The North American Light Rail Experience: Insights for Hamilton

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Acknowledgements

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Executive Summary

This report provides a high level overview of the North American Light Rail Experience with the goal of providing insights for Hamilton, Ontario. Light rail transit (LRT) is a term that emerged at the Transportation Research Board's first conference on this form of transit technology in 1975. The report considers the examples of 30 light rail systems constructed in North America, providing a synopsis of each and deriving lessons relevant for light rail transit planning in Hamilton. In Canada, these cities are represented by Calgary, Edmonton, and Toronto. One immediate difference between LRT developments in the U.S. and Canada is the historically more significant role of the federal government south of the border, though recent federal LRT investments in Waterloo and Toronto may indicate a change for Canada in this regard.

Light rail developments in North America can be separated into two phases. In the first phase, rapid transit planning viewed transportation as inherently separate from land use considerations and new transit services were believed to act as a natural 'magnet' for development, able to attract land use change by their mere presence. Based on the early body of evidence, several researchers came to the conclusion that new transit lines alone had a rather anemic effect on spurring new development, with many lines also suffering from low ridership.

This realization led to the second phase where rapid transit became linked to transit-oriented development (TOD) and in which land use planning began to be recognized as not only an integrated part of the transportation planning process, but a fundamental element in the success of any transit project. The result was a new wave of LRT systems that were reinforced with a number of planning and policy incentives at the local and regional levels. Cities such as San Diego, that constructed their initial lines in the first phase, subsequently shifted into the second phase of LRT and TOD development.

There is a considerable North American literature on light rail transit so a review of this work is one way to derive potential lessons and insights. An observation is that TOD-oriented discourse makes up a large percentage of all policy-oriented research on LRT development. Accordingly, this report places a large emphasis on TOD as a determinant of LRT success.

General Light Rail Policies

The general set of policy tools described includes the promotion of TOD as one element among many. At a high level, this general toolbox includes public transit encouragements (e.g. fare structures and payment systems, free-fare zones, TOD); commuter financial incentives (e.g. discounted travel passes); road pricing (e.g. road and cordon tolls); and road traffic calming (e.g. speed reductions and two way streets) as well as a package of complimentary Transportation Demand Management (TDM) initiatives.

Many of the public transit encouragements relate to how the system itself is designed. Aspects such as frequency of service and an optimal spacing of stations are obviously important. But a strong systems planning philosophy, with LRT acting as the backbone and bus service acting as a feeder, has led to relative success in some cities. Such systems aim to serve many of the highest quality and most

important destinations in the urban area to spur ridership. Riders can also be fed onto an LRT by developing stations with a Park-And-Ride philosophy. Calgary is a good example of this approach, though one problem is that the TOD potential in the vicinity of stations used for this purpose may well suffer. While the topic of general light rail policies is not a major theme in this report, extensive additional details have been compiled in Appendix B for the interested reader.

Policies for Transit-Oriented Development

With respect to TOD, the concept stems from the notion that the built environment plays a fundamental role in influencing travel demand. Most modern descriptions of transit-oriented development generally adhere to Peter Calthorpe's (2003) definition of TOD as "a mixed-use community within an average 2,000-foot walking distance of a transit stop and core commercial area. TODs mix residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot, or car." Research has shown that TOD projects tend to appeal to specific segments of the population (singles, professionals, childless couples, and empty nesters) who place a high value on access to amenities and generally travel less than their suburban counterparts.

The literature emphasizes several aspects for maximizing the potential for successful TOD projects. Strong political leadership is viewed as a critical element in the success of any rapid transit and TOD project. A political champion can help to realize success by marshaling resources, building coalitions, and resolving disputes. Coordinating institutions, streamlining processes, and minimizing red tape are seen as crucial in implementing TOD projects and are dependent on strong political leadership. Including the broader public in the TOD planning, design, and implementation processes is essential to building support for TOD projects within destination neighbourhoods. Creating a vision for the type of community in which people would want to live can be an important tool for guiding the relationship between transit and transit-oriented development. Overall, it is beneficial for all parties if the public sector has a comprehensive and long-term vision for TOD and the political will to support it

The relationship between public agencies and developers is an important theme. Compared to traditional suburban greenfield development, mixed-use and infill TOD projects are typically seen as higher-risk projects for developers and their financial backers. Transit joint development (TJD) is a form of partnership in which the public sector engages directly with the private sector to drive new TOD. Typically, the partnerships are based on revenue and cost sharing. Revenue sharing arrangements include land leases, air rights development, and station interface programs, concession leases, and benefit assessment districts. Cost sharing arrangements include sharing construction expenses or incentive-based programs that provide benefits (e.g. density bonuses) in return for off-loading infrastructure construction costs from the public sector. Creative methods for financing TODs can go a long way in pushing a project to completion and financial partnerships between the public and private sector can spread out risks.

One other way that the public agencies of leading LRT cities exhibit leadership is by making it clear that TOD planning and construction is inherently a long-range endeavour and by planning far ahead. TOD

planning can take place long in advance of rapid transit. Most successful LRT cities covered in this report engaged in some level of TOD planning for many years. Related to the concept of planning far ahead is the possibility for the public sector to engage in the practice of "land banking." By purchasing land prior to the construction of rapid transit, the transit provider can set itself up to capitalize on the land value benefits.

A key focus of TOD is development in the vicinity of stations. Research has shown that in order to maximize their impact, TOD projects should emphasize 'place-making' by creating attractive, memorable, and human-scale environs. Under a TOD philosophy, station vicinities ideally should be designed with activity centres on all sides to ensure activity at the station, high quality designs, engaging public spaces, pedestrian connections, attractive landmarks, and residential uses to ensure around-the-clock activity. In other words, it should be designed more as a 'place' than a 'node.' Research has found that the 'walkability' of a neighbourhood and station-area is directly tied to higher levels of ridership.

Developments can be transit-oriented (TOD) or transit-adjacent (TAD). A TAD is just that – development that is physically near transit. However, it fails to capitalize on this proximity to increase ridership. The TOD school of thought suggests that real estate opportunities should always take priority over low-cost transit solutions, such as running transit in the median of an interstate highway. Examples of the lower cost approach include a new LRT in Denver that runs alongside the I-25 interstate and thus has reduced TOD development potential and an LRT right-of-way in Dallas that makes use of old rail corridors.

TOD is also often associated with higher densities and taller buildings are frequently a source of neighbourhood controversy. Public sector planners typically impose a design template for TODs that calls for vertical mixing of land uses such as ground-floor retail and upper level residential. However, mixed-use projects are trickier to design, finance, and lease compared to traditional single-use developments. Another challenge is that expertise in mixed-use development is generally lacking within the private sector in North America.

Parking is another important TOD theme. At the urban design level, rationalizing parking in urban areas is essential to influencing how transit will be accessed and solving conflicts over whether land goes to parking or development. Typically development projects have strict requirements for parking ratios and replacement parking. Unbundling these requirements from TODs can allow developers to avoid the construction of costly parking structures and save residents thousands of dollars. There are documented examples, unhelpful for TOD success, where developers are forced to meet minimum parking ratios in order to receive project financing.

While this section has summarized some general points about TOD, there are a whole range of specific policy tools that can be implemented in support of the concept. These include, strategic planning tools, a large number of land use policy tools, development assistance tools, place making and access tools, land assembly tools and programmatic and institutional tools. A detailed assessment of these is far beyond the scope of this report but additional details are found in Table 2.2 and in Appendix C.

Outcomes

As well as reporting on absolute ridership in North American light rail cities, this report analyzes ridership on a relative basis using a statistic derived from the thousands of total weekday trips per route kilometre of track (TRK). For ridership, Calgary ranks very highly on an absolute and relative basis and Edmonton does well on both counts also. Slightly more than half of the light rail cities are above 1,000 weekday riders per kilometre (TRK=1) with Calgary at 5.43. Dallas is an example of a city that ranks in the middle of the pack in terms of absolute ridership but ranks poorly on a relative basis (TRK = 0.59). San Diego ranks well on an absolute basis but is mediocre on a relative basis (TRK = 1.14). Boston's high ranking along both dimensions comes with an asterisk as its light rail green line is tightly integrated with multiple heavy rail lines. Portland, Oregon is an often-quoted prototype for light rail excellence but offers modest results on a relative basis (TRK = 1.46).

The effect of LRT on metropolitan congestion has been considered using the Road Congestion Index created by the Texas Transportation Institute. There is some evidence that LRT can at least slow the rate of congestion increase. Overall, results suggest that LRT in and of itself should not be expected to mitigate regional congestion. But light rail in conjunction with TOD has resulted in higher trip rates for public transit and lower levels of automobile ownership and usage.

The cost performance of LRT systems is an important outcome dimension. Transit critics state that light rail in the US has not been successful by strict measure of economics. A study across a subset of LRT cities estimated that only 13.4% of operating costs were paid by riders. Cost recovery is tied in closely with ridership and several previous studies have noted that the decision to build many light rail systems in the United States was based on overestimated levels of ridership that were subsequently not achieved after opening. However, Canadian cities have shown markedly higher rates of cost recovery and cost effectiveness by all measures.

Beyond ridership and cost recovery, another concern for light rail is overruns in original versus actual construction costs. Of four light rail systems built before 1990 (Buffalo, Pittsburgh, Portland, and Sacramento), all but Pittsburgh resulted in costs well above forecasted totals. Newer light rail systems have been constructed closer to original budget estimates although not always on budget. Analysis of system construction costs per weekday passenger for the year 2000 reveals wide variation. Calgary is the cheapest at about $3,000 whereas Buffalo is the second highest at about $40,000. Other than Calgary, no other city is under $10,000.

A final critical LRT outcome dimension is the impact on nearby land values. Transit-oriented development relies on the notion that people value living in areas with access to rapid transit, which makes the redevelopment of properties around station-areas much more likely. Heavy rail is thought to provide the largest capitalization of accessibility benefits into property values followed by commuter rail. Light rail is third, and other technologies such as bus-based systems and streetcars are thought to provide less of a benefit than LRT. But despite even the best transit and TOD intentions, property values will not rise if the market does not value access to transit. For TOD in general, research has shown that land value increases require proactive planning, network development, and transit system maturation.

Prerequisites

Since light rail is not ideal in every circumstance, it is wise to consider that set of prerequisites which appear to greatly increase the chances for success. A favourable local economic environment is a fundamental prerequisite. Experience in North America has shown that rapid transit can play a role in guiding growth that would have occurred anyhow but there must be growth to redistribute for development to occur. By the same token, the promotion of light rail transit and transit-oriented development should not be framed as a 'cure-all' for economically depressed and declining areas. One useful rule of thumb is that TOD projects should be capable of succeeding without transit in order to be successful with transit. It is argued that for mixed-use development around transit to be most attractive to people, these areas ideally need to be experiencing rapid economic growth and traffic conditions need to be bad and getting worse. Given these findings, it is not surprising that review studies have found very few examples of new transit-oriented development in the inner cores of economically distressed cities.

Another light rail prerequisite relates to the quality of the urban nodes that the LRT system connects. For example, the size, location, and accessibility of major employment centres along the route is fundamental to the success of any rapid transit project. Job accessibility is a major factor in the decision to locate in a TOD project and use transit. People will not use transit if they have no reason to travel to where it provides accessibility. Apart from large employment generators, other important metropolitan destinations such as shopping malls, airports, universities, stadiums, downtowns, and waterfronts can improve the perceived value proposition of locating in a TOD.

It can be argued that heavy metropolitan congestion is an important pre-requisite for effective light rail results since relatively uncongested cities tend to experience lower LRT ridership. Cleveland, Pittsburgh, and St. Louis all exhibit road congestion indices below the average of 1.0 and are near the bottom in weekday ridership levels and measures of TRK. Los Angeles, San Diego, and San Francisco maintain both very high levels of congestion and daily ridership. Meanwhile, there is also a school of thought in the literature that road congestion provides the necessary urgency to move the light rail political process forward.

Case Studies

Of the 30 cities included in this report, the examples of Calgary, Buffalo, San Diego, and Minneapolis have been chosen for an expanded case study. Calgary highlights policies that can increase ridership, though its experience with transit-oriented development is lacking. San Diego has learned from its past experience and now offers one of the most comprehensive packages to promote TOD along its LRT network. Minneapolis presents a new LRT system that has benefitted from a comprehensive package of policy and planning initiatives that have helped the Hiawatha Line to exceed all initial expectations. On the other hand, the example of the Metro Rail LRT in Buffalo highlights the risk involved in such a large-scale project. Despite the hopes that an investment in a high-quality LRT system would benefit the local economy, the Metro Rail project has suffered from a decline in both population and employment. Furthermore, both real and perceived barriers to development and redevelopment along the Metro Rail

LRT corridor have limited its ability to revitalize declining neighbourhoods. A summary of each case follows below:

Calgary and the C-Train: Light rail transit in Calgary can be considered successful by a number of metrics. One of the main themes associated with Calgary LRT is cost effectiveness. Ridership is the highest among all LRT systems in North America and the C-Train maintains the lowest costs per weekday passenger. A cornerstone of Calgary's long-term transit plan has been a promotion of transit ridership through the gradual reduction of long term parking in the downtown core relative to growth in the area. Planners in Calgary have reduced minimum parking requirements for buildings connected to LRT stations and the parking supply in the core has remained static despite high levels of growth. The interaction of policies constraining road and parking capacity with policies to promote better bus and LRT service has resulted in a significant increase in transit modal split to downtown from 37% in 1996 to over 42% in 2005.

But while the ridership and cost-effectiveness of the C-Train are among the best in North America, TOD in Calgary is lacking and it has been noted that transit-supportive land uses have been slow to develop in many of the suburban areas served by LRT. Many of the C-Train's stations are oriented to automobile access through the provision of large park-and-ride lots rather than mixed-use development and a number of LRT stations are located in the middle of expressway medians, making the C-Train more of commuter light rail system than one more oriented to TOD. However, some recent TOD success has occurred in Calgary, including some high-density residential, office, and retail projects adjacent to four C-Train stations. More importantly, a critical mass for TOD seems to be emerging in the marketplace. Developer interest in new TOD is beginning to gain momentum as traffic congestion issues throughout the city begin to worsen and a market for transit-oriented living is increasingly present.

Buffalo Metro Rail LRT: Given the fairly modest extent of the Buffalo system, ridership numbers per kilometre of track actually compare somewhat favourably with other US systems, though this level of ridership has been mature for some time. However, the high costs of the initial section due to extensive tunneling, a fragmented planning process, and a decline of population and employment in the Buffalo region have combined to limit the potential of the existing system and any plans for system expansion in the future. Like Calgary, Buffalo designed the Metro Rail system to run in a downtown pedestrian and transit mall, but a chronic lack of employment and population in the downtown core has recently resulted in a call for the mall to be converted back to allowing automobile traffic.

Another disappointment with the Buffalo system has been its inability to drive any sort of development or redevelopment along its alignment and revitalize declining neighbourhoods. The property value impact of LRT was also found to be negligible, with small increases in some station areas and a negative influence in others. The Buffalo example suggests strongly that a healthy local real estate market and existing and future demand for new development, irrespective of transit service, are necessary prerequisites for the success of TOD along any rapid transit line.

In general, the case of Buffalo serves to reinforce the importance of the relationship between rapid transit, TOD, and broader local and regional economic conditions. Despite the premier service offered

by the Metro Rail LRT, local factors such as demographics, population and employment decline, a limited service area, and the flight of residents to suburban areas has resulted in a light rail system that has performed well below expectations and is among the most costly in North America to construct and operate.

The Hiawatha Line in Minneapolis: Minneapolis presents one of the more influential examples of a new LRT system. While not yet approaching the ridership levels of Calgary or Edmonton, the line is showing potential given its young age. Several new TOD projects have been noted in the literature with a healthy outlook for more over the coming years. Minneapolis has had a long-standing program aimed at revitalizing its downtown core by attracting new housing, jobs, and other services, and the addition of the Hiawatha Line LRT has been credited with playing an important role in that process. However, the ultimate success of the project has rested on increased market demand for higher-density residential development spurred by major employment growth in the central business district as well as broader regional factors.

One of the striking aspects of the line is the high quality of destinations along its alignment. It connects landmarks such as Target Field, the Mall of America and the International Airport among several others. One tenet for effective transit-oriented development is that key destinations should be easily reachable along a line to encourage nearby residential concentrations. To this point, there has been some success in that regard along the Hiawatha line, especially nearer to the downtown.

San Diego Trolley: San Diego is often hailed as one of the best examples of light rail and transit-oriented development in the United States. With its first line opening in 1981, the San Diego Trolley was the first new light rail system built in the United States in over two decades. But the city's experience with both LRT and TOD has been decidedly mixed. With one of the oldest modern light rail systems in North America, San Diego has gone through two distinct phases of rapid transit and land use planning. It was originally thought that light rail would act as a natural "magnet" for more compact land use development patterns, but results after being in operation for more than a decade suggested that this was not the case and the decentralization of the city continued unabated.

In response, the city, with the help of planners and scholars in academia, developed some of North Americas first and most progressive incentive programs to encourage transit-oriented development. The result has been a number of TOD projects within Trolley station areas, though it is interesting to note that the vast majority of these have occurred outside of the downtown core in largely suburban areas. Nevertheless, the case of San Diego presents one of the most influential examples of comprehensive rapid transit and land use planning that has served as a model for other cities.

Other Light Rail Cities in North America

In addition to the cases of Calgary, Buffalo, San Diego, and Minneapolis, the light rail examples in Appendix A offer complementary insights into light rail transit in North America. Like Calgary, the case of Edmonton presents one of the better examples of light rail. The system consists of a single east-west line, and there are some similarities to Buffalo in that the central parts of the system were buried underground, limiting the extent of the initial line due to higher associated costs. Though studies of

TOD in Edmonton are limited, the case reveals that Edmonton has put a higher priority on encouraging more development in suburban areas along the LRT line than neighbouring Calgary. Ridership has matured at a reasonable if unspectacular rate for many years, but recent line extensions connecting important suburban areas have driven ridership to new highs, giving Edmonton one of the highest TRK measures at around 5,000 riders per kilometre.

In the US, Portland has long been revered as one of the most progressive light rail cities in North America, and its success is reflected in the number of new TOD projects and higher-than-average TRK statistic. Like Minneapolis, several other newer LRT systems have been helped by strong local economies and have exceeded ridership estimates. Charlotte's first LRT line opened in 2007 to ridership that exceeded initial ridership projections by a wide margin and strong demand for transit-oriented development along the LRT corridor. Denver has also seen its share of new transit-oriented projects, though research shows that much of this new development is transit-adjacent and office growth has not been responsive to LRT. This is attributed to a fragmented regional policy and planning framework as well as alignment choices.

Due to its easy accessibility to the New York City job market, Jersey City's Hudson-Bergen LRT has also seen a large amount of construction activity around stations. Salt Lake City's LRT has attracted more riders than forecast and enjoys widespread public support. Even sprawling Phoenix is credited with LRT and TOD success, exceeding ridership expectations upon opening and attracting more than $1 Billion in new development to station areas. But while these projects are often hailed as successes, it is important to note that when ridership is normalized according to the TRK statistic, each of these cities pales in comparison to the Canadian examples of Calgary and Edmonton and larger US cities such as Boston and San Francisco. This suggests that the overall "success" of light rail in many US cities has been helped by moderate expectations.

While these examples highlight some positive experiences with light rail, Cleveland offers the opposing perspective. Cleveland's LRT system has the lowest ridership statistics for any North American city at about 400 weekday riders per kilometre and light rail has had an anemic effect on promoting new TOD. Similar to Buffalo, Cleveland's Road Congestion Index is among the lowest in the United States, giving little incentive to utilize what is a reasonably comprehensive transit system with a heavy rail subway in addition to two LRT lines. To generate new ridership and alter land use patterns in the city, new TOD planning initiatives have been undertaken as of 2007 and one encouraging sign for Cleveland is that downtown is showing a fair amount of development momentum, though it would be hard to make the case that this is being driven by public transit.

In Los Angeles, three light rail lines attract a significant amount of riders and the system on the whole has been very successful. Many TOD projects have occurred along these lines and have benefitted from a strong demand. But the example of the Blue Line LRT illustrates difficulties in achieving redevelopment and revitalization. While originally conceived as a tool to revitalize depressed neighbourhoods, the Blue Line LRT has been unable to produce a significant amount of new transit-oriented development. Major barriers to new TOD include a lack of available financing due to perceived risks, preconceived prejudices, and an absence of market demand to live in these areas.

Conclusions

The concluding section of the report offers some interpretation of what the findings mean for Hamilton. Some of the main points are as follows:

- Light rail transit has the potential to succeed in Hamilton under the right set of circumstances but it will be a long, challenging and expensive process.

- There is evidence that light rail developments stand a better chance for success in Canadian cities than U.S. cities.

- While traffic congestion helps to drive the case for LRT elsewhere, a comparative lack of congestion in Hamilton offers less support to the local case for LRT. One concern for B-Line LRT and the attraction of new riders is that movements along the corridor are fairly efficient for automobile commuters. Meanwhile, parking in the downtown core is cheap and abundant. The system of one-way streets along the prospective corridor, while good for auto commuting, is not ideal for LRT or for encouraging TOD. In contrast, to support their LRT system, policies in Calgary have made it more challenging to commute downtown by car.

- Success will require a long-term time horizon, strong leadership and strong public support. Even in favourable locations, ridership increases and new developments associated with light rail may proceed slower than anticipated. For example, it is only recently, after thirty years, that ridership on Edmonton's LRT has shown considerable gains. Investments in light rail often take place in an auto-oriented environment where the path of least resistance is the status quo. As such, the need for a high degree of vision, conviction and strong support from the public is clear as all parties contemplate a time when the automobile is less dominant than at present.

- Many cities have experienced success with their LRT systems by exceeding ridership estimates and attracting new TOD. But other light rail projects have exceeded construction cost estimates, fallen short of ridership and land use expectations, and maintain a low overall share of regional trips. As such, planners and policymakers must exercise care and caution in preparing plans and setting expectations for a light rail project.

- LRT itself should be understood as a tool to *guide* development more so than one that *generates* development in and of itself, and likewise TOD is not a product of transit alone, but the interaction between a complex set of local factors. Apart from making travel by private automobile less attractive, a comprehensive array of planning incentives will likely be necessary to induce new investment along the route. To that end, the City of Hamilton is currently engaged in land use planning in advance of rapid transit and appears to be adhering to sound principles for the most part. However, the ultimate driver of success for development and redevelopment projects lies in strong local economic and real estate market conditions.

1

Introduction

The overall purpose of this report is to provide a high level overview of the North American Light Rail Experience with a view to providing lessons for Hamilton, Ontario. In Hamilton, the City has embarked on an ambitious plan to explore options for rapid transit along a number of key transportation corridors, beginning with a proposed east-to-west light rail transit (LRT) line connecting McMaster University to Eastgate Square through the heart of the downtown core and central business district. Like other cities that have constructed light rail lines, one important goal of the Hamilton LRT project is to promote a more transit-friendly urban form along the B-Line corridor to help realize more sustainable patterns of development in the future.

This introductory chapter provides some useful background information for the overview of LRT experiences and is organized into four sub-sections. The first section defines the concept of light rail transit while the second and third sections outline the occurrences of light rail in North America, some differences between the U.S. and Canada in this context and how light rail transit planning in North America can be divided into two phases with regards to the interaction between transportation and land use considerations. Finally, the scope and objectives section of this chapter describes the agenda for this report in more detail.

1.1 Light Rail Transit Defined

Light rail transit is a term that emerged at the Transportation Research Board's (TRB) first conference on this form of transit technology in 1975. The conference came at a time when very little remained of what were once vast streetcar networks in many cities across North America with only eight cities maintaining some form of rail operations in their jurisdictions. Researchers turned their attention to Europe, where a new generation of city railways were emerging from the older generation of traditional streetcar lines, and conference organizers adopted the term 'light rail transit', or LRT to provide a term to describe the concept (Schuman, 2009).

However, the definition of light rail transit can at times be problematic for research. For example, the basic definition adopted by the TRB views light rail as "A metropolitan electric railway system characterized by its ability to operate single cars or short trains along exclusive rights-of-way at ground level, on aerial structures, in subways, or occasionally, in streets and to board and discharge passengers at track or car floor level." (TRB, 2000) But Schuman (2009), writing in the TRB's 2009 Light Rail Conference, attempts to update the original TRB definition by offering a more comprehensive conceptualization based on three loose criteria:

1. Located predominantly on reserved but not necessarily grade-separated rights-of-way
2. Operating electrically propelled vehicles run singly or in trains
3. Providing a wide range of passenger capacities and performance characteristics

Attributes such as these make LRT a highly flexible mode of transportation in terms of functionality (with underground or at-grade stations, elevated or tunneled alignments, and separated or mixed-traffic operation) and passenger volumes. According to Schuman (2009), the flexibility in both definition and functionality has meant that these systems can be classified into three types:

1. Streetcars, with all or most trackage in mixed-traffic lanes
2. Classic LRT lines using a rich mix of at-grade and separated alignments
3. LRT routes that offer rapid transit service through private right-of-ways with no more than a handful of streets crossing the tracks at grade

This type of definition presents a great deal of confusion, as the term streetcar is often used to conceptualize a different form of transit than light rail. According to Schuman (2009), many traditional streetcar operations can be considered LRT, such as Toronto's TTC streetcars and the historic tramways of New Orleans. Some newer systems such as Portland's Streetcar that use modern light rail vehicles but operate in mixed traffic with short, on-demand stop spacing are also defined as the streetcar type of LRT. Meanwhile, other systems that might be considered streetcars such as Philadelphia's Trolleys and Boston's Green Lines, can be defined as LRT due to the rapid transit offered by their operation in an underground tunnel for a portion of their routes. Likewise, some of Toronto's TTC streetcar routes also perform in a similar fashion, with sections of track in a reserved right-of-way or underground stations.

The definitions of the TRB (2000) and Schuman (2009) also omit some more recent types of rail transit that could be considered light rail, such as Ottawa's O-Train and the new Capital MetroRail in Austin,

Texas, which are each powered by diesel multiple unit and diesel-electric multiple unit respectively. Interestingly, other systems based on Intermediate Capacity Transit System (ICTS) trains from the Urban Transportation Development Corporation in the 1970s and 1980s that appear to meet these criteria, such as Vancouver's SkyTrain, Detroit's People Mover, and Toronto's Scarborough RT, are generally not considered LRT by researchers in the field.

For the purpose of examining light rail as it is related to the type of LRT system proposed for Hamilton, this project will adhere to the basic definition from the Transportation Research Board (2000) and an altered version of the definition proposed by Schuman (2009). Due to a lack of relevance to Hamilton, this analysis will omit the more traditional streetcar systems that can be considered LRT by Schuman (2009), as well as the ICTS and diesel-powered systems. However, the more modern Portland Streetcar is included, and though their applicability is likely limited, this project also examines the 'streetcar with portions of rapid transit' operations of Boston and Philadelphia. Toronto's TTC streetcars are included as well because of their proximity to Hamilton and similarities to Boston and Philadelphia.

1.2 Light Rail Transit in North America

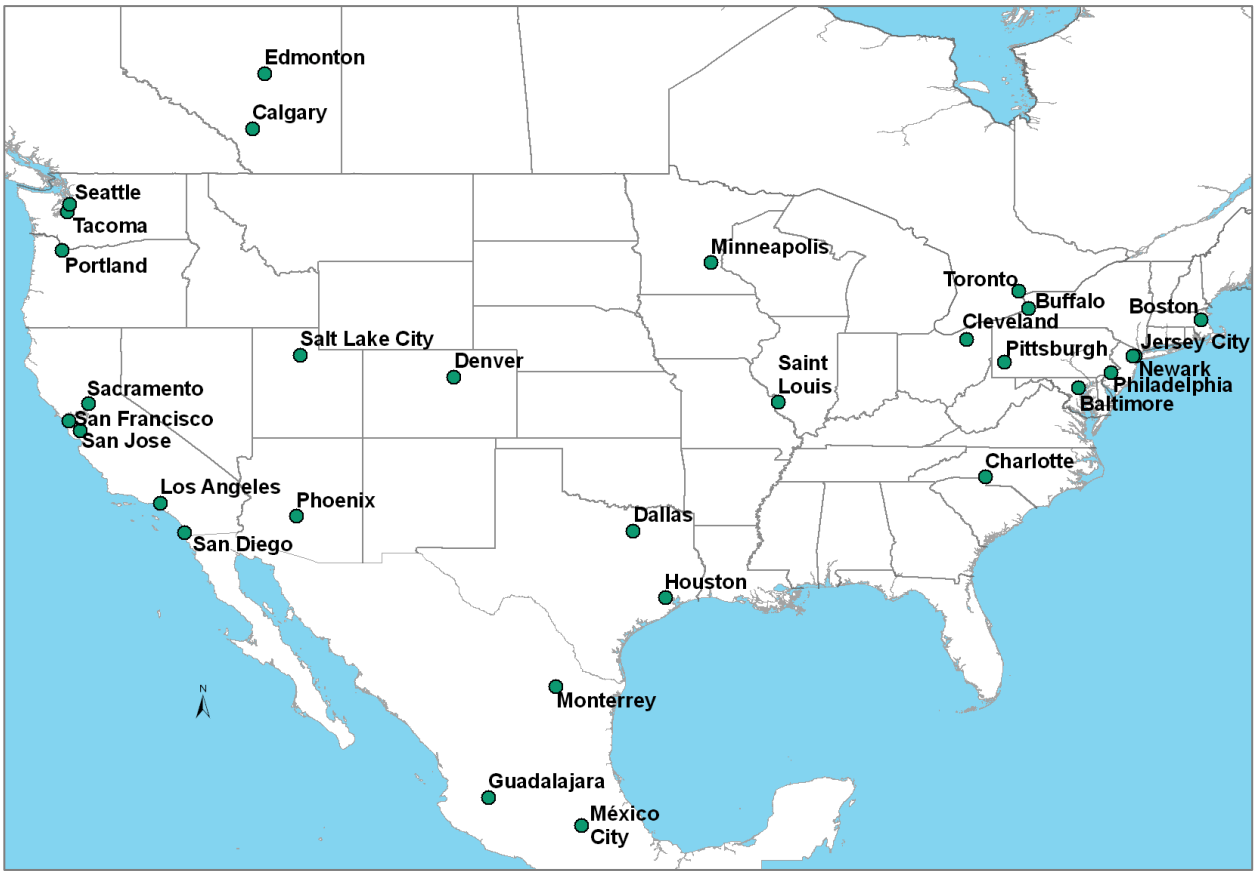
Using the guidelines outlined above as a foundation for further analysis, LRT systems have been constructed in twenty-nine cities across North America since 1975, with many more in various stages of planning. If Toronto's streetcars are included, this number rises to thirty (Figure 1.1). The analysis will explore light rail and transit-oriented development in each of these cities to provide an overview of the relevant lessons for the development of LRT in Hamilton. A brief overview of general system information and transit-oriented development experience in each of the thirty cities is provided in Appendix A. Additionally, four of these cities have been chosen for an expanded analysis in Chapter 3.

Some important differences exist with respect to light rail and transit-oriented development in Canada and the United States. Much of the empirical research on this topic originates from a US perspective, requiring many themes to be localized according to conditions in Canada. Some key insights are used here to frame the discussion of LRT and TOD in Hamilton. One of the biggest differences has been the federal role in local transit. Cities in the United States have benefitted from large federal contributions to rapid transit projects that provide generous funding for planning and implementation. However, as Richard Soberman outlines, a lack of a federal role in Canadian public transit has historically meant that cities in Canada must choose more cost effective options rather than the largesse seen in some cities in the US (Cervero, 1985). It is important to note a recent shift in Canada with significant federal funding being made available for light rail developments in Kitchener-Waterloo and Toronto. There are, however, no formalized federal programs in Canada for such funding.

In general, this has meant that transit in Canadian cities adheres to a higher basis for cost recovery, with many large transit systems reliant on high ridership and farebox revenue. Significant differences also exist in local and regional governance, with Canadian cities exhibiting a higher degree of centralized planning compared to their US counterparts. Some cities, such as Calgary and Edmonton, also have the benefit of automatic incorporation of smaller municipalities as the city expands, ensuring a singular

system of local governance for growing areas. In contrast, many US cities have to contend with multiple municipal governments and regional planning organizations in order to be effective.

Figure 1.1 Light Rail Transit Systems in North America



1.3 The Two Phases of Light Rail Transit Planning

The first phase of light rail transit in North America began in the mid-1970s with the planning and construction of LRT in cities such as San Diego, Buffalo, and Portland. This phase of rapid transit planning was notable for its view of transportation as inherently separate from land use considerations. New transit services were believed to act as a natural 'magnet' for development, able to attract land use change by their mere presence. With this perception, planners and policy actors generally felt little need to encourage development around transit facilities, preferring instead to provide high quality transit services and let the market dictate when and where new development would occur.

However, research on these early LRT systems has indicated that the impact of these new transit investments on land use settlement patterns was minimal. Evidence has shown that actual construction and implementation of land use development projects was slow to follow, leading to the conclusion that new transit lines alone have had a rather anemic effect on spurring new development (Black, 1993; Loukaitou-Sideris & Banerjee, 2000; Babalik-Sutcliffe, 2002; Hass-Klau & Crampton, 2002). Furthermore, many carried low numbers of passengers and had a minimal effect on public transport usage, car traffic,

and air pollution (Pickrell, 1989; Black, 1993; Mackett & Edwards, 1998; Hass-Klau & Crampton, 2002; CTOD, 2011).

One outcome was the emergence of the concept of transit-oriented development (TOD) in the late 1980s. For rapid transit and TOD, it was believed that land use change would only occur when new transit systems were supported with a package of other incentives. This realization led to the second phase of the relationship between rapid transit and transit-oriented development in which land use planning began to be recognized as not only an integrated part of the transportation planning process, but a fundamental element of the success of any transit project.

The result was a new wave of LRT systems that were reinforced with a number of planning and policy incentives at the local and regional levels to ensure the goals of these projects would be met. Cities that constructed their initial lines in the first phase have since shifted into the second phase of LRT and TOD development. Examples include: San Diego, Sacramento, San Francisco, Baltimore, and Salt Lake City. Each has since become engaged in TOD planning much earlier for new transit investments compared to their previous lines (Arrington, 2003).

The delineation of LRT and TOD into two phases of development should not be conceptualized as exclusive. Many systems continue to be developed that place a smaller value on transit-oriented development or are unable to promote more TOD due to a variety of local factors. However, integrated land use planning and the potential for land use change has been made a fundamental element of securing federal dollars for transit infrastructure in the United States. While no comparable program exists in Canada at the federal level to engrain TOD, future LRT systems in Canada can benefit from the experience of counterparts in the US.

1.4 Scope and Objectives

The brief overview provided above helps to clarify that transit-oriented development has been an integral aspect of the light rail experience in recent years. Accordingly, from a policy perspective, there is a fairly large emphasis placed on TOD in this report although other policy topics are certainly covered. The evidence appears to suggest that the success or failure of light rail is to a large degree intertwined with the success or failure of TOD. Much of the general research on TOD approaches the topic in consideration of all rapid transit technologies, such as heavy rail subways, commuter rail, light rail, and bus rapid transit. To the extent that this report discusses TOD, it is in reference to light rail.

As noted, many cities have constructed new LRT systems since the late-1970s and each offers important insights that stand to enrich the rapid transit planning process in Hamilton. In addition to TOD, this analysis is supplemented with consideration of associated light rail themes such as traffic congestion, ridership, light rail system costs, and land value impacts.

There are some caveats about this report to keep in mind. This research is a high level overview of the North American LRT experience to offer a sense of perspective. There are wide a range of potential transit research topics that are covered below and many would merit considerably more in-depth analysis than can be provided here. For example, tax increment financing is an example of a TOD policy

that could be analyzed at the report level in its own right. While the intent of this project is to offer possible insights about light rail in Hamilton, it is important to note that this report is not primarily about Hamilton and no detailed analysis of the Hamilton case has been undertaken as part of this work.

The main body of this report is separated into three additional Chapters. Chapter 2 reviews the general North American literature on light rail with an emphasis on recipes for success. Dimensions of interest include useful policy perspectives and specific policy tools with an emphasis on TOD. Other important aspects are a review of specific quantitative outcomes of past light rail projects and an examination of potential light rail pre-requisites that can be important. Chapter 3 reviews four real-world cases in cities where light rail has been implemented and offers and opportunity to consider Chapter 2 insights in a more applied context. Finally, Chapter 4 offers some concluding marks with some assessment of the implications for light rail in Hamilton. Note that Appendix A in particular is an integral part of this document as it provides brief overviews of all the LRT cities in North America and in this way complements Chapter 3.

Overview of Policies, Outcomes, and Prerequisites

A considerable amount of research details the progression of North American light rail systems. Accordingly, the purpose of this Chapter is to review some highlights of this literature and the lessons that it provides for prospective light rail systems. The first section of this Chapter reviews some of the policy approaches that are employed to maximize the potential for light rail success. Transit-oriented development and the associated umbrella of policies are part of this list but the topic of TOD is so important from a policy perspective that it merits its own second section of this chapter. The third section of the Chapter focuses on some of the key quantifiable outcomes from light rail developments such as ridership, impacts on congestion, cost performance and land value impacts. Finally, there is a section on pre-requisites that ought to be considered prior to any system development.

2.1 Key Policies and Perspectives

While TOD increasingly monopolizes the policy discussion as it relates to LRT, there are other considerations that arise in the literature. Many of these are related to policy "carrots and sticks" which discourage automobile use and encourage the use of transit while others have to do with the overall design philosophy of a light rail system. These aspects are covered in turn below along with some general useful policy perspectives.

2.1.1 Network Planning

One of the first considerations involves the overall planning of the rapid transit network and designing transit facilities to complement one another. A study of 16 US LRT systems found those that took a 'systems planning' approach to LRT generally fared better than those that didn't (Thompson & Brown, 2009). Systems planning is an approach taken by local planners in conceptualizing their LRT systems as an element in a broader, multi-modal network of public transportation options. Under this view, LRT is viewed as a 'backbone' of transit service, with reorganized bus routes feeding into the rail system. Comparatively, other cities have chosen to view LRT as a tool to serve the downtown central business district in competition with other modes, including buses.

Thompson and Brown (2009) ultimately concluded that designing a light rail system as an integrated part of an overall network that serves a multitude of destinations beyond the central business district has resulted in higher levels of regional connectivity and ridership compared to those that are designed to feed downtown areas. This makes intuitive sense, as the more people, jobs, and destinations that are within reach of the broader transit system, the more people will utilize it to reach their destinations.

2.1.2 A Policy Toolbox for Light Rail Transit

A comprehensive toolbox of policies designed to promote a modal shift away from the private automobile and improve the transit riding experience is indispensible in increasing transit ridership. With the help of a variety of sources (Willson & Shoup, 1990; Shoup, 1997; Meyer, 1999; Bianco, 2000; Cervero et al., 2004; Loukaitou-Sideris, 2010; Litman, 2011), MITL has prepared a table of policy tools designed to influence and manage transportation demand as well as promote higher transit utilization. Table 2.1 provides a list of policies and a full detailing of each is included in Appendix B.

Ensuring a transit-supportive built environment through the promotion of transit-oriented development is viewed in this list as an important element in encouraging public transit usage. However, TOD is an area of research in its own right as seen in Section 2.2, and there are many additional policies that can be employed. Transit-oriented development is included in this list to highlight the synergistic and interdependent relationship between policies designed to affect land use considerations and transit in general.

With regard to transit encouragements in Table 2.1, studies of individual travel behaviour reveal that 'by choice' transit riders are receptive to improvements in transit service quality. As such, transit providers should focus on increasing the appeal of their service by running frequent and reliable trains and minimizing wait and transfer times. Consider the example of Newark, New Jersey, where improvements in transit service to Penn Station better connected the city to the New York City and revealed a large TOD market along the LRT line. Other ideas such as free rides on weekends or for a downtown portion of the corridor can incentivize initial and continued ridership (Cervero et al., 2004; Loukaitou-Sideris, 2010).

Table 2.1 Policy Tools in Support of Rapid Transit

1. Public Transit Encouragements
• Improved Transit Service
• Improved Stops and Stations
• Reduced Fares
• Convenient Fare Structure and Payment System
• Free Fares or Fare-Free Zone
• Park and Ride Facilities
• Promote Transit-Oriented Development
2. Commuter Financial Incentives
• Removal of Free Parking
• Discounted Transit Passes
• Employee Parking Pricing
• Parking Cash Out
• Travel Allowances
• Discounted Transit Passes
3. Road Pricing
• Road Tolls
• Cordon Tolls
4. Road Traffic Calming
• Speed Reductions and Two-Way Streets

2.1.3 Station Areas as Park-And-Ride or Transit-Oriented Development

While the provision of park-and-ride facilities is noted in Table 2.1 as a good method of encouraging transit usage, there is tension that must be resolved by planners and policy makers regarding the dedication of land around transit stations to the automobile or to transit-oriented development. Looking at the cities analyzed in this report, it is clear that some light rail systems have turned out more oriented to transit-oriented development than others and these types of higher-level planning decisions that relate to the basic nature of the light rail system itself will thus have a large bearing on whether TOD policies can even be implemented.

In the case of Calgary (see Chapter 3), a concerted effort was made to reduce parking supply downtown in conjunction with the provision of an abundance of park-and-ride lots at LRT stations outside of the downtown core. A key result has been North America's most successful LRT system in terms of ridership. However, the state of TOD in Calgary leaves a lot to be desired and the C-Train has not had a strong impact on reshaping land use patterns in the region. Furthermore, the popularity of these park-

and-ride lots now means that any attempt to redevelop these areas would be met with considerable opposition from suburban residents.

Other cities opt for an approach more rooted in transit-oriented development, such as neighbouring Edmonton, which prefers to promote development around its LRT station areas and operates feeder bus services to nearby suburban areas. San Jose has recently changed its conceptualization of station areas by converting some of its park-and-ride lots to new development, and research by Hess and Lombardi (2004) notes that much success has been achieved in more suburban TOD projects in many cities across North America.

There is no clear answer to the issue of planning station areas as park-and-ride lots or as nodes for TOD. If used strategically and planned according to local needs and conditions, either approach can be beneficial by promoting transit-oriented communities or by providing an easy transfer for more automobile-oriented suburban neighbourhoods. In the latter case, park-and-ride lots offer an opportunity for land banking and joint development projects on transit agency or publicly held land. In general, the issue of parking should be handled early in the LRT and TOD planning process in accordance with long-range objectives for local land use patterns and their interaction with the transportation system.

2.1.4 Transportation Demand Management

In addition to the policies designed to encourage transit use, there are a number of additional strategies that fall under the rubric of Transportation Demand Management (TDM). These are designed to reduce congestion and shift travel demand away from the personal automobile such as the promotion of walking and cycling, ridesharing programs, shuttle services, flexible working hours, and work-from-home initiatives or telecommuting. While these measures are not directly related to encouraging transit ridership, they can be complimentary to rapid transit and should be considered as part of an overall regional transportation plan. Transportation Demand Management is an area of research in its own right and a further analysis is beyond the scope of this project. Interested readers should turn to the work of Litman (2011), which provides a comprehensive database of TDM initiatives.

2.2 Policies and Perspectives for Transit-Oriented Development

A considerable body of literature has emerged that demonstrates important lessons for maximizing the positive impact of new investments in transit infrastructure. Based on this work, one of the most fundamental factors to the success of any rapid transit project is the coordination of land use and transportation planning to promote a more transit-supportive environment. Loosely termed transit-oriented development, this style of development builds on the foundations of smart growth and urban sustainability to encourage the construction of higher-density, mixed-use residential or commercial areas along transit corridors and station-areas.

2.2.1 What is Transit-Oriented Development?

Transit-oriented development has become a large topic of interest among scholars in academia and the public and private sectors. But what is TOD? The concept has gone by many names, such as 'transit villages', 'transit-supportive development, and 'transit-friendly design' (Cervero et al., 2002). At its most basic, transit-oriented development stems from the notion that the built environment plays a fundamental role in influencing travel demand. Historical accounts of TOD make note of its role in shaping North America's early streetcar suburbs wherein transit was built to support the development of new neighbourhoods. Given the accessibility options of many people at the time, proximity to transit was a cornerstone of settlement patterns. However, the advent of the automobile in the post-World War II period resulted in a significant decline in this style of development (Bernick & Cervero, 1997; Belzer & Autler, 2002).

One of the first major works to further conceptualize TOD was Cervero and Kockelman (1997) in which travel demand was linked to the "3-D's" of density, diversity, and design. More specifically, demand for public transit was found to be an outcome of land use densities, land use diversity such as a mixing of uses, and pedestrian-oriented designs in the San Francisco Bay Area. Transit-oriented development essentially gives a name to these defining elements.

Most modern descriptions of transit-oriented development generally adhere to Peter Calthorpe's (2003) definition of TOD as "a mixed-use community within an average 2,000-foot walking distance of a transit stop and core commercial area. TODs mix residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot, or car."

Though many definitions differ in the literature, Cervero et al. (2002) report that most share several common elements:

- Mixed-use development
- Development that is close to and well-served by transit
- Development that is conducive to transit riding

In addition, some less-universally noted aspects of TOD include:

- Compactness
- Pedestrian- and cycling-friendly environs
- Public and civic spaces near stations
- Stations as 'places' or community hubs

The City of Hamilton has adopted these principles in preparing its two Transit Oriented Development Guidelines documents (2010a; 2010b). The first document serves as an introduction to the TOD concept, while the second proposes transit-oriented development guidelines for Hamilton. The latter design guidelines have been approved by Hamilton City Council in August of 2010 and now form the

basis of the City-Wide Corridor Planning Principles and Design Guidelines planning initiative currently underway to shape future growth in Hamilton's identified transit nodes and corridors.

But transit-oriented development should not be understood as a pre-packaged concept. Dunphy et al. (2004) argue that the scripted and formulaic notion of TOD as a master-planned mix of retail, office, and residential uses is too narrow, and that while desirable, presents only a small part of the potential for development around transit. Because there is ample room for development near many transit stations, any development – small scale or large scale – in these locations is likely to enhance the urban qualities of station-areas.

While a range of housing types can be incorporated into transit-oriented developments, research by Cervero et al. (2004) argues that these projects tend to appeal to specific segments of the population (singles, professionals, childless couples, and empty nesters) who place a high value on access to amenities and generally travel less than their suburban counterparts. As a result, these projects naturally entail a different set of risks, standards in construction, and requirements for success and can benefit from a number of additional planning and land use strategies such as those outlined below.

2.2.2 Leadership and Partnerships

Political Leadership: Strong political leadership is viewed as a critical element in the success of any rapid transit and TOD project. A political champion can help to realize the project by marshaling resources, building coalitions, and resolving disputes. This has been especially important in cities and regions in the United States that have used referendums on tax measures to fund transit. While leadership has been discussed in the public sector, Cervero et al. (2004) add that initiative and support from private sector actors can also be fundamental. Political leadership can work in the other direction as well. Patterns of growth across North America have favoured automobile-oriented suburbanization for many decades. This dispersed growth has a direct effect on the politics of transit investment. Dunphy et al. (2004) argue that suburban constituents are increasingly less inclined to support traditional transit operations serving core area residents.

Coordinating institutions, streamlining processes, and minimizing red tape are seen as crucial in implementing TOD projects and are dependent on political leadership. However, Babalik-Sutcliffe (2002) reports that the level of cooperation among policy and planning entities in TOD and rapid transit projects tends to be limited to rhetoric without any meaningful coordination. Though Hamilton does not have to contend with the various layers of local and regional government seen in some cities in the United States, coordinating among actors at the local and provincial levels and streamlining developmental processes would go a long way towards ensuring TOD projects can get off the ground.

Loukaitou-Sideris (2010) recommends the establishment of joint corridor coordination bodies consisting of high-level representatives from all different public sector entities involved to move beyond the rhetoric of cooperation, establish a corridor-level vision for TOD, and make coordination among planning and policy actors.

Inclusiveness and Public Input: Including the broader public in the TOD planning, design, and implementation processes is essential to building support for TOD projects within their destination neighbourhoods. Outreach and education ensures local citizens and public and private sector stakeholders can work out their differences while fending off potential NIMBY backlash (Cervero, et al., 2004). Creating a vision for the type of community in which people would want to live can be an important tool for guiding the relationship between transit and transit-oriented development. While traditional development patterns are largely influenced by the private sector, the creation of a shared vision can help to ensure that developers pursue compatible strategies that reinforce local goals for TOD. This type of planning is inclusive in accommodating citizens and can also help new developments to be supported by local communities (Cervero et al., 2004; Dunphy et al., 2004).

Partnerships for Transit Joint Development: Transit joint development, or TJD for short, is an additional area of transit-oriented development in which the public sector engages directly with the private sector in partnerships for the construction of transit-oriented development. The topic of transit joint development is large in its own right, and is a topic for future research, though this section provides a brief introduction to the concept. According to Cervero et al. (2002), TJD can be defined as any formal agreement or arrangement between a public transit agency and a private individual or organization that involves either private-sector payments to the public entity or private-sector sharing of capital costs in mutual recognition of the enhanced real estate development potential or market potential created by the siding of a public transit facility.

In practice, this translates to revenue sharing and cost sharing arrangements. Revenue sharing arrangements include land leases, air rights development, and station interface or connection-fee programs, concession leases, and benefit assessment districts. Examples of cost sharing include sharing construction expenses, incentive-based programs that provide benefits (e.g. density bonuses) in return for off-loading infrastructure construction costs from the public sector, and joint use of equipment like ventilation and air conditioning systems.

The foundation of TJD is the idea of mutually beneficial relationships for TOD. Private-sector actors benefit because the accessibility bonuses of being near transit are capitalized into higher rents or greater occupancy, and the public sector benefits through the sharing of construction costs and opportunities for revenue generation. However, the potential for TJD depends on the ability of rapid transit to provide land value impacts. As mentioned in Section 1.3, LRT generally provides a lower level of value capitalization compared to heavy and commuter rail. Furthermore, the potential for value capture is largely dependent on local conditions. Nevertheless, as will be shown in Section 2.3.4, some light rail systems have had a positive impact in commercial and residential property markets.

Partnerships between the public and private sectors in transit-oriented development have the potential to benefit both sets of actors and each brings a complimentary set of strengths to the table. According to Dunphy et al. (2004), the public sector has the power to resolve land assembly problems, ensure that the site is development-ready, ease the entitlement process, contribute land, and fund infrastructure costs through revenue generation tools. Private developers can bring real estate experience, contacts

with end users, and the understanding of financial resources. Together these actors have the ability to ensure a successful outcome for both parties involved in the TOD process.

Working with Developers: Compared to traditional suburban greenfield development, mixed-use and infill TOD projects are typically seen as higher-risk projects for developers and their financial backers. As such, depending on local conditions, Cervero et al. (2004) recommend that some latitude in TOD planning be provided to the development community to relax the standards for new projects. Furthermore, a rich package of incentives such as zoning overlays that increase permissible densities, diversify land uses, and prevent incompatible land uses should be used to make TOD projects more attractive (Cervero, et al., 2004).

Creative methods for financing TODs can go a long way in pushing a project to completion and financial partnerships between the public and private sector can spread out risks. Local governments can leverage their superior borrowing position to offer bonds at favourable rates while the private sector can offer years of business experience and more traditional funding sources. According to Cervero et al. (2004), the need for creative financing is especially evident in the case of infill TOD projects in underperforming markets that are seen as a risk by private sector actors and their financial backers.

Interviews with property developers in the United States also indicated that these actors would like to operate within a clear set of objectives and expectations from the public sector. This is generally accomplished through a comprehensive and long-term vision for TOD and the political will to support it. At the planning level, clarity can come from station-area plans that are specific in the type of land uses to be supported. In general, giving latitude to the development community should not mean compromising public goals (Cervero et al., 2004; Dunphy et al., 2004).

Given the risk and uncertainty present in many TOD projects due to their atypical development nature, all actors involved in transit-oriented developments can benefit from a detailed, informative, and carefully crafted comprehensive station-area planning process that lowers risk and sets expectations. Developers have also indicated a role for the public sector in upgrading station-area designs through infrastructure provision such as improved pedestrian connections and the capacity of local utilities.

Early TOD Planning: Public agencies exhibit leadership by making it clear that TOD planning and construction is inherently a long-range endeavour and by planning far ahead. Most successful cities covered in this report engaged in some level of TOD planning for many years. A key aspect is that TOD planning can take place in advance of rapid transit, such as the case of Phoenix, AZ. Advance TOD can ensure a city's vision and goals will be followed, minimize uncertainty for developers, and streamline the development process (Loukaitou-Sideris, 2010). Pre-planning for rapid transit is one of the best ways to ensure that a new LRT project can 'hit the ground running' and achieve its goals (Cervero, et al., 2004).

Related to the concept of planning far ahead is the possibility for the public sector to engage in the practice of "land banking." By purchasing land prior to the construction of rapid transit, the transit provider can set itself up to capitalize on the land value benefits. Cities like Copenhagen and Stockholm have a tradition of engaging in this practice (Smith & Gihring, 2006). Land is 'banked' until a suitable level of value increases have occurred, at which point in time the transit or local redevelopment agency

disposes of the land on the property market or engages in joint development partnerships to construct transit-oriented developments on the site.

2.2.3 Station Vicinities

Transit Stations as Nodes or Places: Research has shown that in order to maximize their impact, TOD projects should emphasize 'place-making' by creating attractive, memorable, and human-scale environs. This means resolving the conflicting goals of conceptualizing transit station-areas as 'places' (neighbourhood centres featuring a host of mixed-uses, amenities, and pedestrian-friendly designs) or merely as 'nodes' (access points to transit and an interface between modes in a regional transportation network) (Cervero, et al., 2004).

Walking access and the quality of the overall pedestrian environment are critical to successful TODs. Cervero et al. (2004) note that the majority of residents living within ¼ mile of a transit station arrive at the station by foot or bicycle. However, this share plummets dramatically in cases with a less pedestrian-friendly environment that features physical as well as symbolic and psychological barriers such as wide and busy roads and an incomplete sidewalk network. Furthermore, research in Salt Lake City by Werner, Brown, and Gallimore (2010) found that the 'walkability' of a neighbourhood and station-area was directly tied to higher levels of ridership. According to Dunphy et al. (2004), the site should be designed with activity centres on all sides to ensure activity at the station, high quality designs, engaging public spaces, pedestrian connections, attractive landmarks, and residential uses to ensure around-the-clock activity. In other words, it should be designed more as a 'place' than a 'node.'

A related theme is the distinction made in the TOD literature between developments that are transit-oriented (TOD) and transit-adjacent (TAD). According to Cervero et al. (2002), a TAD is just that – development that is physically near transit. However, it fails to capitalize on this proximity to promote more transit riding. TADs typically exhibit a lack of any functional connectivity to transit in terms of land use composition, means of station access, or general site design. Other factors include a lack of consumer services, an absence of pathways or bike routes, or the presence of physical barriers that render these developments simply proximate to transit. TAD projects can include many elements of TOD, such as high densities and a mixing of uses. However, the lack of functional connection to transit ensures that these developments do not maximize their potential in enabling many of the benefits associated with the TOD concept.

The overall alignment of a transit line will have a huge impact on whether a station is perceived as a place or a node and whether a development is more TOD or TAD. According to Dunphy et al. (2004), real estate opportunities should always take priority over low-cost transit solutions, such as running transit in the median of an interstate highway. In the case of Denver, its new LRT runs alongside the I-25 interstate for the majority of its route and has necessitated heavy investments in new pedestrian infrastructure to make station-areas accessible. The result has been a profound negative effect on the developmental potential of the line, where the majority of land uses remain fundamentally transit-adjacent and automobile oriented. Conversely, in San Diego, planners have made an explicit attempt to maximize the developmental potential of a new LRT line.

Density is also seen as a fundamental element of TOD. However, in terms of neighbourhood opposition, it is also one of the most controversial. Many design guidelines have been prepared that highlight the levels of density required to support transit, and many recommendations do not require the skyscrapers that many citizens fear on their blocks (Pushkarev & Zupan, 1977; Ewing, 1997). TOD planners should approach the requirement for density in such a way that it incorporates local feedback and minimizes stakeholder opposition.

Public sector planners typically impose a design template for TODs that calls for vertical mixing of land uses such as ground-floor retail and upper level residential. However, Cervero et al. (2004) caution that mixed-use projects are trickier to design, finance, and lease compared to traditional single-use developments. Getting the correct 'formula' for the mixture of uses is crucial to a project's chances at success. This requires aligning the formula with market realities while also taking into consideration future needs.

Expertise in mixed-use development is generally lacking within the private sector in North America, meaning many firms are likely to be uncomfortable with specific design requirements. While the retail component of TODs may be a generator of activity within a station-area, it must be in accordance with considerations for market potential based on traditional private sector barometers. Dunphy et al. (2004) argue that public agencies must resist the temptation to require TODs for transit in the absence of adequate market support. Nevertheless, mixing of uses is seen as a fundamental aspect of creating vibrant TOD neighbourhoods and should still be championed by planners.

Parking Issues: Planning policy that reduces parking requirements play a crucial role in transit-oriented development. At the urban design level, rationalizing parking for TODs in urban areas is essential to influencing how transit will be accessed and solving conflicts over whether land goes to parking or development. Parking can create a massive obstacle to transit use by influencing individual mode choice and making the environment at a station less pedestrian friendly. Furthermore, parking must be taken into consideration for future TOD as well. Cervero et al. (2004) caution that the presence of a surface parking lot for park-and-ride at a transit station can make future development contentious by pitting drivers against neighbourhood residents.

These problems can be avoided by designing surface parking away from main transit areas or confining it to a structured lot if property values are high enough to warrant the added cost. Dunphy et al. (2004) recommend four strategies for dealing with parking: move it away from station-areas, share it with other surrounding land uses, deck it with structured parking facilities, and wrap it with surrounding retail and services. Willson (2005) agrees, adding that parking requirements should be flexible and aligned with actual levels of demand as best as possible.

Typically development projects have strict requirements for parking ratios and replacement parking. Unbundling these requirements from TODs can save residents thousands of dollars and allow developers to avoid the construction of costly parking structures. Furthermore, the lower automobile rates of TODs provide an opportunity to adjust the impact fees of these projects accordingly.

In some places, parking ratios can affect project financing. For example, the Center for Transit-Oriented Development (2011) reports that although Charlotte's TOD guidelines allow for reduced parking requirements, developers typically build to the maximum ratio allowed (1.5-1.7 spaces per unit) because it is required to receive project financing. In other words, the best interests of TOD sometimes conflict with entrenched perceptions of the financial and development communities.

2.2.4 Policy Tools

There are a wide range of policy tools that can be employed to help create and enhance vibrant and healthy communities to support rapid transit. Table 2.2 provides an overview of these tools, with a more comprehensive overview of each included in Appendix C. This list was derived from a detailed overview of strategic policy tools prepared by the United States Environmental Protection Agency (2009) for application to light rail transit planning in Phoenix, AZ, and should be considered in tandem with the tools to support rapid transit presented above. While the table of policy tools provides an overview of the strategies that can be employed to promote transit-oriented development, not all of these tools can be applied to every transit corridor or station area depending on local conditions.

Loukaitou-Sideris (2010) notes that although disincentives and requirements are useful for bringing amenities to a jurisdiction, if they are too burdensome, many developers will be scared away. Striking the right balance between 'carrots' and 'sticks' at the outset is important, but monitoring and adjusting this balance as time goes on is crucial. Furthermore, while many initiatives on their own can help to generate the desired land use changes, by themselves they may not be enough to adequately attract the most transit-supportive development. Consequently, the power of promoting TOD comes in the overall package of supporting policies.

Table 2.2 Policy Tools for Transit-Oriented Development

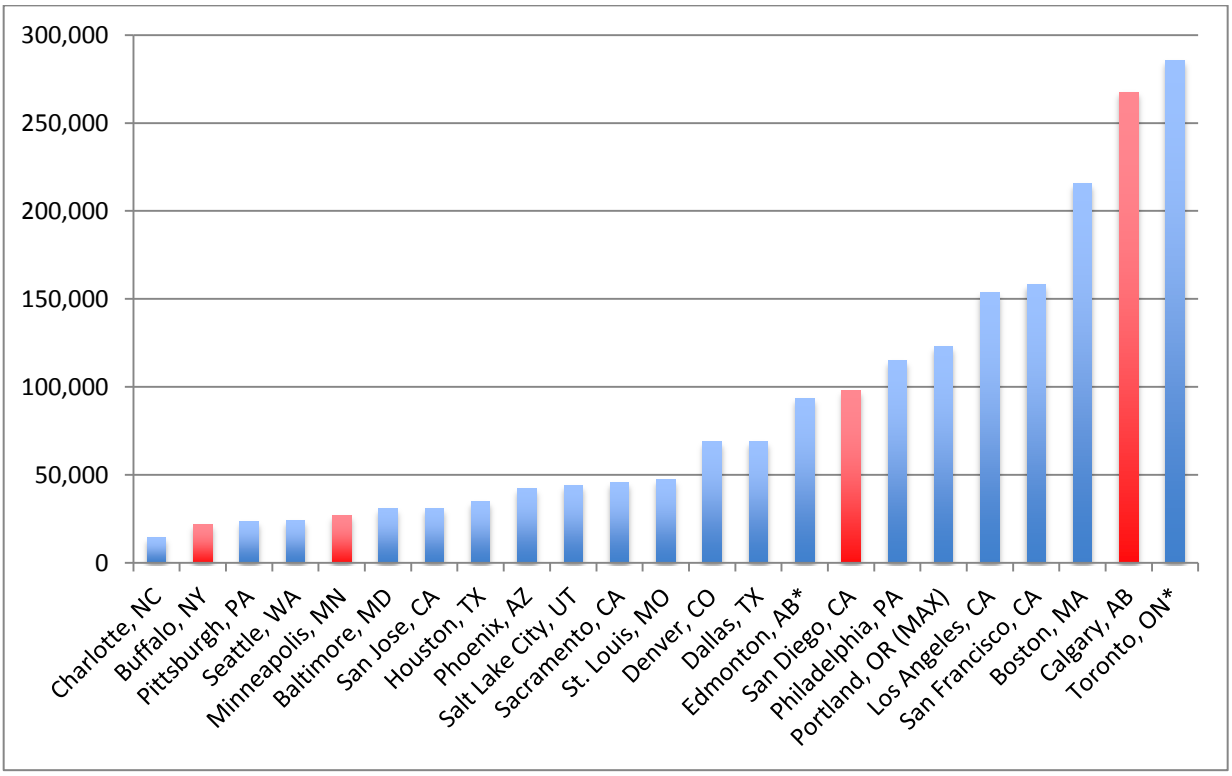
1. Strategic Planning Tools
• Regional and Local TOD Strategic Plan
2. Land Use Policy Tools
• Prepare Station Area Plans and Market Studies
• Station Area Rezoning A: Rezone Station Areas
• Station Area Rezoning B: Use Restrictions Based on Public Health and Safety and Transportation Impacts
• Station Area Rezoning C: Optional Overlay Zone
• Land Use Intensity Tools A: Density Bonuses
• Land Use Intensity Tools B: FARs and Building Height Bonuses
• Land Use Standards Enhancement A: Form-Based Codes
• Land Use Standards Enhancement B: Design Guidelines
• Parking Tools A: Revised Parking Standards
• Parking Tools B: Shared Parking
• Parking Tools C: Parking Districts
3. Development Assistance Tools
• Fast Track Development Review
• Capital Funding for Infrastructure
• Tax-Increment Financing
• Reduced Impact Fees in Station Areas
4. Place Making and Access Tools
• Streetscape and Pedestrian/Bicycle Improvements
• Façade and Site Frontage Improvement Program
• Tax-Exempt Bonds
• Tax Abatement
5. Land Assembly Tools
• Joint Development Program
• Land Acquisition Loan Funds
• Funds for Buying Available Parcels on the Open Market
6. Programmatic and Institutional Tools
• Business District Association or Business Improvement District
• Marketing and Outreach Strategies
• Livable Communities Program
• Community Development Corporation (CDC) Lead Efforts
• Housing Trust Funds

2.3 Outcomes

2.3.1 Normalized Ridership

One area of focus for this report is to examine ridership in a normalized or relative basis as opposed to only the raw, absolute figures. As a preliminary, Figure 2.1 reports on the absolute ridership numbers for LRT cities in the United States and Canada based on very recent data. The four case studies of this report in Calgary, San Diego, Minneapolis and Buffalo are highlighted in red. With respect to the two Canadian LRT cities, it can be seen that Calgary and Edmonton rank quite high on an absolute ridership basis.

Figure 2.1 Daily Light Rail Ridership in Selected North American Cities



Source: APTA (2011), Edmonton data from (ETS, 2011); Toronto data from APTA (2010)

Alternatively, ranking light rail cities according to their ridership per kilometre helps to control for the extent/length of each system. Other things being equal, one would expect more extensive systems to experience higher ridership. The statistic is calculated as thousands of total weekday trips per route kilometre (TRK). This statistic was then used to rank each of the light rail cities between the US and Canada (Table 2.3). Table 2.3 also provides the metropolitan area Road Congestion Index (RCI) as calculated by the Texas Transportation Institute. This concept is discussed further in Section 2.3.2.

Table 2.3 Light Rail System Characteristics, Normalized Ridership, and Congestion Indices

City	Lines	Stat-ions	Km	Daily Riders (1,000s)	TRK Index	TTI RCI Index[a]
Boston	4	66	36	215	5.972	1.21
Calgary	3	36	49	266	5.429	N/A
Edmonton	1	15	21	94	4.476	N/A
Houston	1	16	12	35	2.917	1.15
San Francisco	6	33	59	158	2.678	1.32
Buffalo	1	15	10	22	2.200	0.73
Los Angeles	3	56	99	154	1.556	1.54
Portland (Max)	4	85	84	123	1.464	1.14
Salt Lake City	3	28	31	44	1.419	0.97
Minneapolis	1	19	20	27	1.350	1.10
Phoenix	1	32	32	42	1.313	1.24
Newark	2	20	16	20	1.250	1.10
Denver	5	36	56	69	1.232	1.13
Philadelphia	7	68	97	115	1.185	1.07
Tacoma	1	5	2.6	3	1.154	N/A
San Diego	4	53	86	98	1.140	1.32
Seattle	1	13	25	24	0.960	1.08
Jersey City	3	24	44	42	0.955	1.10
Charlotte	1	15	15	14	0.933	1.05
Sacramento	2	45	59	45	0.763	1.27
Baltimore	3	33	48	31	0.646	1.18
St. Louis	2	37	74	47	0.635	0.87
Pittsburgh	2	60	40	24	0.600	0.75
Dallas	3	55	116	69	0.595	1.17
San Jose	3	70	70	31	0.443	1.30
Cleveland	2	35	24	9	0.375	0.84

a: Source: TTI, 2011

The results of this analysis show that there is no clear correlation between the length of a city's light rail network and transit ridership. There are several small systems that are near the top of the list and some quite extensive systems that are near the bottom. Other than Boston, the Canadian cases of both Calgary (5.429) and Edmonton (5.476) emerge as leaders among their North American counterparts with over 5,000 riders per kilometre, putting them well above the average of all cities (1.678). Recall that Calgary and Edmonton have also ranked highly in terms of absolute ridership. Boston's (5.972) high TRK ratio is partly attributable to its connections to an extensive heavy rail subway system that serves the downtown core. Toronto's TTC streetcars (3.800) also perform well, though they are not typically considered part of a modern LRT system and as such are not included in the table.

Some cities with newer light rail systems perform well, such as Houston (2.917), Salt Lake City (1.419), Minneapolis (1.350), and Denver (1.232) and are likely to experience improving ratios as each system matures. Somewhat surprisingly, the Buffalo system ranks fairly highly on the basis of TRK (2.20) as it serves a fair number of riders given its limited extent. Other cities such as Cleveland (0.375) and San Jose (0.443) perform at a much lower level than the North American average.

An interesting comparison emerges between cities with extensive light rail systems. The provision of an extensive transit network is often noted as a method of attracting riders by connecting more destinations within a city, but according to this basic analysis, some of the most expansive light rail networks appear to be operating at lower levels of efficiency.

At 116 kilometres, the Dallas system is actually the most extensive in North America and was constructed in a fairly cost-effective manner by utilizing existing rights-of-way from old rail lines. Given the extent of the system, ridership is disappointing at about 600 TRK, or about the same as Pittsburgh. While there has been some apparent TOD progress in Dallas, it has been noted that old rail corridors, with their associated industrial landscapes, are not the best initial canvas for new development. Dallas has relatively high levels of congestion and yet its overall transit share of commuting trips is at 1.4% despite large investments in light rail. In a sprawled city like Dallas, light rail may not meet the needs of a majority of trips to decentralized destinations so drivers choose instead to endure congestion on the car commute.

Portland and San Diego are similar in that they have developed some of the most aggressive (many would say progressive) policies to encourage TOD including the utilization of tax increment financing districts to encourage new development in station areas. On a ridership basis, San Diego is at 1.14 TRK while Portland is approaching 1.50 TRK and each has experienced a high degree of success in promoting new development and redevelopment projects along their LRT lines. The extensive light rail system in Los Angeles (99km) performs better than all of these cases with a TRK index of 1.556. However, despite high levels of TOD, neither of these cities approaches the levels of ridership per kilometre of Calgary or Edmonton.

2.3.2 Impact of Light Rail on Road Congestion

One of the main justifications for building a light rail transit system is that some drivers will switch their mode of transportation and alleviate some of the strain on road and highway networks. However, there is little evidence that LRT can decrease traffic congestion (Mackett & Edwards, 1998; Babalik-Sutcliffe, 2002). Even in Portland, the extensive MAX LRT system was found to have had a negligible impact on reducing peak-period congestion in its first ten years of operation, though it did slow the development of automobile-oriented households (Deuker & Bianco, 1999).

According to the Texas Transportation Institute's (TTI) most recent mobility report, US cities with and without light rail both experienced an increase in congestion (2011). Research by Garrett (2004) using TTI data from 1982-2000 in four cities with light rail does suggest that light rail can have an impact in slowing the rate of increase in congestion (Table 2.4). The year at which each city opened a light rail transit line is noted in bold. TTI Road Congestion Indices form a ratio based on actual traffic conditions

versus free flow travel times. A TTI index of 1.0 is average, with values below 1 below average and those above 1 indicating higher than average congestion.

While the results in Garrett (2004) do suggest some moderation in congestion trends after the opening of light rail, the measures do not explicitly take local population and economic conditions into account. An analysis of more recent TTI data from 1982-2010 by MITL shows no discernible trend between the opening of a light rail line and a reduction or slowing of congestion for the cities covered by Garrett (2004) and others in this analysis.

Results suggest that an investment in LRT in and of itself should not be expected to mitigate regional congestion. But light rail in conjunction with TOD has resulted in higher trip rates for public transit and lower levels of automobile ownership and usage (Pushkarev & Zupan, 1977; Cervero et al. 2004). One other complication with the impact of LRT on congestion reduction is that any easing of congestion can be quickly offset by induced demand and a resulting increased demand to travel.

Table 2.4 Evolution of Congestion in Selected Light Rail Cities

	St. Louis		Baltimore		Sacramento		Dallas	
Year	TTI Index	% Change	TTI Index	% Change	TTI Index	% Change	TTI Index	% Change
1982	0.870	---	0.750	---	0.760	---	0.730	---
1983	0.875	0.57	0.775	3.33	0.796	4.77	0.759	3.94
1984	0.880	0.57	0.800	3.23	0.833	4.55	0.788	3.79
1985	0.885	0.57	0.825	3012	0.869	4.35	0.816	3.65
1986	0.890	0.56	0.850	3.03	0.905	4.17	0.845	3.52
1987	0.895	0.56	0.875	2.94	**0.941**	**4.01**	0.874	3.40
1988	0.900	0.56	0.900	2.86	0.978	3.85	0.903	3.29
1989	0.905	0.56	0.925	2.78	1.014	3.71	0.931	3.19
1990	0.910	0.55	0.950	2.70	1.050	3.58	0.960	3.09
1991	0.930	2.20	0.963	1.32	1.068	1.67	0.960	0.00
1992	0.950	2.15	**0.975**	**1.30**	1.085	1.64	0.960	0.00
1993	**0.970**	**2.11**	0.988	1.28	1.103	1.61	0.960	0.00
1994	0.990	2.06	1.000	1.27	1.120	1.59	0.960	0.00
1995	0.998	0.81	1.014	1.40	1.136	1.43	0.982	2.29
1996	1.006	0.80	1.028	1.38	1.152	1.41	**1.004**	**2.24**
1997	1.014	0.80	1.042	1.36	1.168	1.39	1.026	2.19
1998	1.022	0.79	1.056	1.34	1.184	1.37	1.048	2.14
1999	1.030	0.78	1.070	1.33	1.200	1.35	1.070	2.10
2000	1.030	0.00	1.100	2.80	1.250	4.17	1.100	2.80

Source: Garrett, 2004

2.3.3 Cost Performance of Light Rail

Based on data from the Federal Transit Administration in the United States, a case can be made that light rail transit systems in the US underperform in terms of cost-benefit analysis and cost-recovery measures. Transit critics such as O'Toole (2010) note that light rail in the US has not been successful by strict measure of economics. While transit advocates are quick to note the perceived external non-rider benefits of rapid transit such as economic development, other authors such as Gordon and Kolesar (2011) note that even when these benefits are taken into account, light rail still performs poorly in cost recovery with an average of only 13.4% of operating costs paid by riders (across the LRT systems included in their analysis). While Gordon and Kolesar (2011) include many light rail systems based on diesel and historic streetcar operations, it is interesting to note that the top performing light rail city in their analysis is Houston with a cost-recovery ratio of 32.4%. Other above-average ratios include San Diego (22%) and Philadelphia (21.4%).

One of the main reasons behind cost-recovery issues is low ridership. As noted above, many light rail systems in the US perform at a low level of ridership per kilometre. But in absolute ridership terms, previous studies have noted that the decision to build many light rail systems in the United States was based on overestimated levels of ridership that were subsequently not achieved after opening (Pickrell, 1989; Black, 1993). However, to return to differences between light rail in Canada and the United States, it should be noted that Canadian cities have shown markedly higher rates of cost recovery and cost effectiveness by all measures (Black, 1993; Hubbell & Colquhoun, 2006; McKendrick et al. 2006), with Calgary and Edmonton outperforming their peers in the US.

Beyond ridership and cost recovery, another concern for light rail is overruns in original versus actual construction costs. Pickrell (1989) reports that out of four light rail systems built before 1990 (Buffalo, Pittsburgh, Portland, and Sacramento), all but Pittsburgh resulted in costs well above forecasted totals. Both Buffalo and Portland saw significant cost overruns in excess of 50%, while Sacramento fared better at 13%. However, Pittsburgh's light rail system was under budget by 11%. Recent research from Dantana et al. (2006) shows that newer light rail systems have been constructed closer to original budget estimates, though O'Toole (2010) has found that newer systems in Charlotte, Denver, and Minneapolis have come in over-budget. Nevertheless, based on ridership, cost recovery, and construction overruns, an argument can be made that the assumptions and justifications behind these projects were incorrect and that many light rail systems should not have been built.

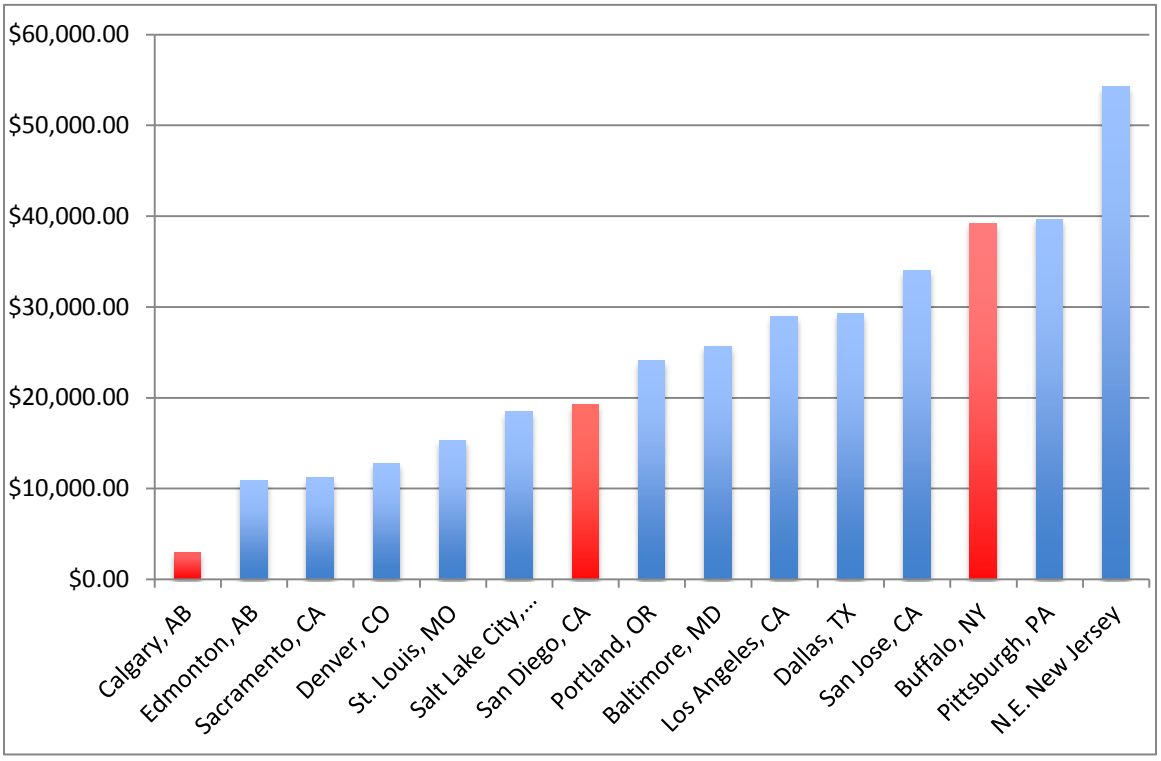
Figure 2.2 presents a metric for the total cost per weekday passenger in 2000, corrected for inflation to 2010 USD. This information is charted in Figure 2.3, highlighting the cities selected for further analysis in Chapter 3. Minneapolis was not included as the source material covers LRT systems constructed up until the year 2000. In general, it is well known that light rail and public transit systems do not cover costs. In fact, all mature transportation systems including road networks operate with some form of public subsidy. Furthermore, as Babalik-Sutcliffe (2002) notes, despite the poor cost-benefit ratios and cost overruns seen in many of the systems included in this analysis, political support for light rail and rapid transit in general remains strong and many of these systems continue to be built and extended in cities across North America.

Table 2.5 System Cost per Weekday Passenger

City	Year of Line Opening	Total Cost (Million US) (2010)	Total Length (km)	Total Cost per KM in Million (US) (2010)	Weekday Boardings (2000)	$ / Weekday Passenger (2010)
Sacramento, CA	1987, 1998	$321.2	33.2	$9.7	28,800	$11,152.90
Baltimore, MD	1992, 1997	$657.5	47.3	$13.9	25,600	$25,682.84
St. Louis, MO	1993	$484.4	30.6	$15.8	31,700	$15,282.02
Salt Lake City, UT	1999	$392.4	24.1	$16.3	21,300	$18,422.77
Denver, CO	1994, 2000	$374.3	22.5	$16.6	29,400	$12,730.19
Calgary, AB	1981, '87, '90	$546.8	29.3	$18.7	187,700	$2,913.26
San Diego, CA	1981, 1986	$1,587.3	75.3	$21.1	82,600	$19,216.31
San Jose, CA	1981, 1999	$1,081.6	46.0	$23.5	31,800	$34,013.41
Pittsburgh, PA	1985	$955.9	40.6	$23.6	24,100	$39,663.49
Edmonton, AB	1978-1992	$390.9	12.2	$32.0	36,000	$10,859.29
Portland, OR	1986, 1998	$1,715.7	52.6	$32.6	71,100	$24,130.80
Dallas, TX	1996, 1997	$1,114.7	32.2	$34.6	38,100	$29,257.61
Los Angeles, CA	1990, 1995	$2,371.1	67.6	$35.1	81,900	$28,951.13
N.E. New Jersey	2000	$1,215.8	16.1	$75.5	22,400	$54,277.61
Buffalo, NY	1984	$932.0	10.3	$90.5	23,800	$39,159.36

(McKendrick, Colquhoun, Charles, & Hubbell, 2006)

Figure 2.2 System Cost per Weekday Passenger



(McKendrick, Colquhoun, Charles, & Hubbell, 2006)

2.3.4 LRT and TOD Land Value Impacts

Many studies have examined rapid transit and TOD by attempting to quantify the capitalization of accessibility benefits in property values. According to Landis (2004), the theory of capitalization is that the market value of improved public services will be transmitted, or 'capitalized' into the values of nearby or adjacent parcels of land. Using hedonic regression models, researchers have been able to infer the impact of transit into sale and rent prices for residential and commercial properties for each type of transit technology. Hedonic models assume that many goods are a combination of different attributes, and that the overall transaction price can thus be decomposed into the component, or hedonic prices of each attribute. Using statistical techniques and land sales data, researchers can isolate the impact of proximity to rapid transit on the price of a parcel.

Though much has been written about the effects of heavy rail on land values, a smaller body of research exists discussing the relationship between light rail and market capitalization. The general fundamentals behind TOD are that rapid transit systems such as heavy rail subways or metros, commuter rail, light rail, and rapid bus services can offer travel time savings that result in accessibility benefits. Transit-oriented development relies on the notion that people will in turn value living in areas with access to rapid transit, which makes the redevelopment of properties around station-areas much more likely.

Cervero (2004) notes that because of differences in service intensity, speed, and coverage, there is a 'spectrum' of developmental potential for each type of rail transit system. The general rule in TOD literature is that heavy rail tends to provide the largest capitalization of accessibility benefits into property values, followed by commuter rail. Light rail is third, and other technologies such as bus-based systems and streetcars generally provide less of a benefit than LRT. This is not to detract from the ability of light rail to influence transit-oriented development, as many studies have found positive capitalization of transit proximity into property values. However, much of the research on transit-oriented development considers LRT alongside heavy rail and commuter rail, making it difficult to separate out insight relevant to a city conducting light rail transit planning such as Hamilton.

Table 2.5 offers a review of previous literature regarding the land value impacts of light rail transit systems. In general, research in many cities has shown that LRT can be capitalized into local land values and that properties exhibit a price premium in the vicinity of a station. However, land value premiums are inherently tied to local conditions and no generalizations can be made. Despite even the best transit and TOD intentions, property values will not rise if the market does not value access to transit. Some cities exhibit this trend, such as the Blue Line LRT in Los Angeles (Loukaitou-Sideris & Banerjee, 2000), and in Buffalo, where the Metro Rail LRT was found to have a negative influence on property values around some stations (Hess & Almeida, 2007). For TOD in general, Cervero et al. (2004) show that land value increases require proactive planning, network development, and transit system maturation.

Capturing the value increases that TODs can provide is a way to generate revenue. Typical value capture methods employed by local governments have included special assessment and tax-increment financing districts, though a range of other tools have been used around North America. But like transit joint development, the success of these tools depends largely on the capitalization of transit into land values.

Table 2.6 Land Value Impacts of Light Rail Transit Systems

Authors	Location (Line)	Extent of Property Value Impact	Major Conclusions
Al-Mosaind et al. (1993)	Portland (Eastside MAX)	+10.6% for homes within 500 metres	-Where transit plays a minor role, transit's impact on property values is minimal -Accessibility outweighs negative nuisance effects
Cervero & Duncan (2002a)	San Diego (Trolley)	+10% (East Line) and +17% (South Line) for multi-family homes, disbenefit for single-family housing	-Land value impacts dependent on land use type -Commercial benefits low
Cervero & Duncan (2002b)	San Jose (VTA Light Rail)	+1-4% for homes and apartments near light rail, disbenefit for condominiums by 6%	-Land value impacts dependent on land use type
Cervero & Duncan (2002c)	San Jose (VTA Light Rail)	+23% in value for commercial properties within ¼ mile of a light rail station	-Other factors such as concentration of employed residents also important
Chen et al. (1998)	Portland (Eastside MAX)	-$32.20 per metre further from station	-Negative impact begins at a distance of 100m from station
Dueker & Bianco (1999)	Portland (Eastside MAX)	Median house value increases at a faster rate closer to stations	-A house located at a station will decrease by 5%, 2%, and 1% if it is located 400ft., 600ft., and 800ft. away from a station
Garrett (2004)	St. Louis (MetroLink)	-2.5% for every one-tenth mile further from a rail station	-Nuisance outweighed by large accessibility benefit for homes
Hess & Almeida (2007)	Buffalo (MetroRail)	+2-5% of the city's median home value for properties within ¼ mile of rail	-Significant positive effect at stations near University, but significant negative at other stations means benefits not universal on line
Landis et al. (1994)	Sacramento (Light Rail)	No discernable impact	-The extent to which a rail system captures ridership from its market area effects the extent to which property values are increased -Frequency of service and regional accessibility affect the amenity of a rail system
	San Jose (VTA Light Rail)	-$1.97 per metre closer to light rail (may be due to industrial and commercial uses)	
	San Diego (Trolley)	+$2.72 per metre closer to Trolley	
Voith (1993)	Philadelphia (SEPTA)	+8% in values for homes with access to rail	-Value of CBD accessibility fluctuates with economic health of the central city
Weinstein & Clower (2002)	Dallas (DART)	+32% in assessed values near DART stations	-Compared to 20% in control group areas not served by rail

2.4 Pre-Requisites

One interesting question is the extent to which certain pre-requisites need to be in place for LRT and TOD to be successful. Three themes relating to local economic conditions, employment accessibility and traffic congestion are examined in this context.

2.4.1 Local Economic Conditions

Scholars such as Knight and Trygg (1978) and Cervero (1984; 1994) conclude that urban rail systems should not be understood as drivers of new economic growth. Rather, experience in North America has shown that rapid transit can play a role in guiding growth that would have occurred anyhow. Essentially, the benefits of transit and TOD are not automatic – there must be growth to redistribute for development to occur. By the same token, the promotion of light rail transit and transit-oriented development should not be framed as a 'cure-all' for economically depressed and declining areas.

Cervero et al. (2004) argue that if mixed-use development around transit is to be attractive to people, these areas need to be experiencing rapid economic growth and traffic conditions need to be bad and getting worse. This is revealed in the cases of Charlotte, Denver, and Jersey City, where high employment and population growth in each city resulted in a surge in new development oriented to rapid transit lines serving these jobs. In each case, LRT was highlighted as an important tool to redistribute growth within the city. In Minneapolis LRT has been used as a tool for redevelopment in conjunction with a comprehensive long-term revitalization strategy for underutilized areas. Efforts have benefitted from robust local economic conditions and a growing population.

A general rule advocated by Arrington (2003) is that TOD projects have to be successful without transit in order to be successful with transit. Despite the promise of transit-oriented development and the benefits it can offer, it is important to remember that TOD is just a label and market fundamentals govern whether private capital is invested in development around transit stations. This investment is essentially a function of strong capital market conditions and market demand, and a lack of these means that private sector financers will be unlikely to support any TOD projects. Beyond the basic marketplace, some lenders are also unwilling to fund projects that do not meet their perceived guidelines, such as TODs with reduced parking supplies (Cervero et al., 2004).

Hess and Lombardi (2004) sought to study the relationship between transit and TOD and the revitalization of declining urban areas. They note that because of historical patterns of land use development, the concept of TOD is far more natural and common in the inner areas of older cities such as Boston or Toronto than in the downtowns of newer, more automobile-oriented cities. After a review of TOD cases, their research revealed that while some TOD has occurred in the downtowns of economically vibrant cities, it is very difficult to find examples of new transit-oriented development in the inner cores of economically distressed cities. They attribute this to a lack of development in these areas, both TOD and otherwise, suggesting that distressed inner cities present unique challenges to promoting TOD and urban revitalization. This outcome can be seen in the examples of Cleveland, Philadelphia, and Pittsburgh included in this report. In the slow-growth case of Buffalo's MetroRail (see

Chapter 3), high levels of population flight and a stagnating economy have contributed to the system's anemic level of ridership and capitalization in local property values.

Another example is the Blue Line LRT in Los Angeles, as detailed by Loukaitou-Sideris (2000). This line travels through some of the poorest and most neglected neighbourhoods in the city and was specifically designed as a tool to generate benefits to these areas. However, despite high levels of ridership, a lack of market potential has meant that little development has taken place in these neighbourhoods in the first nine years that the Blue Line operated (Loukaitou-Sideris & Banerjee, 2000).

2.4.2 Employment Accessibility

Though the density of residential units in the proximity of transit is often noted as an important element in generating ridership, the size, location, and accessibility of major employment centres is also fundamental to the success of any rapid transit project. Cervero (2007) states that job accessibility is a major factor in the decision to locate in a TOD project and use transit while Dill and Wardell (2007) note that the accessibility of job sites by transit is directly correlated to workers utilizing modes other than the automobile. While a basic consideration, many people will not use transit if they have no reason to travel to where it provides accessibility. As the case of Calgary shows, increasing employment to areas served by LRT lines is crucial to generating high levels of ridership. Furthermore, promoting employment outside of the downtown core at other stations along the LRT system by mixing land uses at TOD sites is a good way of smoothing peak periods of demand and promoting reverse commutes.

2.4.3 Road Congestion

Light rail transit can be considered in terms of the impact it has on traffic congestion, as it was in Section 2.3, but it can also be examined as a possible pre-requisite for a successful LRT implementation. Relatively uncongested cities often experience lower LRT ridership. Returning to the TTI Road Congestion Index, which forms a ratio based on actual traffic conditions versus free-flow conditions, there are some interesting results in the U.S. to consider. For example, Cleveland (0.84), Pittsburgh (0.75), and St. Louis (0.87) all exhibit TTI indices below the average of 1.0 and are near the bottom in weekday ridership levels and measures of TRK. Los Angeles (1.54), San Diego (1.32), and San Francisco (1.32) maintain both very high levels of congestion and daily ridership. To some extent, this relationship weakens when TRK measures of ridership per system kilometre are taken into account, with San Diego exhibiting average performance.

Apart from statistical measures of congestion, Dunphy et al. (2004) argue that an important element of congestion is the feedback it provides into the political process, which can in turn influence the ability of policy actors to champion transit. Congestion has been found to play a fundamental role in influencing suburban voters to support transit initiatives, as new riders are perceived as potentially subtracting from road traffic. This is an important aspect since political influence has suburbanized with the general population. A downside is that many transit agencies end up creating a bloated system serving areas with marginal developmental potential (Dunphy et al., 2004). Suburban voters tend to be more concerned with issues that affect them directly, such as congestion, than being sympathetic to the problems of inner cities.

3

Four North American Case Studies

This section presents four case studies designed to complement the overview of light rail transit cities presented in Appendix A with a more detailed exploration of the experiences with LRT and transit-oriented development and illustrate several of the key lessons identified in Chapter 2. This report has selected the examples of Calgary, Buffalo, San Diego, and Minneapolis for further analysis. Each was chosen because, aside from San Diego, these cities are not typically examined in relation to light rail and transit-oriented development in the popular literature, and each offers a different lesson relevant to light rail transit planning in Hamilton. Table 3.1 and Figure 3.1 provide a brief orientation to system characteristics, ridership and ridership trends since 1995, and each city's respective Road Congestion Index score.

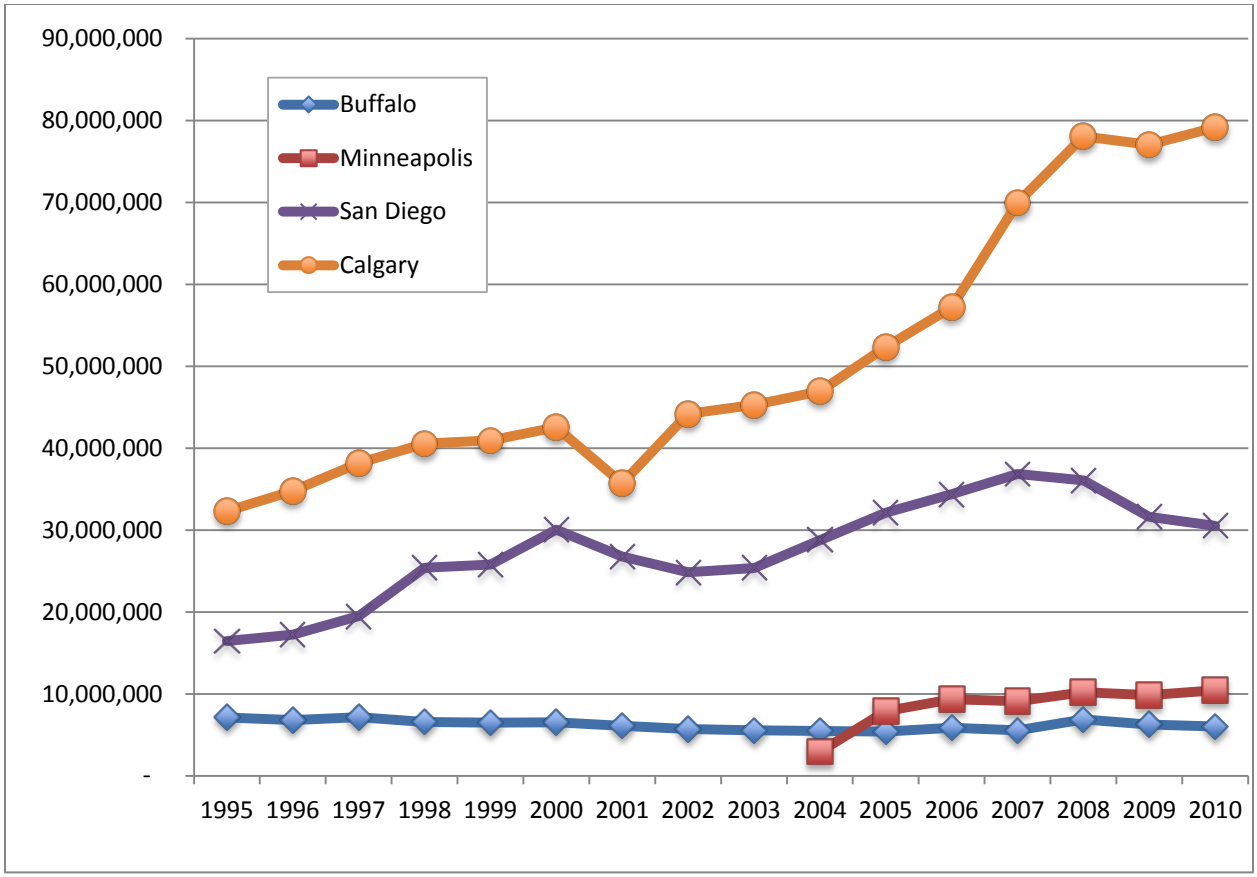
Calgary presents an interesting case of a city in which light rail performs exceptionally well in terms of ridership and cost effectiveness for a variety of reasons. This success has occurred despite little emphasis on transit-oriented development by planners and policymakers. The experience with light rail in Buffalo provides a cautionary tale of LRT as a tool for urban revitalization in a declining metropolitan area and suggests lessons for implementing light rail in slower-growth urban areas. San Diego has emerged as a leader in TOD in North America and is included in this analysis due to the sheer amount of literature available that details its extensive transit-oriented development planning initiatives and policy tools. Lastly, Minneapolis is a recent case that has learned from past experience with light rail and

transit-oriented development in other jurisdictions and has taken an integrated approach to transportation and land use planning for its first LRT line. The success of Minneapolis's Hiawatha line suggests a model for implementing LRT and TOD in other cities. The other cities in this report are covered in Appendix A.

Table 3.1 Light Rail System Characteristics, Normalized Ridership, and Congestion Indices

City	Lines	Stns.	Km	Daily Riders (1,000s)	TRK Index	RCI Index[a]
Calgary	3	36	49	266	5.429	N/A
Buffalo	1	15	10	22	2.200	0.73
Minneapolis	1	19	20	27	1.350	1.10
San Diego	4	53	86	98	1.140	1.32

Figure 3.1 Annual Light Rail Ridership for the Four Cases (1995-2010)



(APTA, 2011)

3.1 Calgary

Light rail transit in Calgary can be considered successful by a number of metrics. Ridership is the highest among all LRT systems in North America and the C-Train maintains the lowest costs per weekday passenger. However, the experience of transit-oriented development along Calgary's LRT lines is mixed. This section outlines Calgary, the C-Train and its success, and the state of TOD in the city.

The population of Calgary has exploded, doubling over the last thirty years. Economic activity is also strong, with Calgary hosting the second-largest number of corporate head offices of any city in Canada. The city has developed around a concentrated downtown core that has over 112,000 jobs and 12,000 residents within a 3.5 square kilometre area. Surrounding the downtown core are relatively low-density suburban residential communities (McKendrick et al., 2006).

C-Train Overview

Calgary's C-Train stretches 48.8km and consists of 36 stations on three lines separated into two routes – the South Line and Northwest Line form Route 201 while the Northeast Line makes up Route 202. The West Line will open in 2012, further extending Route 202. All routes share common tracks in the downtown portion of the network, which also acts as a fare-free zone. Total investment to date is over $1 Billion (McKendrick et al., 2006).

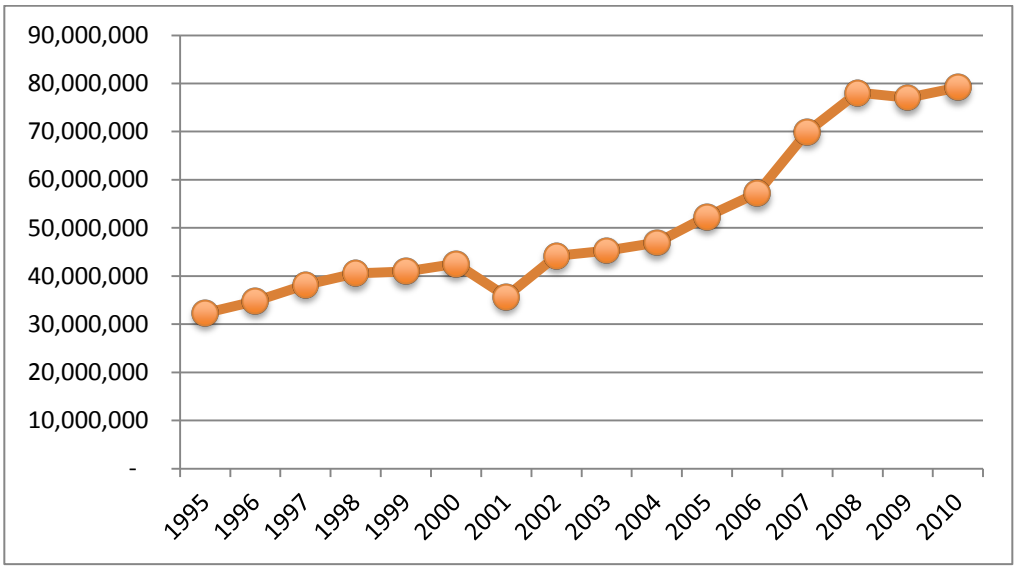
It was not until 1976 that the decision was made by city council to invest in light rail transit over BRT due to the latter's ability to offer more cost-effective, reliable, and comfortable means to move large volumes of people and its ability to attract new development along its route (Cervero, 1985; McKendrick et al., 2006). The C-Train began service in 1981 with the opening of the 12.9 kilometre South Line LRT followed by the Northeast Line in 1985. The first section of the Northwest Line opened in 1987 prior to the 1988 Olympic Games.

Ridership on the C-Train began at an estimated 40,000 daily passengers in its first year (McKendrick et al., 2006). Demand has exploded in recent years, giving Calgary the highest ridership of all LRT systems in North America at 267,500 daily passengers (Figure 3.2). This level of ridership is a significant achievement for a city of Calgary's size, especially when compared to the three other cities in this expanded analysis (Figure 3.1) and other LRT systems in North America (Figure 2.1). However, ridership on the C-Train is unbalanced in peak periods, with the vast majority of trips (75%) headed to downtown in the AM and outbound in the PM (McKendrick et al., 2006). Nevertheless, a 25% share of travel outside of the downtown is respectable for a system largely designed to serve commuting to and from the core of the city. As a result of rapid population growth and increased ridership, both the C-Train and local bus services are currently operating at capacity during peak periods. In response, a further $1 Billion is to be invested in expanding capacity and maintaining infrastructure (McKendrick et al., 2006).

Twenty-five of the system's stations are located in suburban areas and are spaced approximately every 1.6km. This large spacing allows the C-Train to cover more ground at higher speeds. Stations typically range from grade-separated platforms to large enclosed structures with elevators and escalators, with most stations featuring bus terminals and park-and-ride lots. For the 11 stations downtown, the C-Train

operates within a fare-free transit mall shared with buses and emergency vehicles (McKendrick et al., 2006).

Figure 3.2 Annual LRT Ridership in Calgary, 1995-2010



Cost Effectiveness

The cost effectiveness of the C-Train has long been a fundamental aspect of the project. Plans for rapid transit were first undertaken in the 1960s, which included an examination of a number of different technologies such as BRT and heavy rail metro lines. These plans occurred at a time when Calgary's population was less than half of a million, requiring that planners maximize the length of the system with the funds available. As a result, medium-capacity LRT was chosen rather than a heavy rail subway (Hubbell & Colquhoun, 2006). Furthermore, surface LRT was chosen over a more expensive, grade-separated system as in Buffalo or neighbouring Edmonton (Cervero, 1985; McKendrick et al., 2006). The result has been a system that operates 82% at-grade surface operation in a protected right of way, 8% in a tunnel, 5% on bridges, and 5% within a downtown transit mall (McKendrick et al., 2006).

To save on capital expenditures, large amounts of rights-of-way were secured by the City of Calgary well ahead of the construction of LRT along several corridors. Medians for future LRT services were provided in the construction of many new roads in the outlying suburbs. Furthermore, the City of Calgary entered into a lease agreement with Canadian Pacific Railway for the lease of an existing railway alignment for the construction of most of the South Line (McKendrick et al., 2006).

To minimize construction and operating costs, planners have adopted a number of cost saving measures. For example, LRT stations are sited in strategic neighbourhood locations with large catchment areas and these stations are integrated with neighbouring land uses. The majority of stations use simple utilitarian designs and traffic signals have been designed to give LRT priority operation and maximize the efficiency of the choice for surface alignment. Downtown, a surface transit mall was chosen rather than the more costly option of extensive underground tunneling. Furthermore, park-and-

ride facilities are subject to maximum parking requirements of 15-20% of peak hour / peak direction transit trips to reduce station size and promote feeder bus services (McKendrick et al., 2006).

As a result of the cost effective measures employed during construction, Calgary's C-Train is among the most cost-effective of fifteen light rail systems considered by McKendrick et al. (2006) in North America when measured on capital costs per mile of track. But as Figures 2.2 and 2.3 in Chapter 2 illustrated, when the cost per passenger per week is taken into account by dividing capital costs by weekday boardings, the high ridership on the C-Train allows it to be up to 18 times more cost-effective than other cities in North America.

Cervero (1985) reports that Calgary's LRT was built at a cost of $175 Million – two-and-a-half times the cost of Edmonton's LRT despite the lack of tunneling required. However, the system is much larger than Edmonton's, and the cost-effectiveness of Calgary's LRT planning has allowed the city to construct a much larger network than would have otherwise been possible.

Transit-Oriented Development

Despite the success of the C-Train to attract high levels of ridership and transit-oriented downtown employment, its effect on land use patterns remains limited. LRT has helped create a high level of ridership and transit-oriented downtown employment. In terms of residential development, McKendrick et al. (2006) note that the C-Train has spurred some new high-density projects along the LRT corridor to the west and south of the downtown core. However, Cervero (1985), Hubbell and Colquhoun (2006), and McKendrick et al. (2006) have noted that transit-supportive land uses have been slow to develop in much of the suburban areas served by LRT.

A significant factor limiting TOD has been the preclusion of transit-supportive development by incompatible land uses and a lack of a long-term TOD implementation strategy on the part of the City. For example, many of the C-Train's stations are oriented to automobile access through the provision of large park-and-ride lots rather than mixed-use development. Furthermore, a number of LRT stations are located in the middle of expressway medians, such as Brentwood Station in Figure 3.3 below. While park-and-ride lots do provide a source for future development on City-owned land, the design of C-Train station areas as transportation nodes rather than 'places' hosting a variety of development means that the TOD around LRT stations is currently limited.

Hubbell and Colquhoun (2006) note that the City had opportunities to acquire properties for the development of major employment centres along LRT corridors as identified in the 1995 Calgary Transportation Plan (Figure 3.4). The idea was that the City could protect these areas until a market for higher density development emerged. However, little action was taken due to the immediate costs of purchasing the land. Now many of these areas have been fully developed as automobile-oriented 'big box' retail areas with very little employment and no mixing of land uses (Hubbell & Colquhoun, 2006). In general, many opportunities for the long-term development of TOD have been missed and the expectations of substantial new development spurred naturally by LRT have not been met (Cervero, 1985; Hubbell & Colquhoun, 2006; McKendrick et al., 2006).

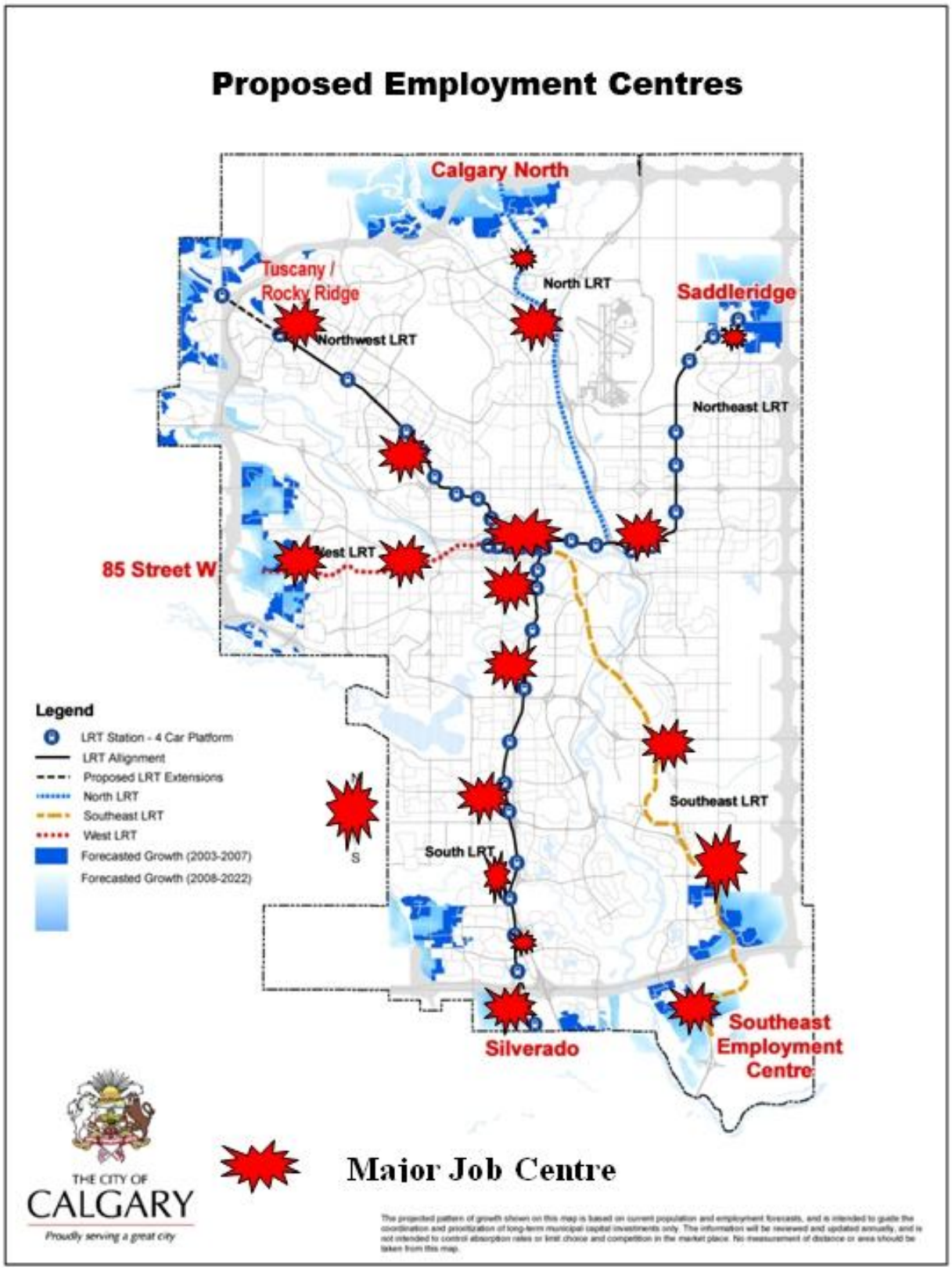
Figure 3.3 Brentwood C-Train LRT Station Area

Large park-and-ride facilities and LRT station in expressway median

Nevertheless, the City of Calgary has gradually become more active in adopting a policy framework to promote TOD, such as the Calgary Transportation Plan (1995), the Sustainable Suburbs study (1995), Transit-Friendly Design Guidelines (1995), the Calgary Plan (1998), and Transit Oriented Development Guidelines (2004). To help facilitate TOD, Calgary introduced zoning bonuses and other land use incentives to spur station-area development. Following several years of inclusive planning through neighbourhood meetings, planners designated most of Calgary's LRT station areas as mixed-use centres with zoning bonuses allowing up to 80% increases in floor-area ratios for land within 400m of a station (Cervero, 1985). Further bonuses are offered in the downtown section of the network for properties that improve the pedestrian environment through arcades, open spaces, and direct access to stations through elevated skywalks (Cervero, 1985).

The focus of land use policies has been towards the preservation of the central business district as a major employment centre and the attraction of new high-density residential development in the downtown and near major transit stations and bus corridors. Furthermore, the City has utilized its strategic land use and transportation policy plans to encourage a shift in the location of major suburban employment centres away from the east side of Calgary and closer to residential and LRT station areas in the west (Hubbell & Colquhoun, 2006).

Figure 3.4 Proposed Employment Centres in the 1995 Calgary Transportation Plan



(Hubbell & Colquhoun, 2006)

A cornerstone of Calgary's long-term transit plan is the gradual reduction of long term parking in the downtown core relative to growth in the area. Planners in Calgary have reduced minimum parking requirements by as much as 80% to one space for every 25 workers for buildings connected to LRT stations (Cervero, 1985). Current parking regulations for office properties require one parking stall for every 140m^2 of net floor area. The City also has a cash-in-lieu of parking policy for properties in the downtown core area, which includes the 7th Avenue LRT corridor and the 8th Avenue pedestrian mall. Funds from the Calgary Parking Authority are used to construct parking structures on the outskirts of the downtown core that are connected to major centres through an extensive network of elevated walkways (Hubbell & Colquhoun, 2006).

Despite the missed opportunities, some TOD success has occurred in Calgary, including residential, office, and retail projects adjacent to four C-Train stations. The City is currently engaged in a number of new TOD undertakings on its own land in LRT station areas, such as 'The Bridges' mixed-use TOD that will develop a 15ha (37 acre) site with 1,500 new residential units and office and retail space adjacent to Bridgeland/Memorial Station. The redevelopment of the depressed east side of downtown is also underway through a partnership between the City, the Federal and Provincial Governments, and the development industry and the creation of a Tax Increment Financing zone. Other station areas have been zoned for mixed-use TOD and a best practices and design guide have been prepared (Hubbell & Colquhoun, 2006).

More importantly, a critical mass for TOD seems to be emerging in the marketplace. Hubbell and Colquhoun (2006) report that developer interest in new TOD is beginning to gain momentum as traffic congestion issues throughout the city begin to worsen and a market for transit-oriented living is increasingly present. As long as policies that limit road and parking capacity, incentives for new development around LRT stations, and a market for transit-oriented living continue to exist, these factors suggest a healthy marketplace for TOD in Calgary in the future.

Factors Conducive to LRT in Calgary

Outside of transit-oriented development, the C-Train in Calgary has been very successful. The high level of ridership and cost-effectiveness of Calgary's C-Train can be attributed to a number of factors. These are broken down into the broad themes of planning, parking, and political and public support:

Planning: The success of Calgary's C-Train can partly be attributed to a legacy of transit-friendly planning in the city. The C-Train can trace its routes back to the rapid transit planning of the 1960s that identified transit as a fundamental element of Calgary's transportation future. After the choice of LRT technology in the 1970s, planning for an extensive C-Train network began with the reservation of rights of way in five major transportation corridors, with a sixth identified in 1987. Advance plans to promote transit usage ahead of the LRT were also put in place, such as the Blue Arrow express bus service which paralleled the future C-Train lines (McKendrick et al., 2006).

A lack of road construction has also helped build transit ridership. Included in the transportation vision of the 1960s were plans for further road construction, however these were quickly met with intense public opposition. In response, future transportation plans were designed with a much smaller road

component. This policy has lived on in Calgary's transit planning for the central business district. For example, employment in downtown Calgary has grown by 18,000 jobs from 1992-2005, but no major improvements to road access have been constructed (Hubbell & Colquhoun, 2006).

Parking: Parking policies have also played a significant impact in the success of the C-Train. It was recognized in the 1970s that transit would have to play a major role in transporting workers to and from downtown. To reduce the demand for future road construction, the City of Calgary chose to limit the amount and location of downtown parking, and in recent years new development has consumed what remains of Calgary's downtown surface lots (McKendrick et al., 2006). Though Calgary's downtown has witnessed considerable employment growth, parking supply has remained static and monthly rates have risen to approximately $250 in 2005, among the highest in Canada (Hubbell & Colquhoun, 2006).

The combination of low parking supply, high prices for long-stay parking, limited road capacity, and ample park-and-ride facilities at C-Train stations has encouraged a very high share of transit for workers in the downtown core. The interaction of policies constraining road and parking capacity with policies to promote better bus and LRT service has resulted in a significant increase in transit modal split from 37% in 1996 to over 42% in 2005 (Hubbell & Colquhoun, 2006). McKendrick et al. (2006) attribute the capacity of the C-Train's peak ridership to the equivalent of about 16 free-flow traffic lanes that would otherwise have been required.

Political and Public Support: Support for LRT by policy actors and the public has been high, evidenced through the continual incremental expansions of the Northwest and South Lines occurring in 1990, 2001, 2003, and 2004. The construction of the new West Line has also been approved and is currently underway for a 2012 opening. At the provincial level, the Province of Alberta has agreed to allocate five cents per litre from the gas tax for fuels consumed within Calgary towards future transit development (Hubbell & Colquhoun, 2006). The City of Calgary also chose to dedicate 70% of its $886 Million portion of the 2004 Alberta Municipal Infrastructure Program to transportation infrastructure upgrades (Hubbell & Colquhoun, 2006). Additionally, the majority of future transportation infrastructure funding in Calgary (53%) is dedicated to transit with the remainder (47%) for roads (Hubbell & Colquhoun, 2006).

Though this support is strongly correlated to the system's success, the willingness of the public and political actors to support the development of the network over time has had a major effect on the ability of the C-Train to evolve as it has.

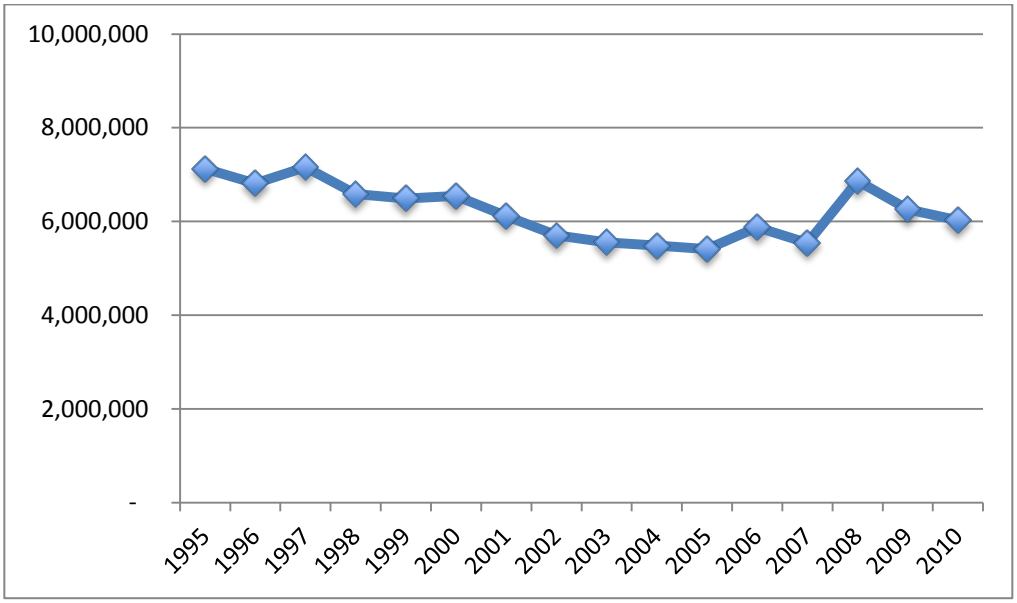
3.2 Buffalo

LRT in Buffalo offers a cautionary tale for cities interested in pursuing rapid transit as a tool for urban revitalization. Ridership on the Metro Rail LRT is low and transit-oriented development is virtually non-existent. Although Metro Rail was perceived as a necessity for urban revitalization and had sufficient political backing, the lack of a strong regional economy has limited the potential to revitalize declining neighbourhoods and the downtown core. This section presents an overview of Buffalo, the Metro Rail LRT, the city's experience with TOD, and reasons for the failure of the Metro Rail project.

Metro Rail Overview

Buffalo's Metro Rail consists of a single 10.3km line that runs along Main Street connecting the HSBC Arena to the southern campus of the University of Buffalo. The line is a hybrid of surface and subway service with the majority of its track and stations underground. Planning for Metro Rail began in the 1960s with key objectives of anchoring the revitalization of the central business district and slowing population decline. Ridership on Buffalo's Metro Rail has largely remained stagnant. While data from the APTA only covers 1995-onwards, ridership has been low and at times has exhibited a negative trend. Numbers appeared to be on an upswing in the late 2000s, but have since began to decline once again to around 6 million passengers per year (Figure 3.5).

Figure 3.5 Annual LRT Ridership in Buffalo, 1995-2010



Ridership is below the three other cities in this section (Figure 3.1) and is the second lowest among all systems in North America which report to the APTA (Figure 2.1 in Chapter 2). However, these statistics can be misleading, as when controlled for system length using the TRK index, Buffalo's light rail line performs better than several other systems in North America (Table 2.3 in Chapter 2). Though the current line was originally conceived as the first phase in an extensive transit network, system expansion has been precluded by the high costs of construction for the underground sections of the line and low levels of ridership.

A result of Metro Rail's low ridership is high costs per passenger that place Buffalo among the most expensive light rail systems in North America to operate. When dividing capital costs by weekday riders, the system is estimated to cost over $39,000 (2010 USD) per weekday passenger (Figures 2.2 and 2.3 in Chapter 2). However, this estimate was based on ridership levels in 2000, which have since gone down. According to the assessment of operating costs for systems built prior to the year 2000 in Figures 2.2 and 2.3, Buffalo ranks behind only Pittsburgh and the combined cost of both systems in New Jersey for the most expensive light rail systems in the United States.

Transit-Oriented Development

Buffalo's Metro Rail has encouraged little in the way of transit-oriented development since it began service in 1984, especially in neighbourhoods that are further away from the downtown (Hess & Lombardi, 2004). Hess and Almeida (2007) attribute this to a fragmented planning process for Metro Rail throughout the 1960s and 1970s between Federal, State, and local-level planning organizations that has resulted in a lack of coordinated development around transit stations. In response, the city has tried to encourage more TOD through its Transit Station Area District legislation, which outlines zoning, design, and parking regulations on properties adjacent to underground Metro Rail stations. However, as a development-starved city, Buffalo has permitted several non-complying developments within station areas (Hess & Lombardi, 2004).

Some land use and transportation planning has occurred, such as designating much of the downtown section of the corridor as a pedestrian mall. However, this area has also suffered due to population decline and, as of writing, reports are that the city will reintroduce cars to the downtown portion of Main Street, forcing the LRT to operate in mixed traffic. A successful project has been Fountain Place in downtown Buffalo. Completed in 1989, the development consists of four separate office buildings with 750,000 square feet of space and a large plaza with a fountain and ice-skating rink linked to the Fountain Place LRT station (Basbin et al., 1997).

One other large and ambitious TOD project was proposed by the City of Buffalo in 1994 for the large park-and-ride lot at LaSalle Station, proposing a mid-rise tower of offices and apartments above the station. The plan called for the redevelopment of 76 acres of former railroad land with 200 market-rate housing units, a new elementary school, and approximately 100,000 feet of retail (Basbin et al., 1997). However, this plan has failed to materialize (Hess & Lombardi, 2004). Nevertheless, Hess and Lombardi (2004) do hypothesize that the presence of LRT may have cushioned the decline of neighbourhoods along its alignment.

Factors Precluding TOD in Buffalo

The degree to which Metro Rail can be called a failure is a matter of debate. Metro Rail continues to operate and perform its basic function as a transit option in the city. However, ridership remains low and the LRT has failed to achieve broader goals of stemming regional population decline and the revitalization of certain depressed neighbourhoods and the downtown core. The causes can be attributed to regional economic activity and demographics at the regional macro level, and issues related to Metro Rail at the local level.

Regional Economic Activity: Employment in Buffalo has declined in recent years as manufacturing has decreased its presence in the city. Buffalo, and upstate New York more broadly, has been undergoing a significant restructuring in its economy, with gains in service sectors such as healthcare, education, and business services offsetting losses in manufacturing. However, growth in the region has been much slower than other areas of New York State (Federal Reserve Bank of New York, 2007). Current trends indicate that Buffalo has weathered the recent recession reasonably well, though losses in

manufacturing continue to occur and house prices are now at 10% below their peak levels (Wial & Shearer, 2011).

Demographics and Population Decline: In concert with its economic struggles, central Buffalo has suffered a tremendous loss of population. Hess and Almeida (2007) report that of all the cities with LRTs that opened in the 1980s-1990s, Buffalo is the only one to have experienced serious population loss. The inner city has been the hardest hit, losing 18% of its population. The broader metropolitan area has fared better, experiencing a 6% drop. At its peak, the city was at one time home to just under 600,000 residents, but this was reduced to half that amount by the year 2000 (Kraus, 2000). In comparison, of other cities mentioned by Hess and Almeida (2007), all increased their populations by 30% or more in the same time period. The exception is St. Louis, which also lost population in its central city, though this was offset by gains in the broader metropolitan area.

Like many cities across North America, Buffalo has witnessed the flight of residents to suburban areas. Kraus (2000) reports on the extensive expressway system that was constructed to connect the inner city to its suburban districts. As seen in many other cities across North America, these policies have served to make access to downtown easier for suburban residents, but have generally resulted in an acceleration of downtown population loss.

But a related issue to Buffalo's population decline and suburbanization is that of racial tensions and their impact on policy and planning decisions. Kraus (2000) has identified a number of racially motivated decisions that have shaped Buffalo's patterns of development and migration, ultimately concluding that the residential location options for African Americans were greatly limited and subsequently Buffalo has developed as a segregated city. Kraus (2000) argues that Buffalo's African American population has largely been isolated and marginalized on the eastern side of the city, with the Caucasian population moving to the outer suburban areas that were essentially off-limits to other groups. Though racial segregation is declining, downtown Buffalo and its inner core areas have continued to suffer as a result of these policies.

Geographic Coverage: Aside from broader regional trends, part of Metro Rail's failure can be attributed to Metro Rail's limited geographic coverage and the 'network effect' of regional transit systems. At 10.3km, the current line is small, and furthermore, its current alignment serves only the inner core of the city and does not reach any of Buffalo's suburban areas (Hess & Almeida, 2007). Hess and Almeida (2007) note that the current section of LRT was meant as only a starter line for a much broader rapid transit network across the region. However, in the more than 20 years since Metro Rail began service, the region has been unable to agree on a plan to extend the Metro Rail service. As a result, the current 10.3km alignment fails to provide regional accessibility to major employment centres and consequently attracts a small share of regional transportation trips.

3.3 San Diego

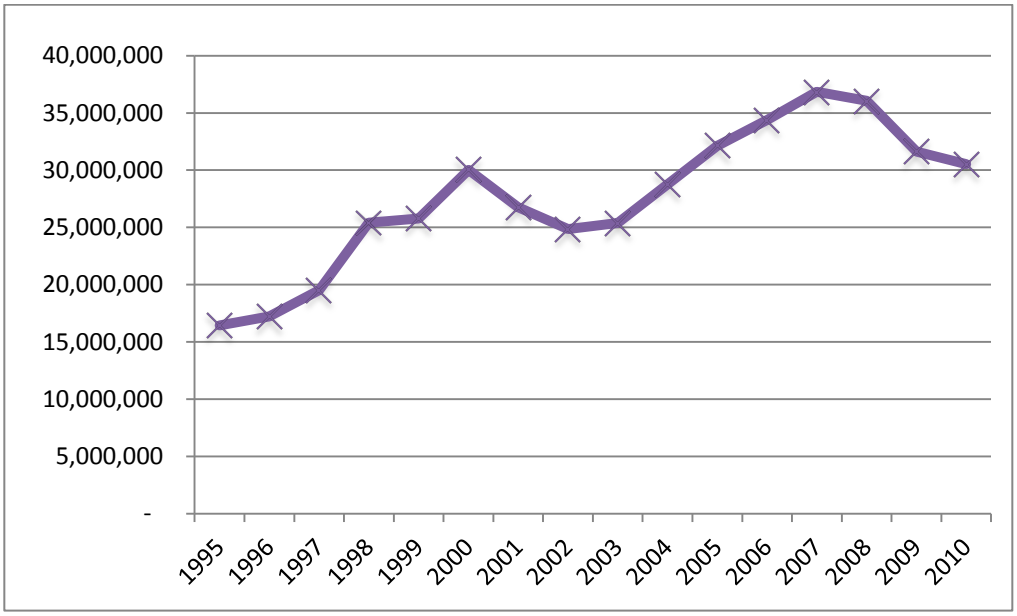
San Diego has emerged from a first-phase light rail and transit-oriented development city to become a leader in TOD in North America with one of the most comprehensive transportation and land use planning processes. It is the eighth-largest city in the United States and the second largest in California with a metropolitan statistical area population of 3.1 million. Because the region had only 500,000 people at the end of 1950, the rapid growth of San Diego has occurred after the automobile became dominant and as such development has largely followed an auto-oriented pattern (Duncan, 2011). The Trolley and its associated TOD programs have attempted to reverse this pattern of growth. Interestingly, the rate of employment growth in San Diego since 1970 is higher in the Central Business District (235%) than outside of it (189%) (Brown & Thompson, 2009).

Trolley Overview

The San Diego region includes a number of mode choice options, one of which is the San Diego Trolley light rail system. The San Diego Trolley opened in 1981 and was the first new light rail system built in the United States in over two decades. The Trolley currently consists of three main lines that link downtown San Diego to its outlying suburban areas: the Blue, Orange, and Green Lines, which opened in 1981, 1986, and 2005 respectively. The Blue Line began as a 21km corridor with 18 stations and is unique in that it operates service to the border with Mexico. Two supplementary lines also exist: the Special Event Line and the Silver Line. The Special Event Line began service in 2005, operating on weekends and holidays as a supplementary downtown circulator. The Silver Line is an additional supplementary line that opened in August of 2011 and operates on a downtown loop. Plans are underway for an extension of the Blue Line further north with a goal for completion by 2015.

The Trolley operates on 7.5 to 15-minute headways during peak hours. Ridership has been strong, making it the sixth-busiest light rail system in the United States with more than 100,000 daily trips (Duncan, 2011) and 30,000,000 annual riders (APTA, 2011). However, after a period of growth in the early 2000s, recent numbers do indicate a downward trend in ridership after the onset of the recent broader economic recession after 2008. Figure 3.6 below shows a chart of this San Diego's ridership from 1995-2010.

Figure 3.6 Annual LRT Ridership in San Diego, 1995-2010

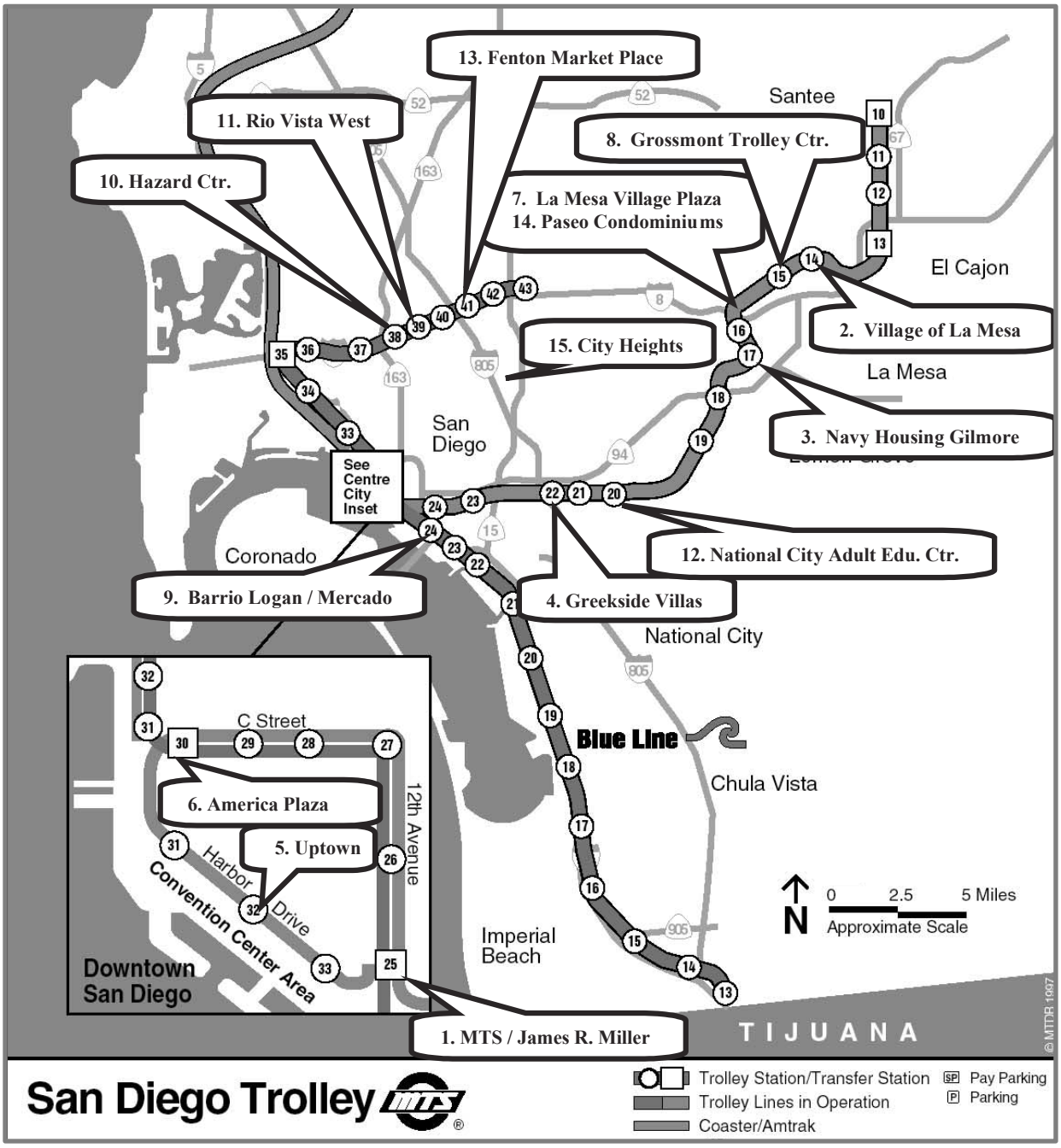


Transit Oriented Development Experience

The Trolley has provided a catalyst for a number of TOD developments since the 1980s that Cervero et al. (2004) classify in two waves. The first saw nine projects completed by the early 1990s, while the second wave of five notable TOD projects occurred during the period of economic boom in the late 1990s to early 2000s. The economic downturn since 2000 has drastically slowed new TOD projects, with only two more by 2004 (Cervero et al., 2004). Of the 15 TOD projects, the vast majority have been located in the suburban areas of San Diego and La Mesa with only two in the urban core of the city (Cervero et al., 2004). These have included transit-based housing, commercial joint-development, and master-planned transit villages. Downtown development has consisted of new office buildings, public spaces, tourist attractions, hotels, and a new conference centre (City of Seattle, 1998). An overview of TOD projects in San Diego as of 2003 is provided in Figure 3.7 below.

Though the city's first LRT line opened in 1981, San Diego did not initiate any TOD planning until several years later (Arrington, 2003). Early studies of what has been classified as the 'first wave' of TOD have generally concluded that the Trolley had little impact on business activities or land development and that overall, the development trends of areas around transit stations in San Diego in this time period generally followed regional development patterns and market demand (City of Seattle, 1998). Part of this could be attributed to the city's orientation towards the private automobile and a lack of policies designed to alter travel patterns within the city. For example, unlike Calgary, the City of San Diego has not attempted to limit parking in the downtown core and a recent analysis performed for the city details a parking supply that is not likely to be constrained until 2015 (CCDC, 2009). It is likely that a lack of policies such as these constrain the ability of the Trolley to generate additional ridership and more TOD.

Figure 3.7 TOD Projects in San Diego County as of 2003



(Cervero, et al., 2004)

Factors Conducive to TOD in San Diego

In response to the mixed experience outlined above, the City of San Diego adopted a number of policy initiatives to promote more transit-oriented development and now features one of the largest and most comprehensive programs to promote TOD at the local and regional levels. At the regional level, the San Diego Association of Governments has created a smart growth plan endorsed by its 18 municipal members. Incentives have also been used at the regional level for TOD pilot programs.

At the local level, the City of San Diego is one of the most progressive and supportive jurisdictions of TOD in the United States. The city has featured TOD design guidelines since 1992 and has pioneered initiatives such as reduced parking standards, station area overlay zoning with density increases, and the provision of mixed land uses. Downtown and East-end Planned Development Districts set land use controls around Trolley stops and place limitations on auto-oriented uses and contain standardized guidelines for pedestrian streetscapes. Other policies include lower trip-generation rates for evaluating the impacts of mixed-use TOD developed by the San Diego Association of Governments and updated street design manuals that allow for narrower street widths in transit areas. The City of San Diego has also adopted a transit-friendly General Plan that envisions a 'City of Villages' as its future urban form, a type of nodes and corridors style for shaping the future growth of the city (City of Seattle, 1998; Cervero et al., 2004).

The MTDB has also planned new lines to explicitly capitalize on development opportunities. For example, the Green Line LRT was designed to cross the San Diego river a number of times to better accommodate existing and future TOD opportunities. Furthermore, the extension to San Diego State University provides an underground station that will allow the line to serve the middle of the campus (Arrington, 2003). All future transit planning decisions in San Diego are made according to the area's TOD potential, with the city avoiding potential rail corridors with little market potential (Cervero et al., 2004).

Despite a shaky start, San Diego is now widely acknowledged as a leader in TOD and has begun to experience success in its efforts (Arrington, 2003). Both Cervero et al. (2004) and Duncan (2011) have noted that market demand for TOD in San Diego is strong. Like Los Angeles, TOD in San Diego has benefitted from changes in demographics towards a more diverse population through immigration and aging, and high levels of congestion. Due to factors such as exclusionary zoning, condominium liability laws, and NIMBY activity, there is a demand for dense, transit-oriented multi-family housing in San Diego has not been met (Cervero et al., 2004).

The desirability of San Diego's TOD projects has generated higher property values. According to Duncan (2011), the prices for condominiums in Trolley station areas with a good pedestrian environment were valued significantly higher than a condo in a similar neighbourhood away from a transit station. Furthermore, similar units near transit stations but without a good pedestrian environment such as more automobile-oriented TADs were found to have values below other units that were not near a transit station. These findings lead Duncan (2011) to conclude that urban design matters and that TOD in San Diego appears to have a synergistic value greater than the sum of its parts.

San Diego has also become a pioneer in LRT joint development projects, with the MTDB steadily increasing its portfolio of projects, such as cost-sharing agreements with a developer of a mixed use project that included the integration of an Trolley station on the site, and the construction of a new MTDB headquarters building that saw the agency act as a property developer (City of Seattle, 1998; Bragado, 1999).

3.4 Minneapolis

Minneapolis presents the case of a city that has learned from the light rail and transit-oriented development experiences of other jurisdictions. Though the Hiawatha LRT line only opened in 2004, a great deal of economic activity has occurred since the project was announced in 1997. Minneapolis has utilized its LRT project as a tool to help generate economic investment and revitalize declining areas and the case of the Hiawatha line presents an example of LRT and TOD success in a mid-sized city.

According to the most recent census, the City of Minneapolis has a population of approximately 382,500, though the broader Minneapolis-St. Paul metropolitan area is home to 3.5 million residents. The economy of Minneapolis is robust and active, moving from more traditional manufacturing to commerce, finance, health care, and logistics. The city is home to the headquarters of six Fortune 500 companies and boasts many additional major employers. Total employment increased 127% between 1970 and 2005 in the Minneapolis region, though growth in the inner core of the city has been slower than in outside counties (Brown & Thompson, 2009). Unemployment has remained low during the recent recession at 6.9% between 2009-2010, well below the national average in the United States of 9.6% (City of Minneapolis, 2010).

Hiawatha Line Overview

The Hiawatha Line is the first in a series of major transit investments in the Minneapolis-St. Paul region. The current alignment connects important regional destinations such as the downtown Minneapolis central business district, the Minneapolis International Airport, and the Mall of America in addition to hospitals, stadiums, civic and institutional sites, and other attractions. Opening in 2004, the current line is 19.8km long with 19 stations, running parallel to Hiawatha Avenue and State Highway 55. The LRT runs in its own reserved right-of-way with 7.5-minute headways during peak periods and 15% of the city's bus routes feed into the train (Brown & Thompson, 2009). Metro Transit operates as a fare-free shuttle for airport passengers between the main terminal at Lindbergh Terminal station and secondary car rental, ticketing, and baggage claim areas at Humphrey Terminal station.

Though public skepticism was high, ridership on the Hiawatha Line has been stronger than expected. First year totals were 3 million passengers, 58% more than had been expected (Goetz et al., 2010). Ridership has grown steadily since then, with the LRT exceeding its projections for 10 million annual riders by 2020 in 2008 (CTOD, 2011). Ridership continues to grow, though current trends suggest a slowdown in the rate of ridership growth (Figure 3.8). A majority of riders use the LRT to get to work, and approximately 40% had never used transit before (Goetz et al., 2010). Current ridership is at 26,900 passengers per day (APTA, 2011).

The total cost for the line was approximately $715 Million, with funding from a variety of sources (Table 3.2). The original cost was to be $675 Million, though a last-minute realignment of the line directly to the Mall of America and the construction of a new transfer station raised the costs by almost $40 Million (Goetz et al., 2010).

Attributed in part to the strong ridership of the Hiawatha Line, a second light rail line, the Central Corridor LRT, is currently under construction. This line will connect downtown Minneapolis, downtown St. Paul, and the University of Minnesota campus. Minneapolis also opened the 64km Northstar commuter rail line in 2009, which connects downtown Minneapolis to Big Lake in the northwest.

Figure 3.8 Annual LRT Ridership in Minneapolis, 2004-2010

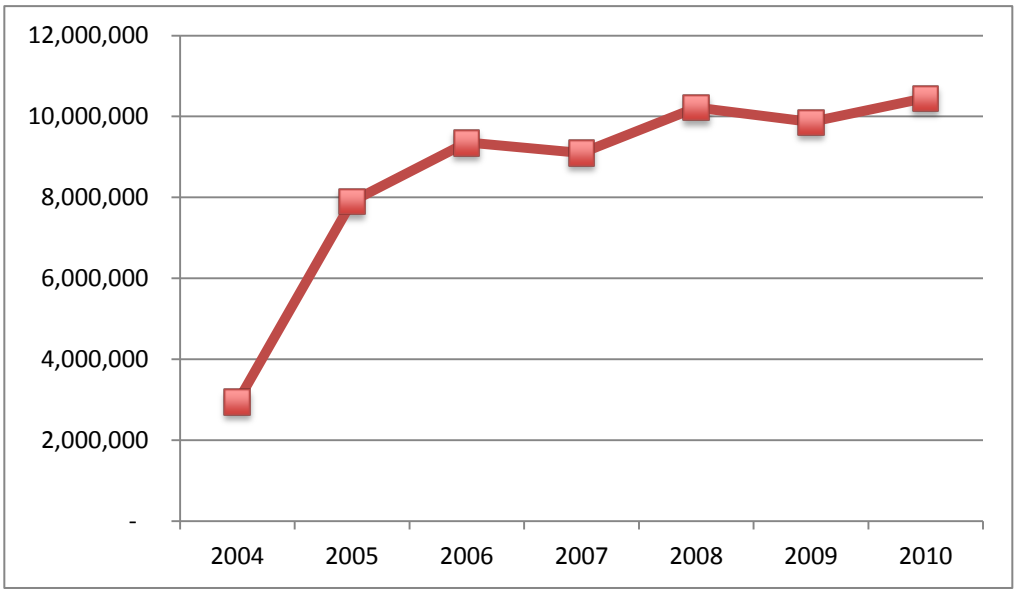


Table 3.2 Funding Amount and Sources for the Hiawatha Line

Source	Amount (USD Millions)
FTA New Starts	$334.3
State of Minnesota	$100.0
Metropolitan Airports Commission	$87.0
Hennepin County	$70.0
Federal Congestion Mitigation Air Quality	$49.8
Transit Capital Grant	$39.9
State of Minnesota In-Kind	$20.2
Hennepin County In-Kind	$14.1
Total	**$715.3**

(Goetz et al., 2010)

Transit-Oriented Development

According to the Center for Transit-Oriented Development (CTOD, 2011), there has been approximately 6.7 million square feet of development along the Hiawatha Line LRT corridor between 2003-2009. The majority of this development (72%) has been concentrated in downtown Minneapolis and fulfills part of a long-term redevelopment strategy for the underutilized riverfront and industrial districts and the depressed downtown area. In general, 86% of all new development that has occurred along the Hiawatha line has been residential (CTOD, 2011). Based on these patterns, CTOD (2011) concludes that

there is a very strong relationship between the location of jobs and new residential development at work in the market for TOD in Minneapolis.

However, TOD planning initiatives outside of the downtown core have not been as proactive or successful and development has been slow to materialize. The CTOD (2011) views this as a consequence of a limited number of publicly owned properties, scarce planning resources, and a general lack of opportunity for new development. Part of this problem is that the potential market for TOD is currently limited by the choice of alignment. Many station areas along the eastern portion of the line feature a number of industrial uses, poor pedestrian connections, and inadequate neighbourhood amenities. Some stations are unfit for development, such as the Fort Snelling, Lindbergh, and Humphrey stations around the airport, although they provide a significant ridership bonus to the line as major traffic generators.

In response, the City has engaged directly with local citizens and the development community through the creation of the Corridor Development Initiative. The program is designed to build consensus among all parties involved in an effort to promote, educate, and streamline the TOD process, with an additional goal of supporting an increase in affordable housing. However, the program is limited by a lack of control over the private land market (Forsyth, Nicholls, & Raye, 2010).

Other programs call for pedestrian improvements at many LRT stations that would see the development of new sidewalks, streetscape upgrades, pedestrian bridges, and bicycle amenities, though these programs have not yet been funded. Tax-increment financing has been considered to remedy this problem, though it typically requires large-scale projects to be effective. Special assessments may also be used, but city planners noted the difficulty in securing the approval of homeowners in the area. Nevertheless, some TOD has occurred outside of the downtown core, with new developments at four stations (CTOD, 2011).

TOD and the Impact of the Hiawatha Line: A study of TOD along the Hiawatha Line by the Center for Transportation Studies at the University of Minneapolis found that LRT had a significant positive impact on property values in Minneapolis, though it was generally limited to the western, downtown side of the line. In the east, residential uses were generally cut off from station areas by industrial development and a four-lane arterial road, with the nearest residential properties approximately 200m away from a station. Compared to the western portion of the route, these patterns suggest that accessibility problems have negated any value impact of the LRT in the east (Goetz et al., 2010). In general, the authors conclude that the Hiawatha line has produced an average $15,755 price premium per multifamily property in station areas, translating to an aggregate increase in property values of $6.9 Million for properties that have sold since 2004.

The authors also found that, based on the percentage of parcels on which building permits were issued, there was not a significantly greater amount of development activity inside station areas along the line than in surrounding neighbourhoods. However, the total value of new development near transit stations was much higher, which suggests projects around the Hiawatha line have been larger in scale than elsewhere in the city (Goetz et al., 2010; CTOD, 2011).

Current TOD: New transit-oriented development projects have occurred at a number of station areas along the Hiawatha line. Figure 3.10 below provides a map of TOD projects with their size and classification in the Hiawatha Line corridor.

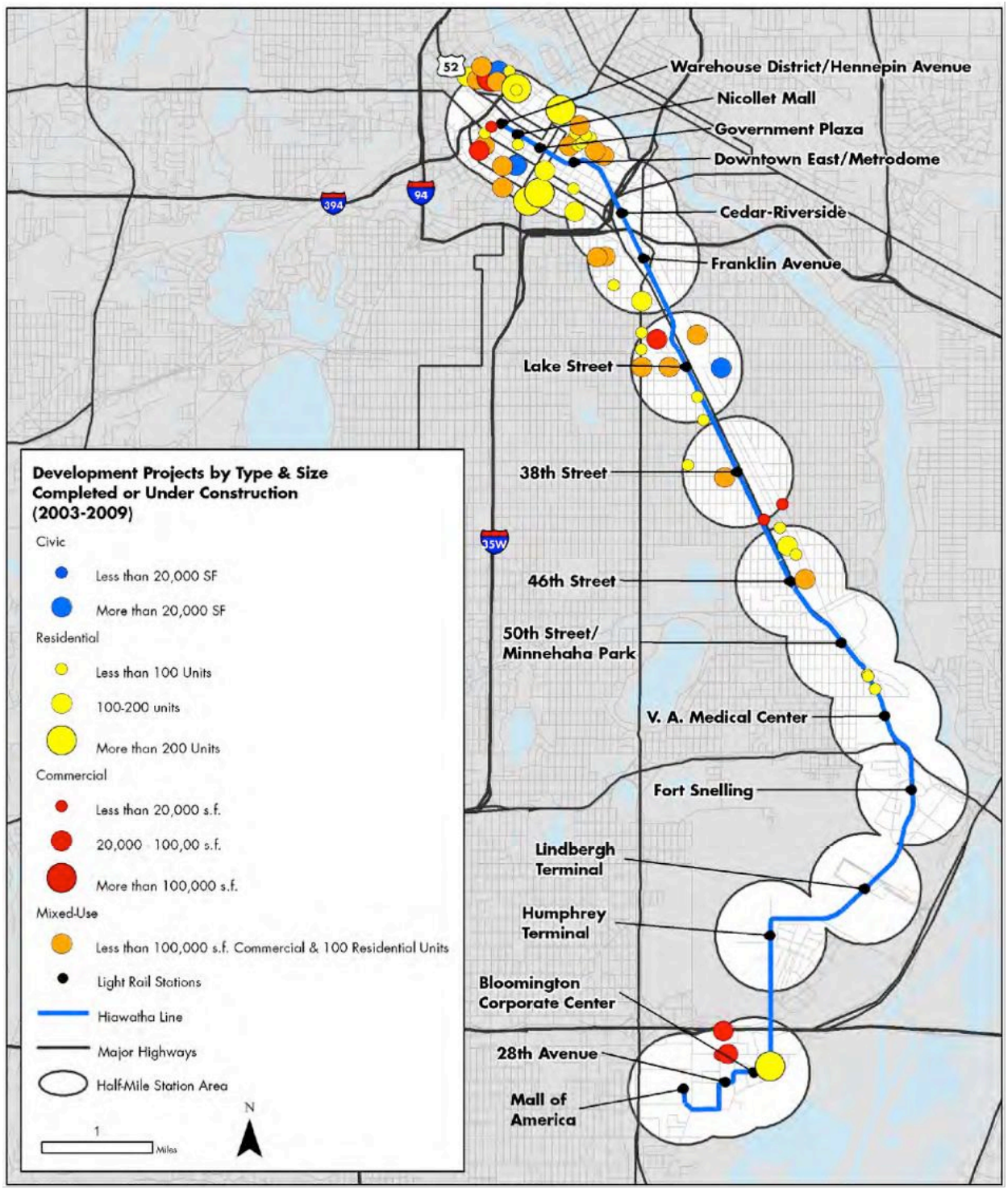
The largest TOD currently underway is at Bloomington Central Station, where a 43-acre site is being developed for a number of uses including housing, offices, hotel, and retail. The site's current tenants have partnered with the developer and the project is expected to build out over the next 10-15 years. The development currently consists of two 17-story condominium towers called Reflections at Bloomington (Figure 3.9), which were completed in 2006. Reports are that the units initially took some time to sell, though the development has become quite popular with empty nesters and second homeowners who value the increased accessibility to the airport provided by LRT. Much of the site currently consists of surface parking for residents, but a phased development plan will eventually see the area transformed into an 'urban village' setting (CTOD, 2011).

The project has gotten considerable support from the City, which has instituted a Tax Increment Financing district to upgrade the urban area around the site. Changing consumer preferences towards TOD-style living have also been credited with having a major impact on recent development trends in and around the downtown core (CTOD, 2011).

Figure 3.9 TOD at Bloomington Central Station

Reflections Condominiums: High-rise TOD near Bloomington Central Station (CTOD, 2011)

Figure 3.10 Hiawatha Line Development, 2003-2009



(CTOD, 2011)

Factors Conducive to TOD in Minneapolis

Public Policies: Public policies have played an important role in the success of transit-oriented development along the Hiawatha line. Soon after the Federal Transit Administration announced funding in 2001, the City of Minneapolis instituted a development moratorium for neighbourhoods along the line that did not already have plans in place. Gradually, station area secondary plans were completed for a majority of the line that established a vision for each neighbourhood and identified implementation needs. Reports from the CTOD (2011) indicate that initial planning forums with stakeholders required a great deal of education, though this process grew more sophisticated with later plans allowing for more intensive development.

Minneapolis' long-standing program for redevelopment and revitalization of the downtown core also benefitted from the introduction of light rail. However, the CTOD attributes much of the success of this program to changing market preferences that coincided with the construction of the Hiawatha line. These market changes are discussed further below.

Market Demand: Market demand has played a large role in the success of attracting new development along the Hiawatha line. The CTOD (2011) credits changing consumer preferences towards higher-density residential buildings with urban amenities as having a major impact on the recent development in Minneapolis' downtown core. However, these changes have been at work for some time. The Hiawatha corridor has experienced a surge in residential development since the LRT was announced in 1997. The total of this development is estimated to be 183% more than would be expected given the rates of new construction throughout the Minneapolis sub-market (Goetz et al., 2010). The CTOD (2011) attributes this to market demand in the early-2000s that strongly favoured new residential units.

3.5 Lessons Learned

The cases of Calgary, Buffalo, San Diego, and Minneapolis present an opportunity to further illustrate the lessons learned in Chapter 2. This section presents a comparative analysis of the four cities, first regarding light rail transit in general, followed by a discussion of approaches for transit-oriented development utilized by each city.

3.5.1 Light Rail Transit

Each of the four cities has approached policies in support of their light rail systems in different ways. Table 3.3 presents an overview of the different initiatives taken in each city based on the analysis above, as well as broad contextual trends and preliminary factors regarding transit-oriented development.

Despite a lack of TOD in the past, an alignment that precludes development in some areas, and a number of missed opportunities to facilitate more TOD, ridership on Calgary's C-Train remains very strong. The success of light rail in Calgary can be attributed to policy and planning decisions designed to focus heavily on serving the downtown, which housed an increasing number of head offices. Policies were adopted to shift travel to public transit, such as a rationing of parking in the downtown core and the provision of park-and-ride lots to feed suburban workers into the downtown via transit. As a result,

with a majority of stations in suburban areas and a large distance between stops, in some respects the C-Train performs almost as a commuter light rail service.

Table 3.3 Factors and Policy Tools in Support of Rapid Transit

	Calgary	Buffalo	San Diego	Minneapolis
Contextual Factors				
Rapid Employment and Population Growth	X		X	X
Political and Public Support	X		X	X
Cost Effective Factors				
High Ridership	X		X	X
Cost-Effective Alignment	X			
Transportation Demand Management				
Transit Mall	X	X		X
Fare-Free Zone	X			
Park-And-Ride Lots	X			
Downtown Parking Reduction	X			
Transit-Oriented Development				
Market for TOD	X		X	X
TOD Success			X	X

Given the fairly modest extent of the Buffalo system, ridership numbers per kilometre of track actually compare somewhat favourably with other US systems, though this level of ridership has been mature for some time. Other than its exorbitant cost of construction, the biggest disappointment with the Buffalo system has been its inability to drive any sort of development or redevelopment along its alignment and revitalize declining neighbourhoods. As Table 3.3 illustrates, a lack of policies designed to alter travel patterns and shift demand to transit has likely contributed to the overall anemic history of ridership and development in Buffalo.

As one of the oldest LRT systems in North America, San Diego's Trolley provides insight into the role of light rail in a city over a long period of time. High ridership in an automobile-oriented west-coast city has made San Diego a model to follow for newer cities considering light rail. The Trolley has benefitted from one of the most progressive local and regional governments who have learned from LRT's rather slow start to enact a number of policies that encourage more transit usage. However, in contrast to Calgary, San Diego has not enacted policies to manage transportation demand, such as limiting parking in the downtown core to promote transit usage. From this analysis it appears as though the majority of these initiatives are more related to promoting transit-oriented development, which have in turn been bolstered by a vibrant economy.

The Hiawatha Line in Minneapolis, while not yet approaching the ridership levels of Calgary or San Diego, is showing potential for its young age. A growing local and regional economy has helped to bolster the LRT project, though Table 3.3 highlights that there is room to adopt more policies designed to encourage transit usage. Nevertheless, the Hiawatha Line presents an encouraging story. One of the striking aspects of the line is the high quality of destinations along its alignment. It connects landmarks such as Target Field, the Mall of America and the International Airport among several others. One tenet of an effective transit service is that key destinations should be easily reachable along a line to encourage nearby residential concentrations. To this point, there has been some success in that regard along the Hiawatha line, especially nearer to the downtown.

Other policies of interest include the use of transit malls in the downtown cores of Calgary, Buffalo, and Minneapolis, though a chronic lack of employment and population Buffalo's downtown has led to a conversion of the mall back to mixed traffic. Calgary is alone in offering a fare-free zone along the downtown transit mall, which has no doubt increased the appeal of the C-Train to frequent and first-time users. Outside of these policies, the promotion of transit-oriented development has also played a large role in the overall role of light rail in each city. This topic is explored further in the next section below.

3.5.2 Transit-Oriented Development

The four cities studied in this chapter also present interesting dynamics with respect to transit-oriented development. Tables 3.4 and 3.5 present an overview of the policy tools and initiatives utilized in each case. Based on this review, it can be seen that some cities offer a much more comprehensive 'package' of policy tools designed to promote more development along their respective light rail lines. This section presents a synthesis of each city's experience with LRT and TOD that serves to highlight the different priorities of planners and policymakers in each city and the evolution of rapid transit planning in North America.

Based on the information obtained for this case study, it can be concluded that San Diego's TOD experience has been decidedly mixed. With one of the earliest light rail systems in North America, LRT was found to be unable to induce land use change on its own. In response, the city has initiated a number of pioneering incentive programs to promote more development around Trolley stations. Results are encouraging, with a number of key projects identified in the literature, though the vast majority have occurred outside of the downtown core in largely suburban areas.

On the other hand, another of light rail's early adopters has not fared nearly as well. Buffalo's experience with light rail and transit-oriented development offers a lesson in the risks involved in promoting TOD in an older slow-growth city. A lack of transit-oriented development around Metro Rail stations has been blamed on a fragmented planning process and lack of vision in the early years of the Metro Rail project, though the City of Buffalo has recently developed a series of policy and planning initiatives to foster more TOD. But as a development-starved city in general, the city has permitted a number of non-complying developments in light rail station areas.

As a recent LRT city, Minneapolis has learned from San Diego and Buffalo and designed its investments in light rail around TOD from the very beginning. The case also illustrates the importance of the prerequisites for success identified in Chapter 2. A growing population and local economy combined with complimentary policies and planning initiatives has allowed light rail to guide new development along the transit line. Furthermore, unlike San Diego, a number of new projects have occurred in the core of the city, demonstrating the ability of transit and TOD to revitalize the downtown and waterfront. Helped by the success of the Hiawatha line, construction has recently started on a second LRT line connecting downtown Minneapolis to its sister city St. Paul.

On the other hand, TOD in Calgary has been rather anemic. But given the success of the C-Train, some may question the need for promoting transit-supportive land use development patterns. Nevertheless, the City of Calgary has recently taken steps to address the lack of transit-oriented development around C-Train stations and now offers a package of policy tools designed to increase densities, lower parking requirements, and improve public infrastructure. Recent reports of worsening congestion in the Calgary region point to increasing interest in more transit-oriented lifestyles and as long as the policies that have helped drive ridership continue, these factors suggest a healthy marketplace for TOD in Calgary.

Table 3.4 Policy Tools for Transit-Oriented Development

	Calgary	Buffalo	San Diego	Minneapolis
1. Strategic Planning Tools				
Regional and Local TOD Strategic Plan	X		X	X
2. Land Use Policy Tools				
Prepare Station Area Plans and Market Studies			X	X
Station Area Rezoning A: Rezone Station Areas		X	X	X
Station Area Rezoning B: Use Restrictions Based on Public Health and Safety and Transportation Impacts				
Station Area Rezoning C: Overlay Zone	X		X	X
Land Use Intensity Tools A: Density Bonuses	X		X	X
Land Use Intensity Tools B: FARs and Building Height Bonuses	X		X	X
Land Use Standards Enhancement A: Form-Based Codes				
Land Use Standards Enhancement B: Design Guidelines	X	X	X	X
Parking Tools A: Revised Parking Standards	X	X	X	X
Parking Tools B: Shared Parking				
Parking Tools C: Parking Districts				

Table 3.5 Policy Tools for Transit-Oriented Development (Cont.)

	Calgary	Buffalo	San Diego	Minneapolis
3. Development Assistance Tools				
Fast Track Development Review			X	
Capital Funding for Infrastructure			X	
Tax-Increment Financing			X	X
Reduced Impact Fees in Station Areas				
4. Place Making and Access Tools				
Streetscape and Pedestrian/Bicycle Improvements	X		X	X
Façade and Site Frontage Improvement Program				
Tax-Exempt Bonds			X	
Tax Abatement				
5. Land Assembly Tools				
Joint Development Program				
Land Acquisition Loan Funds			X	X
Funds for Buying Available Parcels on the Open Market				X
6. Programmatic and Institutional Tools				
Business District Association or Business Improvement District	X	X	X	X
Marketing and Outreach Strategies	X		X	X
Livable Communities Program		X	X	X
Community Development Corporation (CDC) Lead Efforts				X
Housing Trust Funds				X

Conclusions

In this concluding section, key themes that emerged in the light rail overview of North American cities are briefly reviewed and assessed in the Hamilton context. The overall conclusion of this report is that light rail transit has the potential to work in Hamilton under the right set of circumstances but it will be a long, challenging and costly process.

4.1.1 Leadership and Long Term Vision

Developing light rail in a city is a long-term proposition and requires strong leadership and vision. Even in favourable locations, ridership increases and new developments associated with light rail may proceed slower than anticipated and the patience of stakeholders can be tested. For example, despite the high-quality service offered by an alignment that is partially underground, it is only recently, after thirty years, that ridership on Edmonton's LRT has shown considerable gains. Data on the correlation between TOD and ridership suggest that Hamilton should take a long-term view of the potential to increase transit's share of commute trips. Ridership impacts along the B-Line can be more substantial if and when TOD reaches a critical mass of development.

Because B-line LRT will only cross a few of the wards in Hamilton, a majority will not see the immediate benefits of light rail. Furthermore, the issues and needs of suburban areas may not be in congruence

with those of the inner city, leaving many constituents questioning the merits of the project for the city as a whole. Strong political leadership will thus be an important component of seeing the vision through. Partnership and co-operation between the City, other levels of government, developers who may see TOD projects as higher risk and the public will be an essential ingredient in Hamilton as elsewhere.

4.1.2 Comprehensive Strategy Required

Proponents of light rail must not make unreasonable claims towards the perceived power of rapid transit to induce major land use changes and broader economic growth on its own. For any rapid transit project to be successful, it must proceed in concert with a comprehensive strategy for promoting more transit-supportive land use patterns. Tools can include a comprehensive package of development incentives, flexible parking policies, station-area planning techniques to design transit-oriented rather than transit-adjacent projects and 'places' rather than 'nodes'. Insights into mixed-use developments, the financial considerations of the development community, and partnerships with the private sector are also important. The promotion of transit-oriented development will be a fundamental element in capitalizing on the potential of light rail in Hamilton and achieving the broader goals of the rapid transit project.

In Hamilton, considerable progress is underway in developing targets and goals for shaping new growth. The City of Hamilton has learned from the experience of other cities and is using the LRT planning process as an opportunity to coordinate its land use and transportation planning. To date the City has prepared a number of transportation and land-use related studies and work towards a TOD implementation plan is currently in its final stages. Progress in this area includes a number of transportation and land-use related studies that informed Hamilton's 2009 Urban Official Plan, a TOD background paper and design guidelines, and an ongoing initiative to draft a comprehensive set of planning principles and design guidelines to promote more transit-oriented development in the city's key transportation nodes and corridors.

Increasing transit-oriented development in advance of rapid transit can be considered as a useful near-term strategy. The City of Hamilton has adopted key principles in preparing its two Transit Oriented Development Guidelines documents (2010a; 2010b). The first document serves as an introduction to the TOD concept, while the second proposes transit-oriented development guidelines for Hamilton. The latter design guidelines have been approved by Hamilton City Council in August of 2010 and now form the basis of the City-Wide Corridor Planning Principles and Design Guidelines planning initiative currently underway to shape future growth in Hamilton's identified transit nodes and corridors.

The B-Line presents a number of opportunities to utilize transit-oriented development as a way to capitalize on LRT. Some important potential exists in many of the properties currently dedicated to automobile-oriented uses, such as the many large parking lots present in the downtown core that are ripe for redevelopment. There is an opportunity for the City of Hamilton to become directly engaged in transit-oriented development through the purchase of one or more properties, which can then be used

for land banking or as TOD and TJD pilot projects to demonstrate a commitment to redevelopment and revitalization.

4.1.3 The State of the Metropolitan Economy

Even in the most successful cases of light rail and transit-oriented development, the main outcome of an effective transportation and land use strategy seems to be a focusing or redistribution of development that would have otherwise occurred as opposed to a net regional increase in developmental activity. Light rail transit cannot induce major land use change and broader economic growth on its own. Rapid transit should be understood for its potential to act as an important catalyst in an overall package to reshape a growing urban area. Likewise TOD is not a product of transit alone, but the interaction between a complex set of local factors. Rapid transit and TOD have worked best in cities experiencing rapid population and employment growth, such as San Diego, Charlotte, Denver, and Minneapolis. In cities experiencing decline as a light rail system matured, LRT did nothing to reverse the trend.

Despite challenges in recent decades, Hamilton can hardly be described as a city in decline and in fact is experiencing respectable growth; although nothing of the magnitude of Calgary as its LRT system matured. The challenge will be to funnel some of this growth along the B-line corridor. To that end, a strong package of planning and policy incentives will be required to stimulate transit-oriented development.

4.1.4 Light Rail May Work Better in Canadian Cities

Although the sample size is small, light rail appears to stand a greater chance for success in a Canadian city than the typical US city. The ridership ratios for Calgary and Edmonton are far ahead of the numerous US examples. The reasons for this outcome are not completely clear. Among other factors, lower crime rates in Canada may play a role along with Canadian's having more of a "European" or international mindset when it comes to public transit. This piece of evidence assists the case for light rail in Hamilton along with the fact that Calgary and Edmonton were not significantly larger than Hamilton in population terms at the time that their initial systems were developed.

4.1.5 Congestion and Light Rail

In this report, congestion was considered as a possible pre-requisite for LRT and also as an outcome variable to be addressed via LRT. Overall, the conclusion would be that congestion does more to assist with LRT than LRT does to reduce congestion. With some exceptions, higher levels of traffic congestion are generally favourable for light rail transit. When congestion is severe, light rail is seen as a potential solution and there is thus more political and public support for new systems. Note that the hoped-for solution does not always come to pass. Dallas has invested extensively in light rail, is still quite congested, and yet light rail serves only 1.4% of trips. Meanwhile, in uncongested light rail cities such as Buffalo and Cleveland, ridership is low.

For Hamilton, one concern for B-Line LRT and the attraction of new riders is that movements along the corridor are fairly efficient with low levels of congestion for automobile commuters. The associated

system of one-way streets and well synchronized traffic lights is not ideal for LRT or encouraging TOD. In Calgary, LRT was supported by policies that actually discouraged auto commuting into the downtown. Overall, it does not seem that congestion problems will serve as a tailwind for light rail developments in Hamilton.

4.1.6 Access to What Matters

The evidence from other cities suggests that light rail stands a better chance to generate TOD and ridership when it provides good access to many of a city's most important destinations such as major employment nodes. The B-Line corridor presents a number of important opportunities. The prospective alignment features several such destinations and trip generators, connections to regional transit, a concentration of employment in many station-areas, and is within reach of a large number of the city's residents. Ridership on the B-Line bus routes is strong and the potential LRT alignment already features reasonably high densities in many areas. Furthermore, the City of Hamilton continues to grow and attract new investment in the downtown core and along the route. One challenge could be that the western portion of the B-Line is more developed in comparison to eastern portions of the line in terms of major trip recipients/generators.

4.1.7 The Risk Element and Foretelling the Future

Experiences from elsewhere suggest that there is a substantial element of risk in developing light rail systems. In several cases (e.g. Buffalo, Charlotte, Baltimore, Denver, Minneapolis and others) the cost of light rail system construction has been much higher than originally expected, while system cost per kilometre has varied substantially across cities. In an operating sense, the cost recovery ratio for the majority of light rail systems in the United States has often been disappointing and critics of rail transit note that significant and continued subsidies are required to maintain operations. To some extent, past problems reflect the difficulty of stimulating new types of behaviour in a society that remains predominantly auto-oriented. Hamilton is no exception in this respect. Nevertheless, specific segments of the market such as young professionals and empty nesters, are attracted to transit-oriented living and their numbers are likely to increase over time. The high costs of auto ownership and operation may send more people in a transit-oriented direction. On balance, there are several trends which appear to be in place and which may alter the cost-benefit calculation that each person carries out in evaluating transit options.

Appendix

Appendix A Light Rail Transit in North America

Appendix B Policy Tools in Support of Rapid Transit

Appendix C Policy Tools for Transit-Oriented Development

Appendix A Light Rail Transit in North America

Baltimore, MD

System Overview

Operator:	Maryland Transit Administration	Route KM:	48km
Subsidiary:	Baltimore Light Rail	Daily Ridership:	30,800 (APTA, 2011)
Lines:	3	Year Opened:	1992
Stations:	33		

General Information

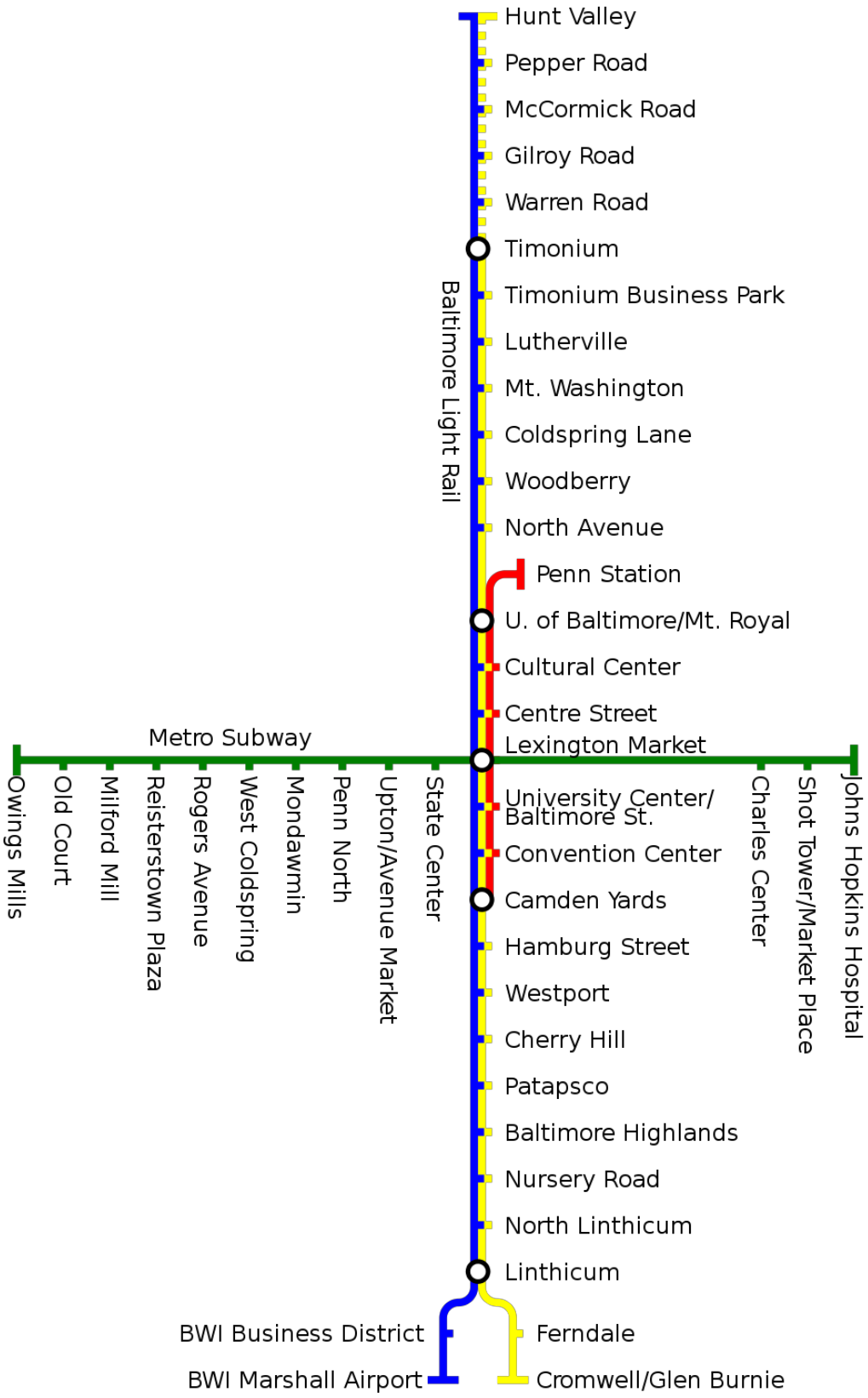
The Maryland Transit Administration's Baltimore Light Rail system provides a north-south rail line that connects downtown Baltimore with portions of its surrounding suburbs. In the downtown section, the LRT operates on city streets, while outside of the central city it runs on its own private right-of-way, utilizing track from defunct historic railway companies.

Originally built as a single 36km line, the system underwent expansion in 1997, adding extensions and spur lines to Penn Station and BWI Airport. However, because much of the system was built along a single track, 17-minute headways were not uncommon at peak periods. To remedy this, the track was doubled between 2004-06, which caused significant service disruptions.

Transit-Oriented Development Experience

The City of Baltimore created a TOD taskforce in 2008 and currently engages in the promotion of transit-oriented development through its Comprehensive Master Plan. In 2004, the city identified three station areas for the creation of TOD pilot projects and continues to work with stakeholders to develop these lands and identify other locations for further development. TOD in Baltimore is mainly supported through planning and land use incentives.

System Map


Hunt Valley
Pepper Road
McCormick Road
Gilroy Road
Warren Road
Timonium
Timonium Business Park
Lutherville
Mt. Washington
Coldspring Lane
Woodberry
North Avenue
Penn Station
U. of Baltimore/Mt. Royal
Cultural Center
Centre Street
Lexington Market
Convention Center
Camden Yards
Hamburg Street
Westport
Cherry Hill
Patapsco
Baltimore Highlands
Nursery Road
North Linthicum
Linthicum
Ferndale
Cromwell/Glen Burnie
BWI Business District
BWI Marshall Airport
Baltimore Light Rail
Metro Subway
Owings Mills
Old Court
Milford Mill
Reisterstown Plaza
Rogers Avenue
West Coldspring
Mondawmin
Penn North
Upton/Avenue Market
State Center
University Center/
Baltimore St.
Charles Center
Shot Tower/Market Place
Johns Hopkins Hospital

Boston, MA

System Overview

Operator:	Massachusetts Bay Transportation Authority	Route KM:	36.4
Subsidiary:	Green Line	Daily Ridership:	215,400 (APTA, 2011)
Lines:	4 Branches	Year Opened:	1897
Stations:	66 Total		

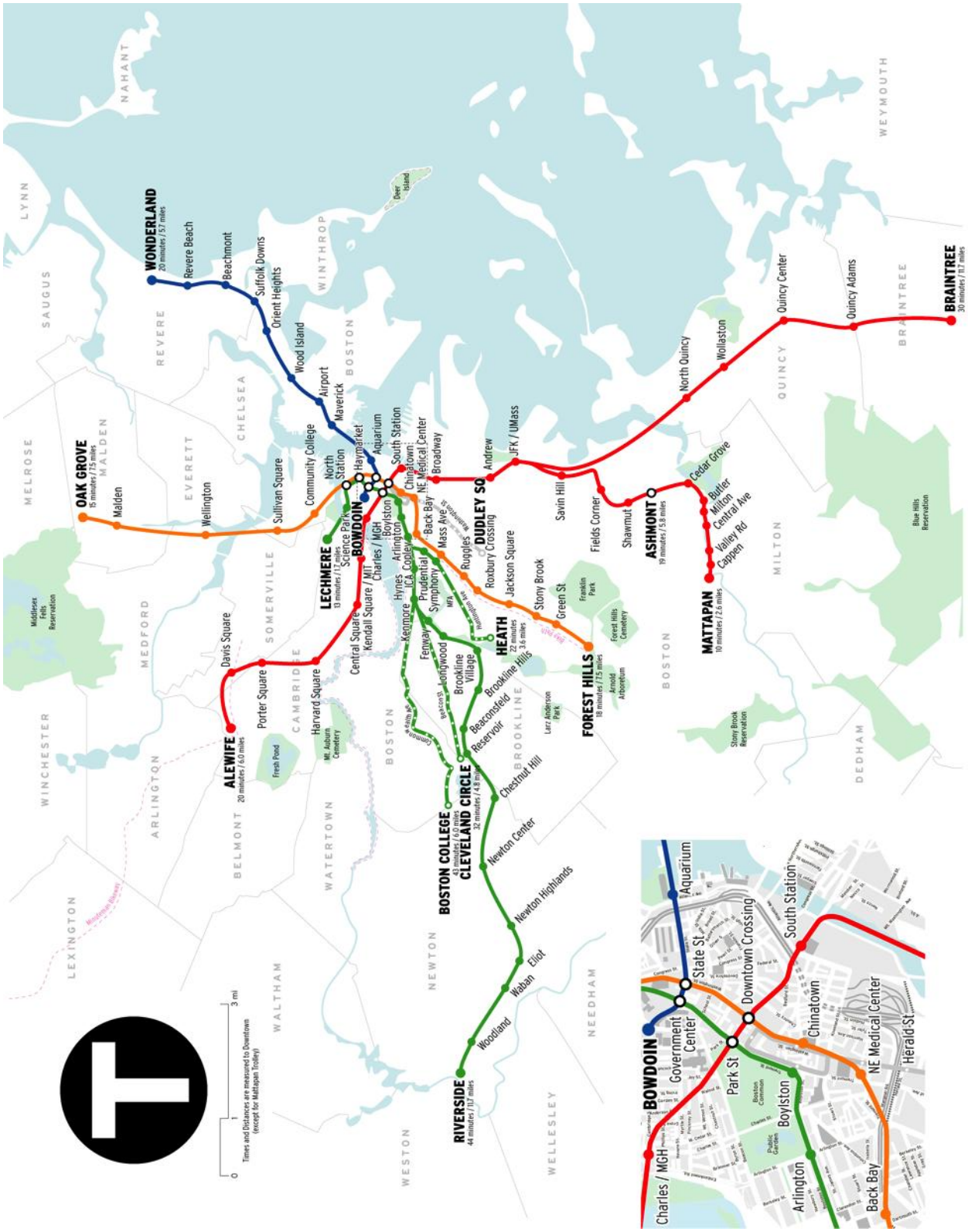
General Information

The MBTA's Green Lines are all that remain of Boston's once-extensive streetcar network. The Green Line consists of four branches – B, C, D, and E that run from downtown Boston to its inner suburbs. The A Branch ceased service in the late 1960s. All branches converge near downtown into a common tunnel with 9 underground stations, though the E Branch splits from the main line earlier and adds an additional two underground stations to its route. An extension of the Green Line is planned that will add six stations to the main line of the route. Though the majority of MBTA's Green Line branches resemble classic streetcar operations with short stop spacing, some consider it an LRT service due to its grade separation along the majority of its branches and longer stop spacing in the downtown core. Ridership of the Green Line is very high, making it the number one light rail system in the United States in daily boardings. The fact that the Green Line intersects with busy mass transit subway lines is one explanation for the high ridership numbers.

Transit-Oriented Development Experience

As a large city and metropolitan area, much of the development in Boston can be considered TOD. However, recently MBTA has been working closely with developers with the explicit goal of promoting development around new and existing station areas. Over the past five years, the MBTA has leased or sold rights for 54 TOD projects on agency land (Ragovin, 2011). Though the Green Line operates as more of a streetcar/LRT hybrid, it has proven attractive to developers. One example is the Arborpoint development at Woodland station in suburban Newton with the developer constructing 180 residential apartments and a $4.3 Million, 85-year ground lease, which MBTA has used to pay for station area improvements (Ragovin, 2011). Another example is the Avenir project on surplus agency land at the Green Line's North Station. Because land use planning is in the purview of the many local governments in the Boston metropolitan area, MBTA works with local planning organizations and other stakeholders to design TODs in an inclusive manner (Ragovin, 2011).

System Map


WONDERLAND
20 minutes / 5.7 miles
Revere Beach
Beachmont
Suffolk Downs
Orient Heights
Wood Island
Airport
Maverick
Aquarium
South Station
Broadway
Andrew
JFK / UMass
North Quincy
Wollaston
Quincy Center
Quincy Adams
BRAINTREE
30 minutes / 11.7 miles
OAK GROVE
15 minutes / 7.5 miles
Malden
Wellington
Sullivan Square
Community College
North Station
Haymarket
Chinatown
NE Medical Center
BOWDOIN
Charles / MGH
Boylston
Arlington
Back Bay
Mass Ave
Ruggles
DUDLEY SQ
Roxbury Crossing
Jackson Square
Savin Hill
Fields Corner
Shawmut
ASHMONT
19 minutes / 5.8 miles
Cedar Grove
Butler
Milton
Central Ave
Valley Rd
Cappen
MATTAPAN
10 minutes / 2.6 miles
LECHMERE
13 minutes / 1.7 miles
Science Park
Kendall Square / MIT
Central Square
Hynes ICA
Kenmore
Prudential
Symphony
Stony Brook
Green St
HEATH
22 minutes
3.6 miles
Fenway
Longwood
Brookline Village
Brookline Hills
FOREST HILLS
18 minutes / 7.5 miles
Davis Square
Porter Square
Harvard Square
ALEWIFE
20 minutes / 6.0 miles
Beaconsfield
Reservoir
Chestnut Hill
BOSTON COLLEGE
43 minutes / 6.0 miles
CLEVELAND CIRCLE
32 minutes / 4.8 miles
Newton Center
Newton Highlands
Eliot
Waban
Woodland
RIVERSIDE
44 minutes / 11.7 miles
MELROSE
LYNN
NAHANT
SAUGUS
REVERE
MALDEN
EVERETT
CHELSEA
WINTHROP
BOSTON
MEDFORD
SOMERVILLE
CAMBRIDGE
WINCHESTER
ARLINGTON
BELMONT
WATERTOWN
LEXINGTON
NEWTON
WALTHAM
WESTON
WELLESLEY
NEEDHAM
BROOKLINE
QUINCY
MILTON
BRAINTREE
WEYMOUTH
DEDHAM
Middlesex Fells Reservation
Fresh Pond
Mt. Auburn Cemetery
Franklin Park
Forest Hills Cemetery
Arnold Arboretum
Lars Anderson Park
Stony Brook Reservation
Blue Hills Reservation
Deer Island
Times and Distances are measured to Downtown (except for Mattapan Trolley)
3 mi
0
Aquarium
State St
Downtown Crossing
South Station
BOWDOIN
Government Center
Park St
Chinatown
NE Medical Center
Herald St
Charles / MGH
Boylston
Arlington
Back Bay
Public Garden
Boston Common

Buffalo, NY

System Overview

Operator:	Niagara Frontier Transportation Authority	Route KM:	10.3
Subsidiary:	Buffalo Metro Rail	Daily Ridership:	21,800 (APTA, 2011)
Lines:	1	Year Opened:	1985
Stations:	8 underground, 7 surface		

General Information

Buffalo's Metro Rail consists of a single 10.3km line that runs along Main Street connecting the HSBC Arena to the southern campus of the University of Buffalo. The line is a hybrid of light and heavy rail service, with the majority of its track and stations underground. Planning for Metro Rail began in the 1960s with key objectives of anchoring the revitalization of the central business district and slowing population decline. Though the current line was originally conceived as the first phase in an extensive transit network, system expansion has been precluded by the high costs of construction for the underground sections of the line and low levels of ridership attributed to significant population decline in the city.

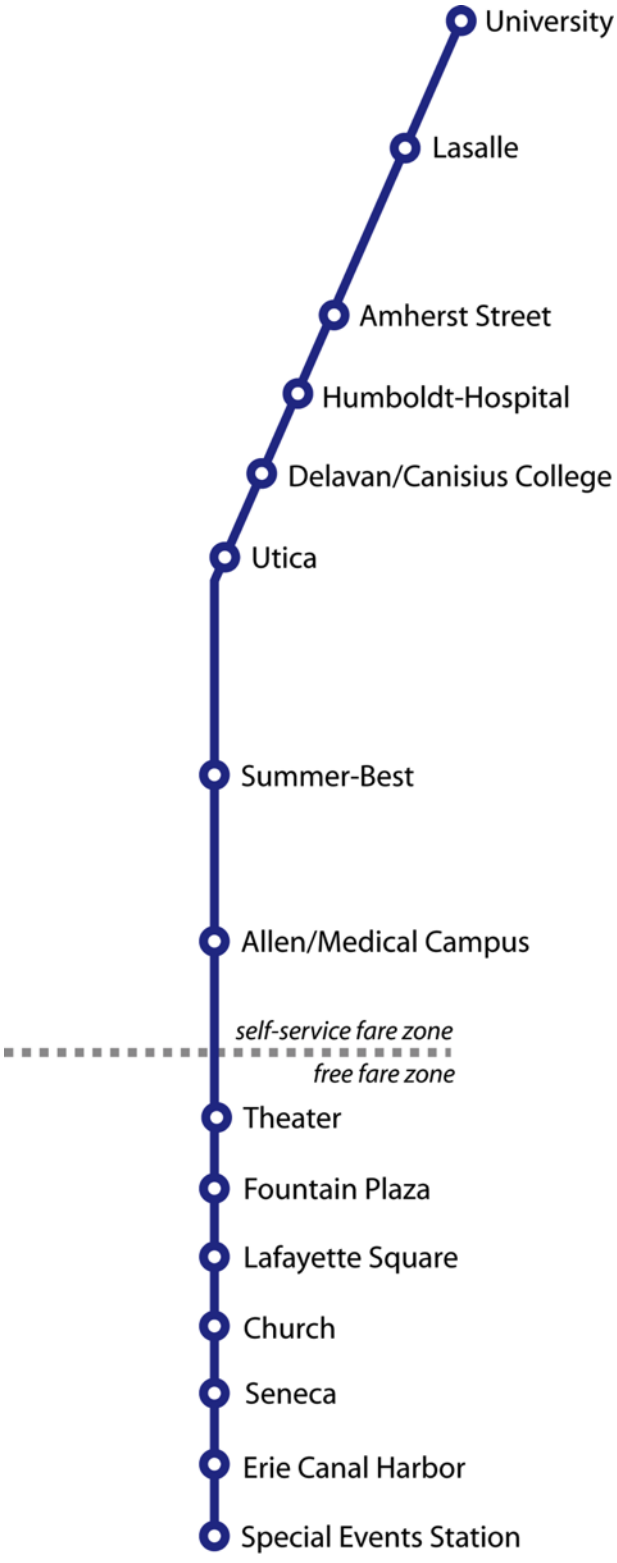
Transit-Oriented Development Experience

Very little in the way of TOD has occurred in Buffalo with the development of the Metro Rail LRT. Hess and Almeida (2007) attribute the lack of activity to a fragmented planning process for Metro Rail throughout the 1960s and 1970s between Federal, State, and local-level planning organizations that has resulted in a lack of coordinated development around transit stations.

Hess and Almeida (2007) ultimately conclude that there exists an opportunity within the failure of the Metro Rail project. Due to the lack of price premiums near stations, Metro Rail's high levels of service, and the corridor's universities, research laboratories, and cultural institutions, there is potential to capitalize on these locations for new TOD development. As such, every effort should be made in the future by stakeholders to coordinate land use and transportation planning to improve Metro Rail's operating efficiency and effectiveness and improve the local economy.

An expanded analysis of Buffalo is provided in Section 2.2.2.

System Map


University
Lasalle
Amherst Street
Humboldt-Hospital
Delavan/Canisius College
Utica
Summer-Best
Allen/Medical Campus
self-service fare zone
free fare zone
Theater
Fountain Plaza
Lafayette Square
Church
Seneca
Erie Canal Harbor
Special Events Station

Calgary, AB

System Overview

Operator:	Calgary Transit	Route KM:	48.8
Subsidiary:	C-Train	Daily Ridership:	267,500 (APTA, 2011)
Lines:	3	Year Opened:	1981
Stations:	36		

General Information

The C-Train can trace its roots back to a 1967 Calgary transportation study that recommended the construction of a two-line rapid transit network. LRT was chosen as the preferred technology in the mid-1970s and the initial South Line LRT opened in 1981. This was followed by the construction of two new lines in the 1980s. All lines have been incrementally extended over time and construction of the new West Line is underway for a 2012 opening. The C-Train consists of three lines separated into two routes. The West Line will open in 2012, further extending Route 202. All routes share common tracks in the downtown portion of the network, which also acts as a fare-free zone. Ridership on the C-Train has been strong since its opening, though demand has exploded in recent years, giving Calgary the highest ridership of all LRT systems in North America.

Transit-Oriented Development Experience

Following several years of inclusive planning through neighbourhood meetings, planners designated most of Calgary's LRT station areas as mixed-use centres with zoning bonuses allowing up to 80% increases in floor-area ratios for land within 400m of a station (Cervero, 1985). Further bonuses are offered in the downtown section of the network for properties that improve the pedestrian environment (Cervero, 1985).

Parking policies have also played a significant role in promoting TOD. Planners in Calgary have reduced minimums by as much as 80% to 1 space for every 25 workers for buildings connected to LRT stations and allows cash payments by developers in lieu of parking to finance peripheral parking structures (Cervero, 1985). Utilizing these policies, parking in downtown Calgary has declined by 1,000 spaces from 1975-1985 even though employment densities have doubled (Cervero, 1985). With these policies in place, the mode share of transit to downtown has improved from 34% in the early 1970s to 45% in 1985 (Cervero, 1985).

Outside of the downtown core, planners in Calgary have adopted an opposite stance by promoting an abundance of park-and-ride facilities. Planners felt this was required given the low-density single-family home nature of outlying station areas that makes automobile access essential to promoting LRT ridership. An expanded analysis of Calgary is provided in Section 2.2.1.

System Map


Calgary Light Rail System Map
June 2009
Tuscany - Rocky Ridge (Opens 2012)
Crowfoot
Dalhousie
Brentwood
University
Banff Trail
Lions Park
SAIT / ACAD / Jubilee
Sunnyside
Westbrook
Sirocco
69th St West
45th St West
26th St West
16th St West
10th St West
8th St West
7th St West
6th St West
4th St West
1st St West
Closed Until Spring 2010
Centre St
City Hall
Olympic Plaza
3rd St East
Convention Centre
Riley Park
McMahon Stadium
Alberta Children's Hospital
Foothills Hospital
Greyhound Bus Terminal
Red Arrow Bus Terminal
West LRT Line Opens 2012
Saddleridge (Opens 2012)
Martindale (Opens 2012)
McKnight / Westwinds
Whitehorn
Rundle
Marlborough
Airport Terminal
Peter Lougheed Hospital
Bridgeland / Memorial
Zoo
Barlow / Max Bell
Franklin
Victoria Park / Stampede
Saddledome
Erlton / Stampede
39th Ave South
Chinook
Heritage
Rockyview Hospital
Southland
Anderson
Canyon Meadows
Fish Creek / Lacombe
Fish Creek Park
Shawnessy
Somerset / Bridlewood
North
201 Somerset/Bridlewood - Crowfoot
202 City Centre - McKnight/Westwinds
City Centre Free Fare Zone
Stations Offer Services In Indicated Direction Only
20090812A / ©2009 Jeff L / trainmaps501@gmail.com
GNU Free Documentation Licence Applies / Not to Scale
Unofficial / Not Affiliated With Any Transit Agency or Provider / No Liability Assumed

Charlotte, NC

System Overview

Operator:	Charlotte Area Transit System	Route KM:	15.4km
Subsidiary:	LYNX Rapid Transit Services	Daily Ridership:	14,300 (APTA, 2011)
Lines:	1	Year Opened:	2007
Stations:	15		

General Information

The LYNX Blue Line is Charlotte's first LRT line that runs from downtown Charlotte to suburban Pineville. With seven park-and-ride facilities at different stations, LYNX bills itself as a mode for a congestion-free commute to downtown Charlotte. The Blue Line has been considered a tremendous success, opening to more than 15,000 riders per day compared to the initial projections of 9,100 (CTOD, 2011). Plans exist to construct four additional rapid transit corridors across the region financed through a 0.5% local sales tax measure. Charlotte also features a local streetcar service called the Charlotte Trolley. The streetcar acts as a compliment to Charlotte's plans for an expanded LRT network and has been cited as a catalyst for new transit investments such as the Blue Line (CTOD, 2011).

Transit-Oriented Development Experience

Charlotte has experienced an economic boom in the 2000s due to rapid growth in the banking sector. This contributed to strong demand for new development in the downtown and along the Blue Line LRT corridor thanks to its convenient access to major employment centres (CTOD, 2011). Prior to the LRT, the majority of the Blue Line corridor consisted of automobile-oriented single-family households. But the Blue Line has sparked tremendous growth in the area, with approximately 9.8 million square feet of new development occurring between 2005 and 2009 (CTOD, 2011). The majority of this (64%) has occurred in the downtown core, which has consisted of a wide variety of cultural, entertainment, commercial, and residential uses. Downtown development is credited to the proximity to employment, a strong economy, and local revitalization efforts (CTOD, 2011).

Development activity outside of the downtown has largely been the redevelopment and reuse of older manufacturing buildings into mixed-use residential, office, and retail projects. In general, the Blue Line is not viewed as a catalyst for new growth, but rather as a compliment to it. The success of new development along the Blue Line is credited largely with a strong local economy and the ability of the LRT to provide a high level of accessibility to major employment centres (CTOD, 2011). Policies to support TOD include station-area secondary planning along with parking and density bonuses. A key aspect of station area zoning is that although height restrictions are in place, there are no limits to densities. The City has also assisted infill development through streetscape upgrades and other infrastructure. Voters approved a $50 Million bond to aid in redevelopment, though the City works with developers to secure additional funds on a project-by-project basis (CTOD, 2011).

System Map


Blue Line
CTC
7th St
Stonewall
3rd St/
Convention Center
Bland
Carson
East/West Blvd
New Bern
Scaleybark
Woodlawn
NORTH
Tyvola
Archdale
South Blvd
77
Arrowood
Sharon Rd West
I-485/South Blvd
MAP LEGEND
LYNX Station
LYNX Park and Ride Station
Charlotte Transportation Center
LYNX Blue Line (South Corridor)
485

Cleveland, OH

System Overview

Operator:	Greater Cleveland Regional Transportation Authority (RTA)	Route KM:	24km
Subsidiary:	The Rapid	Daily Ridership:	8,900 (RTA, 2010)
Lines:	2	Year Opened:	1913 (original), 1980 (existing service)
Stations:	35		

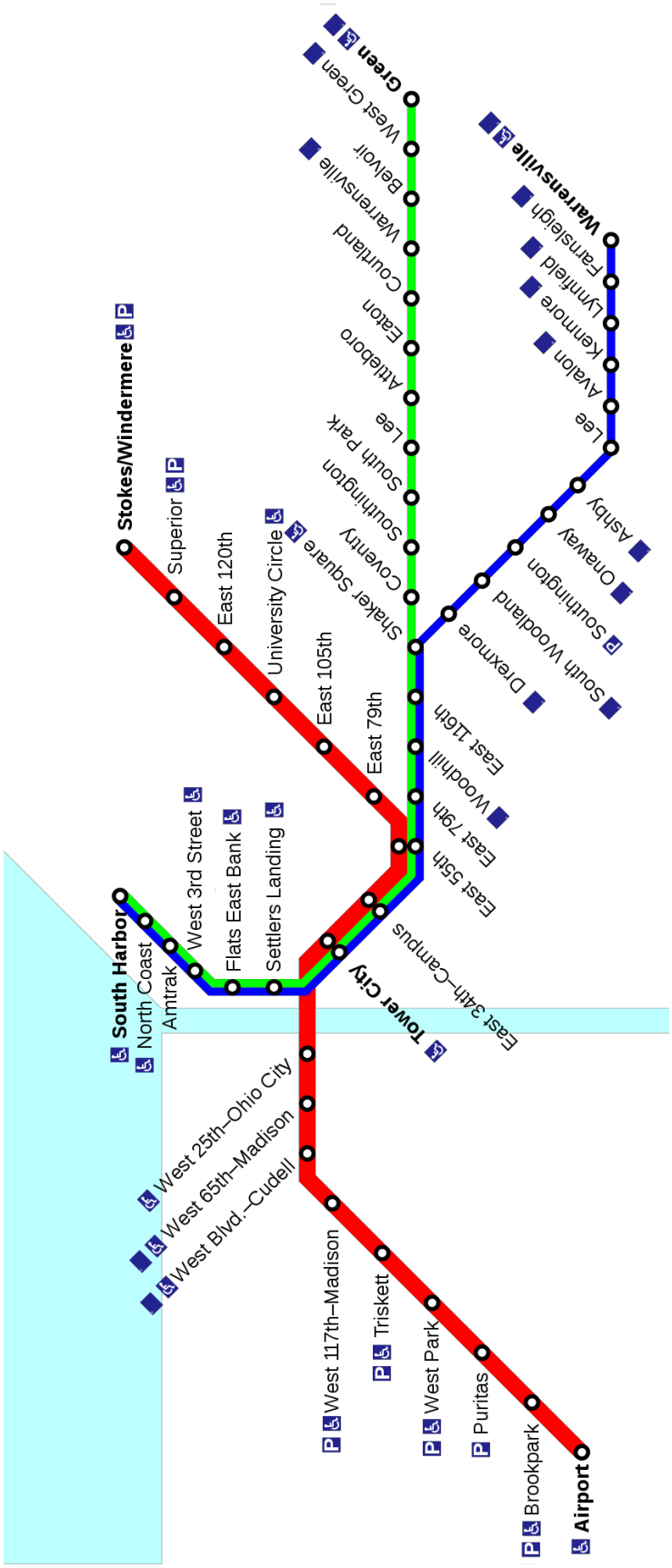
General Information

Cleveland's RTA operates the Red Line heavy rail subway and two LRT lines – the Green Line and Blue Line. Originally built as streetcar lines in the early twentieth century, Cleveland's LRT lines offer rapid transit to the city's outlying suburban areas. RTA took over operation of the lines from the City of Shaker Heights in 1980, undergoing a complete renovation in the process. Both lines were extended in 1996. Ridership on Cleveland's light rail lines remains low at less than 9,000 daily passengers in 2010 (RTA, 2010). When controlling for system length, Cleveland has the lowest number of passengers per route-kilometre than any other system covered in this research. An issue is likely a lack of congestion compared to many other US cities. Like Buffalo, Cleveland's Road Congestion Index is among the lowest in the United States, giving little incentive to utilize what is a reasonably comprehensive transit system.

Transit-Oriented Development Experience

Information on Cleveland's experience with TOD in the literature is limited and the city's transit remains understudied. However, it is generally understood that because the Blue and Green Lines were constructed as part of an integrated land use and transportation project for streetcar suburbs in the early parts of the twentieth century, settlement patterns around the LRT generally conform to TOD principles. Some TOD success has been noted by Basbin et al. (1997), such as the 17-acre mixed use Tower City Center above the nexus of Cleveland's heavy and light rail lines and the revitalization of the Flats entertainment district. Beyond these projects, RTA has recently engaged in several TOD planning initiatives, releasing its TOD Guidelines in 2007. Overlay zoning has been used to promote the construction of mixed-use projects. The document notes that RTA has been engaged in the planning of two TOD projects around LRT stations and is optimistic for more opportunities in the future. Market demand for further TOD-style projects is unclear. Cleveland is viewed as a slow-growth rustbelt city similar to Buffalo (Dunphy et al., 2003). But unlike Buffalo, Cleveland's core population has increased in recent years, giving hope for an emerging market for transit-supportive land use patterns (Hess & Almeida, 2007).

System Map


Green
West Green
Belvoir
Warrensville
Courtland
Eaton
Attleboro
Lee
South Park
Southington
Coventry
Shaker Square
University Circle
East 105th
East 79th
East 116th
Woodhill
East 79th
East 55th
East 34th–Campus
Tower City
Warrensville
Farnsleigh
Lynnfield
Kenmore
Avalon
Lee
Ashby
Onaway
Southington
South Woodland
Drexmore
Stokes/Windermere
Superior
East 120th
West 3rd Street
Flats East Bank
Settlers Landing
South Harbor
North Coast
Amtrak
West 25th–Ohio City
West 65th–Madison
West Blvd.–Cudell
West 117th–Madison
Triskett
West Park
Puritas
Brookpark
Airport

Dallas, TX

System Overview

Operator:	Dallas Area Rapid Transit (DART)	Route KM:	115.9
Subsidiary:	DART Light Rail	Daily Ridership:	69,200 (APTA, 2011)
Lines:	3	Year Opened:	1996
Stations:	55		

General Information

After the opening of the Green Line in December, 2010, DART has become the largest operator of LRT services in the United States in terms of network size. The construction of Dallas' LRT system has also occurred in a relatively short period of time, with the Red Line beginning service in 1996. A fourth line, the Orange Line LRT, is currently under construction with a proposed opening in 2011. Master plans for the DART LRT system envision approximately 257.5km of rail across the Dallas region by 2030, though DART has recently announced that these plans will likely be scrapped due to ongoing financial problems at the transit authority. DART has been financed by a half-cent increase in the local sales tax. Ridership has also been favourable, with the system exceeding initial ridership projections. But while operating in a rapidly growing city, Dallas is increasingly decentralizing and as shown in Chapter 2, the extensive DART light rail service suffers from a low level of ridership per route-kilometre.

Transit-Oriented Development Experience

The relationship between LRT and TOD in Dallas is mixed. Clower et al. (2007) report that there has been more than $4.26 Billion in new TOD projects attributed to the presence of a DART LRT station since 1999, which have generated substantial economic benefits for the city. One of the major policies supporting TOD in Dallas is the creation of TOD Tax-Increment Financing (TIF) districts, established by the city in 2008. The current TIF district contains a series of DART LRT stations and in 2010, more than $8 Billion was dedicated to support TOD projects within the area (City of Dallas, 2010). The City of Dallas has also become engaged in a plan for more affordable housing and revitalizing distressed neighbourhoods (Dallas Economic Development, 2008). Outside of the City of Dallas, DART continues to work with its member cities to better link its stations with pedestrian networks (Arrington, 2003).

The best example of TOD to date in Dallas has been Mockingbird Station, a $145 Million, 10-acre mixed-use project developed around LRT and financed entirely by the private sector outside of a federal contribution towards local infrastructure (Arrington, 2003). Based on this experience, Arrington (2003) reports that many suburban communities in Dallas have now become much more aggressive in pursuing their own TOD projects.

System Map


DART Rail System Map
EFFECTIVE 12/06/10
Map Legend
Red Line
Blue Line
Green Line
Trinity Railway Express (TRE)
No Sunday service on TRE
Orange Line
(Selected Weekday Trips Only)
TRE Fare Zone Boundary
Parking Available
Connecting Service
PARKER ROAD
Downtown Plano
Bush Turnpike
Galatyn Park
Arapaho Center
Spring Valley
LBJ/Central
Forest Lane
Walnut Hill
Park Lane
Lovers Lane
Mockingbird
Cityplace
Deep Ellum
Baylor University Medical Center
Fair Park
MLK, Jr.
Hatcher
Lawnview
Lake June
BUCKNER
DOWNTOWN GARLAND
Forest/Jupiter
LBJ/Skillman
Lake Highlands
White Rock
NORTH CARROLLTON/FRANKFORD
Trinity Mills
Downtown Carrollton
Farmers Branch
Royal Lane
Walnut Hill/Denton
BACHMAN
Burbank
Inwood/ Love Field
Southwestern Medical District/ Parkland
Market Center
Medical/ Market Center
Victory
Pearl
St. Paul
Akard
West End
Union Station
Convention Center
Cedars
8th & Corinth
Dallas Zoo
Tyler/Vernon
Hampton
WESTMORELAND
Morrell
Illinois
Kiest
VA Medical Center
LEDBETTER
Hurst/Bell
Richland Hills
Fort Worth ITC
T & P STATION
CentrePort/ DFW Airport
West Irving
South Irving
TRE
Connecting Services in Fort Worth
Use Fort Worth ITC Station to access:
Local Bus Service
Intercity Rail Service
Downtown Dallas
PLANO
President George Bush Turnpike
CARROLLTON
ADDISON
FARMERS BRANCH
RICHARDSON
GARLAND
ROWLETT
UNIVERSITY PARK
HIGHLAND PARK
FORT WORTH
IRVING
COCKRELL HILL
DALLAS
GLENN HEIGHTS
DFW
LOVE
North Tollway
Dallas
No Smoking on DART Property
call 214.979.1111 or www.DART.org

Denver, CO

System Overview

Operator:	Regional Transportation District	Route KM:	56km
Subsidiary:	RTD Light Rail	Daily Ridership:	69,100 (APTA, 2011)
Lines:	5	Year Opened:	1994
Stations:	36		

General Information

The Southeast Corridor, the newest of Denver's LRT lines, extends from Central Denver to outlying suburban areas and runs adjacent to Interstate 25 for the majority of its alignment. Future expansion of the RTD LRT system with an additional seven transit lines (4 commuter, 2 LRT, 1 BRT) will be funded through a recent regional sales tax increase.

Transit-Oriented Development Experience

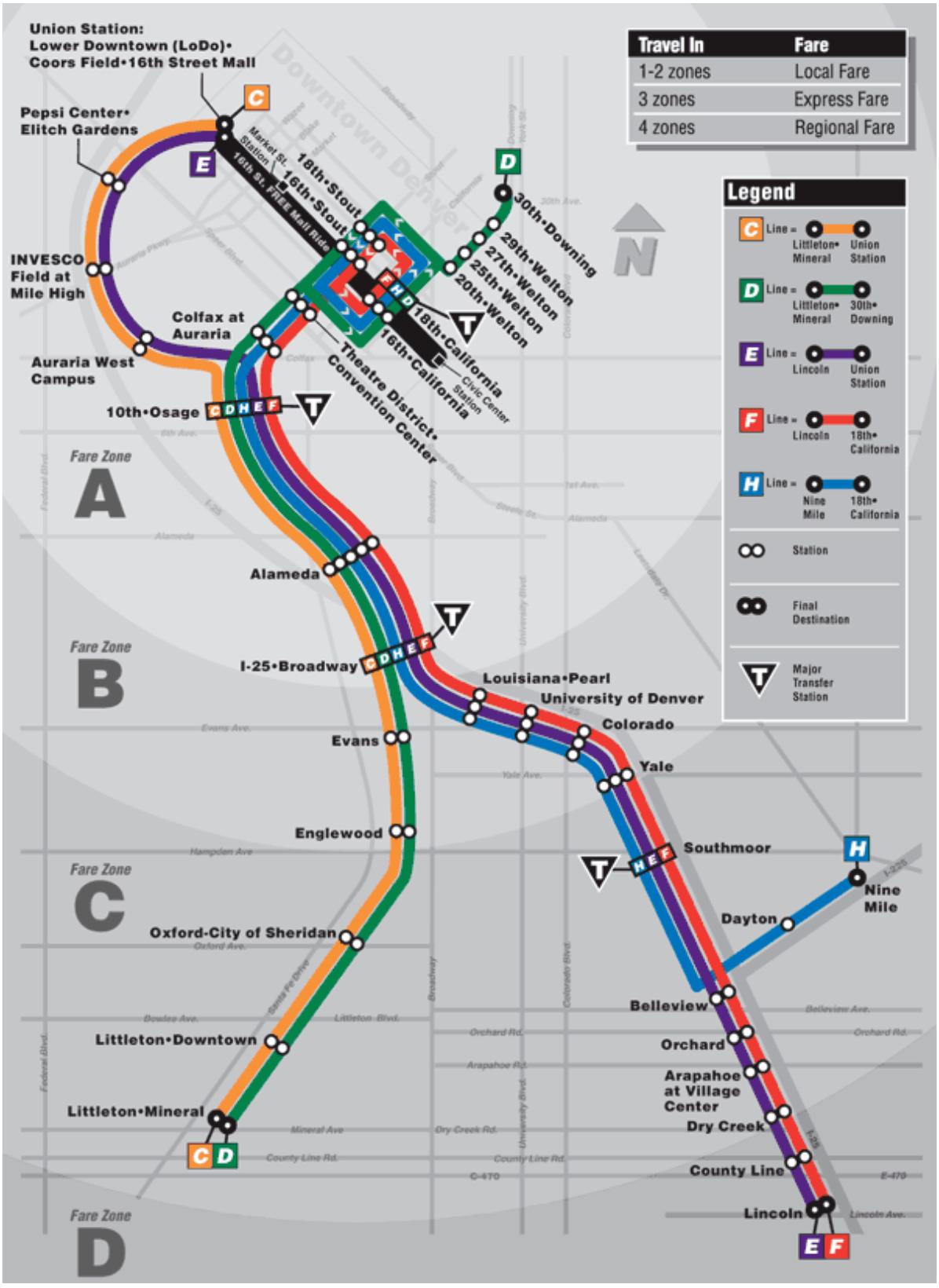
RTD has been actively involved in promoting TOD for the Southeast Corridor. LRT station areas within Denver have been subject to zoning regulations as part of Denver's TOD Strategic Plan of 2006, though some important areas were subject to advance-TOD planning in anticipation of LRT. Other policy tools have included density bonuses, a mixture of uses, and parking reductions. Tax Increment Financing has also been used to finance the environmental remediation of a polluted side for redevelopment (CTOD, 2011).

Demand for TOD in Denver has been bolstered by a strong increase in local employment, with the city adding 83,700 jobs from 2004 to 2008. The majority of this development has been along the Southeast Corridor with new office space and residential development that has largely consisted of small-scale, three- to five-story apartment complexes, though one 50-acre site is currently being redeveloped (CTOD, 2011).

Curiously, much of this development has been outside of the downtown core on large vacant sites along the I-25 corridor, which was already experiencing strong market demand for new development prior to the introduction of LRT service. However, the development remains automobile-oriented in nature and can be considered transit-adjacent rather than transit-oriented. The potential for true TOD place-making along this LRT line is likely limited by its alignment next to the I-25 expressway (CTOD, 2011).

However, outside of the Southeast Corridor, the impact of LRT in Denver is mixed. Current reports are that transit has had very little effect on the location of new office development. Furthermore, Denver's LRT is regional in nature, meaning many local governments have jurisdiction over station area planning outside of the City of Denver itself. Many of these local governments have been slow to capitalize on the development opportunities of LRT, though some are beginning to design station area plans. Much of the opportunity for TOD in these outlying areas consists of Planned-Unit Developments on greenfield sites (CTOD, 2011).

System Map


Union Station: Lower Downtown (LoDo)• Coors Field•16th Street Mall
Pepsi Center• Elitch Gardens
INVESCO Field at Mile High
Auraria West Campus
Colfax at Auraria
10th•Osage
Alameda
I-25•Broadway
Louisiana•Pearl
University of Denver
Colorado
Evans
Yale
Englewood
Southmoor
Nine Mile
Dayton
Oxford-City of Sheridan
Belleview
Littleton•Downtown
Orchard
Arapahoe at Village Center
Littleton•Mineral
Dry Creek
County Line
Lincoln
18th•Stout
16th•Stout
30th•Downing
29th•Welton
27th•Welton
25th•Welton
20th•Welton
18th•California
16th•California
Civic Center Station
Theatre District• Convention Center
Market St. Station
16th St. FREE Mall Ride
Fare Zone A
Fare Zone B
Fare Zone C
Fare Zone D
Travel In
Fare
1-2 zones
Local Fare
3 zones
Express Fare
4 zones
Regional Fare
Legend
Line = Littleton• Mineral Union Station
Line = Littleton• Mineral 30th• Downing
Line = Lincoln Union Station
Line = Lincoln 18th• California
Line = Nine Mile 18th• California
Station
Final Destination
Major Transfer Station
N

Edmonton, AB

System Overview

Operator:	Edmonton Transit System	Route KM:	20.5
Subsidiary:	Edmonton Light Rail Transit	Daily Ridership:	93,600 (ETS, 2011)
Lines:	1	Year Opened:	1978
Stations:	15		

General Information

Edmonton holds the title of constructing the first modern LRT system (Cervero, 1985) and became the first city in North America with a population under 1 million to embark on the construction of a light rail system (ETS, 2010). Construction of the 7.2km route began in 1974 with a budget of $65 Million (1980 Canadian dollars). Compared to Calgary, LRT in Edmonton started with a shorter route due to the added costs of constructing a tunnel and six below-grade stations for the downtown section of the route. Edmonton's LRT has gradually grown since its initial alignment and now covers 20.5km after its most recent extension in 2010. Ridership has gradually grown with the number of weekday boardings on the LRT increasing significantly in 2010 to 93,600, up from 74,400 in 2009 (ETS, 2011). When controlling for the length of the system, Edmonton maintains the third-highest ridership per route-kilometre of all systems covered in this research (Chapter 2). ETS (2011) attributes this growth to the recent expansion of the line to Century Park in 2010. A southern expansion is currently under construction and a new line and a number of extensions to existing lines have been proposed that will greatly extend the coverage of the LRT network in the future.

Transit-Oriented Development Experience

Edmonton has sought to promote TOD by permitting mixed-use zoning and systemically raising densities along the LRT line by allowing floor-area ratios to increase up to 3 for properties within 366m of a station area (Cervero, 1985). Edmonton has also engaged in joint development with the private sector, such as securing over half of the cost of extending the line to the Clareview Town Centre mixed use development. Under the agreement, the property developers paid the city a fixed fee for developable acres and struck a deal to lease air rights above the LRT station (Cervero, 1985). Additionally, Edmonton has discouraged the creation of new parking in the downtown core near the LRT to promote a higher share of ridership to the downtown core. Unlike Calgary however, Edmonton has discouraged park-and-ride facilities for station areas outside of the downtown core, preferring to promote more development near station areas and a higher share of transit commutes through a reorganized system of feeder buses (Cervero, 1985).

System Map


LRT Network Plan
153 AVENUE
113A STREET
STONY PLAIN ROAD
87 AVENUE
156 STREET
83 STREET
NORTH SASKATCHEWAN RIVER
114 STREET
75 STREET
111 STREET
66 STREET
127 STREET
Existing LRT Line
Route approved by City Council
Corridor for future study

Guadalajara, JO

System Overview

Operator:	Sistema de Tren Eléctrico Urbano	Route KM:	24.3km
Subsidiary:	N/A	Daily Ridership:	N/A
Lines:	2	Year Opened:	1989
Stations:	29		

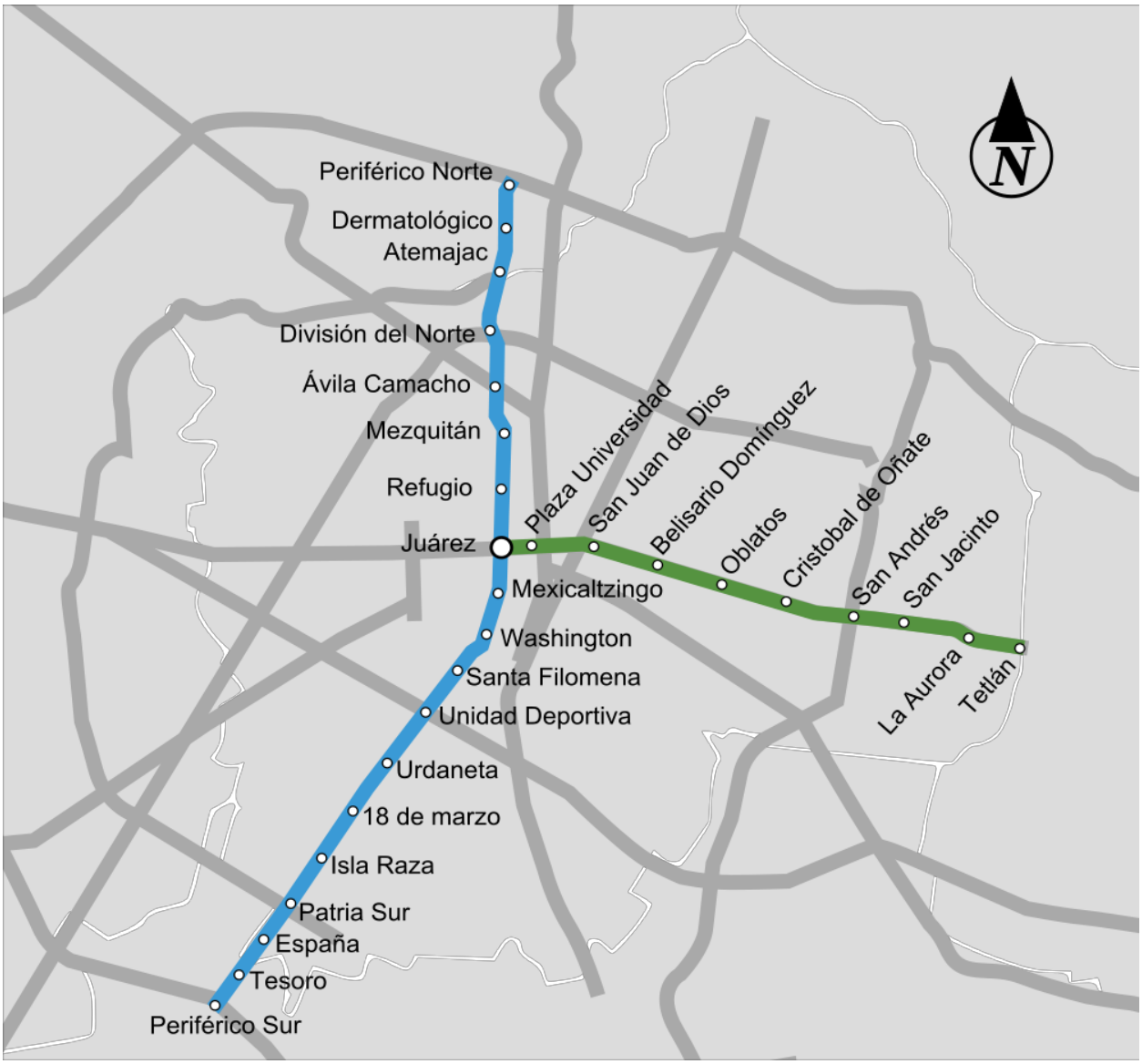
General Information

Opening in 1989, the Guadalajara light rail system operates two lines. The system originally began operations as a trolley-bus network in the 1970s, and was converted to light rail in 1989 to create Line 1. This line is notable for a section of track that runs underground in the city centre, through the rest of its alignment is at grade. Line two followed in 1994, which runs entirely underground aside for a non-passenger connection to its maintenance facility. Plans are currently underway for an extension of the system's current lines and the construction of a new Line 3.

Transit-Oriented Development Experience

No studies of TOD related to the Guadalajara light rail line could be found for this project.

System Map


Periférico Norte
Dermatológico
Atemajac
División del Norte
Ávila Camacho
Mezquitán
Refugio
Juárez
Mexicaltzingo
Washington
Santa Filomena
Unidad Deportiva
Urdaneta
18 de marzo
Isla Raza
Patria Sur
España
Tesoro
Periférico Sur
Plaza Universidad
San Juan de Dios
Belisario Domínguez
Oblatos
Cristobal de Oñate
San Andrés
San Jacinto
La Aurora
Tetlán
N

Houston, TX

System Overview

Operator:	Metro Transit Authority of Harris County	Route KM:	12.1km
Subsidiary:	METRORail	Daily Ridership:	34,800 (APTA, 2011)
Lines:	1	Year Opened:	2004
Stations:	16		

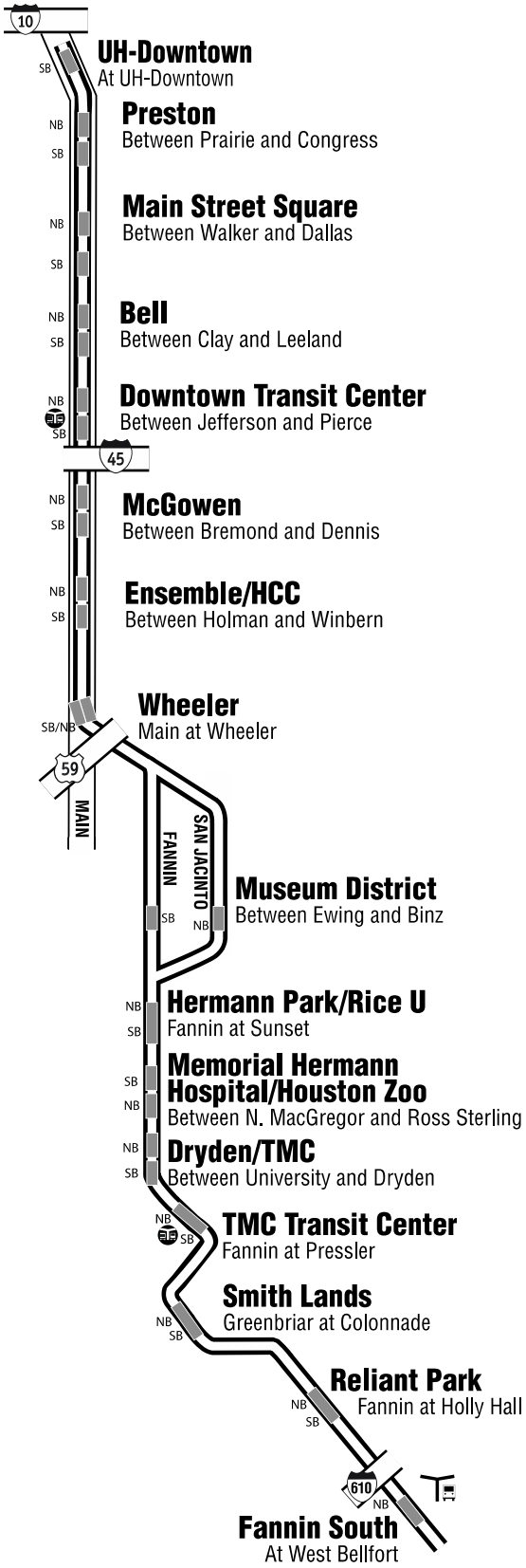
General Information

The opening of METRORail in 2004 came sixty years after Houston's previous streetcar system was shut down. Since opening, the system has been plagued with controversies. Initial accident rates on the line have been considerably higher than other LRT systems, though the majority have been blamed on motorists and pedestrians. METRORail's finances have also been called into question, with the transit authority recently engaging in large cost-cutting measures and a liquidation of assets. Nevertheless, the initial system has generally been successful. At only 12.1km long, Houston's METRORail has a very high level of ridership per kilometre of track. Four additional lines are planned, the first three of which are scheduled to open by 2014.

Transit-Oriented Development Experience

Despite high levels of ridership, Houston's METRO Rail has had a negligible impact on spurring transit-oriented development. No studies of TOD in Houston could be obtained for this project, through there is evidence from within the city that not enough is being done to attract development to METRO Rail station areas. A local news investigation revealed that the new LRT lines have not sparked a great deal of interest from the development community, a problem that is especially apparent when contrasting Houston to the experience with light rail and TOD in Dallas. According to the report, TOD has not been an explicit priority of planners and policymakers in Houston, as unlike in Dallas, neither the city nor METRO are offering any incentives for development and redevelopment (Oberg, 2010). Part of this could be attributed to the fact that Houston is one of the few cities in North America that does not practice land use zoning regulation, preferring instead to rely on ordinances in a case-by-case basis.

System Map


10
UH-Downtown
At UH-Downtown
Preston
Between Prairie and Congress
Main Street Square
Between Walker and Dallas
Bell
Between Clay and Leeland
Downtown Transit Center
Between Jefferson and Pierce
45
McGowen
Between Bremond and Dennis
Ensemble/HCC
Between Holman and Winbern
Wheeler
Main at Wheeler
59
MAIN
FANNIN
SAN JACINTO
Museum District
Between Ewing and Binz
Hermann Park/Rice U
Fannin at Sunset
Memorial Hermann
Hospital/Houston Zoo
Between N. MacGregor and Ross Sterling
Dryden/TMC
Between University and Dryden
TMC Transit Center
Fannin at Pressler
Smith Lands
Greenbriar at Colonnade
Reliant Park
Fannin at Holly Hall
610
Fannin South
At West Bellfort

Jersey City, NJ

System Overview

Operator:	New Jersey Transit (owner) 21st Century Rail Corp. (operator)	Stations	24
		Route KM:	43.8km
Subsidiary:	Hudson-Bergen Light Rail	Daily Ridership:	N/A
Lines:	3	Year Opened:	2000

General Information

The Hudson-Bergen Light Rail system has been designed as a public-private partnership in which New Jersey Transit awarded a contract to 21st Century Rail to design, build, operate, and maintain the LRT line. The system has recently been completed with the opening of its southern terminus in January of 2011. Plans for additional extensions are currently underway.

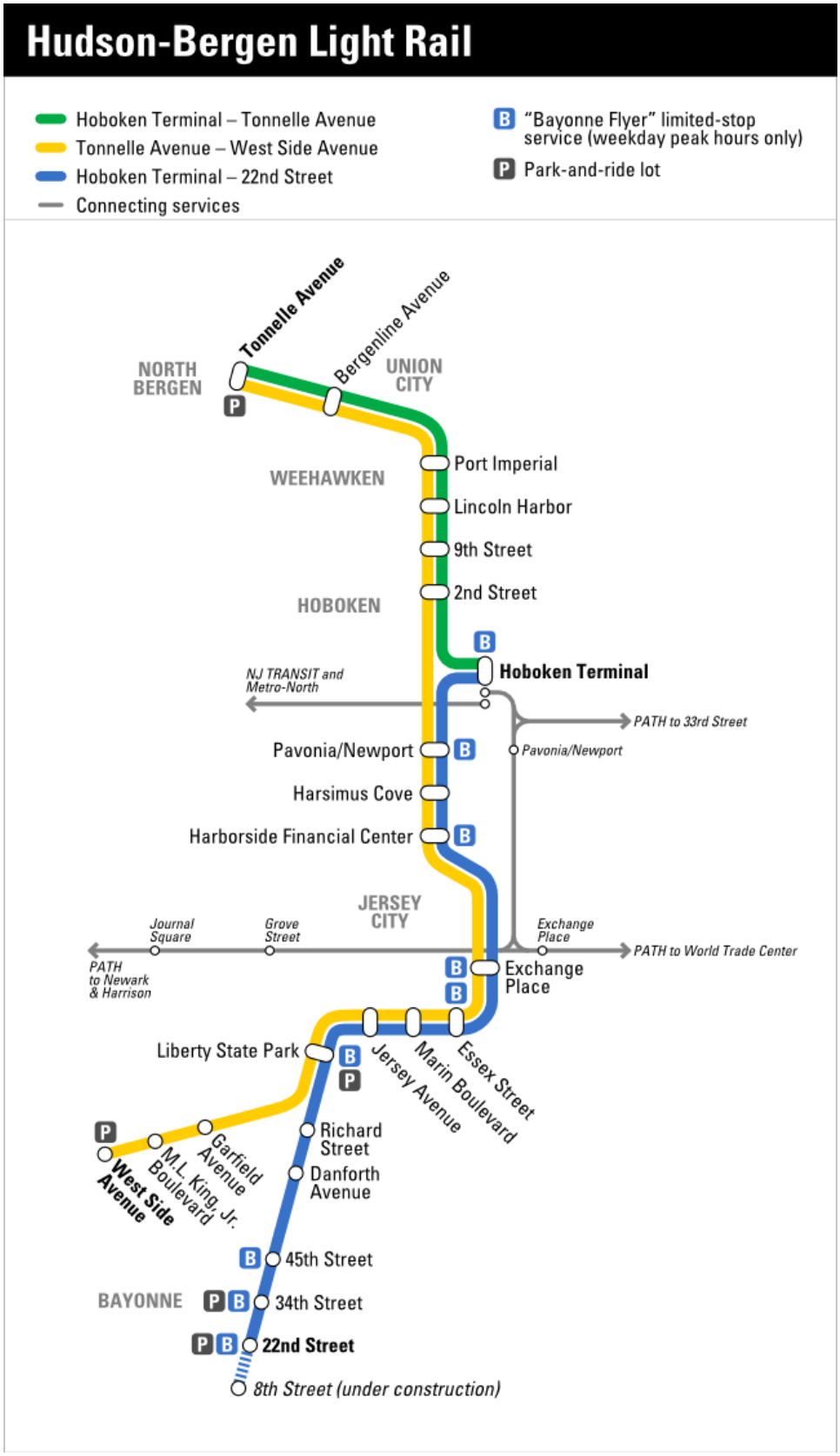
Transit-Oriented Development Experience

The Hudson-Bergen LRT is a major part of the State of New Jersey's smart growth strategy for reducing automobile dependence and encouraging transit-oriented development. The line currently runs through one of the most densely populated areas of the United States with very high levels of transit use. Some major mixed-use projects have occurred, promoted through the creation of urban enterprise and redevelopment zones. Other standard zoning practices have influenced TOD, such as reduced parking requirements, overlay zoning and as-of-right approval processes, and legal protections for buyers of brownfields and contaminated sites (Wells & Robins, 2006). Cervero et al. (2004) also detail TOD policies at the state level, such as a regional smart-growth strategy and a TOD handbook created by NJ Transit.

In general, there has been a large amount of construction activity around LRT stations, including the complete rehabilitation of previously abandoned areas. Fitzsimmons and Birch (2003) detail new development projects along the waterfront. Cervero et al. (2004) note that 690 mid- to high-rise apartment and condominium units, 3.95 million square feet of office space, two major hotels, and 100,000 square feet of office space have been built since the opening of the LRT in 2000. Robins and Wells (2008) estimate Jersey City's recent building activity to be worth $5.3 Billion.

Development in Jersey City has been bolstered by a strong local economy owing to a number of tax incentives that have drastically increased downtown employment and redevelopment. For example, office space increased from less than 2 million square feet in 1985 to almost 16 million in 2005 (Wells & Robins, 2006). While LRT may not have been a catalyst for this development, it has provided a platform for further development. Fitzsimmons and Birch (2003) note that since the introduction of LRT, new the pace of new development has intensified. These trends suggest the ability of LRT to be used as a catalyst for redevelopment when local conditions are receptive.

System Map


Hudson-Bergen Light Rail
Hoboken Terminal – Tonnelle Avenue
Tonnelle Avenue – West Side Avenue
Hoboken Terminal – 22nd Street
Connecting services
"Bayonne Flyer" limited-stop service (weekday peak hours only)
Park-and-ride lot
Tonnelle Avenue
Bergenline Avenue
NORTH BERGEN
UNION CITY
WEEHAWKEN
Port Imperial
Lincoln Harbor
9th Street
2nd Street
HOBOKEN
Hoboken Terminal
NJ TRANSIT and Metro-North
PATH to 33rd Street
Pavonia/Newport
Pavonia/Newport
Harsimus Cove
Harborside Financial Center
JERSEY CITY
Journal Square
Grove Street
Exchange Place
PATH to World Trade Center
PATH to Newark & Harrison
Exchange Place
Liberty State Park
Jersey Avenue
Marin Boulevard
Essex Street
Richard Street
Danforth Avenue
Garfield Avenue
M.L. King, Jr. Boulevard
West Side Avenue
45th Street
BAYONNE
34th Street
22nd Street
8th Street (under construction)

Los Angeles, CA

System Overview

Operator:	Los Angeles County MTA	Route KM:	99.3km
Subsidiary:	Metro Rail	Daily Ridership:	153,600 (LRT) (APTA, 2011)
Lines:	3	Year Opened:	1990
Stations:	56		

General Information

The Los Angeles MTA operates a multi-modal rapid transit network featuring the Red and Purple Line heavy rail subways and the Blue, Green, and Gold Line LRTs. The Gold Line is the newest of MTA's LRT lines, opening in 2003. A number of new and expansion projects are currently being planned, funding for which has been secured by a countywide incremental sales tax increase passed by voters in 2008. Though Los Angeles' legendary disposition to automobile-oriented design presents many obstacles to attracting a large number of riders, the MTA's LRT lines are the third busiest in the United States.

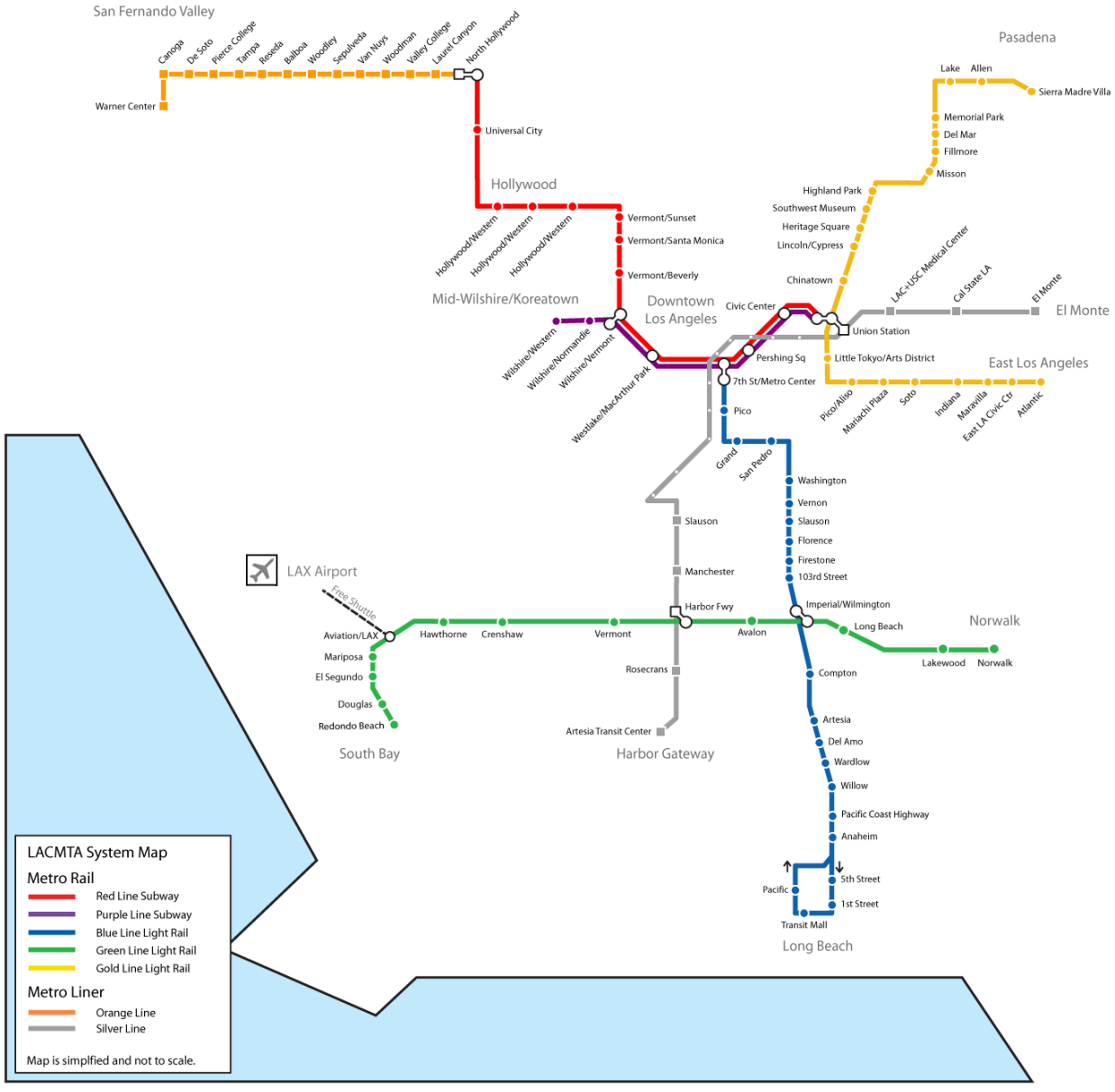
Transit-Oriented Development Experience

TOD along Los Angeles' LRT lines has been solid, though projects in the Blue and Green Line corridors have waned in recent years. This has been attributed to a downturn in the local economy and their alignment, which sees both run through economically troubled neighbourhoods. This has been made up by progress along the recently opened Gold Line LRT, which runs through neighbourhoods where the market for redevelopment is ripe and developer interest remains strong. Several TOD and joint development projects have been announced since the line's opening (Cervero et al., 2004).

TOD is promoted at the regional level through the Southern California Association of Governments, who has recently moved to adopt TOD station area planning for unincorporated lands along the Blue Line and the Los Angeles MTA, who actively promotes TOD in its endeavours. The MTA is also well known for its transit joint-development projects that have seen many transit-oriented developments on agency properties or the lease of air rights. At the local level, TOD is promoted by the City of Los Angeles through the preparation of specific traffic plans for station areas. Zoning reforms such as mixed-use overlays and density bonuses have also recently been introduced (Cervero et al., 2004). However, until this point, much of Los Angeles' TOD has been purely market-driven.

TOD in Los Angeles has benefitted from strong local market demand attributed to large numbers of immigrants from Asia and Latin America and high levels of regional congestion. The TOD market has also been subject to pent-up demand, as exclusionary zoning, strict condominium liability laws, and NIMBY opposition have resulted in many projects not reaching the market (Cervero et al., 2004).

System Map


San Fernando Valley
Canoga
De Soto
Pierce College
Tampa
Reseda
Balboa
Woodley
Sepulveda
Van Nuys
Woodman
Valley College
Laurel Canyon
North Hollywood
Warner Center
Universal City
Hollywood
Hollywood/Western
Hollywood/Western
Hollywood/Western
Vermont/Sunset
Vermont/Santa Monica
Vermont/Beverly
Mid-Wilshire/Koreatown
Wilshire/Western
Wilshire/Normandie
Wilshire/Vermont
Westlake/MacArthur Park
Downtown Los Angeles
Civic Center
Pershing Sq
7th St/Metro Center
Pico
Grand
San Pedro
Pasadena
Lake
Allen
Sierra Madre Villa
Memorial Park
Del Mar
Fillmore
Misson
Highland Park
Southwest Museum
Heritage Square
Lincoln/Cypress
Chinatown
Union Station
LAC+USC Medical Center
Cal State LA
El Monte
El Monte
Little Tokyo/Arts District
East Los Angeles
Pico/Aliso
Mariachi Plaza
Soto
Indiana
Maravilla
East LA Civic Ctr
Atlantic
Washington
Vernon
Slauson
Florence
Firestone
103rd Street
Slauson
Manchester
Harbor Fwy
Imperial/Wilmington
Long Beach
Norwalk
Lakewood
Norwalk
Compton
Artesia
Del Amo
Wardlow
Willow
Pacific Coast Highway
Anaheim
Pacific
5th Street
1st Street
Transit Mall
Long Beach
LAX Airport
Free Shuttle
Aviation/LAX
Mariposa
El Segundo
Douglas
Redondo Beach
South Bay
Hawthorne
Crenshaw
Vermont
Avalon
Rosecrans
Artesia Transit Center
Harbor Gateway
LACMTA System Map
Metro Rail
Red Line Subway
Purple Line Subway
Blue Line Light Rail
Green Line Light Rail
Gold Line Light Rail
Metro Liner
Orange Line
Silver Line
Map is simplfied and not to scale.

Mexico City, DF

System Overview

Operator:	Servicio de Transportes Eléctricos	Route KM:	12.8km
Subsidiary:	Xochimilco Light Rail	Daily Ridership:	N/A
Lines:	1	Year Opened:	1986
Stations:	18		

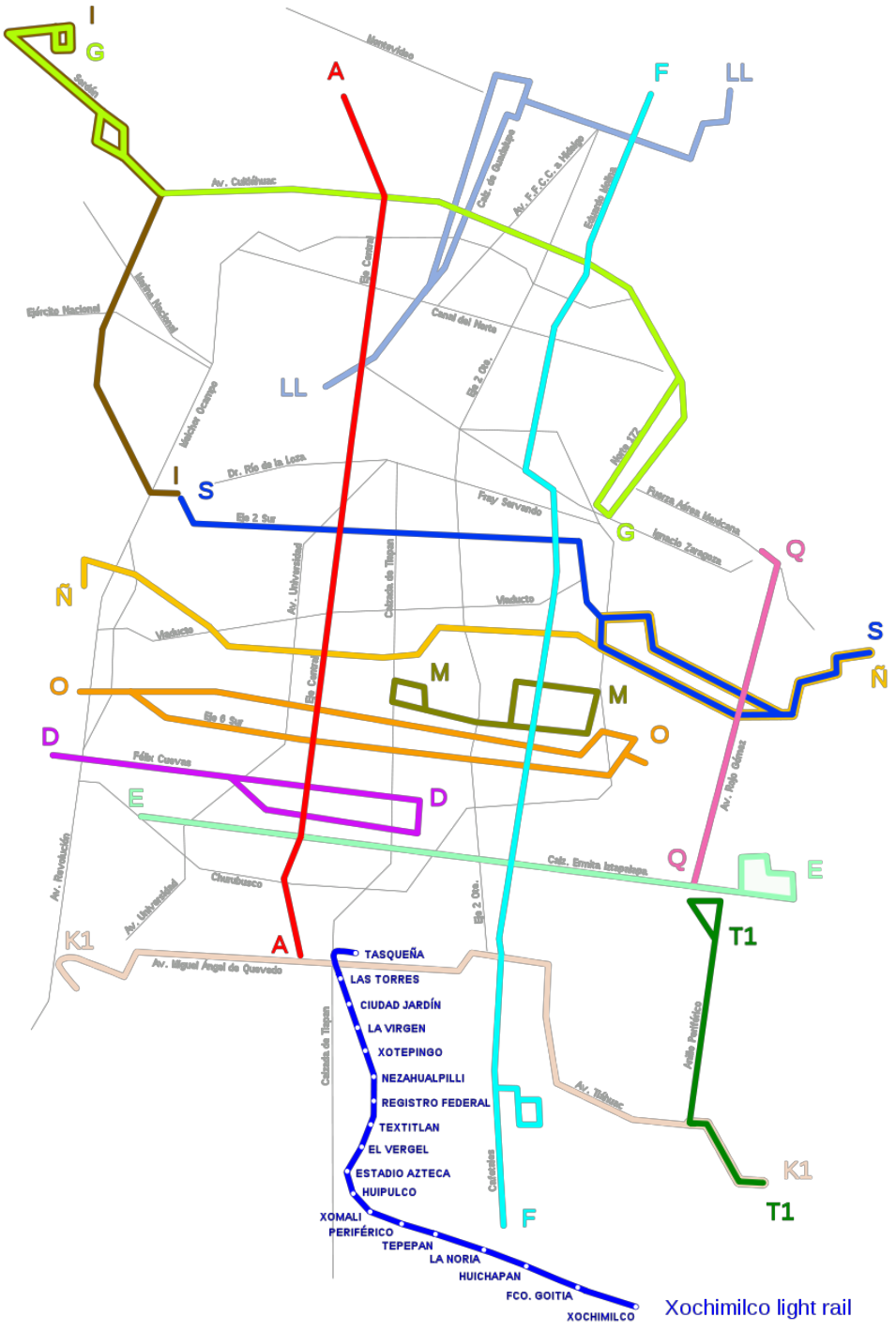
General Information

The Xochimilco Light Rail (known locally as Tren Ligero) line serves the southern part of Mexico City. The LRT connects to, but is not part of the Mexico City Metro, as it is operated by the Servicio de Transportes Eléctricicos (STE), who also operates Mexico City's electric trolleybus system. The current line began service in 1986 after replacing a traditional tram line. Part of the conversion saw many of the previous tram stops replaced with dedicated stations. The alignment of the LRT does not enter downtown and the service generally provides access to the southern portions of Mexico City's urban area. On the map below, the Xochimilco line is in blue, surrounded by the electric trolleybuses operated by STE.

Transit-Oriented Development Experience

No studies of TOD related to the Xochimilco line could be found for this project.

System Map


I
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K1
T1
TASQUEÑA
LAS TORRES
CIUDAD JARDÍN
LA VIRGEN
XOTEPINGO
NEZAHUALPILLI
REGISTRO FEDERAL
TEXTITLAN
EL VERGEL
ESTADIO AZTECA
HUIPULCO
XOMALI
PERIFÉRICO
TEPEPAN
LA NORIA
HUICHAPAN
FCO. GOITIA
XOCHIMILCO
Xochimilco light rail

Minneapolis, MN

System Overview

Operator:	Metro Transit	Route KM:	19.8km
Subsidiary:	Hiawatha Line	Daily Ridership:	26,900 (APTA, 2011)
Lines:	1	Year Opened:	2004
Stations:	19		

General Information

The Hiawatha Line is the first in a series of major transit investments in the Minneapolis-St. Paul region. The current alignment connects a series of important regional destinations such as the downtown Minneapolis central business district, the Minneapolis International Airport, and the Mall of America in addition to hospitals, stadiums, civic and institutional sites, and other attractions.

Ridership on the Hiawatha Line has been higher than expected, exceeding its projections for 10 million riders by 2020 in 2008 (CTOD, 2011). A second light rail line is currently under construction. The Central Corridor LRT will connect downtown Minneapolis, downtown St. Paul, and the University of Minnesota campus.

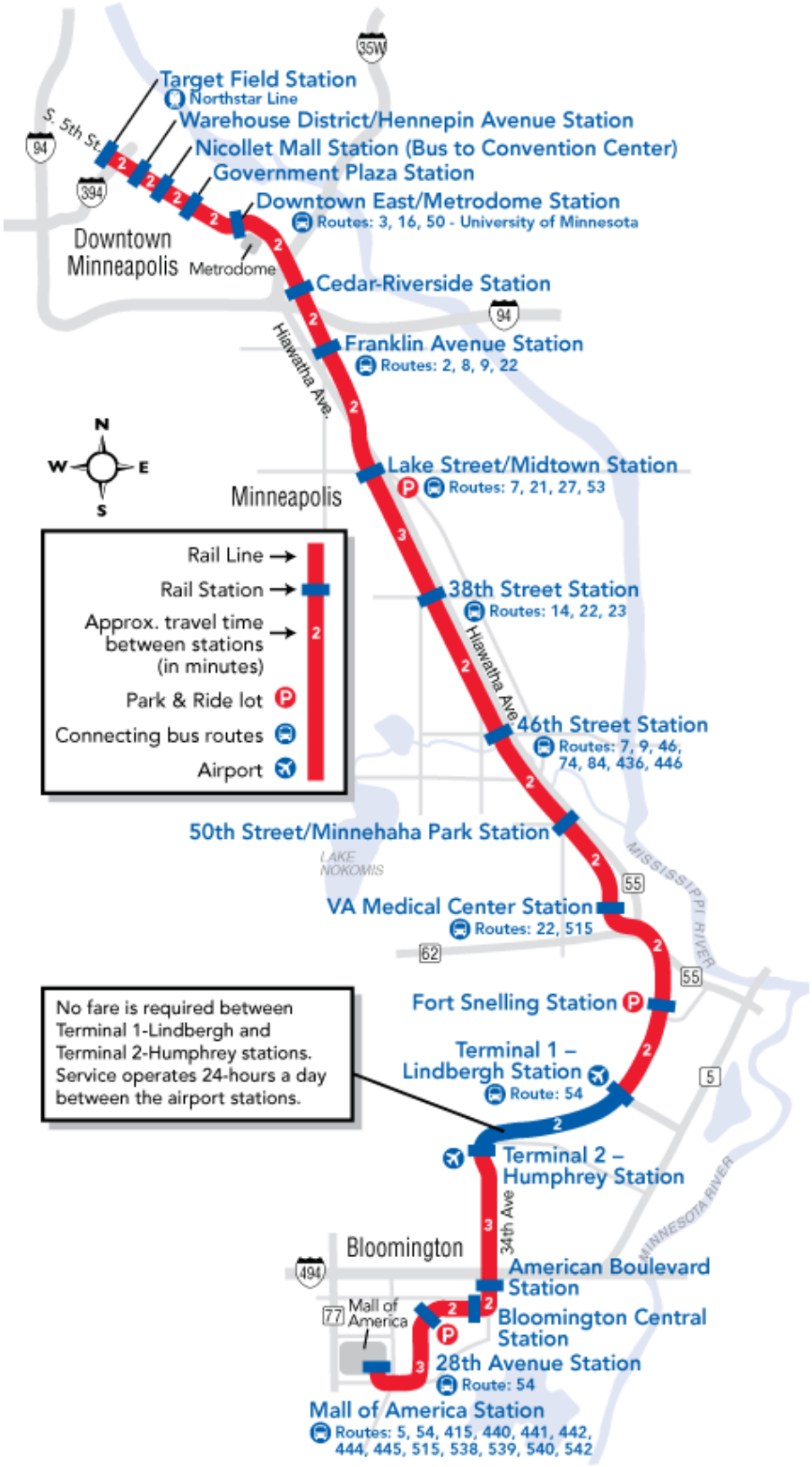
Transit-Oriented Development Experience

There has been approximately 6.7 million square feet of development along the Hiawatha Line LRT corridor since 2003, the majority of which (72%) has been concentrated in downtown Minneapolis (CTOD, 2011). This development fulfills part of a long-term redevelopment strategy for the underutilized riverfront and industrial districts and the depressed downtown area (CTOD, 2011).

TOD development outside of the downtown core has been slow to materialize, though there are a few projects near four stations on the line. Several station areas are unfit for development, such as the Fort Snelling, Lindbergh, and Humphrey stations around the airport. However, these stations provide a significant ridership bonus to the line as major traffic generators (CTOD, 2011).

The largest TOD currently underway is at Bloomington Central Station, where a 43-acre site is being developed for a number of uses including housing, offices, hotel, and retail. The project has gotten considerable support from the City, who has instituted a Tax Increment Financing district to upgrade the urban area around the site (CTOD, 2011). Changing consumer preferences towards TOD-style living have also been credited with having a major impact on recent development trends in and around the downtown core (CTOD, 2011). An expanded analysis of TOD in Minneapolis is provided in Section 2.2.4.

System Map


Target Field Station
Northstar Line
Warehouse District/Hennepin Avenue Station
Nicollet Mall Station (Bus to Convention Center)
Government Plaza Station
Downtown East/Metrodome Station
Routes: 3, 16, 50 - University of Minnesota
Downtown Minneapolis
Metrodome
Cedar-Riverside Station
Franklin Avenue Station
Routes: 2, 8, 9, 22
Hiawatha Ave.
Lake Street/Midtown Station
Routes: 7, 21, 27, 53
Minneapolis
Rail Line
Rail Station
Approx. travel time between stations (in minutes)
Park & Ride lot
Connecting bus routes
Airport
38th Street Station
Routes: 14, 22, 23
46th Street Station
Routes: 7, 9, 46, 74, 84, 436, 446
50th Street/Minnehaha Park Station
LAKE NOKOMIS
VA Medical Center Station
Routes: 22, 515
MISSISSIPPI RIVER
Fort Snelling Station
No fare is required between Terminal 1-Lindbergh and Terminal 2-Humphrey stations. Service operates 24-hours a day between the airport stations.
Terminal 1 – Lindbergh Station
Route: 54
Terminal 2 – Humphrey Station
34th Ave
Bloomington
American Boulevard Station
Mall of America
Bloomington Central Station
28th Avenue Station
Route: 54
Mall of America Station
Routes: 5, 54, 415, 440, 441, 442, 444, 445, 515, 538, 539, 540, 542
MINNESOTA RIVER

Monterrey, NL

System Overview

Operator:	Sistema de Transpore Colectivo	Route KM:	31km
Subsidiary:	Metrorrey	Daily Ridership:	N/A
Lines:	2	Year Opened:	1991
Stations:	31		

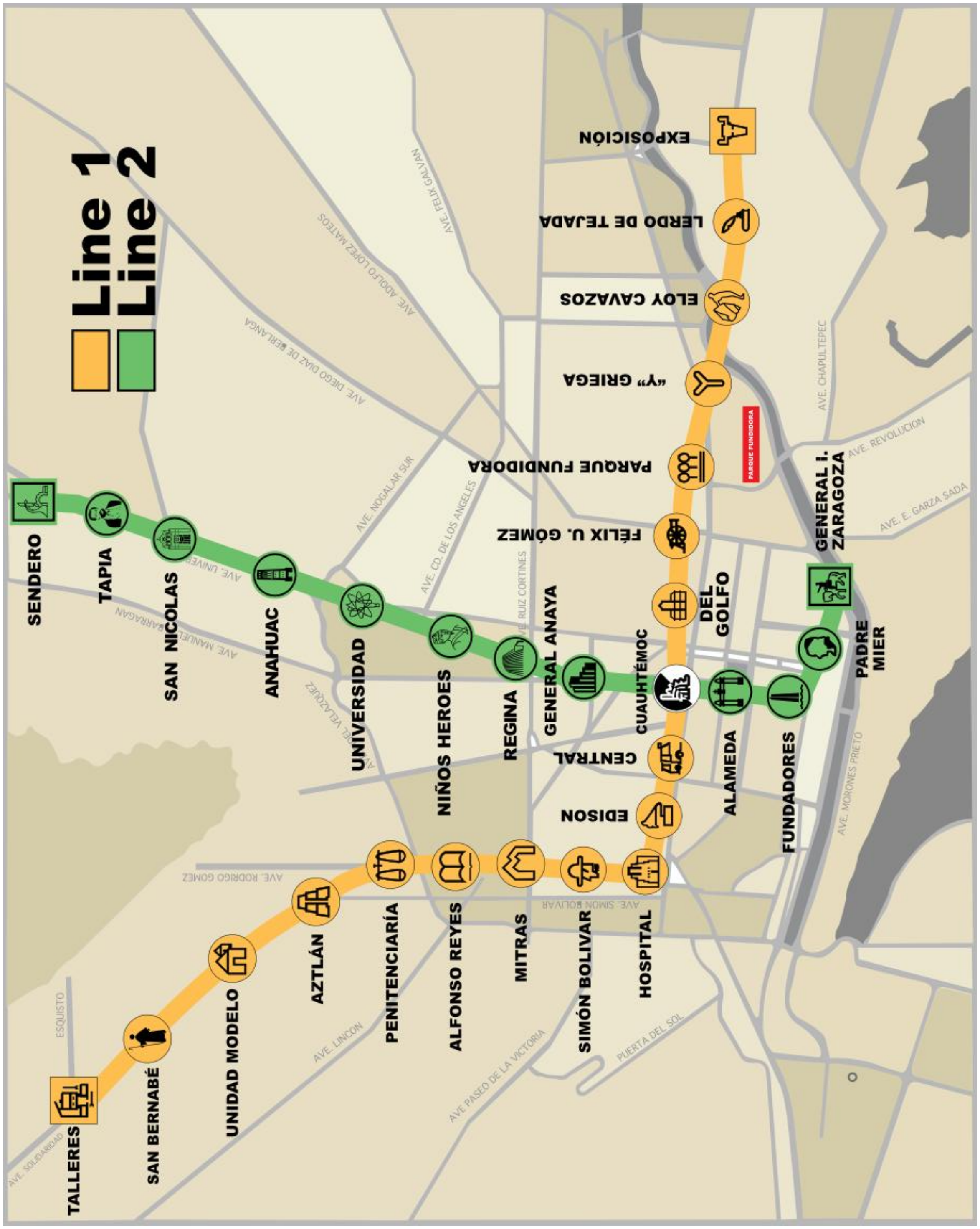
General Information

The Monterrey Metro, known as the Metrorrey, serves the city of Monterrey, Nuevo León, Mexico. It is the newest of Mexico's transit systems, opening in 1991. Two lines are currently in operation – the original Line 1 with 19 stations, and Line 2, which opened in 1994 with 13 stations.

Transit-Oriented Development Experience

No studies of TOD related to the Metrorrey light rail line could be found for this project.

System Map


Line 1
Line 2
TALLERES
SAN BERNABÉ
UNIDAD MODELO
AZTLÁN
PENITENCIARÍA
ALFONSO REYES
MITRAS
SIMÓN BOLIVAR
HOSPITAL
EDISON
CENTRAL
CUAUHTÉMOC
DEL GOLFO
FÉLIX U. GÓMEZ
PARQUE FUNDIDORA
"Y" GRIEGA
ELOY CAVAZOS
LERDO DE TEJADA
EXPOSICIÓN
SENDERO
TAPIA
SAN NICOLAS
ANAHUAC
UNIVERSIDAD
NIÑOS HEROES
REGINA
GENERAL ANAYA
ALAMEDA
FUNDADORES
PADRE MIER
GENERAL I. ZARAGOZA

Newark, NJ

System Overview

Operator:	New Jersey Transit	Route KM:	15.9km
Subsidiary:	Newark Light Rail	Daily Ridership:	N/A
Lines:	2	Year Opened:	1935 (City Subway), 2006 (Broad Street Extension)
Stations:	20		

General Information

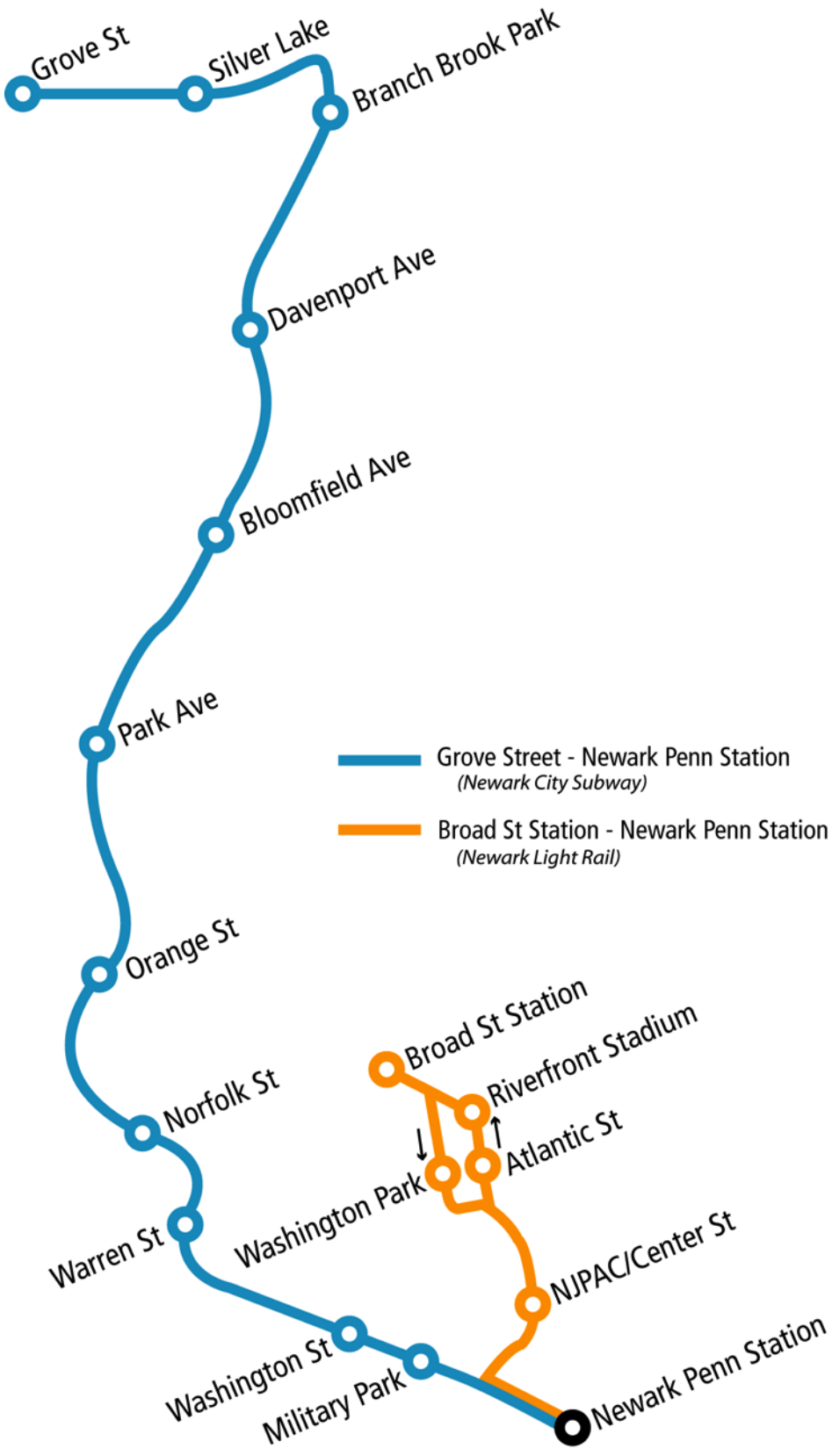
Newark's LRT can trace its history back to the operations of the Newark City Subway, which began service in 1935. New Jersey Transit took over the subway in 1980 and later replaced its older streetcars with modern LRVs, with the conversion complete by 2001. The result is an LRT system that operates as a hybrid LRT/subway with four underground stations. The remainder of the system performs as a traditional surface LRT, though a number of stations are 'open-cut' such as Park Avenue in the image to the left. The system was expanded in 2002 to reach its new suburban terminus at Grove Street by utilizing a shared-track agreement with Norfolk Southern Railway. An additional extension of the LRT lines to Newark Penn Station opened in 2006 after the construction of a new tunnel downtown. Both Penn Station and Broad Street Station provide commuters access to New York City.

Transit-Oriented Development Experience

New Jersey's proximity to New York City has helped it generate a large market for new development. This has translated to new TOD projects at a number of stations, including large-scale redevelopment of Newark's downtown core (Rutgers, 2010). Like Jersey City, demand for new development is likely to remain strong so long as local conditions permit in both New York and New Jersey and speedy service between each city is maintained (Cervero et al., 2004).

As mentioned in the section on Jersey City, New Jersey's TOD experience has benefitted from strong political leadership at the state level that has seen TOD adopted as part of a larger smart-growth agenda for increasing the amount of housing near transit stations to control regional congestion. NJ Transit has also released a handbook on TOD in 1994 for local planning authorities.

System Map


Grove St
Silver Lake
Branch Brook Park
Davenport Ave
Bloomfield Ave
Park Ave
Orange St
Norfolk St
Warren St
Washington St
Military Park
Grove Street - Newark Penn Station
(Newark City Subway)
Broad St Station - Newark Penn Station
(Newark Light Rail)
Broad St Station
Riverfront Stadium
Atlantic St
Washington Park
NJPAC/Center St
Newark Penn Station

Philadelphia, PA

System Overview

Operator:	Southeastern Pennsylvania Transportation Authority (SEPTA)	Stations:	8 underground, 60 surface
		Route KM:	97km
Subsidiary:	Subway-Surface Trolley	Daily Ridership:	115,100 (APTA, 2011)
Lines:	7	Year Opened:	1906

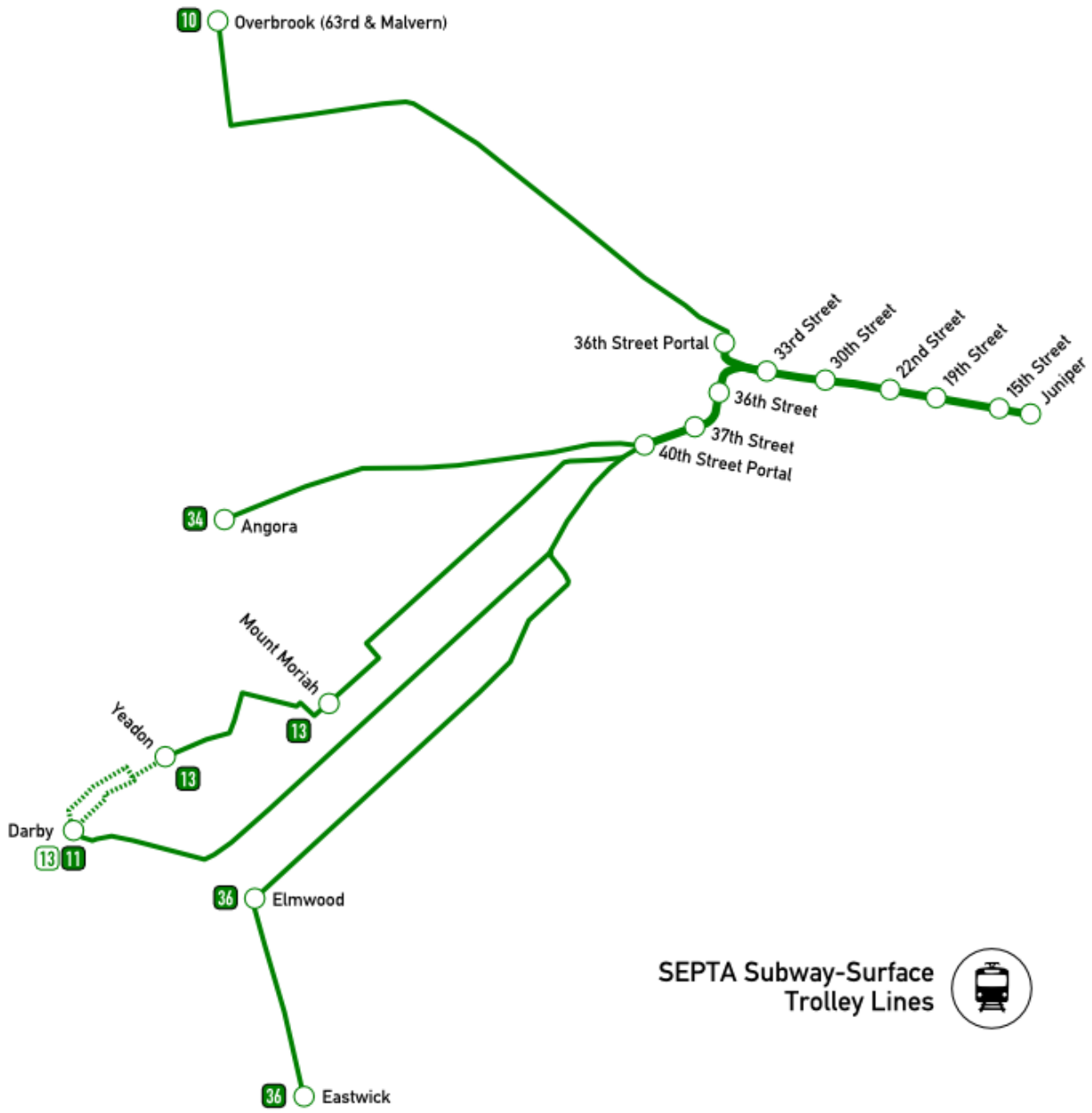
General Information

Philadelphia's SEPTA operates a multimodal network of transit options, one of which is the Subway-Surface trolley. Like Boston's Green Line and San Francisco's Muni Metro, the trolley lines are remnants of pre-World War Two streetcar lines. The current system consists of a number of different routes that operate at street level in Philadelphia's suburban districts. Operation here resembles a typical streetcar, with short stop spacing. However, the trolleys operate in a subway for the downtown portion of the route, sharing the tunnel with other rapid transit trains. This gives the trolleys an element of rapid transit, though their inclusion on the list of LRT systems in North America is subject to some contention.

Transit-Oriented Development Experience

Because Philadelphia's trolley's operate along historic streetcar lines, much of the development around transit stops can be considered early TOD in the sense of the 'streetcar suburbs' outlined by Bernick and Cervero (1997). However, Basbin et al. (1997) have noted that the real estate market in Philadelphia is generally flat and a lack of new office construction attributed to high vacancy rates. Nevertheless, the city has engaged in streetscape and access improvements to revitalize the city centre. TOD projects have been slow to follow, which Basbin et al. (1997) view as an outcome of the older neighbourhoods SEPTA currently serves, local opposition to new development projects, and a the local real estate market. Nevertheless, beyond these examples, the ability of the trolley lines to stimulate TOD remains understudied in the literature.

System Map


10
Overbrook (63rd & Malvern)
36th Street Portal
33rd Street
30th Street
22nd Street
19th Street
15th Street
Juniper
36th Street
37th Street
40th Street Portal
34
Angora
Mount Moriah
13
Yeadon
13
Darby
13
11
36
Elmwood
36
Eastwick
SEPTA Subway-Surface
Trolley Lines

Phoenix, AZ

System Overview

Operator:	Valley Metro Rail, Inc.	Route KM:	32km
Subsidiary:	METRO Light Rail	Daily Ridership:	42,300 (APTA, 2011)
Lines:	1	Year Opened:	2008
Stations:	32		

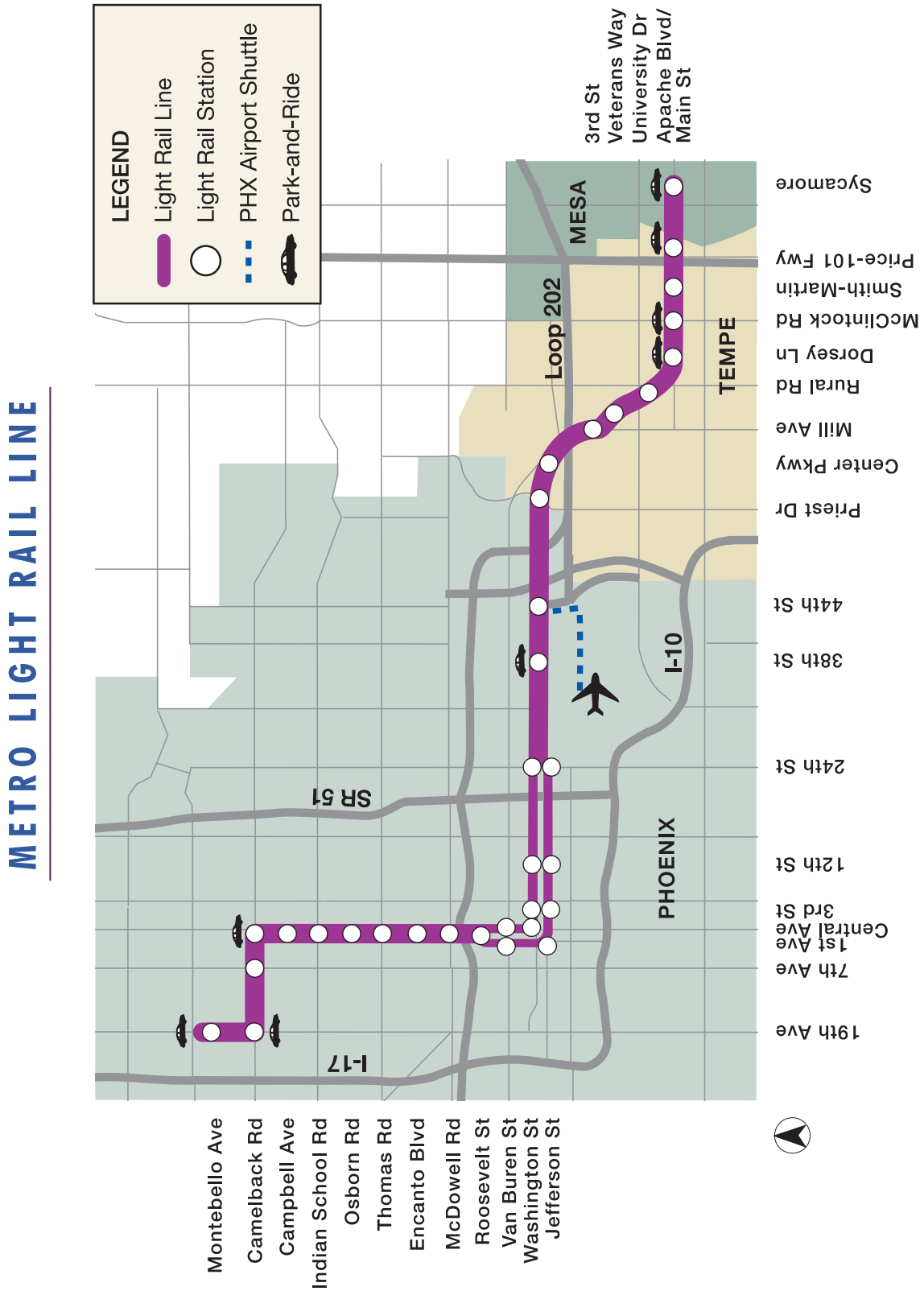
General Information

Valley Metro's light rail system serves the cities of Phoenix, Tempe, and Mesa. It is one of the newest LRT systems in the United States, opening in late 2008. Trains operate at surface level in a reserved central corridor. The LRT is the result of many years of failed transit planning in Phoenix, such as an elevated rail project and a number of others that were rejected by voters in the 1980s and 1990s. It was not until the 2000s that Metro was created, with project financing through a voter-approved .5% share of local sales tax revenue. Response to the LRT has been strong, with ridership exceeding first-year expectations, though Metro is engaged in a number of cost-cutting measures due to budget constraints. Metro is currently in the engineering phase of a 6.4km extension.

Transit-Oriented Development Experience

Though light rail in Phoenix is relatively new, the city has engaged in a campaign for preparing the corridor for rapid transit through 'advance TOD'. According to Atkinson-Palombo and Kuby (2007), Phoenix has adopted a program of overlay zoning with targeted regulations for guiding development in future station areas eight years ahead of the LRT's opening in 2008. Within that time period, almost $1 Billion in new employment, residential, and mixed-use transit-oriented development occurred within station areas, all of which has helped to ensure the success of the LRT project due to the progressive planning in the Phoenix region. Since the opening of the line, the City of Phoenix and its partners, Valley Metro Rail and the City of Mesa, have all sought to promote more TOD along the line. Recent initiatives include learning from previous experience in other cities and developing strategies and a policy toolbox for encouraging more development along the corridor (Reconnecting America, 2009). However, Proposition 207: The Private Property Rights Protection Act has slowed efforts for new TOD, as it requires the public sector to reimburse property owners for any negative changes in their property values attributed to planning policies.

System Map


METRO LIGHT RAIL LINE
LEGEND
Light Rail Line
Light Rail Station
PHX Airport Shuttle
Park-and-Ride
Montebello Ave
Camelback Rd
Campbell Ave
Indian School Rd
Osborn Rd
Thomas Rd
Encanto Blvd
McDowell Rd
Roosevelt St
Van Buren St
Washington St
Jefferson St
I-17
SR 51
PHOENIX
I-10
Loop 202
MESA
TEMPE
19th Ave
7th Ave
1st Ave
Central Ave
3rd St
12th St
24th St
38th St
44th St
Priest Dr
Center Pkwy
Mill Ave
Rural Rd
Dorsey Ln
McClintock Rd
Smith-Martin
Price-101 Fwy
Sycamore
3rd St
Veterans Way
University Dr
Apache Blvd/
Main St

Pittsburgh, PA

System Overview

Operator:	Port Authority of Allegheny County	Route KM:	40km
Subsidiary:	Pittsburgh Light Rail (The T)	Daily Ridership:	23,600 (APTA, 2011)
Lines:	2	Year Opened:	1987
Stations:	60		

General Information

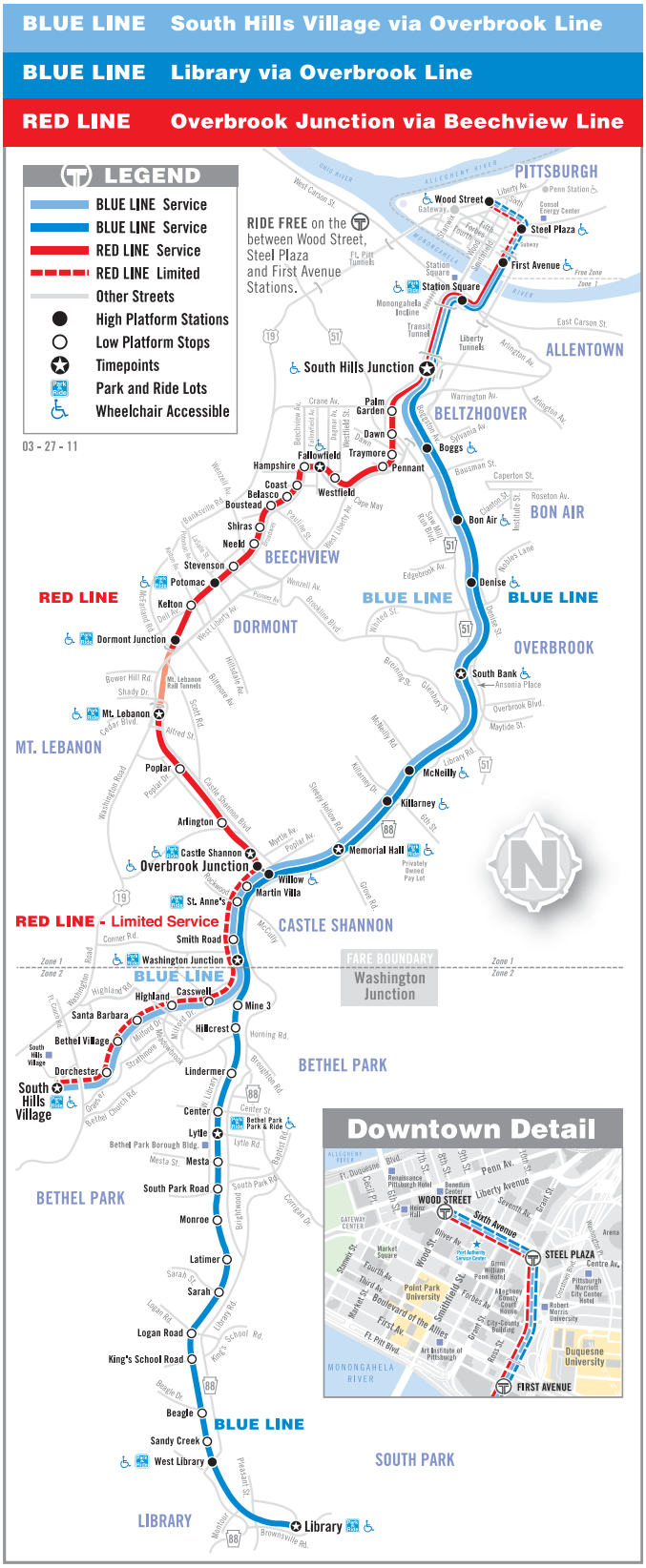
Pittsburgh's light rail functions as a hybrid LRT system, featuring surface operation in suburban areas and three underground stations in the downtown. The T light rail network consists of the Blue and Red Lines, though the blue line is often referred to in two sections. The LRT network is a conversion of the city's last remaining streetcar lines, and is most heavily used downtown, where Pittsburgh has instituted a free fare policy.

Brown and Thompson (2009) report as a small part of the Port Authority's transit system, the LRT could be better utilized by re-arranging bus routes to feed into the lines. Some routes have been altered to feed the trains, but an additional fee for transferring to the LRT remains in place. An extension of the system under the Allegheny River has been in planning since 1999, but has been stalled by unexpectedly high bids from construction companies. The T light rail network also includes some legacy streetcar operations.

Transit-Oriented Development Experience

Studies of transit-oriented development attributed to the Trolley are limited. An investigation by Cervero and Seskin (1995) found that planners and transit agency representatives have been unable to identify any specific new downtown development attributable to the trolleys. In general, though the downtown core is growing, Pittsburgh is seen as an older, reasonably high-density city with little to no inner-city growth, meaning the prospects for large-scale TOD attributed to the LRT is limited (Dunphy et al., 2003; Hess and Almeida, 2007).

System Map


BLUE LINE South Hills Village via Overbrook Line
BLUE LINE Library via Overbrook Line
RED LINE Overbrook Junction via Beechview Line
LEGEND
BLUE LINE Service
BLUE LINE Service
RED LINE Service
RED LINE Limited
Other Streets
High Platform Stations
Low Platform Stops
Timepoints
Park and Ride Lots
Wheelchair Accessible
03 - 27 - 11
RIDE FREE on the between Wood Street, Steel Plaza and First Avenue Stations.
PITTSBURGH
Wood Street
Steel Plaza
First Avenue
Station Square
South Hills Junction
ALLENTOWN
BELTZHOOVER
Palm Garden
Dawn
Fallowfield
Traymore
Hampshire
Pennant
Boggs
Coast
Belasco
Boustead
Westfield
Bon Air
BON AIR
Shiras
Neeld
BEECHVIEW
Stevenson
Potomac
Kelton
Denise
RED LINE
BLUE LINE
BLUE LINE
DORMONT
Dormont Junction
OVERBROOK
South Bank
Ansonia Place
Mt. Lebanon
MT. LEBANON
Poplar
McNeilly
Killarney
Arlington
Castle Shannon
Overbrook Junction
Memorial Hall
Willow
Martin Villa
St. Anne's
RED LINE - Limited Service
CASTLE SHANNON
Smith Road
Washington Junction
FARE BOUNDARY
Washington Junction
BLUE LINE
Highland
Caswell
Mine 3
Santa Barbara
Hillcrest
Bethel Village
BETHEL PARK
Dorchester
Lindermer
South Hills Village
Center
Lytle
Bethel Park Park & Ride
Mesta
South Park Road
BETHEL PARK
Monroe
Latimer
Sarah
Logan Road
King's School Road
Beagle
BLUE LINE
Sandy Creek
West Library
SOUTH PARK
LIBRARY
Library
Downtown Detail
WOOD STREET
STEEL PLAZA
FIRST AVENUE
Sixth Avenue
Penn Av.
Liberty Avenue
Point Park University
Duquesne University
MONONGAHELA RIVER

Portland, OR (1)

System Overview

Operator:	Tri-County Metro Transportation District (TriMet)	Stations:	85
		Route KM:	84.3km
Subsidiary:	Metropolitan Area Express (MAX)	Daily Ridership:	123,000 (APTA, 2011)
Lines:	4	Year Opened:	1986

General Information

The Portland MAX is an extensive light rail network operated by TriMet. The first line opened in 1986, the funding for which came from money originally dedicated to a canceled freeway project. Three other lines have been constructed since that time, with the most recent (Yellow Line) opening in 2004. A number of new lines and extensions have also been proposed. While the MAX runs in its own right-of-way for the majority of its alignment, parts of the system operate on surface streets in reserved lanes in downtown Portland. Downtown also features the Portland Transit Mall, which is closed to other motorized vehicles. Ridership on the MAX has been strong since opening, ranking it as the fourth-busiest LRT system in the United States behind those of the much larger cities of Boston, San Francisco, and Los Angeles.

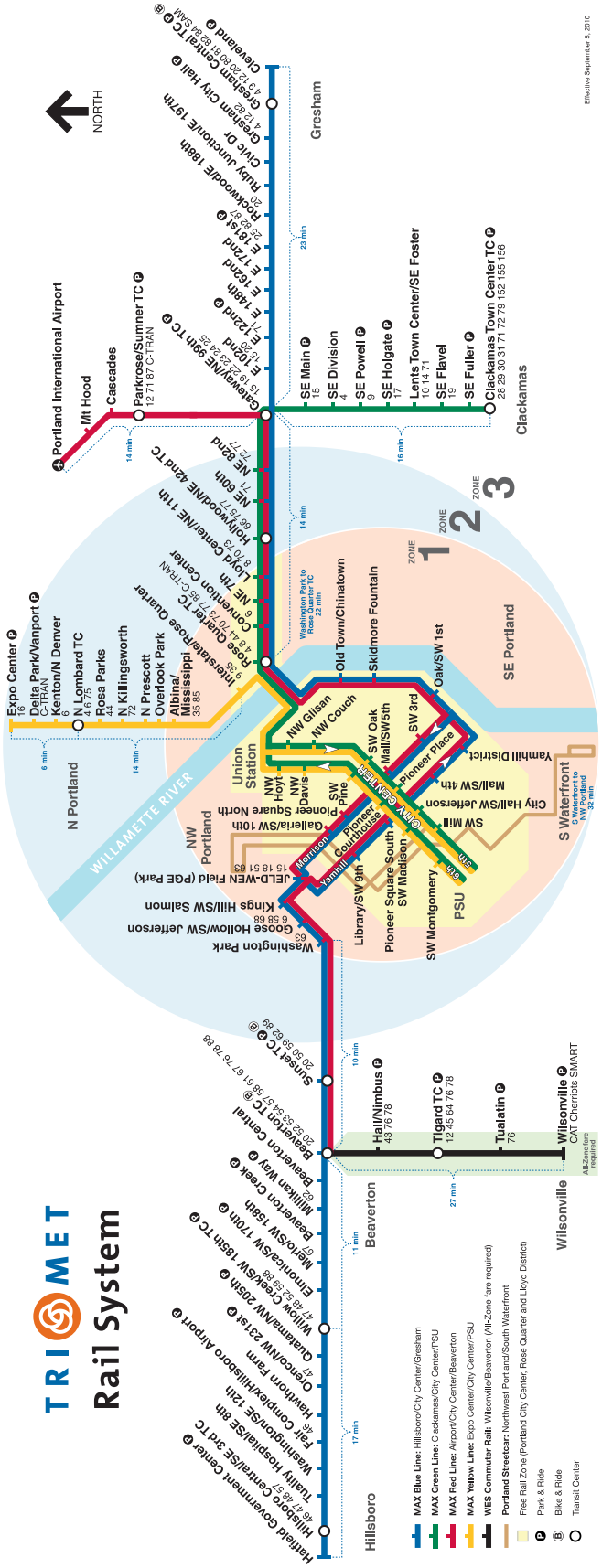
Transit-Oriented Development Experience

Portland has been described as having the most aggressive TOD program in North America (Arrington, 2003). However, G.B. Arrington (2003) argues Portland has also placed a large bet on transit as a major tool for managing growth in the region through the 2040 Growth Management Strategy and the creation of an urban growth boundary. This plan requires local governments to limit parking supply and adopt zoning and comprehensive plan changes to get two-thirds of jobs and 40% of households in corridors served by LRT (Arrington, 2003).

Since opening, Portland has realized more than $3 Billion in new development within walking distance of MAX stations (Arrington, 2003). These projects have been promoted using planning incentives to achieve higher densities, a mixing of uses, better design, and lower parking ratios. TOD has also been used as a tool to finance the construction of new transit investments, such as the Airport light rail extension that saw the private sector contribute to the capital costs of the project to develop new TOD projects when the line is completed (Arrington, 2003).

Portland also houses Orenco Station, one of the best examples of LRT-based transit-oriented development in North America. Built on a 199-acre site, Orenco is a new community developed around transit (Arrington, 2003).

System Map


TRIMET
Rail System
NORTH
Effective September 5, 2010
Gresham
Cleveland
Gresham City Hall
Civic Dr
Ruby Junction/E 188th
Rockwood
E 181st
E 172nd
E 162nd
E 148th
E 138th
E 122nd
Gateway/NE 99th TC
E 102nd
Parkrose/Sumner TC
Cascades
Mt Hood
Portland International Airport
SE Main
SE Division
SE Powell
SE Holgate
Lents Town Center/SE Foster
SE Flavel
SE Fuller
Clackamas Town Center TC
Clackamas
ZONE 1
ZONE 2
ZONE 3
SE Portland
Old Town/Chinatown
Skidmore Fountain
Oak/SW 1st
SW 3rd
NW Glisan
NW Couch
SW Oak
Mall/SW 5th
Pioneer Place
Yamhill District
Union Station
NW Hoyt
NW Davis
SW Pine
Mall/SW 4th
City Hall/SW Jefferson
SW Mill
S Waterfront
Pioneer Square North
Gallería/SW 10th
Pioneer Courthouse
Morrison
Yamhill
Pioneer Square South
SW Madison
SW Montgomery
PSU
Library/SW 9th
NW Portland
WILLAMETTE RIVER
N Portland
Expo Center
Delta Park/Vanport
C-TRAN
Kenton/N Denver
N Lombard TC
Rosa Parks
N Killingsworth
N Prescott
Overlook Park
Interstate/Rose Quarter
Albina/
Mississippi
Rose Quarter TC
Convention Center
NE 7th
Lloyd Center
Holladay/NE 11th
NE 60th
NE 82nd
Hollywood/NE 42nd TC
JELD-WEN field (PGE Park)
Kings Hill/SW Salmon
Goose Hollow/SW Jefferson
Washington Park
Sunset TC
Beaverton Central
Beaverton TC
Millikan Way
Beaverton Creek
Merlo/SW 158th
Merlo/SW 170th
Elmonica/SW 185th TC
Willow Creek/SW 205th
Quatama/NW 231st
Orenco/NW 253rd
Hawthorn Farm
Fair Complex/Hillsboro Airport
Washington/SE 8th
Tuality Hospital/SE 12th
Hillsboro Government Center
Hatfield Government Center
Hillsboro
Beaverton
Wilsonville
Hall/Nimbus
Tigard TC
Tualatin
Wilsonville
CAT Cherriots SMART
All-Zone fare required
MAX Blue Line: Hillsboro/City Center/Gresham
MAX Green Line: Clackamas/City Center/PSU
MAX Red Line: Airport/City Center/Beaverton
MAX Yellow Line: Expo Center/City Center/PSU
WES Commuter Rail: Wilsonville/Beaverton (All-Zone fare required)
Portland Streetcar: Northwest Portland/South Waterfront
Free Rail Zone (Portland City Center, Rose Quarter and Lloyd District)
Park & Ride
Bike & Ride
Transit Center

Portland, OR (2)

System Overview

Operator:	City of Portland (owner), TriMet (operator)	Stations:	42
		Route KM:	6.4km
Subsidiary:	Portland Streetcar	Daily Ridership:	N/A
Lines:	1	Year Opened:	2001

General Information

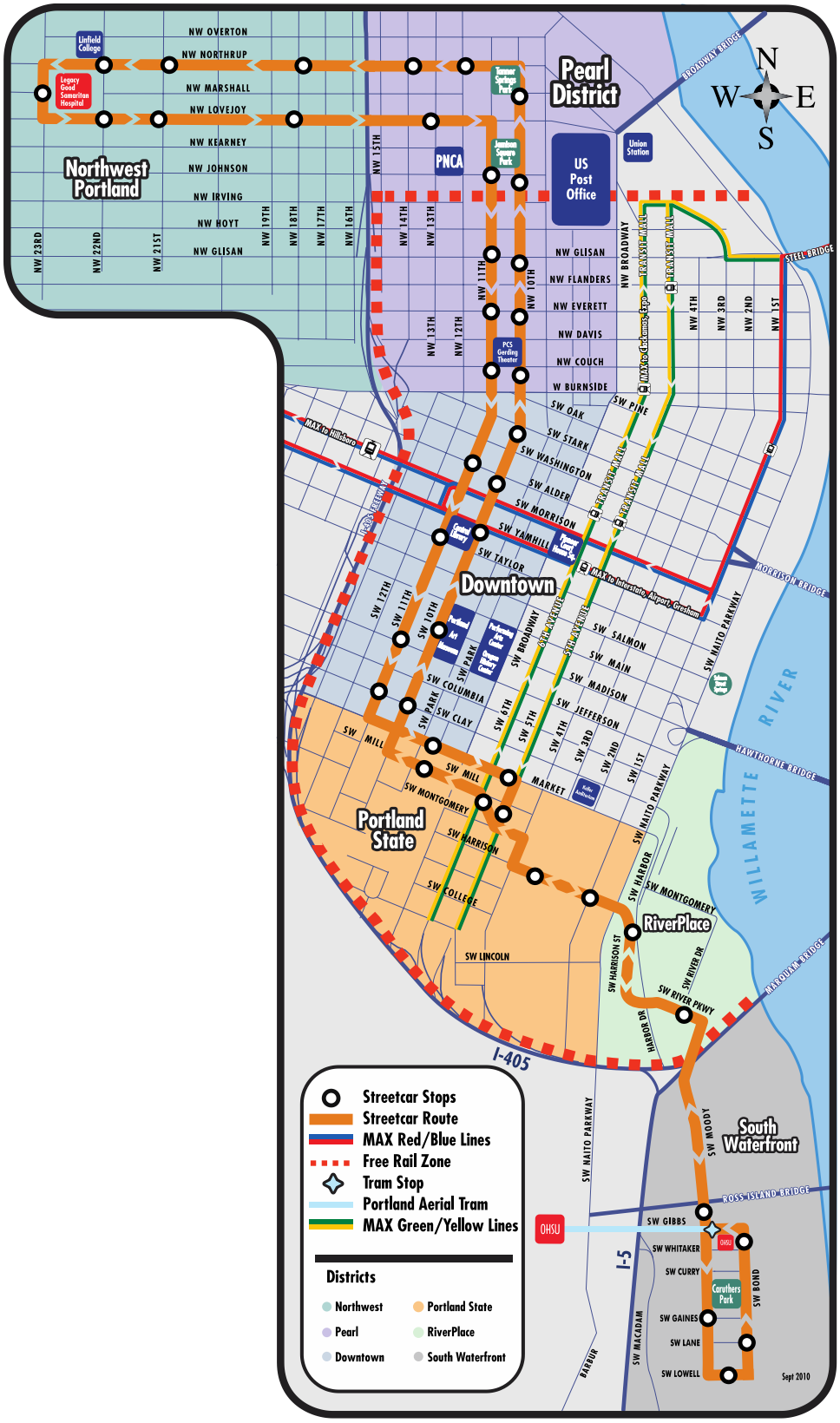
The Portland Streetcar is a single line serving downtown Portland. Like the MAX, the Portland Streetcar is operated by TriMet employees. However, the line is owned by the City of Portland and managed by a non-profit public corporation. The streetcar was initially proposed as part of the MAX system, but the electoral defeat of a bond initiative for the project led to the choice of less-expensive modern streetcars for the project. The cost of the trams is estimated to be less than one-third of designing the line as a MAX LRT (Condon et a., 2008).

The Streetcar differs from the MAX and many other LRT systems in general in the way it operates. The majority of the line runs in mixed traffic and is not given signal priority, unless the vehicle is making a turn. These choices have saved the City of Portland the costs of securing rights of way for the Streetcar's operations, but have resulted in a transit option that behaves much more like a traditional streetcar than rapid transit.

Transit-Oriented Development Experience

Transit-oriented development and redevelopment have been primary goals of the Streetcar project. City officials had hoped the introduction of trams would spur high density development along the line and recoup the funding for the project through increased tax revenues. An investigation by Condon et al. (2008) argues that these expectations have been exceeded, as construction activity along the line increased exponentially between 1997 to 2004. According to the City of Portland (2008) and Condon et al. (2008), densities have increased drastically for these new projects, with floor-area-ratios 90% higher than those in the surrounding area. Based on these developments, the City of Portland (2008) sees a bright future for the Streetcar to influence TOD in the downtown core.

System Map


Northwest Portland
Pearl District
Downtown
Portland State
RiverPlace
South Waterfront
NW OVERTON
NW NORTHRUP
NW MARSHALL
NW LOVEJOY
NW KEARNEY
NW JOHNSON
NW IRVING
NW HOYT
NW GLISAN
NW FLANDERS
NW EVERETT
NW DAVIS
NW COUCH
W BURNSIDE
SW OAK
SW STARK
SW WASHINGTON
SW ALDER
SW MORRISON
SW YAMHILL
SW TAYLOR
SW PINE
SW SALMON
SW MAIN
SW MADISON
SW JEFFERSON
SW MILL
SW MONTGOMERY
SW HARRISON
SW COLLEGE
SW LINCOLN
SW HARBOR
SW RIVER PKWY
SW RIVER DR
HARBOR DR
SW MOODY
SW GIBBS
SW WHITAKER
SW CURRY
SW GAINES
SW LANE
SW LOWELL
SW BOND
SW MACADAM
BARBUR
SW NAITO PARKWAY
NW BROADWAY
NW 23RD
NW 22ND
NW 21ST
NW 19TH
NW 18TH
NW 17TH
NW 16TH
NW 15TH
NW 14TH
NW 13TH
NW 12TH
NW 11TH
NW 10TH
NW 4TH
NW 3RD
NW 2ND
NW 1ST
SW 12TH
SW 11TH
SW 10TH
SW 6TH
SW 5TH
SW 4TH
SW 3RD
SW 2ND
SW 1ST
SW PARK
SW BROADWAY
5TH AVENUE
6TH AVENUE
MARKET
Linfield College
Legacy Good Samaritan Hospital
PNCA
US Post Office
Union Station
Jamison Square Park
Tanner Springs Park
PCS Gerding Theater
Portland Art Museum
Pettygrove Park
First Church
Keller Auditorium
Carothers Park
OHSU
MAX to Hillsboro
MAX to Beaverton, Airport, Gresham
MAX to Clackamas, Oregon City
TRANSIT MALL
STEEL BRIDGE
BROADWAY BRIDGE
MORRISON BRIDGE
HAWTHORNE BRIDGE
MARQUAM BRIDGE
ROSS ISLAND BRIDGE
WILLAMETTE RIVER
I-405
I-5
N
W
E
S
Streetcar Stops
Streetcar Route
MAX Red/Blue Lines
Free Rail Zone
Tram Stop
Portland Aerial Tram
MAX Green/Yellow Lines
Districts
Northwest
Pearl
Downtown
Portland State
RiverPlace
South Waterfront
Sept 2010

Sacramento, CA

System Overview

Operator:	Sacramento Regional Transit District	Route KM:	59.4km
Subsidiary:	Sacramento RT Light Rail	Daily Ridership:	45,600 (APTA, 2011)
Lines:	2	Year Opened:	1987
Stations:	45		

General Information

Sacramento's light rail system consists of two lines serving the downtown area and outlying suburbs. Both the Blue and Gold Lines opened in 1987 as one line, but were reorganized in 2005 to become the separate line delineation that is in use today. Curiously, much of the initial system was designed on a single track, making extremely long headways inevitable for vehicles heading in different directions. This was addressed in the 1990s when the majority of the network was double-tracked. Sacramento's LRT has been hailed as a successful implementation of light rail in a smaller city, and a number of expansions are currently underway.

Transit-Oriented Development Experience

A study of TOD by the City of Seattle in 1998 reported that little TOD has occurred in Sacramento, with Hess and Lombardi (2004) noting that the development that has occurred has been located outside of the downtown core. However, since that time the City and State have formulated new TOD policies to focus new development around transit stations. Other supportive policies include a general plan that supports mixed use and residential development in proximity to light rail stations (City of Seattle, 1998). Though not specific to the LRT corridor, zoning ordinances that contain urban design guidelines, streetscape provisions, and other policies also cover much of Sacramento's downtown core and outer areas. With a growing population and employment, both in the central city and wider region, contacts at Sacramento's Regional Transit District see a bright future for TOD in the city.

System Map


Regional Transit
Light Rail System Map
LEGEND
BLUE LINE
Watt/I-80 to Meadowview
GOLD LINE
Downtown to Folsom
Light Rail Connections
One-Way Platform
Bus Connections
Park & Ride Lot
All light rail stations are wheelchair accessible, except 12th & I southbound
Watt/I-80
Watt/I-80 West
Roseville Road
Marconi/Arcade
Swanston
Royal Oaks
Arden/Del Paso
Globe
Alkali Flat/La Valentina
Bus Connections to CITRUS HEIGHTS
NORTH SACRAMENTO
12th & I
8th & K
11th & K
10th & K
9th & K
Cathedral Square
8th & Capitol
7th & K
7th & Capitol
St. Rose of Lima Park
7th & I/ County Center
Sacramento Valley Station
DOWNTOWN SACRAMENTO
8th & O
Archives Plaza
13th Street (/RT Customer Service & Sales Center)
16th Street
23rd Street
29th Street
39th Street
48th Street
59th Street
University/65th Street
Power Inn
College Greens
Watt/Manlove
Starfire
Tiber
Butterfield
Mather Field/Mills
Zinfandel
Cordova Town Center
Sunrise
Bus Connections to CITRUS HEIGHTS
FOLSOM
Historic Folsom
Glenn
Iron Point
Hazel
RANCHO CORDOVA
EAST SACRAMENTO
MIDTOWN
Broadway
4th Ave./Wayne Hultgren
City College
Fruitridge
47th Ave.
Florin
Meadowview
Bus Connections to ELK GROVE
SOUTH SACRAMENTO
916-321-BUSS (2877)
TDD 916-483-HEAR (4327)
www.sacrt.com

Salt Lake City, UT

System Overview

Operator:	Utah Transit Authority	Route KM:	31km
Subsidiary:	TRAX	Daily Ridership:	43,800 (APTA, 2011)
Lines:	3	Year Opened:	1999
Stations:	28		

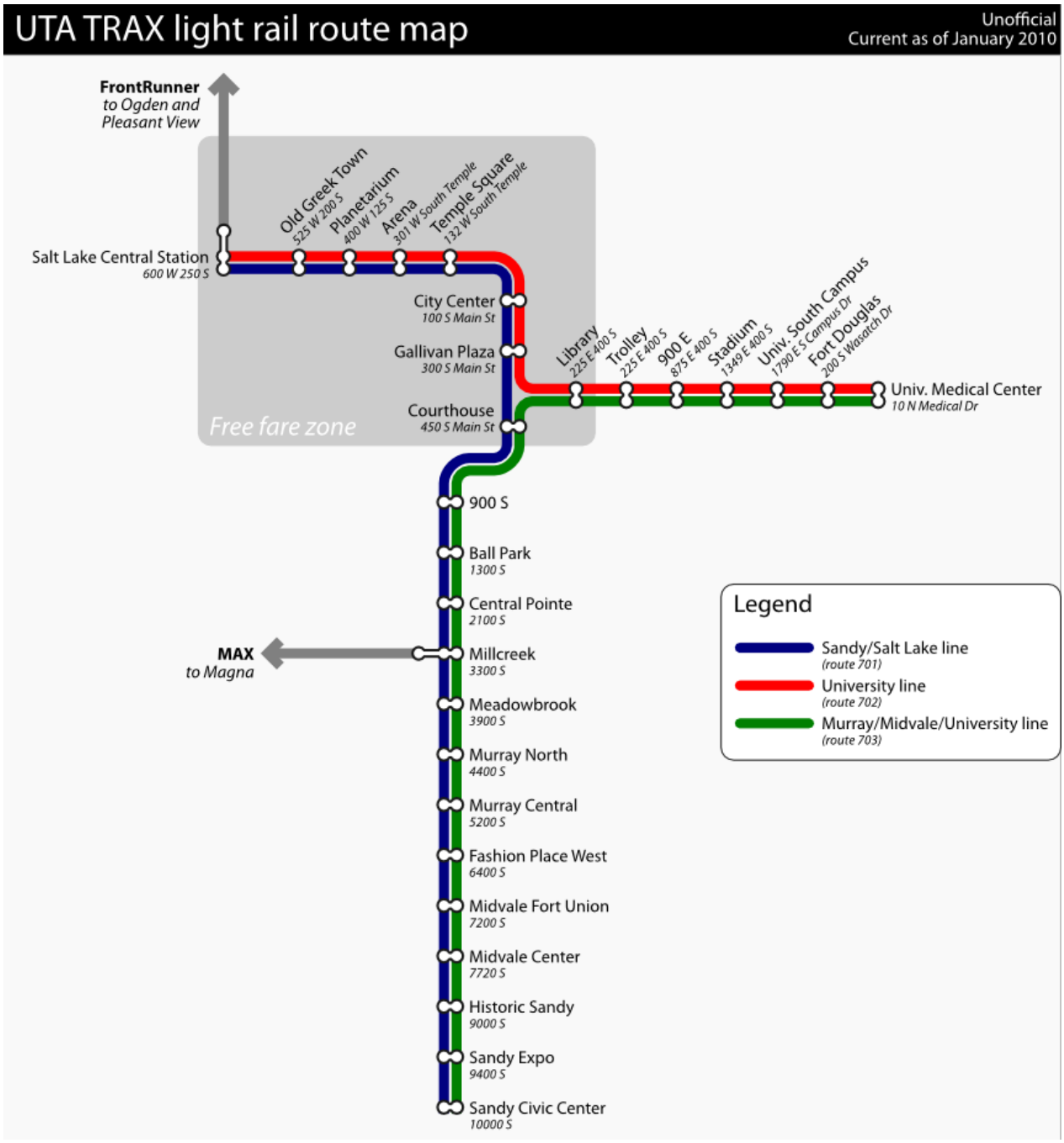
General Information

UTA's TRAX light rail is a three-line system serving downtown Salt Lake City and its outlying suburbs. Initially conceived in the 1980s as a way to mitigate regional congestion, the first line of Salt Lake City's LRT was not completed until 1999. Funding and construction of the line were accelerated after the city won its bid to host the 2002 Winter Olympics. Since that time, a second line and a number of extensions have been constructed, which have reorganized the system into the three lines present today. Despite initial skepticism among citizens, TRAX has exceeded ridership expectations and garnered widespread public support. Future plans are for 3 more lines with an additional 19 stations, the funding for which has been secured through a voter-approved quarter-cent sales tax increase. However, a study by Brown and Thompson (2009) notes that LRT is treated as a competitor to bus service and a lack of feeder routes has had a negative impact on the overall productivity of the system.

Transit-Oriented Development Experience

Salt Lake City did not seriously get involved in TOD until after the construction of its first line (Arrington, 2003). However, since that time progress appears to be promising. While no studies of TOD in the city could be found for this project, other sources have indicated that several projects have been completed and others are underway. For example, Brown and Werner (2009) report that supportive zoning measures and relaxed parking requirements have influenced the redevelopment and revitalization of 900 South Station just south of the central business district. As of 2009 a mixed-use building had been completed with an entire block slated for redevelopment (Brown & Werner, 2009). Another large project that is expected to contain up to 30,000 residents is currently being planned for 5000 acres at the end of the planned Southwest LRT. However, despite these projects, the state of TOD in Salt Lake City is underdeveloped (Brown & Thompson, 2009).

System Map


UTA TRAX light rail route map
Unofficial
Current as of January 2010
FrontRunner
to Ogden and
Pleasant View
Old Greek Town
525 W 200 S
Planetarium
400 W 125 S
Arena
301 W South Temple
Temple Square
132 W South Temple
Salt Lake Central Station
600 W 250 S
City Center
100 S Main St
Gallivan Plaza
300 S Main St
Courthouse
450 S Main St
Free fare zone
Library
225 E 400 S
Trolley
225 E 400 S
900 E
875 E 400 S
Stadium
1349 E 400 S
Univ. South Campus
1790 E S Campus Dr
Fort Douglas
200 S Wasatch Dr
Univ. Medical Center
10 N Medical Dr
900 S
Ball Park
1300 S
Central Pointe
2100 S
MAX
to Magna
Millcreek
3300 S
Meadowbrook
3900 S
Murray North
4400 S
Murray Central
5200 S
Fashion Place West
6400 S
Midvale Fort Union
7200 S
Midvale Center
7720 S
Historic Sandy
9000 S
Sandy Expo
9400 S
Sandy Civic Center
10000 S
Legend
Sandy/Salt Lake line
(route 701)
University line
(route 702)
Murray/Midvale/University line
(route 703)

San Diego, CA

System Overview

Operator:	San Diego Metropolitan Transit System	Route KM:	86.1km
Subsidiary:	San Diego Trolley	Daily Ridership:	98,000 (APTA, 2011)
Lines:	3+1	Year Opened:	1981
Stations:	53		

General Information

With its first line opening in 1981, the San Diego Trolley was the first new light rail system built in the United States in over two decades. The Trolley now consists of three lines that link downtown San Diego to its city's outlying suburban areas. A special fourth line operates on weekends and holidays, performing as a supplementary downtown circulator. The Blue Line operates service to the border with Mexico.

Ridership on the Trolley has been strong, and an extension of the blue line further north is on track to be complete by 2015.

Transit-Oriented Development Experience

An expanded analysis of San Diego's TOD experience is provided in Section 2.2.3.

System Map


Santee
Santee Town Center
Gillespie Field
Arnele Avenue
El Cajon
El Cajon Transit Center
Amaya Drive
Grossmont Transit Center
La Mesa Blvd.
La Mesa
Spring Street
Lemon Grove Depot
Lemon Grove
Massachusetts Avenue
Encanto/62nd Street
Morena/Linda Vista
Fashion Valley Transit Center
Hazard Center
Mission Valley Center
Rio Vista
Fenton Parkway
Qualcomm Stadium
Mission San Diego
Grantville
SDSU Transit Center
Alvarado Medical Center Station
70th Street
Old Town Transit Center
Old Town
Mission Valley
Green Line
Washington Street
Middletown
County Center/ Little Italy
Santa Fe Depot
America Plaza
Civic Center
Fifth Avenue
City College
Park & Market
25th & Commercial
32nd & Commercial
47th Street
Euclid Avenue
Downtown
PETCO Park
Seaport Village
Convention Center
Gaslamp Quarter
12th & Imperial Transit Center
Orange Line
Barrio Logan
Coronado
Harborside
Pacific Fleet
8th Street
National City
Blue Line
24th Street
Bayfront/E Street
Chula Vista
H Street
Imperial Beach
Palomar Street
Palm Avenue
Iris Avenue
Beyer Blvd.
San Ysidro
San Ysidro Transit Center
Tijuana, Mexico
N
Map is not to scale
Special Event Service Only
Solo para servicios especiales
Connecting Bus Routes
Conexión de Rutas de Autobús
Amtrak and COASTER
Amtrak y COASTER
Station
Estación
The Transit Store
102 Broadway
Visitor Information Center
Centro de información turística
Parking (Free- Transit Use only)
Estacionamiento
(Gratis, Solo para Pasajeros)
Pay Parking
Estacionamiento de Cuota
Nights & weekends only

San Francisco, CA

System Overview

Operator:	San Francisco Municipal Railway	Route KM:	59.2
Subsidiary:	Muni Metro	Daily Ridership:	158,200 (APTA, 2011)
Lines:	6+1 Peak	Year Opened:	1912, Light Rail Conversion in 1980
Stations:	9 underground, 24 surface		

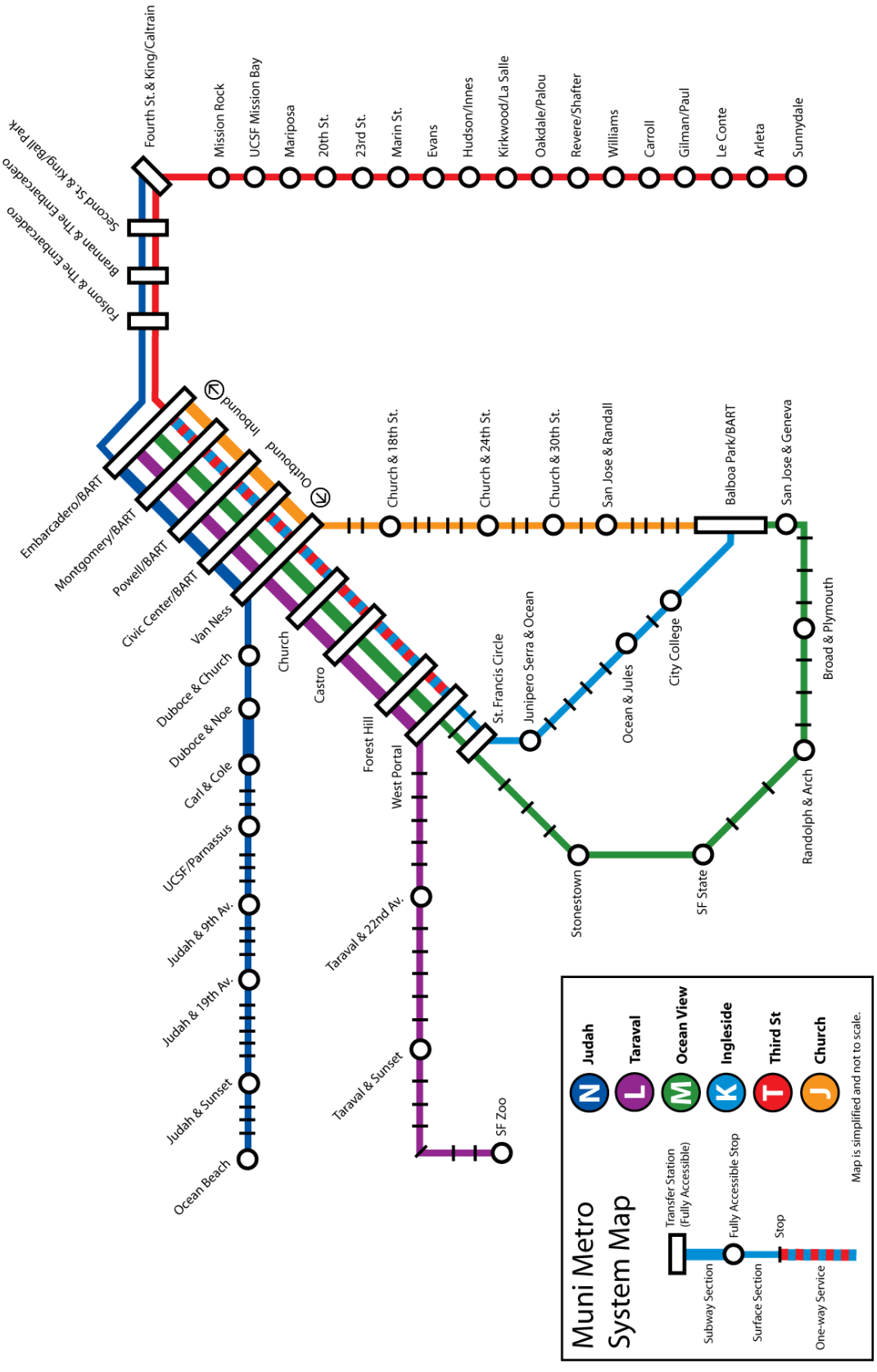
General Information

The Muni Metro is an extensive light rail system serving San Francisco. The majority of the system runs on traditional streetcar alignments that have served the city since the late 19th century. These were converted to LRT in the 1980s. New lines are also being constructed, the most recent of which opened in 2007 and marked the first new rail line in the city in over fifty years. The Muni Metro consists of six lines plus an additional line that operates in peak hours. Operations are a hybrid of traditional streetcar, heavy rail metro, and LRT transit, with 3 tunnels, 9 underground stations, 24 surface stations, and 87 surface stops. A large expansion project is being undertaken for the construction of the Central Subway. Ridership on the Muni Metro is high, with the second-highest number of daily boardings in the United States after Boston's Green Lines.

Transit-Oriented Development Experience

The relationship between light rail and TOD is strong in San Francisco, though typically research has focused on TOD in the broader San Francisco Bay Area and the Bay Area Rapid Transit (BART) heavy rail system. Nevertheless, some TOD examples exist within the City of San Francisco attributed to the Muni Metro LRT. For example, Beatty (2003) notes that the Third Street LRT has acted as a catalyst for new development in the city, which suffers from a chronic shortage of affordable housing. New projects along the line include mixed-use residential and employment projects at a decommissioned shipyard and a new medical research centre. In addition to expanding transit service, the City of San Francisco has contributed to these projects through streetscape improvements and pedestrian infrastructure improvements. However, beyond these examples, it is held that as a dense city well served by transit, most new development in station areas can be considered TOD by default. Beyond this analysis, further information regarding TOD along Muni Metro lines has been difficult to obtain.

System Map


Fourth St.& King/Caltrain
Mission Rock
UCSF Mission Bay
Mariposa
20th St.
23rd St.
Marin St.
Evans
Hudson/Innes
Kirkwood/La Salle
Oakdale/Palou
Revere/Shafter
Williams
Carroll
Gilman/Paul
Le Conte
Arleta
Sunnydale
Second St.& King/Ballpark
Brannan & The Embarcadero
Folsom & The Embarcadero
Embarcadero/BART
Montgomery/BART
Powell/BART
Civic Center/BART
Van Ness
Church
Castro
Forest Hill
West Portal
Inbound
Outbound
Church & 18th St.
Church & 24th St.
Church & 30th St.
San Jose & Randall
Balboa Park/BART
San Jose & Geneva
Broad & Plymouth
Randolph & Arch
SF State
Stonestown
St. Francis Circle
Junipero Serra & Ocean
Ocean & Jules
City College
Duboce & Church
Duboce & Noe
Carl & Cole
UCSF/Parnassus
Judah & 9th Av.
Judah & 19th Av.
Judah & Sunset
Ocean Beach
Taraval & 22nd Av.
Taraval & Sunset
SF Zoo
Muni Metro System Map
N Judah
L Taraval
M Ocean View
K Ingleside
T Third St
J Church
Transfer Station (Fully Accessible)
Fully Accessible Stop
Stop
Subway Section
Surface Section
One-way Service
Map is simplified and not to scale.

San Jose, CA

System Overview

Operator:	Santa Clara Valley Transportation Authority	Stations:	70
		Route KM:	69.7km
Subsidiary:	VTA Light Rail	Daily Ridership:	30,900 (APTA, 2011)
Lines:	3	Year Opened:	1987

General Information

Santa Clara's VTA provides LRT service on three lines. The Green and Blue lines constitute the majority of the LRT network, running from downtown San Jose to outlying suburban areas. The Almaden Shuttle, or Orange Line, is a three-stop spur line. The line is single-tracked and runs single-car trains due to platform constraints. Ridership on the Orange line remains low.

Several new light rail corridors are currently under consideration, and voters approved funding for two new projects in 2000.

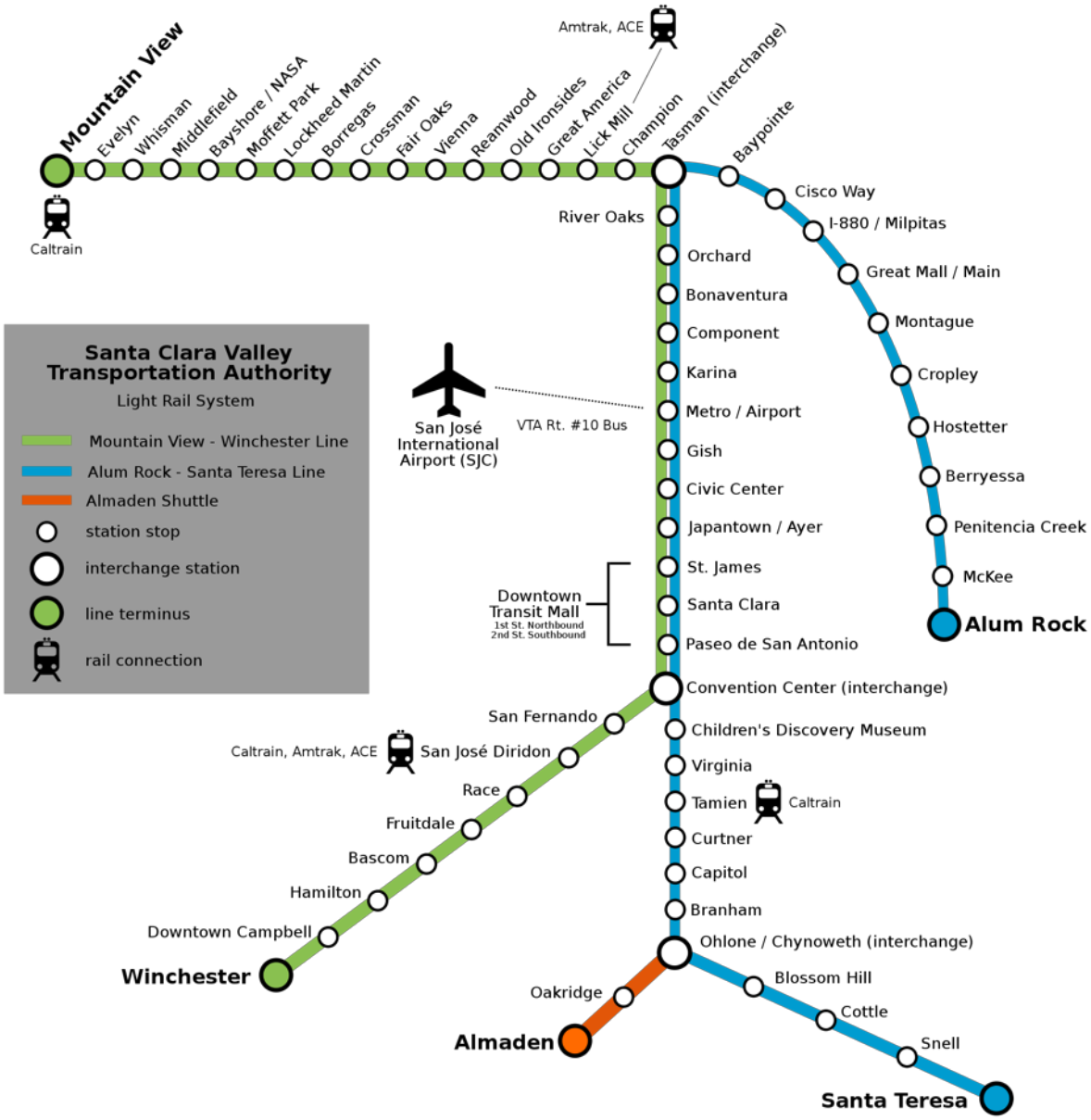
Transit-Oriented Development Experience

The City of San Jose has taken a leadership role in promoting TOD around VTA by revising its general plan to provide for high-density development around LRT stations. Efforts to promote TOD construction accelerated with the opening of the western portion of the green line in 1999, with the cities of Mountain View and Sunnyvale actively pursuing policies supportive of TOD.

As a result, San Jose features a large number of TODs next to its LRT lines and is among the highest in the United States in terms of residential units (Arrington, 2003). Park-and-ride lots have also been converted, such as a former 1,100 space lot now developed as 330 units of affordable housing, 4,400 square feet of retail, and a daycare centre in addition to 240 parking spaces (Arrington, 2003).

However, a more recent analysis by Brown and Thompson (2009) reports that ridership is low across the system owning to factors such as slow service in the downtown core, poor connecting bus services, access problems at many stations, and an alignment next to highway corridors in many places that precludes development.

System Map


Santa Clara Valley Transportation Authority
Light Rail System
Mountain View - Winchester Line
Alum Rock - Santa Teresa Line
Almaden Shuttle
station stop
interchange station
line terminus
rail connection
Mountain View
Evelyn
Whisman
Middlefield
Bayshore / NASA
Moffett Park
Lockheed Martin
Borregas
Crossman
Fair Oaks
Vienna
Reamwood
Old Ironsides
Great America
Lick Mill
Champion
Tasman (interchange)
Amtrak, ACE
Caltrain
Baypointe
Cisco Way
I-880 / Milpitas
Great Mall / Main
Montague
Cropley
Hostetter
Berryessa
Penitencia Creek
McKee
Alum Rock
River Oaks
Orchard
Bonaventura
Component
Karina
Metro / Airport
Gish
Civic Center
Japantown / Ayer
St. James
Santa Clara
Paseo de San Antonio
Downtown Transit Mall
1st St. Northbound
2nd St. Southbound
San José International Airport (SJC)
VTA Rt. #10 Bus
Convention Center (interchange)
San Fernando
Caltrain, Amtrak, ACE
San José Diridon
Race
Fruitdale
Bascom
Hamilton
Downtown Campbell
Winchester
Children's Discovery Museum
Virginia
Tamien
Caltrain
Curtner
Capitol
Branham
Ohlone / Chynoweth (interchange)
Oakridge
Almaden
Blossom Hill
Cottle
Snell
Santa Teresa

Seattle, WA

System Overview

Operator:	Sound Transit	Route KM:	25.1km
Subsidiary:	Link Light Rail (Central Link)	Daily Ridership:	24,200 (APTA, 2011)
Lines:	1	Year Opened:	2009
Stations:	13		

General Information

The Central Link is a recently opened light rail line connecting downtown Seattle to the Seattle-Tacoma International Airport. The Central Link marks the second LRT project undertaken by Sound Transit after the construction of the Tacoma Link. The Central Link also provides connections to Sounder Commuter Rail services to Tacoma and Everett.

The Central Link runs in an existing tunnel for a portion of its downtown route, and is unique in sharing the tunnel with hybrid diesel-electric buses operated by Sound Transit.

Ridership on the Central Link has been strong, rising from 12,000 boardings per weekday in 2009 to more than 24,000 reported in the most recent APTA Ridership Report (2011). Plans for the East Link LRT to downtown Redmond are currently underway with funding approved by voters in 2008. Construction is projected to begin in 2013-2014.

Transit-Oriented Development Experience

A TOD Guidelines document has been prepared by the Puget Sound Regional Council (1999) to guide local municipalities in preparing supportive station area secondary plans. However, the Central Link's effects on TOD remain understudied, most likely due to its opening in 2009 and the relative immaturity of the line's effects on neighbouring land use patterns.

System Map


Pacific Avenue Stn.
Westlake
University Street
Pioneer Square
International District/Chinatown
King Street
Stadium
SEATTLE
SODO
Beacon Hill
Mount Baker
Columbia City
Central Link
Sounder Commuter Rail
(Tacoma-Seattle)
Sounder Commuter Rail
(Everett-Seattle)
Othello
Rainer Beach
TUKWILA
Tukwila
International
Boulevard
SEATAC
SeaTac/Airport
Tacoma Dome Stn.

St. Louis, MO

System Overview

Operator:	Metro Transit	Route KM:	74km
Subsidiary:	MetroLink	Daily Ridership:	47,200 (APTA, 2011)
Lines:	2	Year Opened:	1993
Stations:	37		

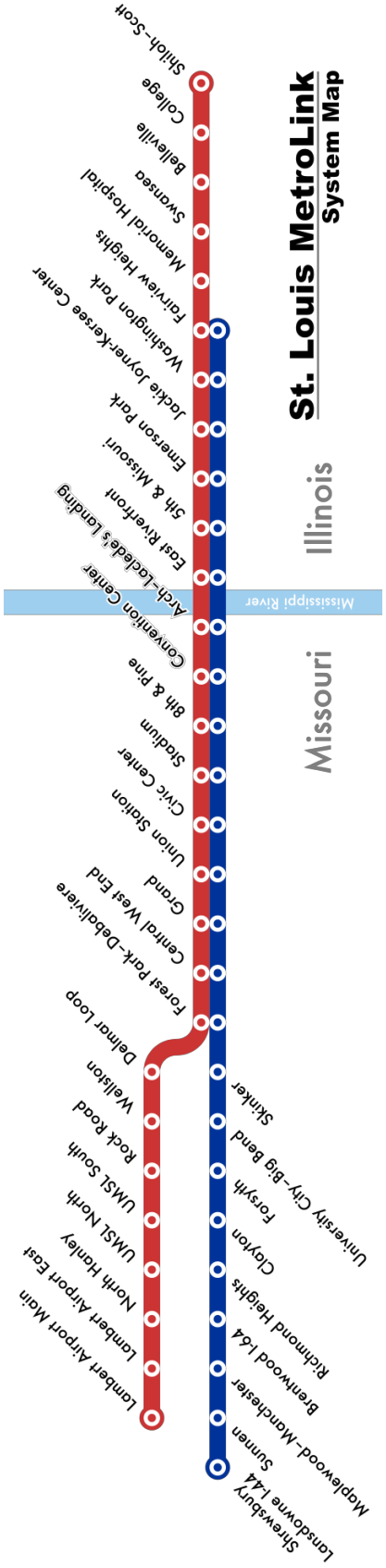
General Information

St. Louis' MetroLink consists of two LRT lines. The initial portion of the system opened in 1993 and has been expanded a number of times. The Blue Line is the most recent, opening in 2006. MetroLink has exceeded initial ridership estimates, but the system has been slow to expand due to a lack of funding at the local, state, and federal levels. However, at a system length of 74km, MetroLink's rate of ridership per kilometre is currently the lowest of all systems explored in this analysis. Both LRT lines use a shared alignment for fifteen stations along the route, and colour coding of the trains into the Red and Blue Lines was launched in 2008 to reduce confusion among passengers. A number of different corridors have been identified for potential LRT expansion as part of an overall regional planning analysis undertaken by the East-West Gateway Council of Governments in 1989.

Transit-Oriented Development Experience

Academic studies of MetroLink's impact on TOD are limited. However, the LRT advocacy group Citizens for Modern Transit (n.d.) reports that since its opening in 1993, there has been $4.3 billion in new development around the original line, leading to a revitalization of the metro area. In addition, a 77-acre, $500 million project in Maplewood is being planned with 600,000 square feet of office space, 340,000 square feet of retail, 1,300 housing units, a 160-room hotel. Despite a lack of information on TOD in St. Louis, research by Garrett (2004) has shown that LRT is being capitalized into residential housing values, where an average increase between 31-32% in price was seen for homes near MetroLink stations. However, the reliability of these sources is unclear and more research needs to be done regarding the impact of light rail in St. Louis.

System Map


St. Louis MetroLink
System Map
Illinois
Missouri
Mississippi River
Shiloh–Scott
College
Belleville
Swansea
Memorial Hospital
Fairview Heights
Washington Park
Jackie Joyner-Kersee Center
Emerson Park
5th & Missouri
East Riverfront
Lacledes Landing
Arch–Laclede's Landing
Convention Center
8th & Pine
Stadium
Civic Center
Union Station
Grand
Central West End
Forest Park–DeBaliviere
Delmar Loop
Wellston
Rock Road
UMSL South
UMSL North
North Hanley
Lambert Airport East
Lambert Airport Main
Shrewsbury
Lansdowne I-44
Sunnen
Maplewood–Manchester
Brentwood I-64
Richmond Heights
Clayton
Forsyth
University City–Big Bend
Skinker

Tacoma, WA

System Overview

Operator:	Sound Transit	Route KM:	2.6km
Subsidiary:	Link Light Rail (Tacoma Link)	Daily Ridership:	N/A
Lines:	1	Year Opened:	2003
Stations:	5		

General Information

The Tacoma Link is a small starter light rail line in Tacoma, Washington whose primary purpose is to transport commuters from a combined parking garage and transit hub to the downtown core. Currently this service is free to use.

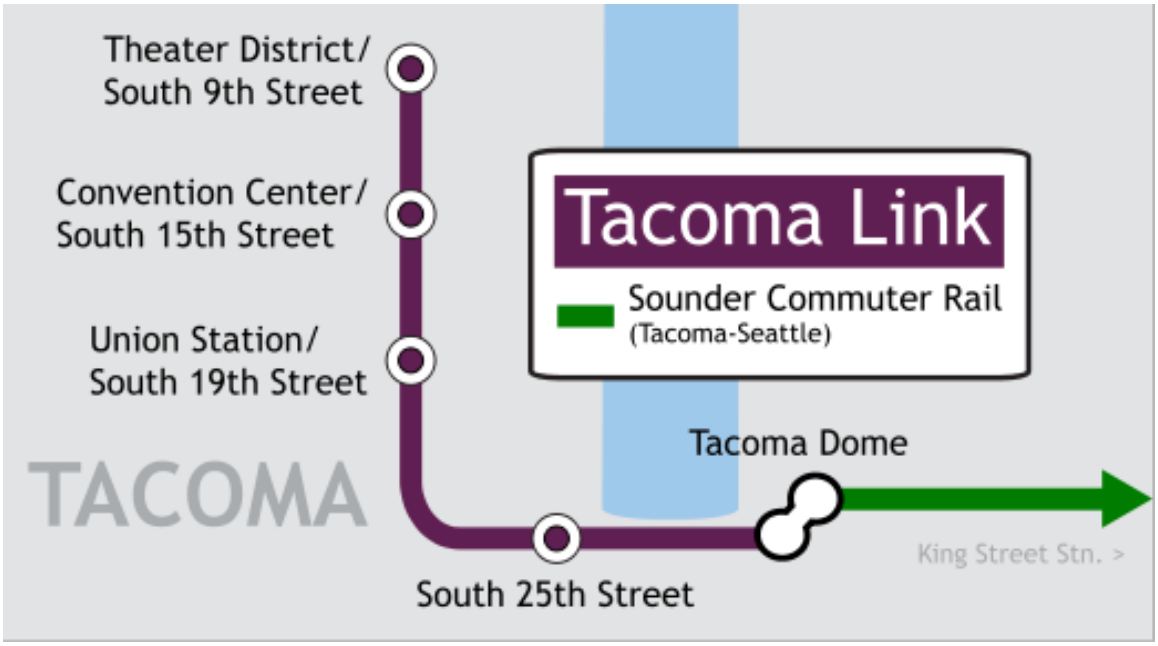
The Tacoma Link got its start in the 1990s as the Puget Sound region dealt with an employment boom driven largely by Microsoft. The Link LRT was approved as part of the regional Sound Move transportation package that became under the jurisdiction of Sound Transit.

The terminus station at Tacoma Dome provides a link to Seattle through the Sounder Commuter Rail service. Although small, the project has exceeded initial daily ridership projections of 2,000 by 2010, with more than 2,400 daily riders in the first year after opening. Several expansion plans are currently being studied (Light Rail Now, 2004). However, ridership trends are difficult to find as the Tacoma Link's ridership data is reported as part of Seattle's Sound Transit to the APTA.

Transit-Oriented Development Experience

Academic studies of the Tacoma Link's effect on promoting TOD appear limited. The LRT advocacy website Light Rail Now (2004) provides anecdotal evidence of developmental impacts gathered from local newspaper articles. Highlights include the ability of the Link LRT and regional commuter rail connections to substantially reinvigorate downtown Tacoma with new office and retail development. In general, the Link LRT and Sounder commuter rail projects have been seen as important catalysts for redevelopment and revitalization in downtown Tacoma (Light Rail Now, 2004). Beyond the downtown, the effects are likely limited by the Link's small track length.

System Map


Theater District/
South 9th Street
Convention Center/
South 15th Street
Union Station/
South 19th Street
TACOMA
Tacoma Link
Sounder Commuter Rail
(Tacoma-Seattle)
Tacoma Dome
King Street Stn. >
South 25th Street

Toronto, ON

System Overview

Operator:	Toronto Transit Commission	Route KM:	75km
Subsidiary:	TTC Streetcar	Daily Ridership:	285,600 (APTA, 2010)
Lines:	11	Year Opened:	1861 (1891 for electric service)
Stations:	100+ stops, 8 underground		

General Information

Toronto's streetcars carry substantially more weekday passengers than any other LRT or streetcar system in North America. However, Toronto's streetcars do not generally meet the criteria to be considered a light rail transit system. The majority of the TTC's streetcar routes operate in the traditional style of mixed traffic operation with on-demand stops and frequent stop spacing. While some routes operate within a reserved right of way, they still offer frequent and on-demand stops. Although the TTC's streetcar network does maintain a number of underground stations, these generally serve as singular stops to connect to Toronto's heavy rail subway system. Plans exist to replace the existing streetcar fleet with light rail vehicles and construction is beginning for a new underground light rail line along Eglinton Avenue.

Transit-Oriented Development Experience

The effect of the TTC's streetcars on transit-oriented development remains unclear. Though Toronto has witnessed a flurry of new development in recent years, the interaction between new density and transit remains understudied in the literature. Of the information that is available, Filion, McSpurren, and Appleby (2006) report a large disconnect between new development and local amenities that have led to low rates of transit ridership and walking. However, due to Toronto's density and traditional grid street pattern, much of this development maintains some degree of transit orientation.

System Map


Toronto Streetcars
route
number (at termini)
loop
station
transfer
VIA Rail
GO Train
Yonge-University-Spadina
Bloor-Danforth
Main Street
Broadview
St. Clair
Bloor-Yonge
College
Dundas
Queen
King
Union
St. George
Spadina
Bathurst
St. Clair West
Dundas West
Queen's Park
St. Patrick
Osgoode
St. Andrew
Broadview Av.
Gerrard St. E.
Queen St. E.
Dundas St. E.
King St. E.
Wellington St. W./E.
Carlton St.
Spadina Av.
Queen's Quay W.
Fleet St.
Bathurst St.
College St.
Dundas St. W.
Queen St. W.
King St. W.
Ronceswalles Av.
The Queensway
Shore Blvd. W
Lake
St. Clair Av. W.
Lake Ontario
501
502
503
504
505
506
508
509
510
511
512

Appendix B Policy Tools in Support of Rapid Transit

Policy Tool	Description	Research Outcomes	Examples
1. Public Transit Encouragements			
Improved Transit Service	Faster, efficient, and more punctual and comfortable service.	Cervero (1990) notes that transit riders are twice as sensitive to changes in travel time as they are to changes in fares and fare structures, suggesting an opportunity to operate more 'premium' transit services.	
Improved Stops and Stations	Provision of more shelters with amenities such as heating and cooling, seating, transit user information and wayfinding guidance, washrooms and refreshments, other convenience and comfort features.	Research by Litman (2008) suggests that improved transit stops and stations can increase ridership by discretionary riders by making travel less stressful and more enjoyable.	
Reduced Fares	Travel discounts that are general or targeted to specific groups, such as lower rates for off-peak travel.	Research by Cervero (1990) suggests transit users are captive and insensitive to changes in fares and fare structures, though this varies by group.	
Convenient Fare Structure and Payment System	Can include zonal or distance-based fare structures that promote equity and payment using electronic devices or smart cards.		
Free Fares or Fare-Free Zone	Providing free fares can attract more by-choice riders. This can occur through either a free 'trial' period for new transit riders or the creation of a fare-free zone along a segment of the rapid transit corridor.	Can promote more transit usage from by-choice riders who might have otherwise not taken transit and can benefit businesses operating in the fare-free zone. Presents serious feasibility challenges for transit agencies.	Calgary, AB – Fare free zone Buffalo, NY – Fare free zone Pittsburgh, PA – Fare free zone Salt Lake City, UT – free day passes to first-time riders.
Park and Ride Facilities	Provide or require the provision of facilities for parking automobiles as well as bicycles for transit riders. Stands to promote ridership by making the transition between transit and other modes easier and more convenient.		Calgary, AB (Extensive park-and-ride facilities) San Diego, CA (Requires bicycle parking for developments near transit stations)

Promote Transit-Oriented Development	Ensuring a built environment that is conducive to transit usage is a fundamental element in encouraging ridership.	While related to demand management policies, transit-oriented development is covered extensively in Appendix C.	
2. Commuter Financial Incentives			
Removal of Free Parking	Research by Bianco (2000) suggests that the price of parking is a primary factor in affecting the mode choice of commuters. In response, some cities have replaced free parking with the installation of parking meters on streets within the transit corridor or target district.	Together with a discounted transit pass program, the installation of meters in Portland, OR's Lloyd District has resulted in a decrease of single-occupancy vehicle usage of 7 per cent (Bianco, 2000).	Portland, OR
Discounted Transit Passes	Free or discounted transit fares or passes provided by companies to employees.		
Employee Parking Pricing	Companies charge for parking at their parking lots or eliminate existing subsidies for off-site employee parking. Can involve a number of methods such as parking passes, meters, or a parking attendant.	Willson and Shoup (1990) found that between 19 to 81 per cent fewer employees drove to work alone when they paid for their own parking in Los Angeles, CA.	Los Angeles, CA Ottawa, ON
Parking Cash Out	Commuters who are offered subsidized parking are also offered the cash equivalent if they use alternative travel modes.	A study of cash out programs in California revealed a 64 per cent increase in carpoolers and a 50 per cent increase in transit riders in eight case studies in Los Angeles, CA (Shoup, 1997).	Los Angeles, CA
Travel Allowances	Similar to parking cash out, travel allowances are paid to employees instead of parking subsidies. This money can then be used for travel, such as a parking spot or transit pass.		
Discounted Transit Passes	Free or discounted transit fares or passes provided to employees.		

3. Road Pricing			
Road Tolls	Variable road tolls intended to reduce peak-period traffic volumes to optimal levels. Designed to change consumption patterns of transportation demand and can promote a higher transit mode share.		
Cordon Tolls	Fees paid by motorists to drive in a particular area, typically a central city. Can lead to a higher transit mode share for trips to this area.		
4. Road Traffic Calming			
Speed Reductions and Two-Way Streets	Drivers maintain a speed that is partly based on comfort. This can be influenced by a number of design factors, such as lane width, visibility, and clearance, and use factors such as traffic volumes and pedestrian activity. Outside of reducing speed limits, a number of roadway design methods can be utilized to reduce road speeds such as narrower lanes, traffic signal synchronization for lower speeds, and the conversion of one-way streets to two-way traffic.	Can reduce traffic accident risk and result in an improved environment for transit users, pedestrians, and cyclists.	

Source: Willson & Shoup, 1990; Shoup, 1997; Meyer, 1999; Bianco, 2000; Litman, 2011

Appendix C Policy Tools for Transit-Oriented Development

1. Strategic Planning Tools

TOD Policy Tool	Description and Purpose	Value and Applicability	Examples
Regional and Local TOD Strategic Plan	Gives the city, transit operator, and governments an opportunity to consider and define all of the stations in the transit network and to evaluate what each will contribute in terms of ridership and the potential for future TOD.	City of Hamilton is currently engaged in a comprehensive land use planning exercise for its identified rapid transit nodes and corridors.	

2. Land Use Policy Tools

TOD Policy Tool	Description and Purpose	Value and Applicability	Examples
Prepare Station Area Plans and Market Studies	Station area plans establish an overall vision for the entire transit district, indicating the type of desired development, appropriate mix of land uses, and likely public amenities that will be provided by both the public and private sectors. Station area planning must take into consideration the function of the station and surrounding areas as part of the regional transit network.	Resulting vision allows property owners and developers to understand what uses and building types may be allowable for their properties and provides certainty about what kinds of development will occur in the area. This type of certainty allows developers to build towards a collective vision. Conducting such a planning exercise in conjunction with real estate market analysis grounds the vision in reality and allows implementation to build off of existing or emerging market momentum.	Phoenix, Mesa, and Tempe, AZ Portland, OR Bay Area (BART), CA City of Denver and Denver Region, CO Los Angeles, CA San Jose, CA
Station Area Rezoning A: Rezone Station Areas	Create new zoning in the station areas that restricts some uses and allows new ones that prioritize activities that generate ridership. This may be done through the creation of new zoning designations or application of existing zoning designations that meet the goals for TOD	Requires a clear rationale for excluding uses. Criteria must be based on transit ridership potential and level of vehicle traffic generated in critical pedestrian zones around a station.	Denver, CO Salt Lake City, UT Minneapolis, MN Jersey City, NJ

Station Area Rezoning B: Use Restrictions Based on Public Health and Safety and Transportation Impacts	Zoning restrictions can be designed to discourage uses or features that generate harmful impacts and/or uses that generate high levels of automobile or truck traffic which would discourage walking and transit ridership and create hazards in a station area given the high levels of pedestrian activity that transit generates.	Requires a clear justification for what uses are allowed in a particular zoning district based on public health, safety, and transportation impacts.	
Station Area Rezoning C: Overlay Zoning	Overlay zones create a separate set of requirements that amend existing zoning in specific areas. Some uses are restricted to prioritize activities that generate significant ridership, while others that support ridership are encouraged. Overlay zoning can be applied to parcels in an area when the overlay is adopted, but in this case, the overlay could be defined as optional zoning. Property owners could elect to use the overlay when they seek to develop or revitalize their properties.	The city should take care to make the uses and requirements of the overlay zoning as attractive as possible while achieving the goals of TOD. However, opt-in overlay zoning decreases the certainty that new development will be compatible with surrounding development and achieve the vision for the station area. The tool will also be affected by market demand for the types, intensities, and amount of land uses described in the overlay zoning.	City of Austin, TX (voluntary) Charlotte, NC South Salt Lake City, UT (voluntary, incentivized) Cleveland, OH Phoenix, AZ Tempe, AZ
Land Use Intensity Tools A: Density Bonuses	Density bonuses can promote mixed-use and compact development while creating the land use intensity that can efficiently support public services and transit usage. Density bonuses grant developers the opportunity to increase the number of units in a development beyond that which is typically allowed by zoning in exchange for providing a public amenity from which the community can benefit. Density bonuses are established to relieve developers the cost burden of an inclusionary housing ordinance that mandates affordable unit set-asides.	Should be coordinated with affordable housing goals. Land cost, property values, and rents determine the true value of increased density. For example, if a project's economic fundamentals justify the higher construction cost per square foot that comes with moving from a wood frame structure with surface parking to a concrete structure with underground parking, then a density bonus permitting additional units would be highly valuable.	San Diego, CA Charlotte, NC Denver, CO Los Angeles, CA Portland, OR
Land Use Intensity Tools B: FARs and Building Height Bonuses	Increased floor area ratios (FARs) and building heights allow more activity to be provided on a given parcel, which is consistent with the goals of TOD. If the uses are marketable and the buildings and parking are affordable, increases in FAR and building	Building heights need to be calibrated according to allowable densities and zoning. May require infrastructure upgrades to support increased density.	Calgary, AB Edmonton, AB In Seattle, green building density bonus

	heights will create more land and development value. Similar to residential density bonuses, commercial intensity bonuses are often linked to the provision of public amenities, such as open space, access improvements, or community or cultural facilities.	FARs and building heights should be acceptable to surrounding neighbourhoods and achievable in the foreseeable future so that they do not encourage unreasonable land value expectations. Value is limited by market demand for density and intensity level afforded by more intensive use of land area.	for LEED Silver or higher and other public amenities
Land Use Standards Enhancement A: Form-Based Codes	A form-based code is a method of regulating development to achieve a specific urban form. Form-based codes create a predictable public realm by controlling physical form primarily, with a lesser focus on land use. Form-based codes address the relationship between building façades and the public realm, the form and mass of buildings in relation to one another, the location and design of parking, and other building form and site planning issues. They may also address the scale and types of streets and blocks. The regulations and standards in form- based codes, presented in both diagrams and words, are keyed to a regulating plan (i.e., a zoning map) that designates the appropriate form, character and scale of development, rather than only the type of land use.	Requires the ability to integrate form-based code into existing regulatory frameworks or overlays. City officials and staff, property owners, and developers would have to accept and understand the focus on built form as opposed to land use and its value to achieving effective TOD. The extent to which form-based codes reduce the need for design review and approvals by the City will be key to its success as an incentive for TOD. Form-based codes need to make the approvals process more straightforward and result in high-quality and marketable TOD.	Leander, TX, one terminus of Austin's MetroRail, has a Smart Code that includes elements of a form-based code. The East Colfax Area Plan in Denver, CO takes a more standard area planning approach, but the plan has resulted in the creation of two 'Main Street' zoning districts that use a form-based code.
Land Use Standards Enhancement B: Design Guidelines	Station area design guidelines can help ensure that new development or redevelopment of existing sites and buildings is pedestrian friendly, attractive, and connects the neighborhood to the transit station. TOD design guidelines often address the design of parking (including landscaping and other buffers around lots), pedestrian furniture, signage, ground-level building façade design and materials, and	If the design guidelines are optional, they may not have much weight or effectiveness, except to the degree that their use can expedite planning approvals of projects by giving more discretionary review responsibilities to staff and minimizing the need to take projects through design review and planning commission review. Applying design guidelines in many cases results in the streamlining	Massachusetts Smart Growth/Smart Energy Toolkit Design Guidelines Bay Area Rapid Transit Station Area Plans (CA) (San Leandro, South Hayward, Glen Park,

	respect for neighborhood spaces. TOD projects could also incorporate low- impact development techniques, such as multi-level or covered parking structures with green roofs and other water harvesting and stormwater management best practices. Similar to station area plans, design guidelines make the city's expectations for the quality of development clear to residents and others, as well as help assure developers that they are investing in an area that will have consistently high- quality development.	of the development review process. The City of Hamilton has completed TOD design guidelines and is actively using them to inform the Draft City-Wide Corridor Planning Principles and Design Guidelines.	San Francisco) City of Denver, CO: Station Typologies, Station Area Plans Seattle TOD Design Guidelines, Seattle, WA
Parking Tools A: Revised Parking Standards	Parking standards could be revised to: 1) allow developers to provide fewer spaces for uses in station areas; 2) create standards for shared parking among separate uses; 3) allow on-street parking to count toward required spaces; and 4) limit the total number of parking spaces required to increase the feasibility of mixed-income housing and mixed-use development by lowering project costs.	Revising parking standards would require a parking strategy that sets parking in an amount and configuration appropriate to demand given the high level of transit access. Appropriate parking levels can encourage transit use, walking, and bicycling. The city would determine the appropriate amount of parking given levels of transit use and access and whether each station area is a local or a regional draw. The type of parking shapes the fundamental value of the incentive – it is more valuable with structured parking than with surface parking. Parking strategies are more effective as part of an integrated set of strategies (e.g., reduced impact fees and street improvements to facilitate walking and transit access, density and FAR bonuses).	Phoenix, AZ Portland, OR Bay Area, CA San Diego, CA Charlotte, NC Denver, CO Jersey City, NJ
Parking Tools B: Shared Parking	The parking that is needed for a specific land use varies by time of day and day of the week. Shared parking aims to reduce total parking demand and the incremental cost of providing parking, rather than reducing the amount of parking required for	Established system for property owners and businesses to support shared parking. Development regulations would need to allow shared parking. Value depends on prevalence of existing surface parking lots, where shared parking is not encouraged	Mesa, AZ

	individual uses. This is done by providing parking that is accessible to a mix of uses (e.g., businesses, institutional or civic uses, residences) and that satisfies the varying needs of the uses at different times. The maximum amount of parking provided is determined by the time of day and day of the week where the combined parking demand of all the uses is highest.	or allowed.	
Parking Tools C: Parking Districts	Parking could be provided in a shared parking lot or structure to provide all or part of the parking needed for the uses in a district. Businesses and, sometimes, residents in the district typically pay for at least a portion of the maintenance and operating costs of the parking and possibly for its construction. Managers of the parking district calculate the appropriate distribution of shared parking for the existing conditions.	Identify parcels that could benefit from having all or some of their parking removed from their property and where opportunities exist for a large parking structure, such as a major shopping center, a station park-and-ride facility, or other publicly owned land. The uses should be compatible with parking that is somewhat removed from the use; for example, most residents will want to have parking near their homes. Limited by the higher costs of structured parking and areas with relatively small parcels where a parking structure is challenging to build.	Redwood, CA, (bus transit) has instituted extensive parking management and parking pricing strategies.

3. Development Assistance Tools

TOD Policy Tool	Description and Purpose	Value and Applicability	Examples
Fast Track Development Review	Creating streamlined development review and building permitting processes, administered by city staff, for projects meeting specific criteria can reduce project financing costs for developers and make TOD more financially attractive.	Applicability depends on the willingness of the local jurisdiction to create a streamlined process or, in some cases, a "green tape" program for TOD. This might be met with protest from non-TOD projects. If the criteria to qualify for expedited review are too loose, it may be difficult to maintain a transparent review process that is true to the intent of the development standards or other criteria. Could be linked to zoning overlay, with only those projects that opt for the overlay receiving the expedited review.	Austin, TX BART Hayward Station, CA
Capital Funding for Infrastructure	There is no single source of funds designed to facilitate transit-oriented development at station areas. The sources of capital funding are the same as those used for regular municipal infrastructure development. The funding challenge is to use these resources to maximize the potential development opportunities in a station area.	Several funding sources are needed as part of a comprehensive, targeted funding strategy. A targeted funding strategy will allow jurisdictions to link funding for infrastructure with the likely beneficiaries of the proposed improvement. This allows jurisdictions to extend their limited resources and lets them benefit from the increased value created by the public investment. The key condition for infrastructure funding is the availability of various funds that can be used. Depending on political will and community support, available incentives may positively impact the value of tools.	MoveOntario 2020, Ontario, Canada New Starts Communities, United States Charlotte, NC
Tax-Increment Financing	Tax increment financing (TIF) is commonly used by cities to pay for infrastructure or other improvements to spur new development and reinvestment in areas that need revitalization, but where market forces are weak. The amount of tax revenue flowing to all of the taxing entities is fixed at	Relies on an increase in tax valuation inside identified TIF zone. Any increase is used to pay off debts issued to the project. TIF's are much more prevalent in the United States than in Canada. However, the Province of Ontario	Dallas, TX Minneapolis, MN Toronto, ON

	a base year level. The increment -- any increase in actual tax revenues above the base year -- is redirected to the TIF district.	has recently introduced a TIF pilot program for the Toronto-York Spadina Subway Extension project.	
Reduced Impact Fees in Station Areas	Waiving or reducing impact fees for development in transit station areas can be a significant incentive, particularly for projects that provide more affordable housing options. Fees are usually reduced or eliminated when an application is made illustrating the number of affordable units that will be built.	A clear fee schedule that includes reduced fees in station areas. Fiscal analysis justifying fee reductions may also be required. Value is tied directly to the level of impact fees assessed and the extent to which they are waived or reduced.	Montgomery County, MD, Maryland Affordable Housing Taskforce

4. Place Making and Access Tools

TOD Policy Tool	Description and Purpose	Value and Applicability	Examples
Streetscape and Pedestrian/Bicycle Improvements	The public realm of the streets and other civic spaces in a station area are the glue that holds a TOD together and creates places where walking is comfortable and enjoyable. One method for encouraging private investment in a station area is by making enhancements to local streets. This could include aesthetic and transportation improvements to existing streets and the creation of new bicycle and pedestrian connections.	Limited by the availability of capital funding to design and construct improvements. To be most effective, streetscape and pedestrian/bicycle improvements should be complemented by development that provides the desired mix and intensity of uses, creating a supportive relationship between the buildings and the street.	Denver Avenue, Portland, OR Alameda County, CA, investments in streetscape improvements around BART stations. Charlotte, NC San Francisco, CA
Façade and Site Frontage Improvement Program	Provide low- or no- interest loans or grants to revitalize existing building façades and lot frontages to make streets in the station area more appealing to pedestrians. A condition of the loan program would be acceptance and compliance with design standards and guidelines for the façade or frontage improvements.	Applicability limited in some station areas that may have more of a focus on revitalization of existing buildings and sites to support more pedestrian activity. The desired improvements need to be affordable and show a return on investment for owners to be willing to take out a loan to make improvements. Most applicable in areas with a traditional	Oakland, CA, Fruitvale Development Corporation has used a façade improvement program and building renovation program to support revitalization for more than 100 properties along the

		neighborhood business district, not a strip mall or other retail center oriented around a parking lot.	International Boulevard BART station area.
Tax-Exempt Bonds	Tax-exempt bonds are issued by a public entity whose interest payments are not subject to or local taxes. This tool is typically paired with Low Income Housing Tax Credits to build affordable housing units. Timeframes for affordability are established through local preferences. Tax-exempt bonds can also be a tool for commercial development.	The funding for bonds must be available, based on available capital from investors. For general issue bonds, the public needs to have sufficient interest and cash available to purchase bonds. Market variations will determine the success of tax-exempt bonds; furthermore constraints exist at the municipal level due to meeting affordable housing requirements.	The state of California has used tax-exempt bonds to fund transit projects including Ohlone-Chynoweth in San Jose. Many development projects require at least types of funding.
Tax Abatement	Tax abatement for TOD has been established to support high-density housing and mixed-use developments affordable to a broad range of the public on vacant or underused sites. The exemptions support TOD projects by reducing operating costs through a ten- year maximum property tax exemption.	Tax abatement programs are typically established for targeted areas of the community. Conditions typically specify the project size, scope and density. The categorization of public benefits by city officials will determine affected impacts upon tool value.	Portland, OR has used tax abatement for encouraging multi-family housing in proximity to transit.

5. Land Assembly Tools

TOD Policy Tool	Description and Purpose	Value and Applicability	Examples
Joint Development Program	Joint development programs formalize public- and private- sector cooperation in planning, design, and construction for a development project that will occur on transit agency-owned land, but will be developed by a private-sector partner. These projects could include sale of air rights above a transit facility, a long-term lease, or a land sale. In some cases, the transit agency will receive full	Requires comprehensive knowledge of market conditions and pro forma analysis for specific stations. Concern related to getting the project to make a profit, or at the minimum, cover its costs. A clear joint development policy should consider the benefits of both ridership and revenue for the transit agency and a process for developer selection	Portland, OR San Francisco, CA Denver, CO Boston, MA Los Angeles, CA

	market value for the transaction, but in others, the transit agency may be required to write down the value of its interest to promote TOD.	managed by staff with real estate development experience and with the help of consultants as needed. However, the balance of risk- reward for joint-development is born by the public and private sector, which can be unpredictable. Joint development programs can be important in spurring additional station area development if it is used as a catalyst for early development projects that set an example and can shift the local market conditions.	
Land Acquisition Loan Funds	Cities assemble various loan funds around the country to assist developers in acquiring land for affordable housing. These funds have not necessarily been targeted to TODs, but many nonprofits are now considering focusing more directly on TOD. These funds are generally for affordable housing projects only, and the loans have been relatively short term, allowing the developer to acquire land before lining up all of its funding sources for the project. Capitalization for these loan funds have come from a combination of sources, including foundations, banks, and various governmental sources.	The value of land acquisition loan funds depends on a number of factors: 1) A viable source of funding and a mechanism to pay back funds if appropriate, 2) A system for prioritizing parcels to be assembled, if coordinated from a municipal source, 3) Incentive programs for land assembly are encouraged if assembly is outside a public-private partnership, 4) A system for prioritizing parcels to be acquired, 5) Available funds for land assembly, and 6) The willingness of property owners to work in a public-private partnership.	Portland, OR Minneapolis, MN Los Angeles, CA Charlotte, NC
Funds for Buying Available Parcels on the Open Market	Unlike the loan fund described in LA-2, these funds can be used to assemble land and create catalyst TOD projects in locations where the market is not yet viable for higher density housing projects. They can also be used to secure land that will be appropriate for TOD in the future, but where current market pressures are likely to result in near-term development that is not transit supportive.	Source of capital that can be used for land banking rather than specific projects. An entity, such as a city or non-profit organization needs to have the capacity to acquire and hold the land until it is suitable for development. Requires parcels that are vacant/underused and of sufficient size to be able to support a critical mass of development.	Minnesota Transit Improvement Area Accounts, Minneapolis, MN

6. Programmatic and Institutional Tools

TOD Policy Tool	Description and Purpose	Value and Applicability	Examples
Business District Association or Business Improvement District	Business or community improvement districts are special purpose districts where property owners and/or businesses within a defined area vote to tax themselves and use the tax revenues, or assessments, to pay for local improvements and/or services. Some districts have the power to bond against their levy and can therefore fund capital improvements. Other districts are more oriented towards services, such as street cleaning, public safety, marketing, and promotional events.	Willingness of businesses and/or property owners to participate. While most of these districts have traditionally included business and commercial property owners only, cities like San Francisco and Denver are considering including a wider range of owners, including institutions like churches and residential property owners. These districts work best in an existing commercial node that has been experiencing declining sales, disinvestment, or other competitive challenges.	Business Improvement Associations, Seattle, WA San Francisco, CA San Diego, CA
Marketing and Outreach Strategies	Many communities use a variety of techniques to "market" their TOD sites to potential developers, as well as to educate elected officials and citizens about the benefits of TOD. These activities range from publicizing TOD sites through brochures and websites, to educational lectures, tours, and other events.	Requires a lead agency with a budget for materials and events. In communities unfamiliar with TOD, these combined activities can have a significant impact on interest in and acceptance of TOD.	City of Denver TOD Strategic Plan, Denver, CO
Livable Communities Program	Regional planning agencies can use a portion of their discretionary transportation funds to support projects that would otherwise not be funded, but that demonstrate desirable public benefits typically related to transportation and land use, such as community planning, improving transit access for minority and low-income residents, and leveraging the funds of other public and private-sector actors.	Policies need to be established to connect the provision of affordable housing with eligibility for transportation improvement funds. Need to develop program goals and evaluation criteria that assess how projects address those goals.	Metropolitan Council, Minneapolis/St. Paul, MN, Livable Communities Act of 1995 METRO TOD Development and Centers Program, Portland, OR

Community Development Corporation (CDC) Lead Efforts	Community Development Corporations (CDCs) are non-profit entities with the broad mission of community revitalization. These organizations typically have a geographic focus and undertake a range of activities to improve both physical and social conditions in their target area. CDCs have taken the lead in developing TOD projects in many cities around the country and have been successful largely because they have access to other funding sources than for-profit developers and can take on more challenging projects.	In station areas that are suffering from disinvestment and/or have a significant low- income population, CDCs can have a major impact by developing TOD projects that could not be produced by for- profit developers. Requires a CDC willing to become actively engaged in funding projects around transit. While popular in many cities in the United States, CDCs are not well known in Canada. Only a few examples exist, none of which are oriented to transit projects.	Seward ReDesign, Minneapolis, MN Fairmont Line, Boston, MA
Housing Trust Funds	Housing trust funds are a dedicated source of funding for affordable housing. These funds are typically established by a governmental agency and have some permanent source of revenue. Revenues can come from some form of tax or from an impact or linkage fee. Contributions from foundations and other donors can also be used for housing trust funds. However, these funds are publically administered and are not typically dependent on philanthropy for support.	Applicability rests in a dedicated revenue source and an explicit goal to fund affordable housing near transit. Many housing trust funds are not necessarily directed towards transit-oriented locations, even though these offer the best long-term value for low- to moderate-income households. The fund's size is the biggest determinate of its impact. The more funding available, the more significant the impact.	Berkeley, CA, Housing Trust Fund Toronto, ON, Social Housing Reserve Fund Vancouver, BC, Affordable Housing Fund

Source: Based on framework of EPA (2009) complimented by information contained within this report

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