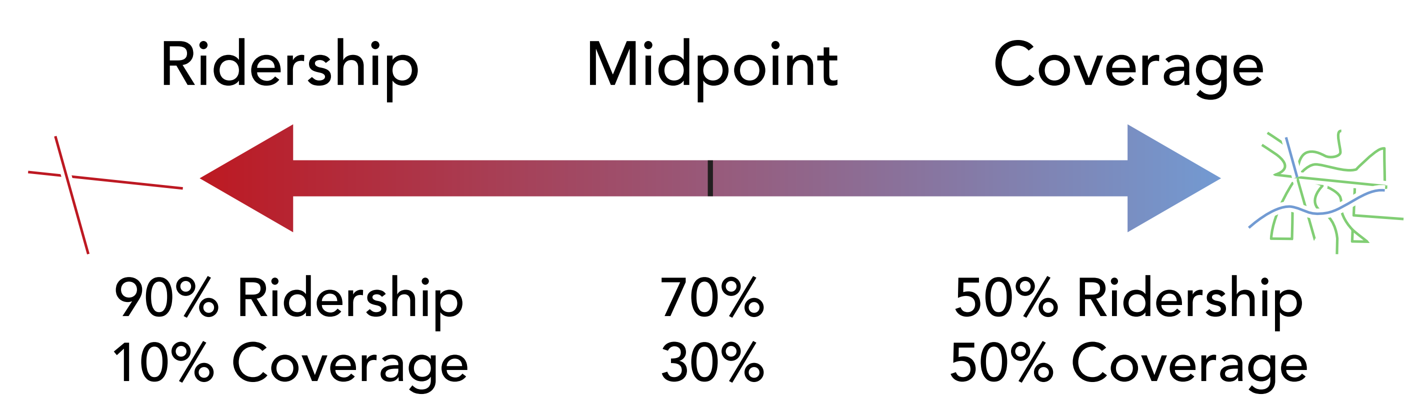


Figure 54: Spectrum of choices and the three conceptual alternatives.

Conceptual Alternatives

Existing Network

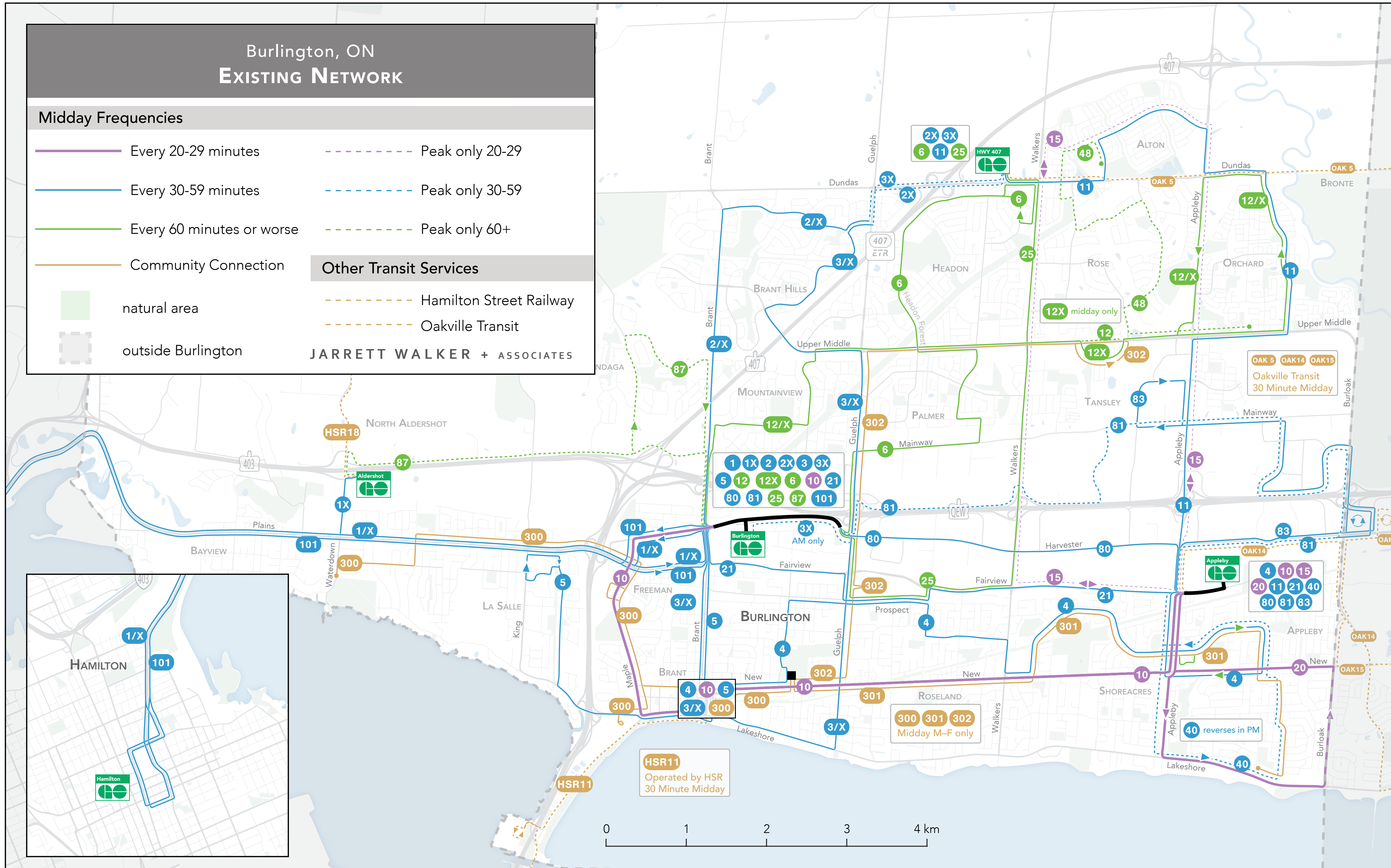
For comparison, the existing transit network for Burlington is shown in Figure 55. Each route in the network is coloured by the frequency of the service.

- Purple lines (like Routes 10 and 20) operate every 20 minutes.
- Blue lines (like Routes 1/X and 101) operate about every 30 minutes, though some blue routes operate about every 40 minutes.
- Green lines (like Routes 6 and 12) operate about every 60 minutes, though some green routes operate less frequently.
- Dashed lines operate only at peak hours and are coloured by their frequency at the peak hour.
- Dashed tan lines show service provided by neighbouring transit agencies.
- Solid tan lines show the Community Connection Routes (300, 301, and 302) that only operate mid-day on weekdays.

The maps on the next pages show each of the three concepts with a similar colour system. In reading these maps, please look first at the legend, which will remind you of the colours and their meanings.

These colours will have similar meanings in all maps produced throughout this project, so it is worthwhile to learn them. Without an understanding of these colours it is impossible to understand what each concept proposes.

Figure 55: Existing Network



Conceptual Alternatives

Coverage Concept

The Coverage Concept map shows a network that is very similar to today's system.

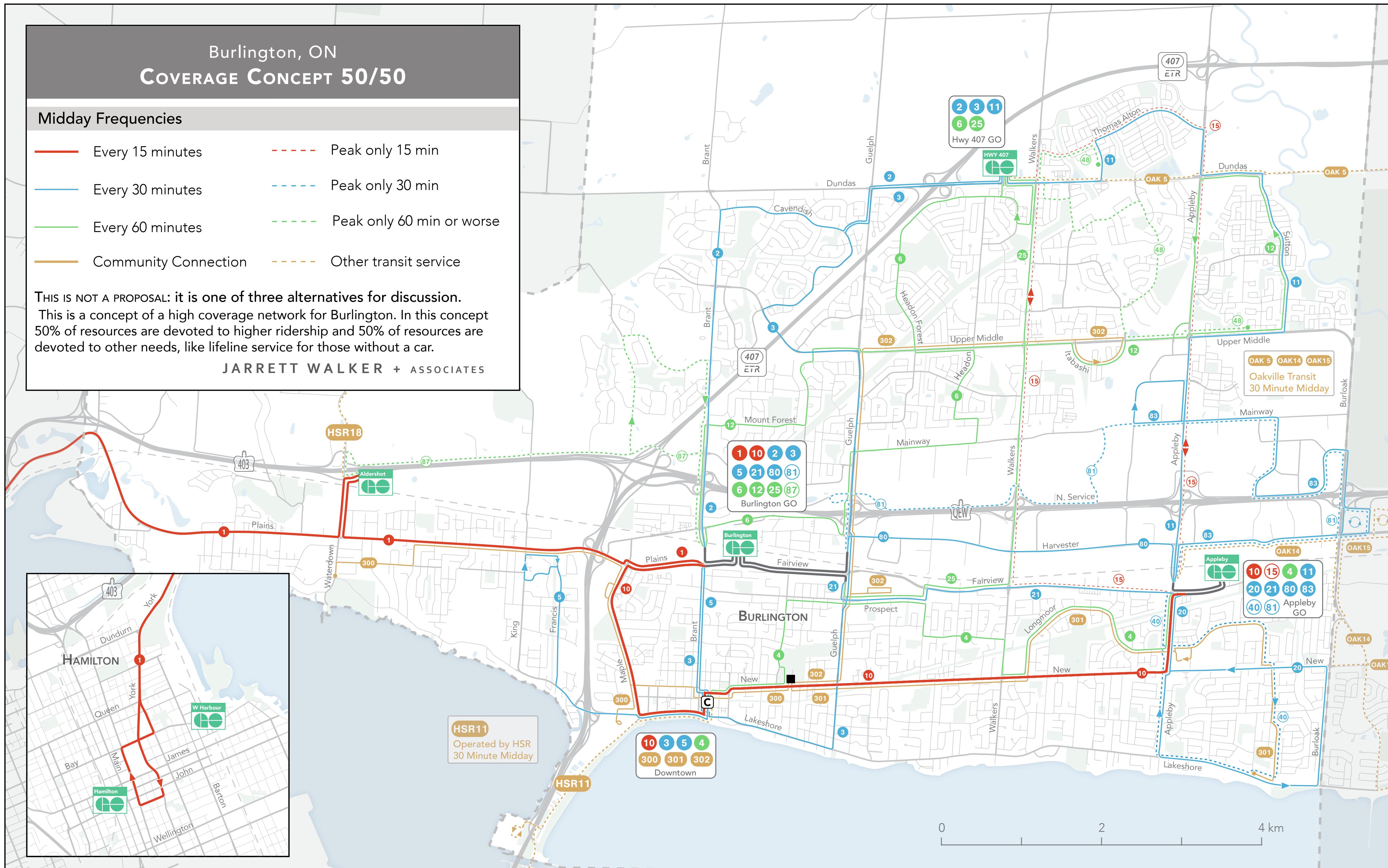
Like the existing system, the Coverage Concept devotes half of the budget to coverage goals and the other half to ridership goals. Within that limit, some modest streamlining is done. There are many blue and green routes covering most parts of the city plus peak-only lines providing additional service.

There are only two all-day red (frequent) lines:

- Route 1 on Plains Road is frequent (every 15 minutes). Route 101 has been removed to provide afford consistent 15-minute frequency all-day.
- Route 10 on New Street is also frequent.

Community Connection Routes, which only run for four hours in the middle of the day, are retained in this concept as they provide a different type of coverage than other low frequency routes. By providing service closer to the front door of shopping centres and hospitals, these routes minimize walking distances as much as possible.

Figure 56: Coverage Concept



Conceptual Alternatives

Midpoint Concept

The Midpoint Concept map shows a network with some key changes compared to the existing network that would increase ridership.

In this concept, 70% of resources are spent on service that should garner high ridership relative to cost while 30% of resource are spent on service that is meant to provide coverage to areas where ridership is not likely to be high.

Some key changes include:

- Route 1 on Plains Road is frequent (every 15 minutes) and now extends across Fairview Street to Appleby GO, creating a continuous frequent route across the southern part of Burlington.
- Route 10 on New Street is also frequent.
- A segment of Route 2 along Brant Street provides frequent service (every 15 minutes) from Burlington GO to downtown.
- All blue routes (2, 3, 5, 7, 11, 20 and 23) have 15-minute service during the peak (except for Route 12).
- Routes 2 and 11 interline at Hwy 407 GO, providing a single seat ride from the northeastern parts of Burlington to Burlington GO and downtown.
- The Community Connection Routes and some lower-ridership peak-only routes have been removed to afford the increase in frequency on other routes.

Figure 57: Midpoint Concept

Conceptual Alternatives

Ridership Concept

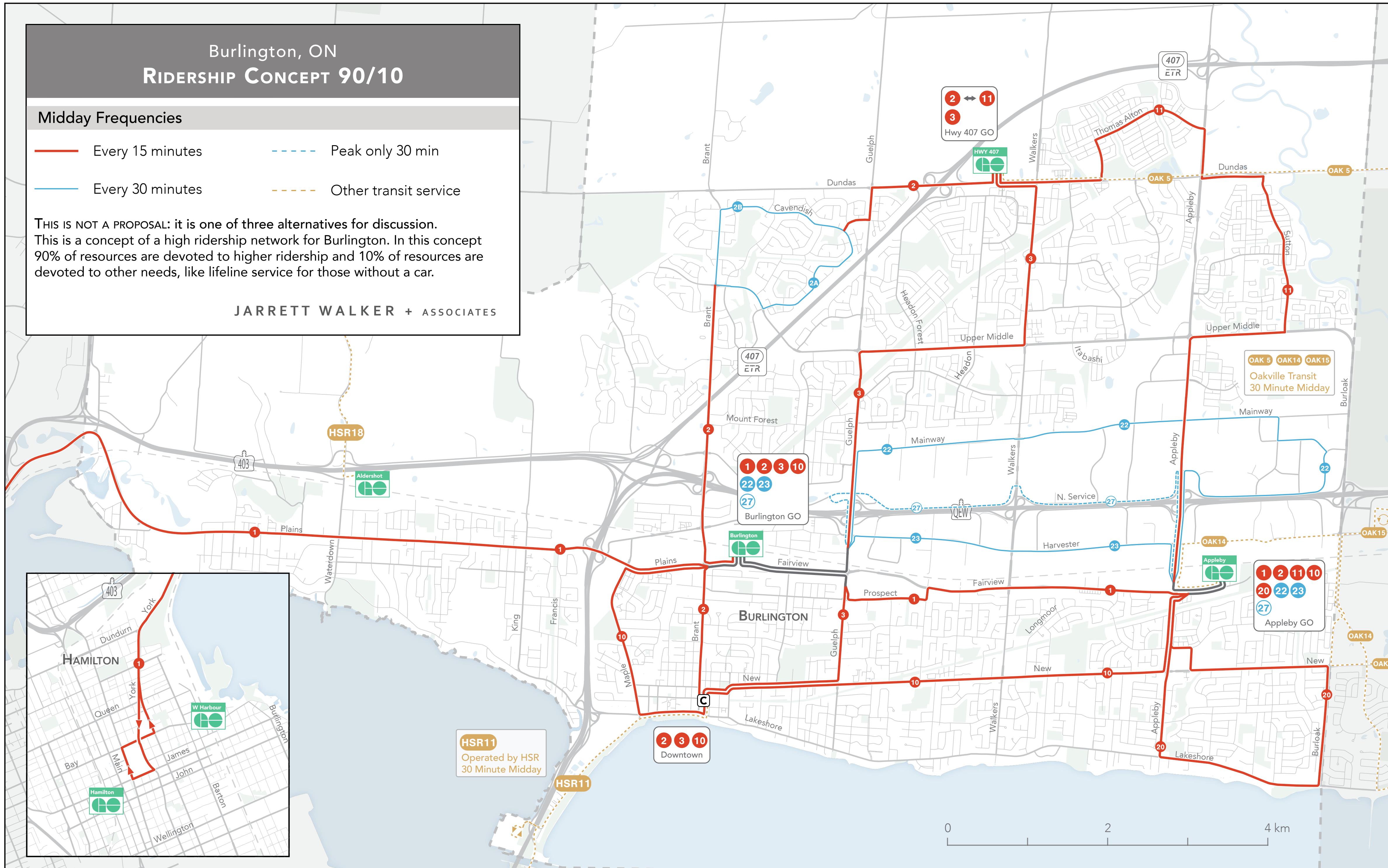
The Ridership Concept map shows a network with major changes compared to the existing network that would increase ridership.

In this concept, 90% of resources are spent on service that should garner high ridership relative to cost while 10% of resource are spent on service that is meant to provide coverage to areas where ridership is not likely to be high.

Some key features and changes include:

- Similar to the Midpoint, Route 1 on Plains Road is frequent (every 15 minutes) and extends across Fairview Street to Appleby GO, but it does not stop at Aldershot GO.
- Route 10 on New Street is frequent.
- Route 20 on Lakeshore/Burloak is frequent and has two-way service.
- Routes 2 and 3 are frequent but Route 3 now goes via Upper Middle and Walkers to Hwy 407 GO and Route 2 branches to serve all of Cavendish Drive.
- The two remaining blue routes (22 and 23) have 15-minute service during the peak.
- Routes 2 and 11 interline at Hwy 407 GO, providing a single seat ride from the northeastern parts of Burlington to Burlington GO and downtown.
- There are no green routes (hourly service) in this concept.

Figure 58: Ridership Concept



Descriptions of the Alternatives

On the following pages, we describe the main characteristics of the Alternatives, in particular how they differ from one another, and from the existing network.

For comparison purposes, a table describing the frequency and span of existing routes is shown at right.

Budget and fleet

These Alternatives were designed to use the same number of service hours, which is approximately equal to Burlington Transit's existing service hours for fixed route service. No additional funding for transit is assumed.[1]

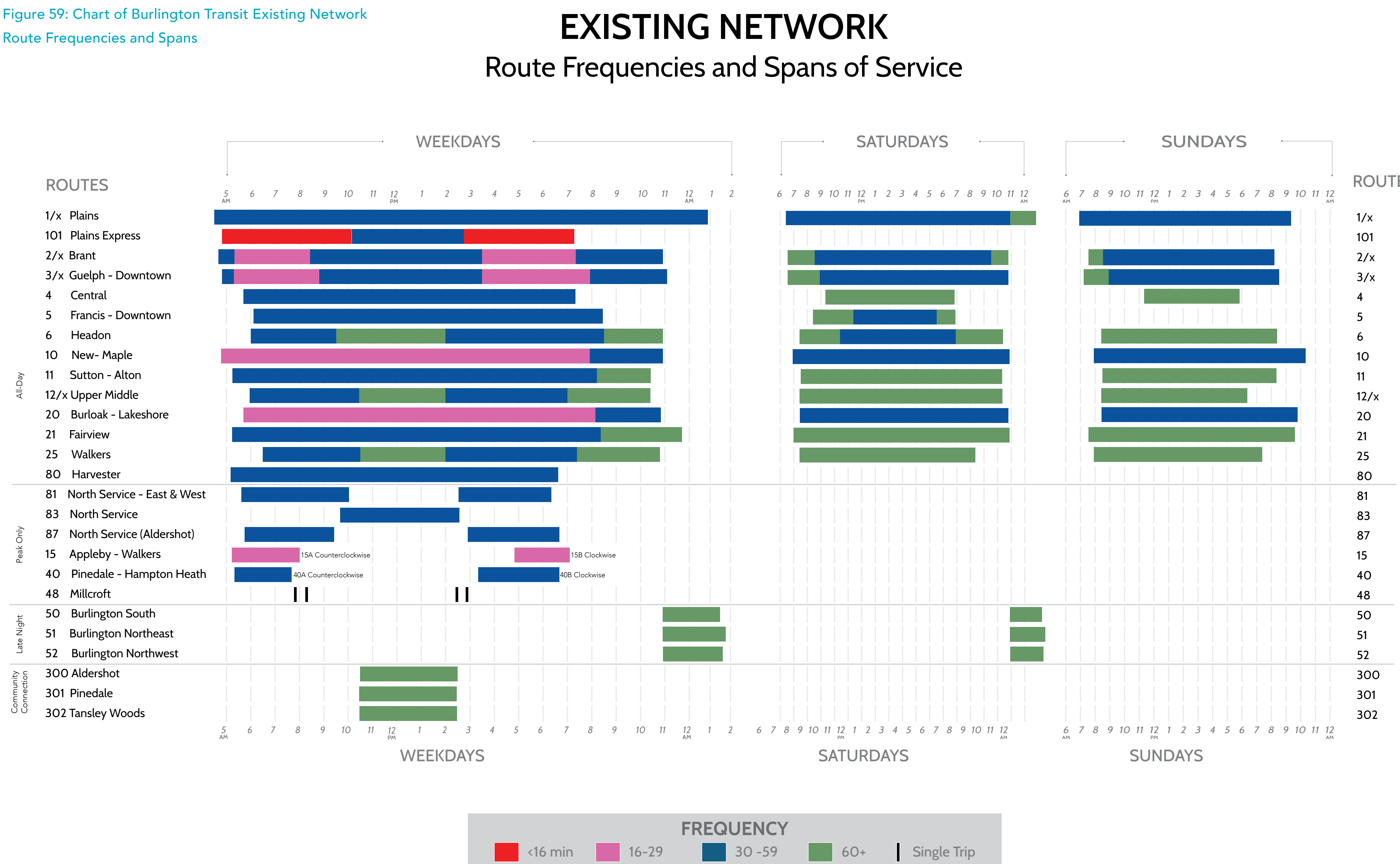
These alternatives would also fit within Burlington Transit's expected fleet limitations in 2018, requiring at most 44 vehicles in active service at any one time (plus spares).

Service categories

We have deliberately used a simpler set of service categories across all three of the Conceptual Alternatives, so that differences in frequency and span are easier to notice when comparing the three maps. This means that a line of a given color offers the same frequency and span as other lines of the same color, on all three maps. The only exception to this is that all routes on the Coverage Concept operate one additional hour per day than the Midpoint or the Ridership Concept.

The frequencies and spans of service on each route in the Alternatives, and in the existing network, are shown in colorful tables on this page and the following pages. The hours of service represented in these tables are meant to be approximate, rounded to the nearest hour.

Figure 59: Chart of Burlington Transit Existing Network Route Frequencies and Spans



One key difference from the existing network is that all three alternatives keep most routes running seven days a week and on holidays. Today's system has a separate schedule for holidays that provides less service than on Sundays. So if a route runs all day on weekdays, it runs on Saturday and Sunday as well (except for Route 80 in the Coverage Concept). In the existing network numerous routes do not run on Sundays or holidays.

Another key difference is that the span of service in each alternative is more consistent for all routes, but it is also generally shorter than today's span of service. There are no late night routes and most service ends by 9 or 10 pm.

1 The operating budget for these Conceptual Alternatives is about 165,000 service hours per year.

Conceptual Alternatives

Figure 60 shows the frequency and span of service for all routes in the Coverage Concept. Most routes in this concept have a similar frequency as today but there is less extra peak frequency on Routes 2 and 3. Routes 1 and 10 have 15-minute frequency which makes it easier to time connection with the hourly and half-hourly routes.

As discussed in Chapter 4, a key issue with the existing network is that about two-thirds of existing service does not have sufficient layover and recovery to ensure reliable operations. Therefore, the span and frequency of service that is shown in the existing service map and existing frequency and span chart is unreliable and unsustainable.

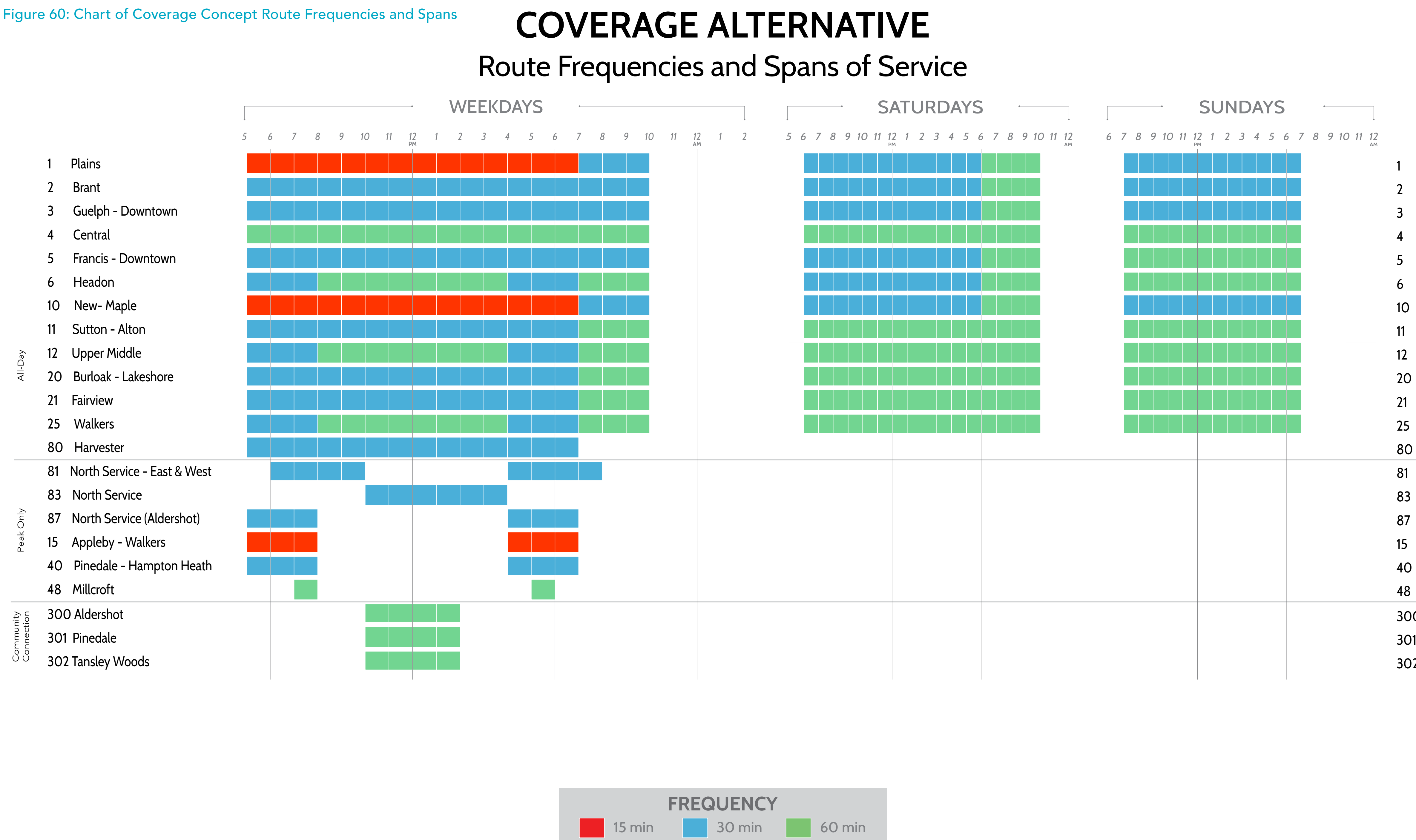
Each of the three service concepts correct this issue, at the cost of having to reduce the span of service. Also, each concept is designed to have a consistent start and end time for every route, so that differences in frequency of service is the primary difference. This is done intentionally so that the public, stakeholders and elected officials can focus on the key trade-off, frequency and ridership versus coverage.

In a draft proposal or a fully operational network, the actual start and end time of each route would vary more than what is shown in the span and frequency charts of these concepts to more closely fit the demand of each route.

Therefore, readers can and should provide thoughtful comments on the need or desire for additional service in the evening or late at night on specific routes, but that is not the focus of the trade-off discussion at this phase of the Integrated Transit Mobility Plan.

Like the ridership-coverage trade-off, an increased span of service would have to come at the expense of frequency during the day or coverage should the desire be to stay within existing financial resources.

Figure 60: Chart of Coverage Concept Route Frequencies and Spans



For example, if one wanted to run Route 1 later in the evening than is shown in one of the concepts, the cost to run later would have to be borne by reducing the frequency of Route 1 or another route during the day or by reducing or eliminating coverage (such as by shortening Route 1 or eliminating service on another route). Alternatively, additional funding would need to be allocated to reach the desired state.

Figure 61 shows the frequency and span of service for all routes in the Midpoint Concept. Similar to the Coverage Concept, Routes 1 and 10 have 15-minute frequency which makes it easier to time connection with the hourly and half-hourly routes. Route 2 is a 30-minute route, but with the overlay of Route 2b on Brant from Burlington GO to downtown the effective frequency on that section is every 15 minutes.

The remaining 30-minute routes (2, 3, 5, 7, 11, 20 and 23) all have 15-minute service during peak hours, creating a large high frequency grid during peak times.

On weekends, most routes are half-hourly or hourly, but service is retained on all routes except 23 (Harvester) and the peak only routes.

Figure 62 shows the frequency and span of service for all routes in the Ridership Concept. In this alternative, nearly all routes are frequent all day, including Routes 1, 2, 3, 10, 11 and 20. Only three routes remain that do not provide all day frequent service (22, 23 and 27). The two remaining 30-minute routes (20 and 23) have 15-minute service during peak hours, expanding the large high frequency grid during peak times.

On weekends, most routes run every half-hourly for most of the day.

Figure 61: Chart of Midpoint Concept Route Frequencies and Spans

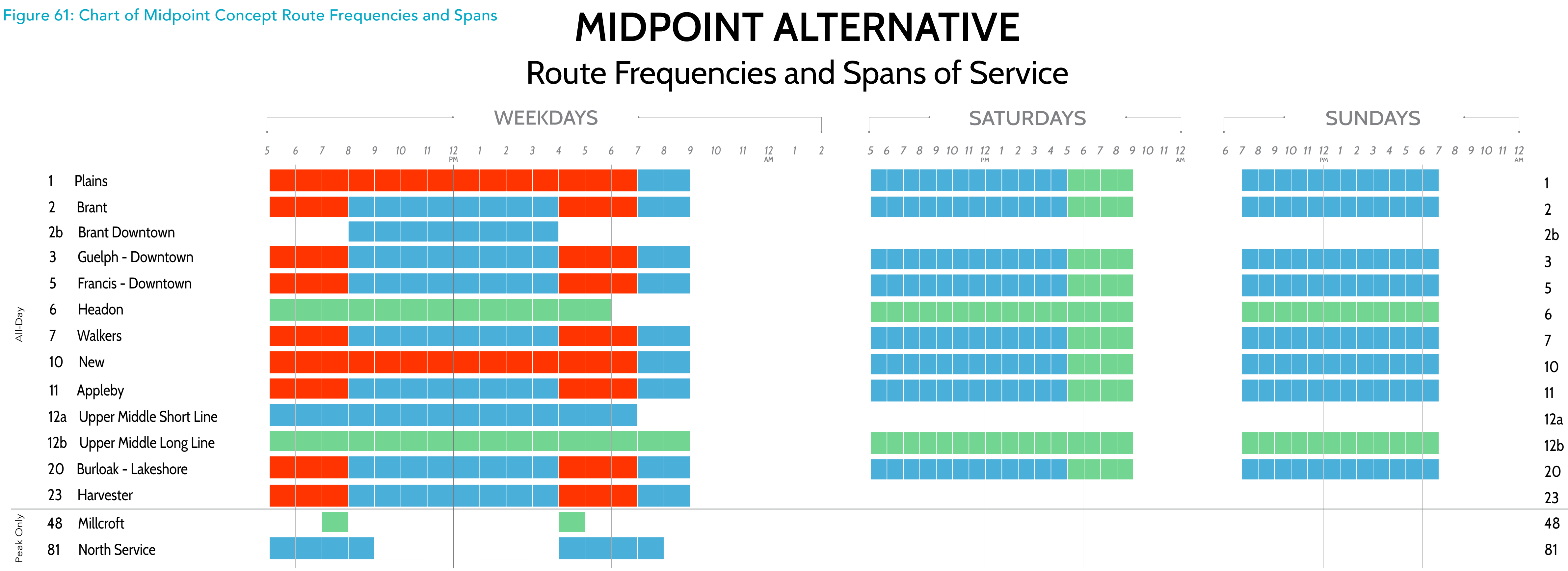
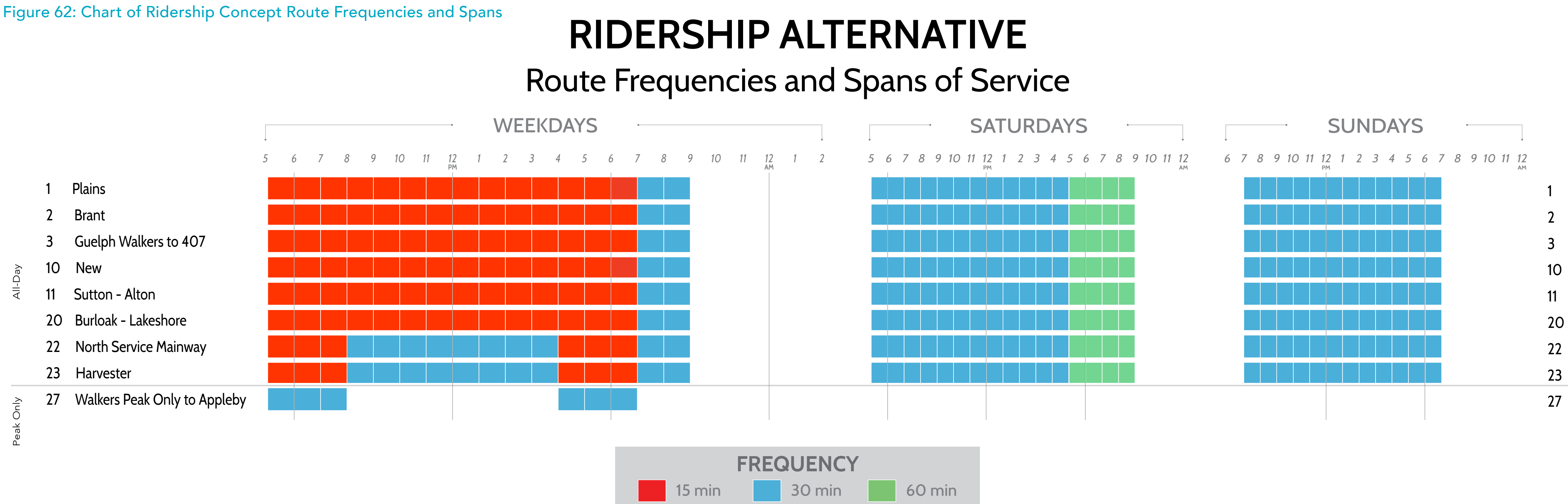


Figure 62: Chart of Ridership Concept Route Frequencies and Spans



Comparing Coverage and Ridership Potential

By simply comparing the maps on the previous pages, it is clear that the Ridership Concept would cover less of Burlington, and the Coverage Concept would cover more. But how many residents and jobs does that geographic coverage represent?

The charts at right illustrate how the conceptual alternatives would change the number of residents and jobs that have access to *any* service (no matter how useful) and to *frequent* service within 400 metres.[1]

Predictably, the Ridership Concept gets service (of any frequency) close to fewer residents and jobs (65% of residents, and 87% of jobs) than do the existing network and Coverage Concept. The Midpoint Concept falls in between, covering 76% of residents and 89% of jobs.

In exchange, however, the Ridership Concept gets frequent service within 400 metres of many more residents (51%) than do the other two alternatives (25% for Midpoint and 21% for Coverage). Of course, the Midpoint reaches many more people at the peak with the extra 15-minute service provided during peak times.

The Ridership Concept also gets frequent service within 400 metres of vastly more jobs (52%) than do the other two alternatives (32% for Midpoint and 23% for Coverage). It does this by concentrating service into fewer routes, in places where residents and jobs are also concentrated.

Access to frequent service is a good estimate of potential ridership. While frequency alone is not enough to cause high ridership, frequency deployed along direct routes, in places that are dense, walkable and proximate to one other, does tend to lead to high ridership, and to lower operating costs, and thus to high productivity.

Figure 63: Chart of Residents with Access to Transit by Concept

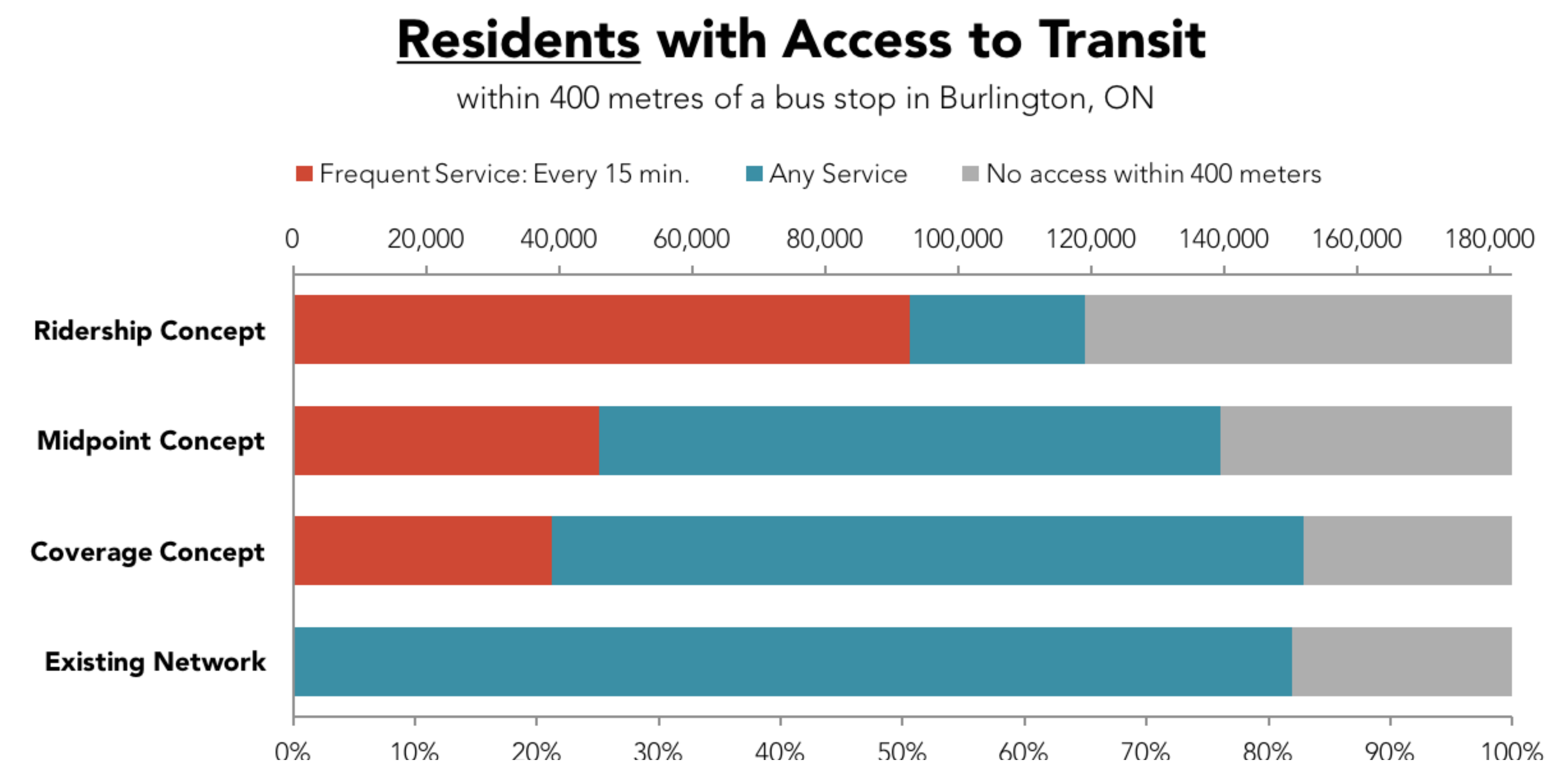
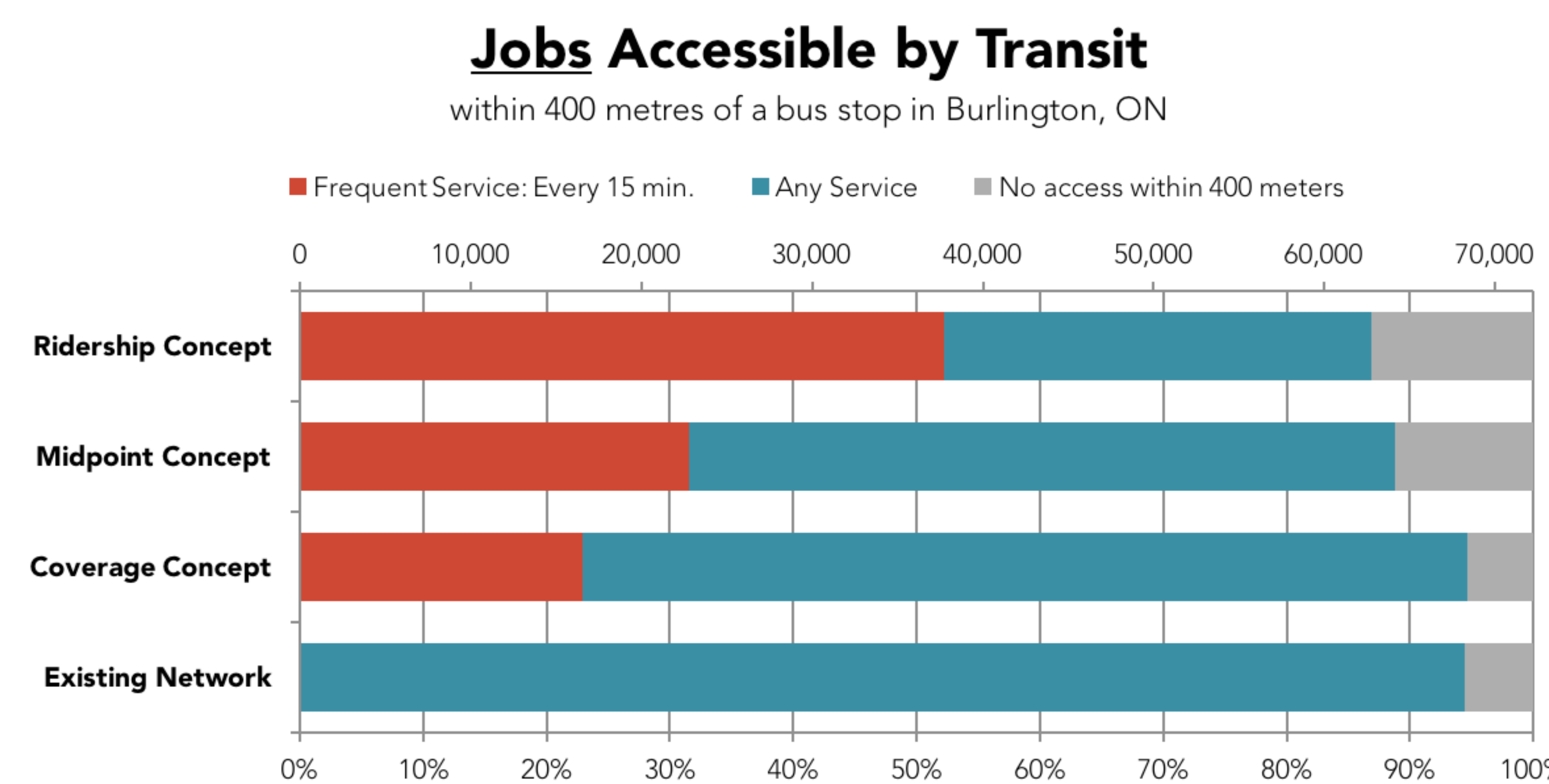


Figure 64: Chart of Jobs with Access to Transit by Concept



1 Data limitations requires that this analysis is done using the air distance (also called "as the crow flies" distance) to estimate the people and jobs near transit. We know this is imperfect and that it often corresponds to 600-700 metre walk, higher in areas with more disconnected street networks.

Liberty and Opportunity

To understand why the high frequency networks in these alternatives, and particularly in the Ridership Concept, have such high ridership potential, it is helpful to consider what they do in geometric terms.

Quite simply, high frequency services, especially in a grid pattern where many connections are possible, maximize the range of useful destinations that can be reached quickly, for the maximum possible number of people.

While this point can be proven with data, it also becomes obvious if we think about how travel decisions are made. For a person to choose transit over other modes, transit must provide a reasonable travel time to reach their destination. It stands to reason that when transit offers access to more destinations within a shorter travel time, to more people, it will attract higher ridership.

We can visualize this change in travel times and access, and compare alternatives to one another using this measure. We have analyzed, for several locations around the Burlington, what places can be reached in a fixed amount of time. Maps of this information are called "isochrones."

In all of the following isochrones in this section, you will see a dot for a key location in Burlington and a series of maps. Those maps will show where you could be, in a fixed amount of time, by walking and riding transit.

We sometimes refer to these as maps of liberty and opportunity because that's what they are. If someone chooses to rely on transit, they will be constrained by where transit can readily take them, and will experience the blobs in these images as walls around where they can go and what they can do. For someone to choose to rely on transit, and especially for them to decide to not own a car or to share a car with others, these blobs have to contain enough of the places that make people's lives complete: jobs, education, shopping, services, social opportunities, and so on.

You use this tool to think about access in the reverse, as well. For a work site or store at the selected point, the blobs show who could readily get there: the employees it can attract and the customers who might visit.

Of course, the real measure of usefulness is not just how much geographic area we can reach, but how many useful destinations we can access within that space. All geographically accurate maps tend to emphasize land area, when what really matters is population and activity. That's why each page in this section shows not just isochrones, but also reports the numbers of jobs and residents within each isochrone, in accompanying tables.

Computer models that predict ridership have always been doing this analysis, behind the scenes. It has long been known that a good indicator of the ridership from a place is how many other useful places can be reached quickly from there, weighted by the number of people likely to be attracted to each of those destinations. More ridership arises from service being useful, for more people, to get to more places.

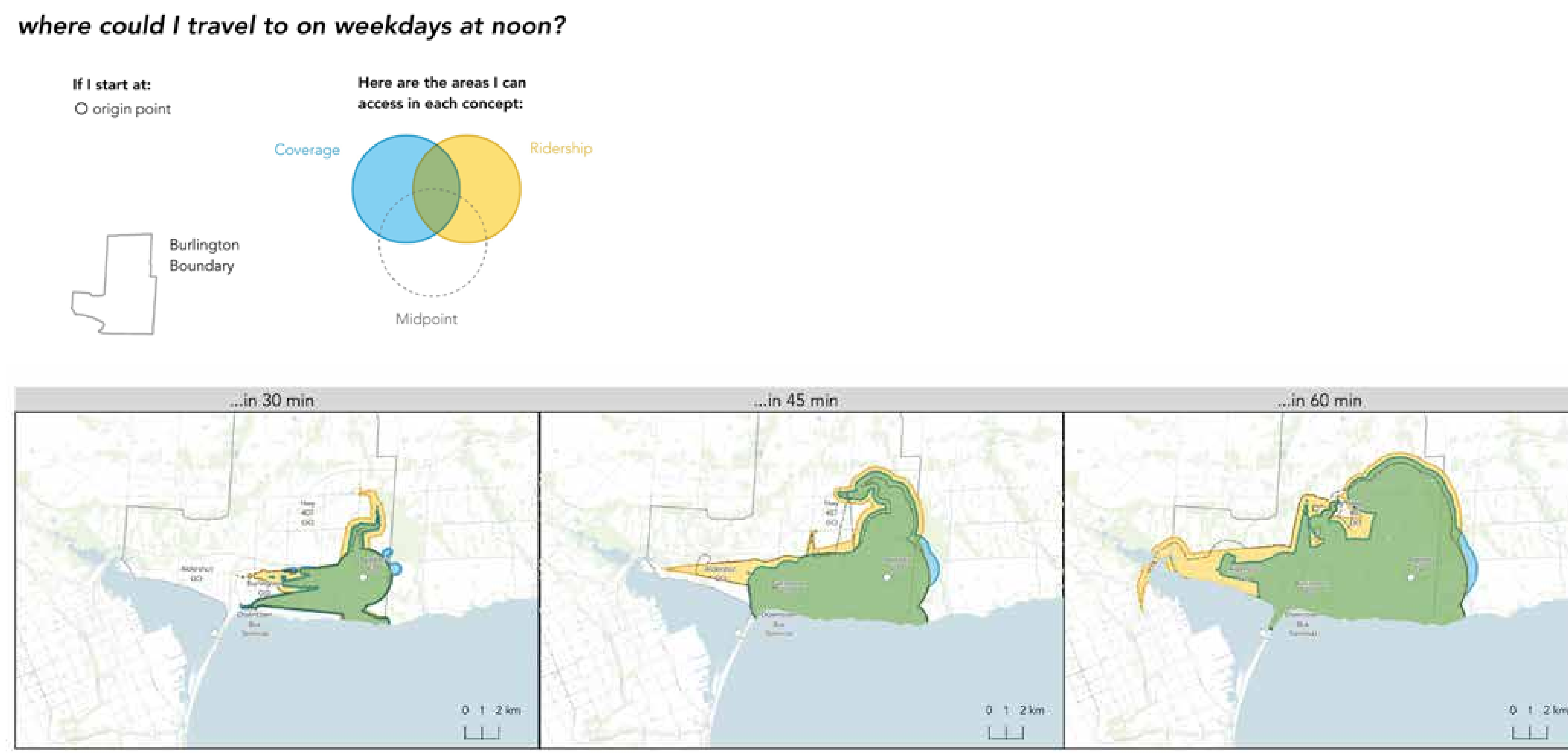
Thus larger isochrones – and dramatically larger numbers of jobs and residents within them – have always been a good indicator ridership potential.

This helps to explain why the Ridership Concept has the highest ridership potential and Coverage Concept has the lowest. The Ridership Concept offers the greatest expansion in where people can go, especially for those who live in the most transit favourable development patterns. Of course, the Ridership Concept does this by not trying to serve places where transit is less cost-effective, thus requiring people who live in those places to find other options for transportation.

Ridership is not the only payoff of large isochrones. Liberty and opportunity have their own value to Burlington, aside from how they affect transit ridership. For lower income people, transportation is the biggest barrier to employment, and can also limit access to education.

When low-income people are able to get to more places in less time, it means they have more choices in their lives, and in that sense, more freedom.

Figure 65: Example of Isochrone Maps and Diagram



From Appleby GO,

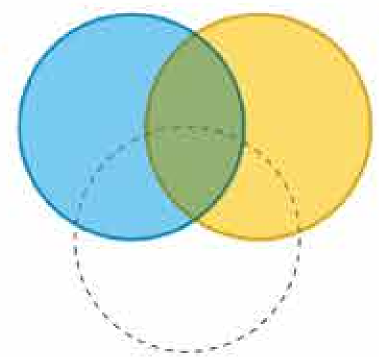
where could I travel to on weekdays at noon?

If I start at:

○ origin point

Burlington Boundary

Here are the areas I can access in each concept:



▶ This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	3,700	-	4,400	-
15	Midpoint	4,200	12%	4,700	8%
15	Ridership	4,200	12%	4,800	10%
30	Coverage	42,600	-	26,200	-
30	Midpoint	43,000	1%	27,800	6%
30	Ridership	54,200	27%	31,500	20%
45	Coverage	101,700	-	54,700	-
45	Midpoint	106,900	5%	56,700	4%
45	Ridership	121,600	20%	60,200	10%
60	Coverage	146,200	-	65,700	-
60	Midpoint	171,800	17%	69,300	5%
60	Ridership	170,400	17%	69,200	5%

Data: Halton Region Employment Survey 2015, Census 2016

From Burlington GO,

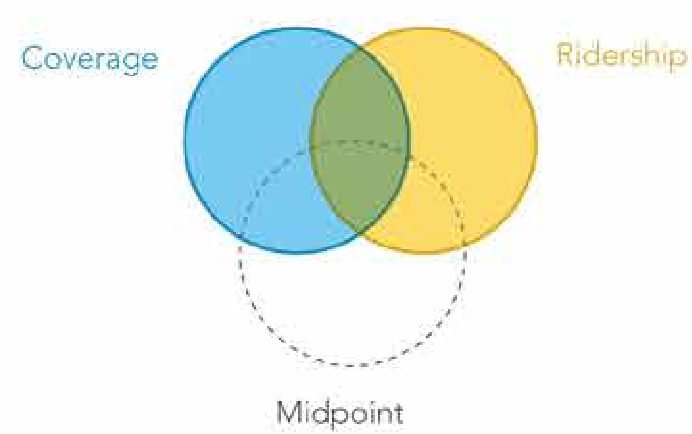
where could I travel to on weekdays at noon?

If I start at:

O origin point

Burlington Boundary

Here are the areas I can access in each concept:

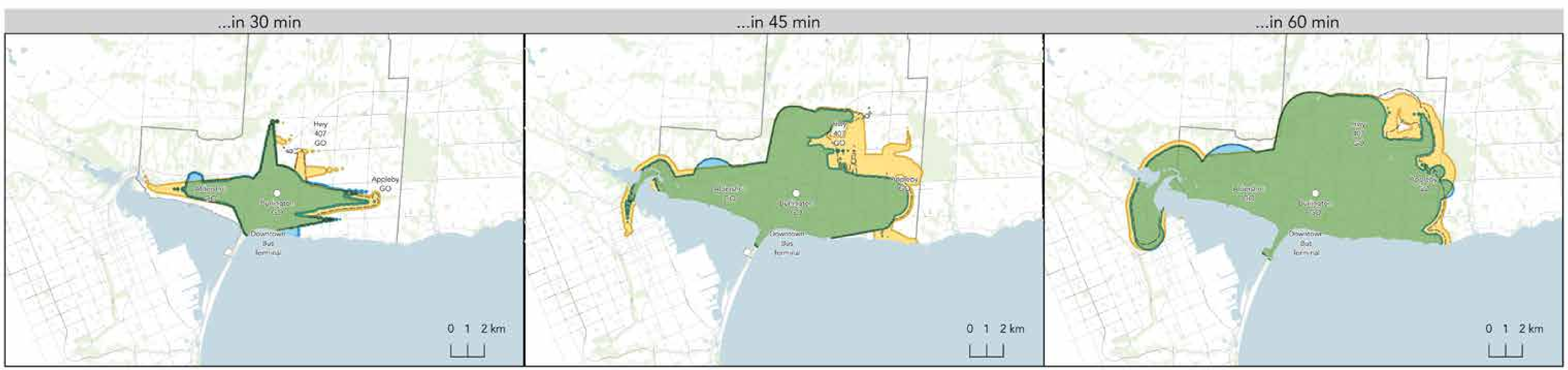


This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	5,100	-	3,200	-
15	Midpoint	5,000	-3%	3,100	-1%
15	Ridership	6,100	19%	4,000	25%
30	Coverage	52,900	-	29,400	-
30	Midpoint	57,500	9%	31,500	7%
30	Ridership	63,300	20%	33,300	13%
45	Coverage	105,200	-	49,000	-
45	Midpoint	112,700	7%	50,900	4%
45	Ridership	138,500	32%	62,500	28%
60	Coverage	155,600	-	66,300	-
60	Midpoint	171,200	10%	68,200	3%
60	Ridership	176,800	14%	70,500	6%

Data: Halton Region Employment Survey 2015, Census 2016



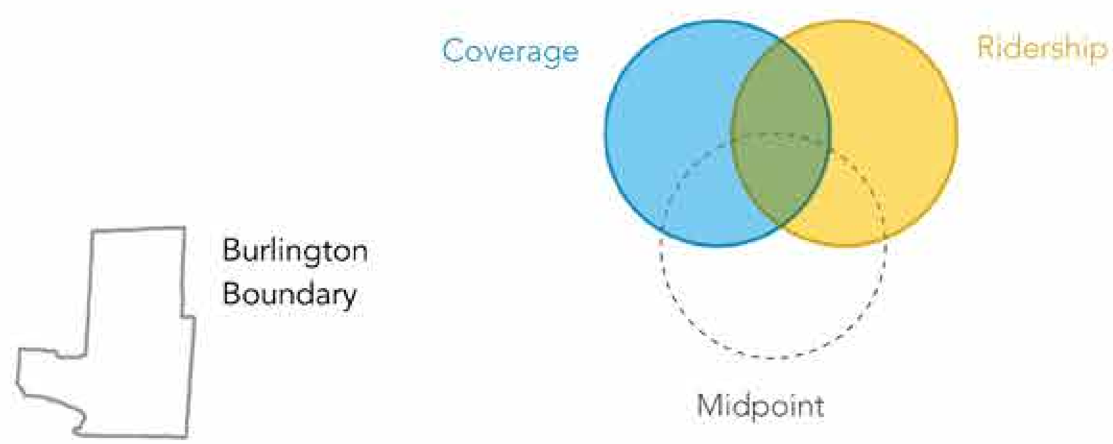
From Aldershot GO,

where could I travel to on weekdays at noon?

If I start at:

○ origin point

Here are the areas I can access in each concept:

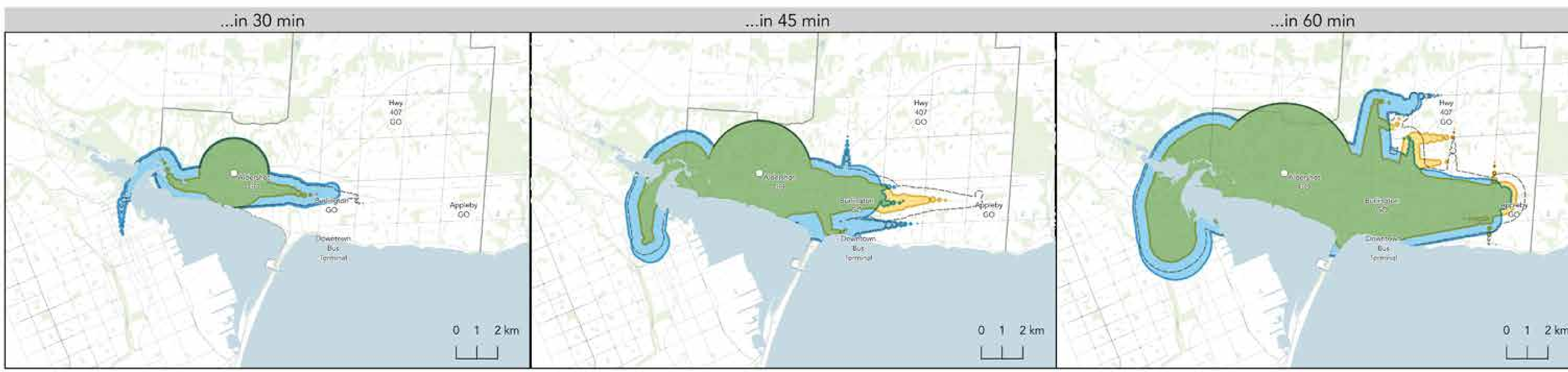


This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	1,800	-	1,100	-
15	Midpoint	1,500	-15%	1,100	-2%
15	Ridership	800	-56%	1,000	-7%
30	Coverage	20,000	-	6,900	-
30	Midpoint	19,300	-4%	6,900	0%
30	Ridership	11,500	-43%	3,400	-51%
45	Coverage	47,600	-	19,900	-
45	Midpoint	55,400	16%	29,500	48%
45	Ridership	35,100	-26%	16,400	-18%
60	Coverage	94,200	-	43,400	-
60	Midpoint	102,800	9%	49,400	14%
60	Ridership	82,600	-12%	42,900	-1%

Data: Halton Region Employment Survey 2015, Census 2016



From Hwy 407 GO,

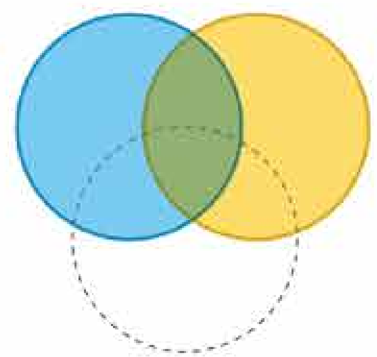
where could I travel to on weekdays at noon?

If I start at:

○ origin point

Burlington Boundary

Here are the areas I can access in each concept:

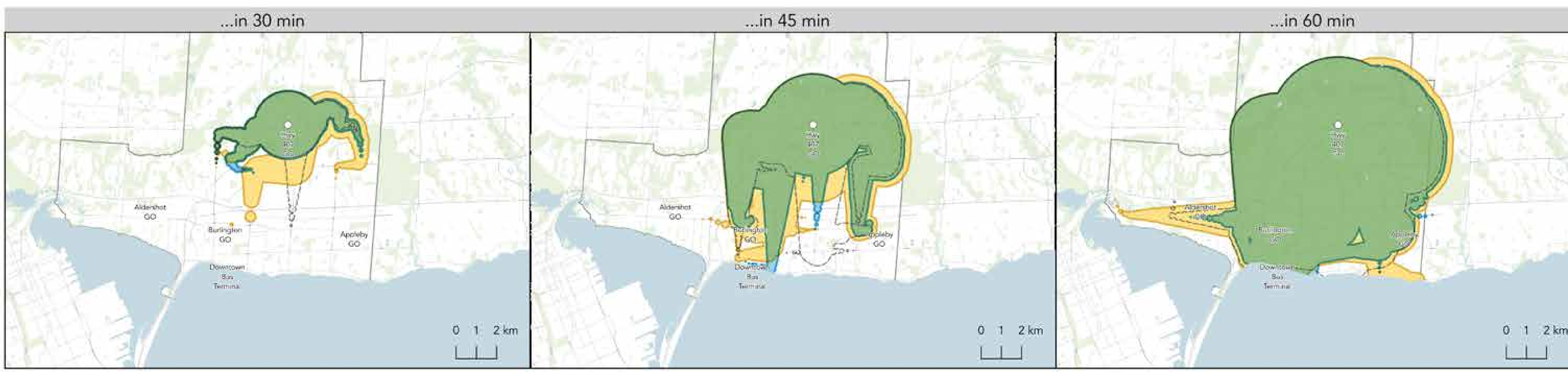


This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	4,500	-	900	-
15	Midpoint	4,500	0%	900	0%
15	Ridership	6,900	53%	1,100	19%
30	Coverage	32,900	-	2,900	-
30	Midpoint	33,000	0%	4,400	50%
30	Ridership	57,300	74%	8,000	176%
45	Coverage	90,000	-	25,200	-
45	Midpoint	91,200	1%	27,500	9%
45	Ridership	107,300	19%	39,300	56%
60	Coverage	145,300	-	62,600	-
60	Midpoint	153,300	6%	62,000	-1%
60	Ridership	162,800	12%	66,200	6%

Data: Halton Region Employment Survey 2015, Census 2016



From Downtown Bus Terminal,

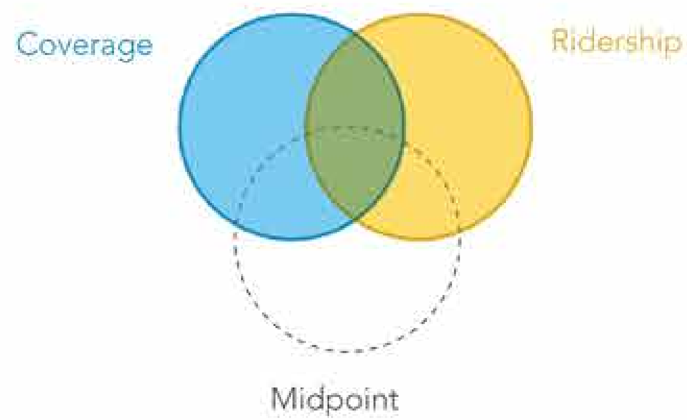
where could I travel to on weekdays at noon?

If I start at:

O origin point

Burlington Boundary

Here are the areas I can access in each concept:

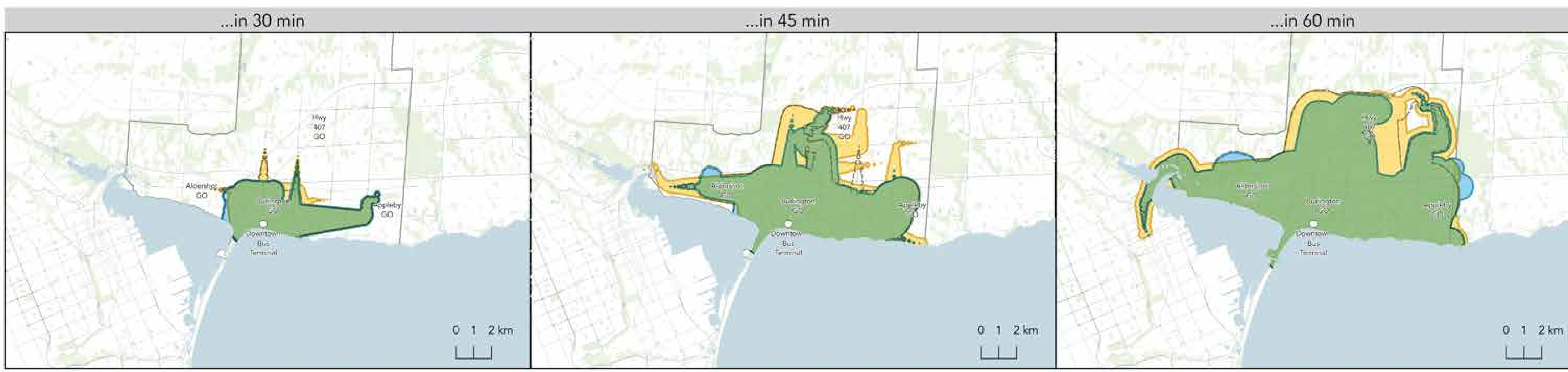


This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	11,100	-	5,200	-
15	Midpoint	11,000	-1%	5,100	-1%
15	Ridership	11,200	0%	5,200	0%
30	Coverage	48,800	-	17,800	-
30	Midpoint	49,000	0%	18,000	1%
30	Ridership	48,900	0%	20,400	14%
45	Coverage	92,700	-	41,600	-
45	Midpoint	97,100	5%	42,300	2%
45	Ridership	119,800	29%	49,100	18%
60	Coverage	145,200	-	63,200	-
60	Midpoint	162,800	12%	64,900	3%
60	Ridership	171,900	18%	69,000	9%

Data: Halton Region Employment Survey 2015, Census 2016



From Appleby & New,

where could I travel to on weekdays at noon?

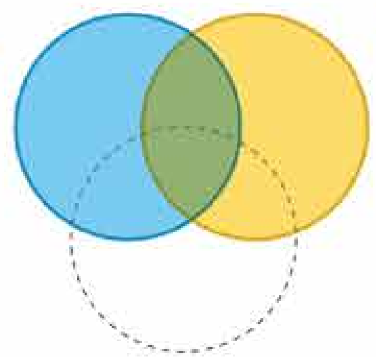
If I start at:

O origin point

Here are the areas I can access in each concept:

Coverage

Ridership



Midpoint

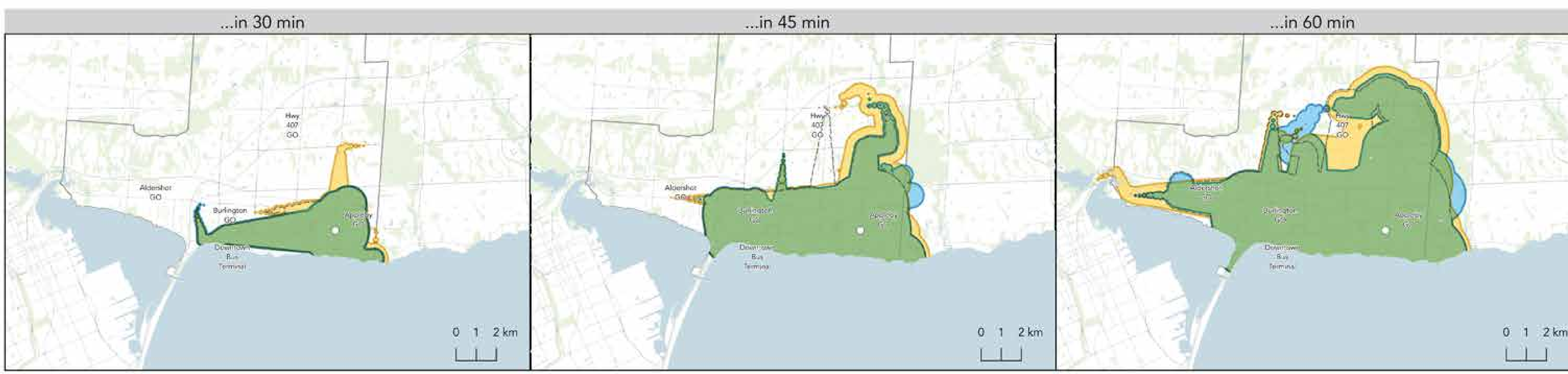
Burlington Boundary

This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	7,900	-	1,700	-
15	Midpoint	7,800	-1%	1,700	-2%
15	Ridership	9,700	23%	2,000	17%
30	Coverage	45,600	-	15,200	-
30	Midpoint	45,100	-1%	16,600	10%
30	Ridership	48,400	6%	20,200	33%
45	Coverage	84,500	-	46,800	-
45	Midpoint	88,400	5%	47,200	1%
45	Ridership	99,000	17%	51,400	10%
60	Coverage	143,700	-	65,800	-
60	Midpoint	152,300	6%	66,700	1%
60	Ridership	158,500	10%	67,800	3%

Data: Halton Region Employment Survey 2015, Census 2016



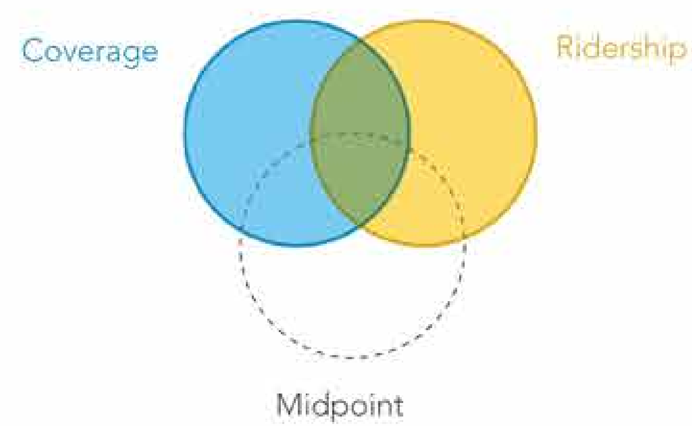
From Guelph & Prospect,

where could I travel to on weekdays at noon?

If I start at:

○ origin point

Here are the areas I can access in each concept:



Burlington Boundary

▸ This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	5,400	-	4,100	-
15	Midpoint	6,000	10%	5,100	23%
15	Ridership	7,200	33%	5,400	30%
30	Coverage	32,200	-	21,100	-
30	Midpoint	44,300	38%	29,100	38%
30	Ridership	55,900	74%	32,100	52%
45	Coverage	93,100	-	44,400	-
45	Midpoint	114,800	23%	52,800	19%
45	Ridership	135,600	46%	61,700	39%
60	Coverage	155,300	-	64,700	-
60	Midpoint	168,200	8%	67,900	5%
60	Ridership	177,600	14%	70,100	8%

Data: Halton Region Employment Survey 2015, Census 2016

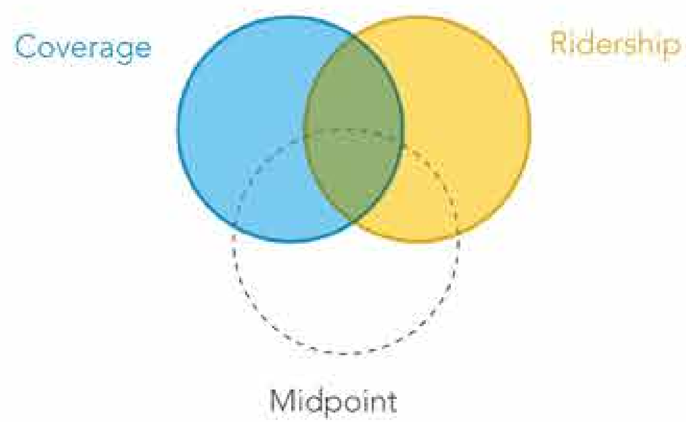
From Appleby & Upper Middle,

where could I travel to on weekdays at noon?

If I start at:

○ origin point

Here are the areas I can access in each concept:

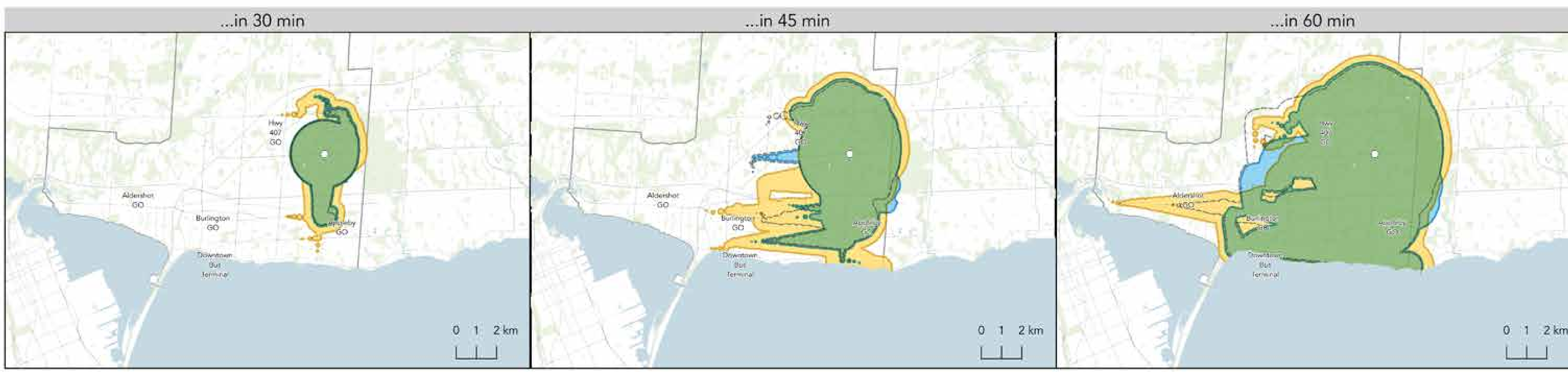


▶ This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	4,200	-	2,400	-
15	Midpoint	4,200	0%	2,400	0%
15	Ridership	4,700	12%	3,000	28%
30	Coverage	24,200	-	13,000	-
30	Midpoint	22,900	-5%	12,100	-7%
30	Ridership	36,500	51%	18,000	39%
45	Coverage	67,400	-	29,800	-
45	Midpoint	68,600	2%	31,900	7%
45	Ridership	97,500	45%	48,700	63%
60	Coverage	140,700	-	60,000	-
60	Midpoint	155,300	10%	61,500	3%
60	Ridership	155,600	11%	64,400	7%

Data: Halton Region Employment Survey 2015, Census 2016

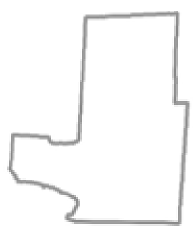


From Haber Community Center,

where could I travel to on weekdays at noon?

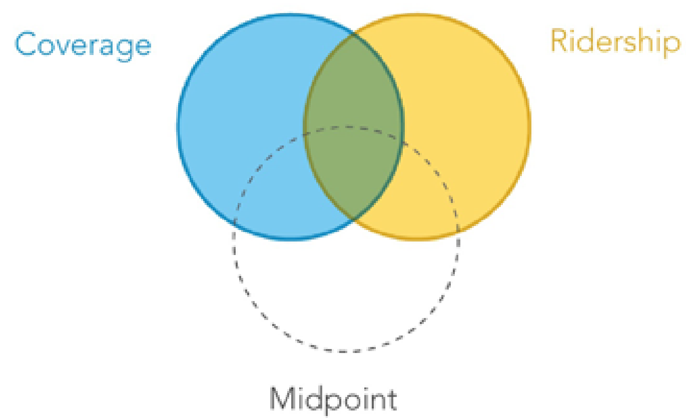
If I start at:

O origin point



Burlington Boundary

Here are the areas I can access in each concept:

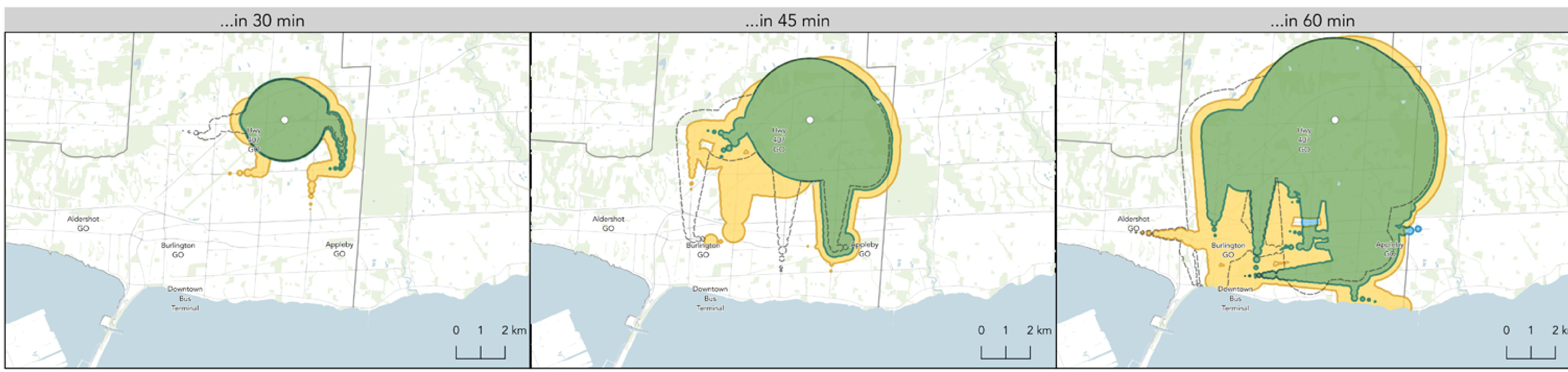


▶ This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	8,500	-	600	-
15	Midpoint	8,500	0%	600	0%
15	Ridership	9,800	15%	800	34%
30	Coverage	25,400	-	3,100	-
30	Midpoint	25,800	2%	3,100	0%
30	Ridership	36,400	43%	5,000	62%
45	Coverage	51,900	-	15,100	-
45	Midpoint	69,600	34%	17,300	14%
45	Ridership	81,200	56%	25,100	66%
60	Coverage	102,400	-	38,000	-
60	Midpoint	130,200	27%	54,000	42%
60	Ridership	143,100	40%	59,300	56%

Data: Halton Region Employment Survey 2015, Census 2016



From Walkers & Upper Middle,

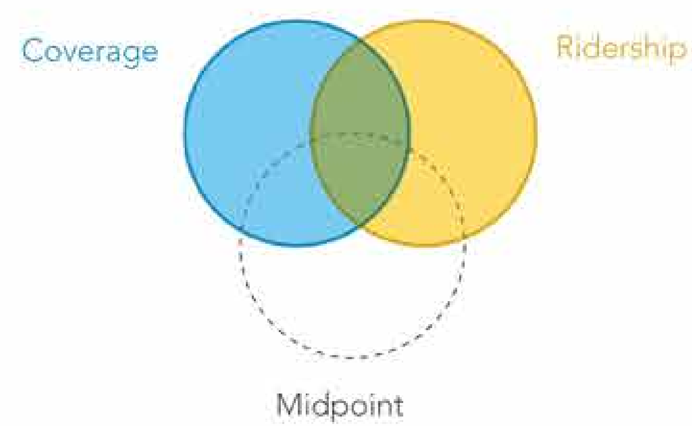
where could I travel to on weekdays at noon?

If I start at:

O origin point

Burlington Boundary

Here are the areas I can access in each concept:

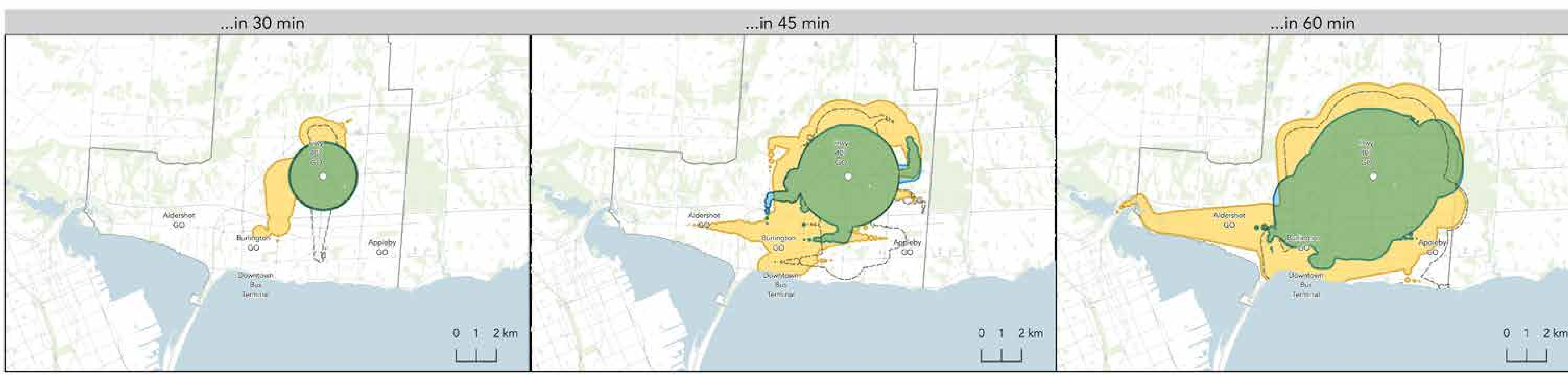


This table shows the number of residents and jobs located within each travel time for each concept, rounded to the nearest hundred. The percent change shows the change in population and jobs compared to the Coverage Concept.

Residential and Job Access

Time	Concept	Population	% Change	Jobs	% Change
15	Coverage	7,600	-	1,200	-
15	Midpoint	7,600	0%	1,200	0%
15	Ridership	9,300	22%	1,500	24%
30	Coverage	23,700	-	6,100	-
30	Midpoint	28,100	19%	10,100	65%
30	Ridership	38,900	64%	12,500	105%
45	Coverage	52,600	-	22,400	-
45	Midpoint	70,800	35%	30,200	35%
45	Ridership	102,700	95%	42,100	88%
60	Coverage	105,000	-	46,300	-
60	Midpoint	149,700	43%	62,500	35%
60	Ridership	158,000	51%	66,200	43%

Data: Halton Region Employment Survey 2015, Census 2016



Conceptual Alternatives

Next Steps

Burlington Transit and the City of Burlington will use these conceptual alternatives as tools to engage residents, bus riders, stakeholders, and elected officials in a conversation about the transit choices and trade-offs for the City of Burlington. The goal of this conversation is to find the right balance in the ridership-coverage spectrum.

Comments and suggestions about other changes to the network will also be considered in drafting the recommended network, but the big picture about the ridership-coverage trade-off will be the guiding principle of the draft network design.

Everyone has a voice in helping to determine the direction for this plan. So the entire study team encourages the public to read and study this report carefully. Then discuss the trade-offs with neighbors, friends, colleagues, fellow transit riders and other Burlingtonians to help determine what direction you want your transit agency to take.

Burlington Transit and the City expect to engage in public outreach from July 2017 through the fall of 2017 via community meetings, online surveys and a variety of other opportunities for community conversation around these concepts.

Input from the public and stakeholders will inform the decision about where the future transit network should be designed within the ridership-coverage spectrum. That spectrum, represented in Figure 66, means that the community does not have to pick just one concept.

The City could decide that the network should be designed at some point between the three concepts. For example, the City could decide that the recommended network should be designed as at 80% Ridership and 20% Coverage. Such a decision would result in a network that looks somewhere between the Ridership and Midpoint Concepts.

Or the city could decide that the recommended network should be designed at 60% Ridership and 40% Coverage. Such a decision would result in a network that looks somewhere between the Coverage and Midpoint Concepts. The decision about the ridership-coverage trade-off will set the major parameters for how the future transit network for Burlington will be designed and set the policy for how resources for transit should be allocated now and in the future.

Once that decision is made by the City, Burlington Transit, the City, and the consultant team will develop a draft recommended transit network in early 2018 and the community will have an opportunity to review and comment on that draft plan.

A decision on the ridership-coverage trade-off will be informed by the public feedback and will set the major parameters for the recommended transit network design.

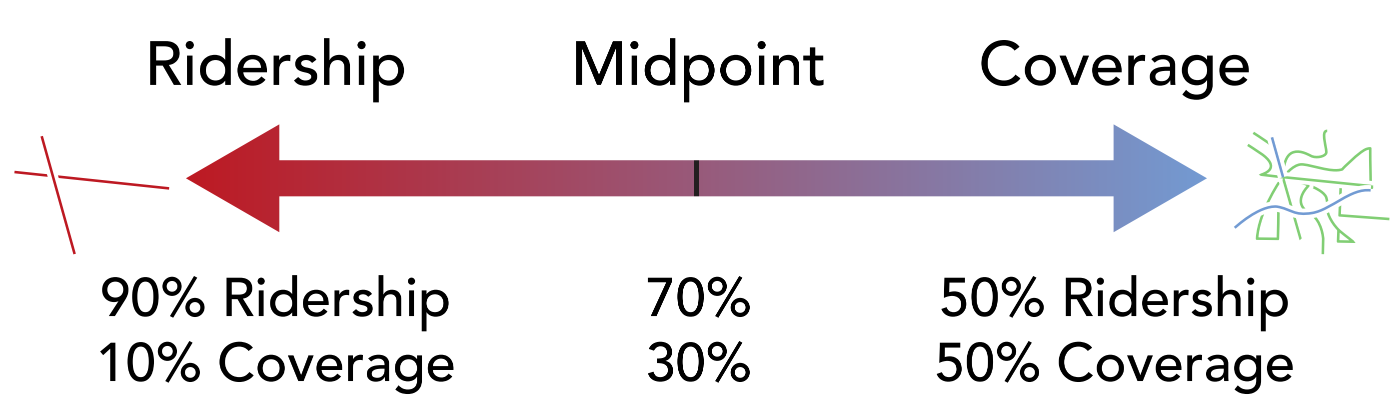


Figure 66: Spectrum of choices and the three conceptual alternatives.