

**The Potential for Bus Rapid Transit to Promote Transit Oriented Development:
An Analysis of BRTOD in Ottawa, Brisbane, and Pittsburgh**

By

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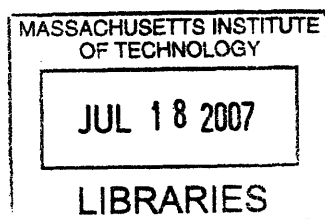
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Abstract

This thesis explores the conditions under which bus rapid transit (BRT) can promote transit oriented development (TOD). At a time when cities throughout the U.S. are searching for methods to reduce road congestion and limit greenhouse gas emissions, it is critical that city leaders have access to research that can best direct their decisions.

Most literature recognizes that, without government intervention, TOD is unlikely at rail stations. The question of whether BRT can promote TOD, however, has not previously been explored. Ottawa, Brisbane, and Pittsburgh serve as case study examples of cities with BRTOD.

Analysis of these three cities demonstrates a range of conditions under which BRTOD has occurred. Ottawa has concentrated development at many stations, but it is only where a special effort was made to consider pedestrian conditions and a mix of uses that TOD emerged. Brisbane's BRTOD is the result of careful government efforts to locate BRT stations near existing and planned development that could easily conform to the TOD pattern. Pittsburgh's two BRTOD projects are the result of a community based initiative to shape a neighborhood's new growth. The experiences of all three cities can be used to guide future transit and land use planning in U.S. cities.

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CHAPTER 1: Introduction

Cities across the country are recognizing the limitations of the automobile in serving resident mobility needs. Most cities have not been able to maintain a level of road construction consistent with increases in resident's travel demands. Simultaneously, nations throughout the world are recognizing the earth's resource limits. The expense of fossil fuels, upon which we depend for gasoline and many other products, are escalating and becoming increasingly more difficult and costly to acquire. Carbon dioxide, a combustion engine by-product, is contributing to global warming, resulting in potentially disastrous climate changes.

These are just a few of the reasons why many U.S. cities, particularly those most auto dependent, are considering implementation of rapid transit systems. Rail is currently the most common mode of U.S. mass transit, but increasingly cities are considering the merits of Bus Rapid Transit (BRT). BRT functions much like rail in that it runs within its own right-of-way, separate from automobiles, and is frequently grade separated as to avoid intersection conflicts. The most significant difference between BRT and rail transit is that the buses have the flexibility of exiting the busway and running on city streets with mixed traffic. BRT construction and maintenance costs are extremely variable depending on the city's implementation method and busway amenities. In this way, the costs cannot be directly compared with that of rail without knowledge of system specifics. Regardless, many cities consider the BRT option because they know examples of places where BRT has been implemented at a fraction of the cost of rail.

The debate over whether rapid transit can, in its own right, spur compact, walkable, mixed-use development (TOD) at its stations is ongoing, but most literature supports the idea that TOD is unlikely next to rail stations without government intervention. These ideas are based on U.S. wide experience with rail transit.

The question of whether BRT can promote TOD, on the other hand, is yet to be answered. Most U.S. BRT systems are very young (less than five years), so there has been limited time in which to see a land use impact. Pittsburgh, PA is the notable exception with a BRT system that dates to 1977. There are also long-standing BRT examples throughout the world.

This study begins to answer the question of whether BRT can promote TOD and, more specifically, under what conditions this might happen. The second chapter provides an overview

of the study's methodology. The third chapter reviews existing literature on the topics of BRT and TOD. Chapters four through six are case studies of three cities that have had BRT for a minimum of seven years: Ottawa (Canada), Brisbane (Australia), and Pittsburgh (USA). The case studies provide an overview of the cities themselves and the BRT systems in place. They also include an initial analysis of whether TOD exists on the BRT lines and the potential role that city policy and financial investments made in promoting or not promoting TOD. Chapter seven then compares the experiences of the three cities.

Finally, the concluding chapter makes recommendations for initiatives U.S. cities could undertake to encourage the TOD pattern on future BRT corridors. More specifically the section discusses reasons why BRT could be a strong mass transit mode for promoting TOD in U.S. cities with low-density, auto dependent development patterns and very high growth rates.

CHAPTER 2: Methodology

There is limited published research on the land use impacts of BRT, particularly in regard to Bus Rapid Transit Oriented Development (BRTOD). Much of the research that has been done focuses on the well established Latin American systems. The economic and social conditions in Latin American cities, however, are often distinctly different from those in the U.S. Since my ultimate goal is to make recommendations for implementing BRT in low-density U.S. cities, I selected a research method that allowed me to directly collect BRT land use information on cities most similar to those in the U.S. The case study method, therefore, was most appropriate for answering my research question.

Case Study Selection

In addition to selecting cities with economic and social structures similar to those in the U.S., I also selected cities in which the BRT had functioned for a minimum of seven years. In this way, the BRT would likely have been in place long enough to evidence at least some land use impacts. Additionally, if city conditions or policies changed over the time period, there was enough time to view any impact from the change in circumstances. The cities of Ottawa, Brisbane, and Pittsburgh best fit the qualities described here.

Analysis Method

For each case study city I needed to determine whether there is TOD at any of the BRT stations. I also needed to identify the policies and other conditions that influenced the location of the development at the stations and its conformation to a TOD urban design pattern. The methods I used to make this determination were: literature from academic and professional studies, city government planning reports and ordinances, personal interviews, a site visit in Ottawa, Google Earth aerial photo analysis, ground level station area photographs, and development site plans.

I began with a careful review of existing literature on each city's BRT system, regardless of whether it addressed the issue of TOD. Ottawa and Pittsburgh both established their BRT systems and designed associated policies with primary objectives other than station design and

development. For these cities the BRT was intended as a competitive alternative to the automobile and a method for limiting future increases in road use. Existing BRT literature for these cities gave me a better understanding of the city conditions and transit needs both at implementation and today.

Interviews were a key component of data collection. I interviewed city planners, developers, elected officials, and community advocates. I also visited the City of Ottawa for seven days in January 2007. This visit was particularly valuable as it allowed me to hold in-person interviews, ride the BRT system, and walk the station areas. The visit also gave me easier access to the government documents that are not easily accessible outside Canada. I took many photographs documenting station area conditions.

The site visit to Ottawa provided critical information for evaluating the existence of TOD at the stations. The site visit combined with use of Google Earth aerial photography gave me the best understanding of station area development patterns, existence of pedestrian amenities, and the ways in which residents use the spaces around the stations. For Brisbane and Pittsburgh I relied on aerial photography, interviews, and photographs available on-line or from my interviewees to understand the physical station area conditions. From these sources I was able to determine development pattern within ¼ mile compared with that beyond ¼ mile, walkability of development within ¼ mile, and some land uses. I gathered further information on land uses from interviews and on-line GIS resources. In order to understand the policies and economic conditions in each city, I relied on interviews, zoning/ planning ordinances, master planning documents, and published research.

Data Collection Efforts

I originally intended to analyze the existence of TOD using detailed land use data analysis. I contacted multiple agencies and organizations in the three case study cities and combed through the available census data for the three countries. Unfortunately I was unable to collect the appropriate information.

The most difficult data to collect was that of square footage for the buildings in the city. Ideally I would have compared the square footage of development, by sector, within ¼ mile of the stations with that beyond ¼ mile. In this way I could compare development density and mix

of uses in the two areas. I could have then established metrics to evaluate how much of a difference needed to exist in order to constitute TOD.

Once I realized that square footage data for entire buildings was not available, I tried to collect residential and work population data for the areas within $\frac{1}{4}$ mile and beyond $\frac{1}{4}$ mile. Had I been able to obtain this information, I could have converted the numbers into estimates of square footage to use for the original analysis. Residential population data was readily available through the census, but I could only obtain employment location information at county levels. This was not precise enough to meet my analysis needs.

CHAPTER 3: The Transportation and Land Use Connection

A Brief History of U.S. Transit and Land Use Planning

Throughout American history each era's growth pattern has been the direct result of the dominant transportation mode of its time. According to urban historian Peter Muller, there were "four eras of intrametropolitan growth and transportation development" during 19th and 20th century U.S. history (2004, 61). The eras are Walking-Horsecar Era (1800-1890), Electric Streetcar Era (1890-1920), Recreational Automobile Era (1920-1945), and Freeway Era (1945-Present). The Electric Streetcar was the centerpiece of a fairly compact transportation and land use system. The streetcar allowed people to move outside the city into lower density suburban environments; however the residents were dependent upon the streetcar for access to the city. This dependency ensured that the private streetcar owners had enough revenue to maintain an efficient, reasonably priced transit system (Muller 2004). The automobile was mass introduced in the U.S. in 1916 and in the 1920s cities and suburbs were already feeling its physical and economic impact. The car enabled owners to move to locations beyond that served by public transportation. The market responded with auto-oriented development patterns that, in turn, reinforced auto use and reliance. As American mode preference shifted toward the automobile, streetcars could not compete and operators began to lose money (Muller 2004). By the 1960s the government had taken over most public transit service.

The years following World War II saw the first freeway construction and the population's even further distribution across the landscape (Muller 2004). Federal government transportation policies emphasized the upgrade of overburdened suburban and rural roads, and maintenance on neglected highway infrastructure. They largely ignored the rapid decline in transit ridership and deterioration of transit infrastructure. No federal funds were available for transit planning or construction (Weiner 1999). The U.S. government continued to promote auto travel over transit alternatives with the Federal-Aid Highway Act of 1956. This act allocated funds for construction of the authorized 41,000 mile Interstate and Defense Highway System at a federal government share of 90% (Weiner 1999). It was not until 1962 that the U.S. government formally recognized the need for integrated road, transit, and land use planning. As part of that year's Federal-Aid Highway Act the federal government required implementation of

comprehensive urban transportation plans for any region receiving federal-aid highway funds. Plans were to include some consideration for non-automobile transit modes. Even so, federal transit assistance was largely unavailable and public transit planning remained minimal until the 1970s (Weiner 1999).

Finally in 1970, in response to widespread criticism about the federal government's lack of attention to its projects' social, economic, and environmental implications, Congress passed The Urban Mass Transportation Assistance Act. By adopting this act, for the first time the federal government specified a long-term funding commitment for mass transit (Weiner 1999).

By this time, however, the rapid population distribution had led to substantial declines in transit ridership. The 1970 nation wide transit market share represented 3.63% of all trips, and by 1980 it had fallen further to 2.82%. In the year 1990 transit mode share hit 1.9% and by 2000 it had dropped yet again to 1.7% (publicpurpose.com 2007). Even with federal financial assistance and construction of rapid transit systems in cities across the country, transit ridership continued to decline and vehicle miles traveled climbed.

Residential decentralization had led to employment and service decentralization and ultimately auto oriented, suburban development patterns. Cities could no longer maintain adequate road capacity given constant increases in vehicle miles traveled. As a result, even in the face of declining transit ridership and increasing auto dominance, federal government financial assistance encouraged many cities to consider rapid transit planning (Mieskowski and Mills 1993). In 1989 federal government funds covered 50-85% of operating expenses and approximately 80% of capital improvements costs for most city transit systems (Baum-Snow & Kahn 2000). This substantial federal support has led to a demand for federal funds, now available through the New Starts program, that far outweighs the Congressional allocation.

Early federal funding went to auto based cities, such as Los Angeles and Houston, that already realized their inability to improve traffic flow through roadway expansion and wished to construct rapid transit systems (Muller 2004). Unfortunately, public transit construction without appropriate land uses is not enough and "transit's market share has been declining in these cities over the past two decades. One major reason is that transit lines are incapable of serving even a significant minority of the increasingly dispersed travel demands in the low density, automobile-oriented outer suburban city" (Muller 2004, 83).

As of 1998, cities cannot be awarded New Starts money without evidence of integrated transit and land use planning (Weiner 1999). Despite early efforts to promote auto alternatives, the dominant U.S. growth pattern remains the dispersed, sprawling build environment adapted to the independent movement of the private automobile (Muller 2004). The resulting dependence on the automobile has created both financial and quality of life consequences in today's communities. According to Muller, "in much of the United States today, people already pay more for transportation than for clothing, entertainment, and health care combined; and, in a steadily rising number of urban regions, residents spend more on transportation than on housing" (2004, 83).

It is under these circumstances that planners and urban theorists are considering land use practices and policies that can both support efficient public transit service and also be supported by public transit. The term Transit Oriented Development is often used to describe these initiatives.

The Theory of Transit Oriented Development

The theory of TOD is that people who live in a certain physical environment are more likely to use public transit as their preferred mode of transportation. If this is the case, then the U.S. can increase its transit mode share by promoting appropriate land design and development near its transit stations.

According to Robert Cervero (1998), author of *The Transit Metropolis*, there is no globally applicable formula for achieving TOD. Existing land uses can influence appropriate mode choice as much as mode choice can impact appropriate TOD development patterns. The extent to which mode should drive land use decisions and existing land use should drive mode selection depends on the city's physical, economic and social conditions. Cervero organizes cities into four types: adaptive cities, adaptive transit, strong-core cities, and hybrids. Using case study examples, Cervero shows that cities with lower density, spread out growth, or those with dispersed suburbs need flexible public transit, often involving more than one mode. Compact cities with mixed-use development nodes and strong central cores are often best served by fixed-rail options. New TOD development then, responding to existing public transit (rail, bus, bus rapid transit, ferry, etc), may take different forms. Cervero sees TOD as the micro-scale components that, if designed in the appropriate context, create a strong transit metropolis. As

long as the result is compatible, mutually supportive transit and land use, the TOD is a success. If, city wide the transit and land-uses are well adapted and integrated with each other such that transit is an efficient alternative to the automobile, the Transit Metropolis itself is a success. Cervero emphasizes, however, that in order for accessibility by public transit to rival that of the automobile, the station area development must be part of a regional vision for efficient public transit. In other words, TOD must exist throughout the transit system.

A description of the kind of environment that promotes transit access is offered by many planning professionals. Muller (2004) makes the point that the streetcar suburbs of the early 1900s are probably the ideal example of transit oriented development. All development, both in the center city and the suburbs, needed to be within walking or biking distance of a public transit station as there were no other options for traveling from one place to another. Bernick and Cervero (1997) reinforce this concept by describing transit villages (their term for TOD) that function much like the streetcar suburbs. Bernick and Cervero explain that, “at its core, the transit village is a compact, mixed-use community, centered around the transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more” (5). The authors go on to say that the additional travel options available in TOD should translate into higher property values.

Economic theory supports this notion of increased property values at transit nodes. Ricardian Rent is a microeconomic term suggesting that potential renters and owners are willing to pay more for housing that is in preferable locations. A simple model of a monocentric city for which employment is located at city center shows that rents fall in proportion to increasing distance from employment center (DiPasquale and Wheaton 1996). Furthermore, empirical evidence from the city of Boston shows that better locations will have higher property values and, therefore, higher development densities. There is a substitution effect between structure and land (DiPasquale and Wheaton 1996). These theories can be applied to a central location such as a rapid transit station. McMillen’s (2004) analysis of housing prices on the Chicago Midway transit line for the years 1983 to 1999 supports this theory. Not only does this study show an increase in property values at stations on the existing line, it shows the market respond to the anticipation of the line’s construction.

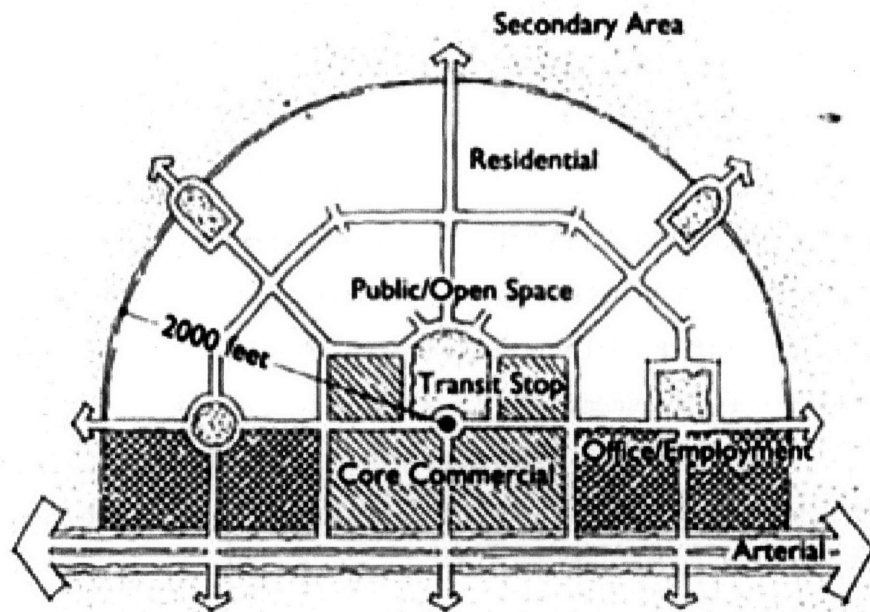
Theoretically, an extensive rapid transit system should spur the construction of TOD around its stations. The more extensive the rapid transit system and the better integrated with other modes, the more competitive that transit is with the automobile. Locations adjacent to public transit should provide residents and workers with efficient auto alternatives for accessing destinations and, therefore, should gain valuable. This increase in value encourages high density development.

Transit Oriented Development—The Definition

Transit Oriented Development (TOD) refers to a development pattern adjacent to public transit stations. The term is often used to describe physical environments designed such that public transit is a competitive transportation alternative to the automobile. It is a difficult concept to define because it has both quantitative and qualitative aspects. For this reason, practitioners and theorists struggle to identify indicators against which specific developments can be compared. The debate includes, not only how to measure TOD, but also what to measure. In particular, the question remains whether TOD is only about the form of the development or if function is also important in defining the term. For example, if a development conforms to all the TOD criteria, but in practice residents do not choose to use the public transit, is it still TOD? There are several authors and practitioners who have begun to identify measurable criteria that can, at least, begin to define TOD.

In architect Peter Calthorpe's (1993) book, *The Next American Metropolis*, he defines TOD as "mixed-use districts within a comfortable walking distance of a transit stop and core commercial area (about 2,000 feet). A walkable environment makes it attractive for residents, visitors, and employees to travel on foot to transit and conveniences." He elaborates on this concept by explaining that "buildings in TODs address the street and sidewalk with entries and windows, not blank walls or parking lots. Parking is placed to the rear of the building . . . Street alignments should not isolate surrounding uses from local conveniences, as is the case with circuitous street networks. Instead, street alignments should provide direct and inviting routes to local destinations." Figure 3.1 shows the diagram often associated with Calthorpe's TOD definition.

Figure 3.1 Calthorpe's Transit Oriented Development Diagram (1993)



Source: Calthorpe, 1993

In 2004 three publications attempted to summarize a decade of TOD research. The Urban Land Institute published *Development Around Transit: Strategies and Solutions That Work* (Dunphy et al 2004) and The Federal Transit Authority (FTA) sponsored a state of the practice report, *Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects* (Cervero et al 2004). These two documents provide a thorough overview of TOD history, describe the evolution of its practice, and, using case study analysis, make an argument for how U.S. cities should proceed in their practice of transit related development. *The New Transit Town* (Dittmar and Ohland 2004), also outlines TOD history, but argues that the variation in TOD definitions makes it difficult to analyze this history and effectively develop lessons learned. For this reason, Dittmar and Ohland use a chapter of their book to review common TOD definitions and, ultimately, propose a definition with which they can rigorously analyze several case study examples.

In the Urban Land Institute's *Development Around Transit: Strategies and Solutions That Work* (Dunphy et al 2004), the authors focus on all development near transit stations and make a clear distinction between Transit Oriented Development (TOD) and Transit Adjacent

Development (TAD). Transit Adjacent Development is development that is physically close to a transit station, but does not have the physical links to function in cooperation with transit.

Dunphy explains, “Clustering development near transit is not beneficial if the development and the transit are not functionally related” (Dunphy 2004, 5). Transit Oriented Development is distinctively different in that it creates an environment in which public transit is a realistic and efficient alternative to auto travel. In order for this to occur, the development must not only be within walking distance of the transit station, but must provide safe and comfortable access for pedestrians. To clarify, Dunphy et al (2004) describe the “4 Ds” of TOD—distance, density, diversity, and design. Specifically, TOD includes, “(1) a variety of services within walking distance of the transit station; (2) good pedestrian connections to transit and between buildings; (3) buildings that are outwardly oriented toward the street rather than inwardly oriented toward parking” (Dunphy et al 2004, 5). Many TOD proponents also describe its ability to promote community interaction. The ULI document, though descriptive in its differentiation of TOD and TAD, does not attempt to develop indicators.

The FTA sponsored state of the practice report, *Transit-Oriented Development in the United States* (Cervero et al 2004), does not promote one definition of TOD and makes the argument that TOD can only be quantified on a regional basis. It presents various methods for describing the TOD development pattern and states that the definition’s quantitative aspects are largely dependent on the specific region’s existing development density. The FTA study team conducted hundreds of surveys and interviews throughout the U.S. The report notes that TOD definitions were generally agreed upon within professional sectors. Transit professionals, for example, saw TOD as “a pattern of dense, diverse, pedestrian-friendly land uses near transit nodes that, under the right conditions, translates into higher patronage” (Cervero et al 2004, 7). Local government officials were more likely to incorporate specific measurements, such as floor area ratio (FAR) minimums, building setbacks, and distance to stations. Interestingly, the study found that few regional planning agencies, such as MPOs and state DOTs, use standardized TOD definitions.

The authors of *The New Transit Town* (Dittmar and Ohland 2004), believe this lack of agreement on TOD definition, combined with the numerous parties needed to create new development/ redevelopment, hinders TOD success nation wide. The 1990s saw the enthusiasm and imagination to propose TOD in cities throughout the country. Unfortunately, many of these

projects suffered from a lack of understanding about how to implement this development pattern in the age of the automobile. Zoning codes, finance institutions, parking ordinances, and local transit and planning agencies were not prepared to manage mixed-use, pedestrian oriented development patterns. This situation lead to construction of projects with TOD labels that reflect few original TOD concepts. As a result, Dittmar and Ohland propose a performance based definition of TOD. They explain that “their goal is to define TOD so that it is easily replicable but still has enough flexibility that it can respond to the different realities of American communities” (Dittmar and Ohland 2004, 39). Their text is intended not as the final statement on the TOD definition, but as a framework for clarifying the TOD concept over time.

Figure 3.2 provides an overview of the Dittmar and Ohland TOD definitions, by TOD typology. In reality, it is less of a definition than a series of guidelines for developers and planners working in a range of urban and suburban conditions. It indicates, for example, the kind of land uses and densities most appropriate for certain modes and transit frequencies.

Figure 3.2 Dittmar and Ohland's Criteria for Guiding Transit Oriented Development

TABLE 2.3—TOD TYPOLOGY

TOD TYPE	LAND-USE MIX	MINIMUM HOUSING DENSITY	HOUSING TYPES	SCALE	REGIONAL CONNECTIVITY	TRANSIT MODES	FREQUENCIES	EXAMPLES
Urban Downtown	Primary office center Urban entertainment Multifamily housing Retail	>60 units/acre	Multifamily Loft	High	High Hub of radial system	All modes	<10 minutes	Printers Row (Chicago) LoDo (Denver) South Beach (San Francisco)
Urban Neighborhood	Residential Retail Class B commercial	>20 units/acre	Multifamily Loft Townhome Single family	Medium	Medium access to downtown Subregional circulation	Light-rail Streetcar Rapid bus Local bus	10 minutes peak 20 minutes offpeak	Mockingbird (Dallas) Fullerton (Chicago) Barrio Logan (San Diego)
Suburban Center	Primary office center Urban entertainment Multifamily housing Retail	>50 units/acre	Multifamily Loft Townhome	High	High access to downtown Subregional hub	Rail Streetcar Rapid bus Local bus Paratransit	10 minutes peak 10–15 minutes offpeak	Arlington County (Virginia) Addison Circle (Dallas) Evanston (Illinois)
Suburban Neighborhood	Residential Neighborhood retail Local office	>12 units/acre	Multifamily Townhome Single family	Moderate	Medium access to suburban center Access to downtown	Light-rail Rapid bus Local bus Paratransit	20 minutes peak 30 minutes offpeak	Crossings (Mountain View, CA) Ohlone-Chynoweth (San Jose, CA)
Neighborhood Transit Zone	Residential Neighborhood retail	>7 units/acre	Townhome Single family	Low access to a center	Low	Local bus Paratransit	25–30 minutes Demand responsive	
Commuter Town Center	Retail center Residential	>12 units/acre	Multifamily Townhome Single family	Low	Low access to downtown	Commuter rail Rapid bus	Peak service Demand responsive	Prairie Crossing (Illinois) Suisun City (California)

This information will, at minimum, provide a foundation for understanding the kind of characteristics associated with TOD in given circumstances. The table includes existing development examples in order to guide planners and developers in selecting the appropriate criteria against which to measure their own development proposal.

Transit Oriented Development—Definition for this Study

The definition of TOD for this study requires that development:

- Be located within ¼ mile of the transit station.
- Have a higher density than development beyond ¼ mile of the station.
- Contain a mix of uses.
- Provide a safe and comfortable pedestrian connection to the station.

I do not include a requirement that people in the development actually use the transit. My perspective on this is consistent with that for form based design. A critical element of good planning is allowing for flexibility and evolution of uses over time. If we design our TOD so that public transit access can be competitive with the automobile, then this allows individual opinions and lifestyles to change over time within the same built environment.

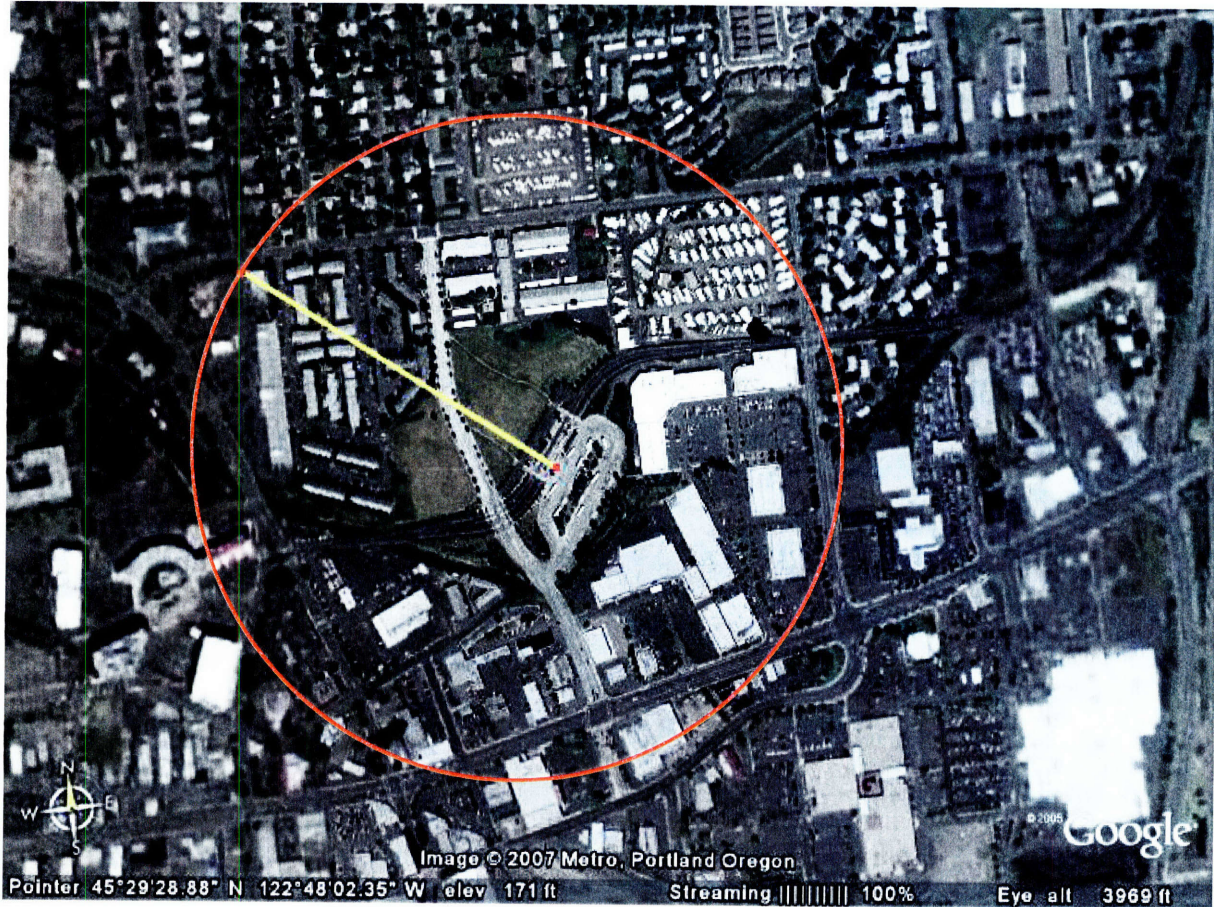
For the three case studies I evaluate the existence of TOD at specific stations based on aerial photographs, ground level photos (if available), and interviews with locals. In the case of Ottawa I include site visit as a method for evaluating TOD existence. For a baseline understanding of the aerial photo characteristics I have in mind, I've provided two example TOD photos below. They are both aerial photos of stations on Portland's MAX light rail system. The first one, Figure 3.3, is of an urban, downtown environment that meets all my definitional requirements for TOD. The second, Figure 3.4, is a suburban station that also meets my requirements for TOD. Note in the suburban example there are a mix of office, retail, and residential uses within a quarter mile of the station. Even though there is a parking lot to serve the strip retail center, the buildings are arranged such that pedestrians exiting the station can avoid the parking lot and safely walk to the stores, in this case without even crossing a street. The street that the pedestrian needs to cross in order to enter the residential neighborhood is narrow. Ideally this street would be well marked or designed to indicate to drivers that this is a pedestrian crossing location. I cannot, however, tell from the aerial photo whether such indicators are present in this circumstance.

Figure 3.3 Downtown Area Transit Oriented Development



Note: Yellow line represents a 1/4 mile radius.

Figure 3.4 Suburban Area Transit Oriented Development



Bus Rapid Transit

Bus Rapid Transit (BRT) is a public transit mode that has been used successfully in Latin America, Canada, Australia, and parts of Europe. The City of Pittsburgh has also had a small BRT service since 1977, but only in the last few years have other U.S. cities seriously considered BRT as a viable public transit mode for their cities. As U.S. cities begin to discuss the role that BRT could play in their communities, citizens debate the value of BRT, the conditions under which it can best serve a population, and the impact BRT will have on land development patterns. In order to begin to address these questions, it is important to have a basic understanding of the mode itself and how it has been used in the past.

The terms Bus Rapid Transit, Busway, and Express Bus are three of the many terms that have been used interchangeably to describe any kind of bus, roadway, or technology

enhancement intended to improve city/ suburban bus service. Across the world this enhanced bus concept has taken many different forms. In an attempt to summarize these many service features and better organize the international discussion of Bus Rapid Transit (BRT), leading scholars and practitioners collaborated with the Institute for Transportation and Development Policy (ITDP) to publish The Bus Rapid Transit Guide. The document is updated regularly as the BRT concept is spreading and evolving.

According to the ITDP, BRT is a combination of both quantitative and qualitative characteristics that can be placed on a quality spectrum. This spectrum, shown in Figure 3.5, includes the many varying factors that create an enhanced bus service and characterizes the extent to which they contribute to improved service. At the far end of the spectrum, what the report calls “Full BRT,” is a bus service with the following characteristics: (Wright et al 2006)

- Segregated busways or bus-only roadways over the majority of the length of the system’s trunk/ city centre corridors.
- Location of the busways in the central verge of the roadway rather than in the curb lane.
- Existence of an integrated “network” of routes and corridors.
- Enhanced stations that are convenient, comfortable, secure, and weather-protected.
- Stations provide access from a platform level with the bus floor.
- Special stations and terminals to facilitate physical integration between trunk routes, feeder services, and other mass transit systems (if applicable).
- Pre-board fare collection and fare verification.
- Fare- and physical-integration between routes, corridors, and feeder services.
- Entry to system restricted to prescribed operators under a reformed business and administrative structure (“closed system”).
- Distinctive marketing identity for system.

Such a specific definition describes only two BRT systems in the world: Bogota’s TransMilenio and Curitiba’s Rede Integrada de Transporte (Wright et al 2006). A slightly less rigorous definition, what the IDRP calls BRT (with no modifier), is busways segregated from traffic for the majority of the system’s length, and two additional characteristics that improve service.

These two characteristics may be from the list of other Full BRT requirements, listed above, or from the following list of additional features: (Wright et al 2006)

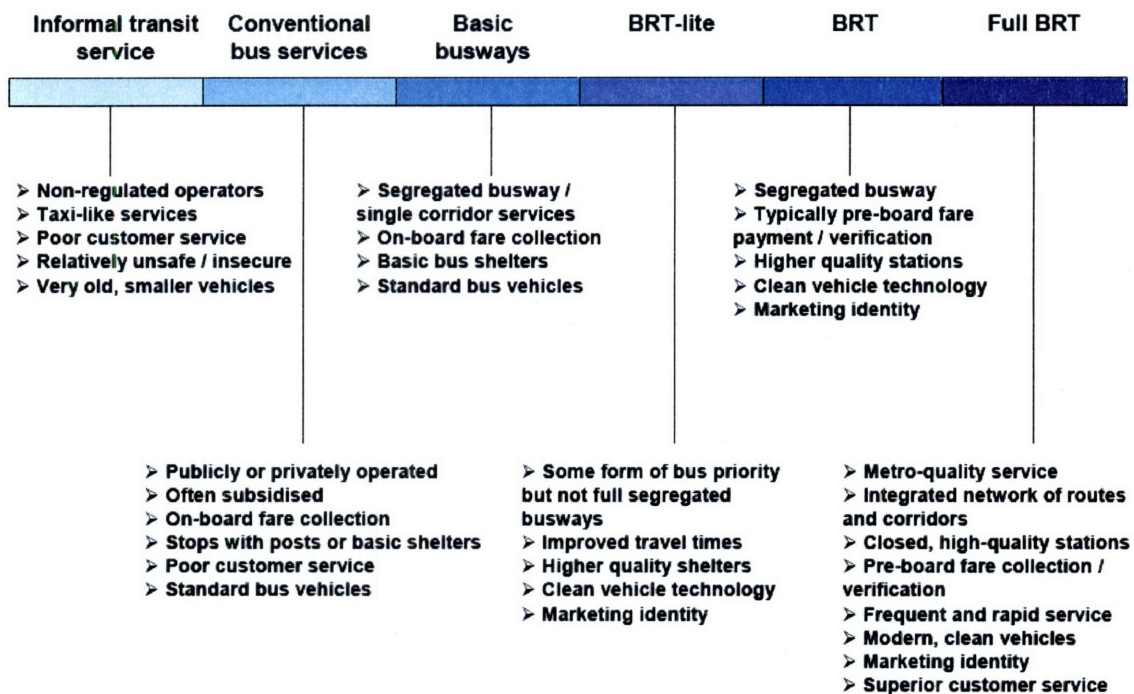
- Low-emission vehicle technologies (Euro III or higher).
- System management through centralized control centre, utilizing ITS applications such as automatic vehicle location.
- Special physical provisions to ease access for physically-disadvantaged groups, such as children, the elderly, and the physically disabled.
- Clear route maps, signage, and/or real-time information displays that are visibly placed within stations and/or vehicles.

This less rigorous definition describes forty additional BRT systems around the world, four of which are in the U.S. (Boston's Silver Line Waterfront, Los Angeles' Orange Line, Miami's S. Miami-Dade Busway, and Pittsburgh's Busway). Ottawa's Transitway system and Brisbane's Southeast Busway are also categorized as BRT (no modifier) on this spectrum.

Though not formally identified as a method for enhancing BRT service, the ITDP report emphasizes the value of implementing policies that discourage driving in conjunction with the city's public transit facilities investment. These driving disincentives may include parking fees, congestion pricing, and day use limitations. This kind of comprehensive approach to transportation demand management requires committed political leadership with a strong vision for the city's multi-modal future. In some places, such as Bogota, cities have invested in other alternative transportation infrastructure that supports BRT. This may include sidewalks, bike facilities, greenways, and support for taxis and pedicabs (Wright et al 2006).

Figure 3.5 The Quality Spectrum of Tyre-Based Transit

Figure 13 The quality spectrum of tyre-based transit



Source: Wright 2006

BRT in Latin America

The cities of Curitiba, Brazil and Bogota, Colombia are famous worldwide for their successful and innovative use of Bus Rapid Transit. There are, however, over twenty cities in Latin America with operating BRT systems, spanning the quality spectrum.

The busway concept existed as early as the 1960s. It was not until 1974, however, when Curitiba opened a fully integrated busway system, more similar to rail service than standard bus service, that the value of BRT as a viable mode of public transportation became widely recognized. Curitiba's BRT initiative provided bus service competitive with the automobile, but also pedestrian and park improvements and new social programs as part of its BRT system. Over the next two decades the city continued to upgrade the BRT service, making efficiency

improvements such as pre-board payment, something else, and express bus services. Today ridership is at 2.3 million passengers per day (Lubow 2007). Curitiba's success on a limited budget caught the attention of leaders throughout Latin America and, ultimately, throughout the world. Today Curitiba is considered to have one of the highest quality BRT systems in the world.

Bogota, Colombia is the other Latin American city that has received significant attention for its BRT system, TransMilenio. It is important to note that part of Bogota's success was learning from Curitiba's example, but recognizing the need to adapt the mode to suit its own unique conditions. The concept of BRT had been discussed in Bogota for many years and in 2000, under the leadership of Mayor Enrique Penalosa, the city government recommending that the funds originally earmarked for constructing the first line of the planned rail system be used to construct an entire BRT system that would replace the need for rail altogether. This BRT system construction included not only the physical BRT infrastructure itself, but also the parks and paths designed as a part of the multi-modal approach to transit planning. In addition to the physical innovations introduced through TransMilenio, Penalosa introduced a new business model for public transportation (Menckhoff 2005). As is true in many Latin American countries, Bogotá's previous bus system consisted of many independent private bus providers with replicated routes and little coordination or cooperation. The introduction of TransMilenio meant not only introduction of this new integrated BRT system, but also policies to discourage the excessive number of private operators. Additionally, the city gave concessions for both the trunk line and the feeder bus routes. These private companies are responsible for bus procurement, maintenance, drivers, and fare collection. This approach allowed the city and private sector to share expenses, risk, and future financial gains (Menckhoff 2005). Bogota's BRT success has itself become a model public transit system and inspired cities around the world to consider BRT as their primary public transit mode.

It is very difficult to measure the impact of BRT on land values and development. In order to truly measure the impact, it is necessary to neutralize the potential effect of other factors, such as an existing development node, on an increase or decrease in land values/ development. Perhaps the best analysis to this point is provided by Daniel Rodriguez and Felipe Targa in their 2004 paper entitled *Value of Accessibility to Bogota's Bus Rapid Transit System* (Rodriguez and Targa 2004). Latin America's experience with BRT is only somewhat useful in estimating future BRT success in the U.S. because of the differences in the economic and social conditions.

This paper, however, provides a strong methodology for performing this kind of analysis and establishes and demonstrates that BRT does seem to influence property values – a first step, in any case, towards possibly inducing TOD.

Rodriguez and Targa use a hedonic model, controlling for “structural characteristics, neighborhood attributes and proximity to the BRT corridor” (Rodriguez and Targa 2004, 587). Due to difficulty accessing data they analyzed the impact on residential rents alone, noting that commercial and other residential properties need to be included in future studies. They found “evidence that better physical accessibility to BRT station location is associated with higher asking prices for multifamily residential rental properties” (606). Rodriguez and Targa acknowledge that these results actually demonstrate that rental property owners believe their property to be more valuable given its easy access to BRT, but it is still unclear whether the market will, in fact, respond positively to these increased rents. The study was conducted only two years after the completion of the Bogota BRT system and this, the authors realize, indicates additional study limitations. Furthermore, future research should consider the potential negative impacts of being so close to the transit as to be negatively impacted by noise and pollution, or at least perceptions of these factors (Rodriguez and Targa 2004).

BRT in Canada, Australia, and Europe

Ottawa, Canada’s BRT was constructed in 1983 and is now one of the most extensive and highly patronized BRT services in the world. Even with this kind of success, no other Canadian cities have constructed BRT systems. Within the last few years, however, seven Canadian cities have begun the BRT planning process. In 1986 Adelaide, Australia built a fixed guideway BRT system, but the concept was not repeated again until the 2001 opening of Brisbane’s South East Corridor BRT line. In 2003 Sydney opened a BRT system (Currie 2006). European examples of BRT are primarily found in France. The City of Rouen has the most prominent European example, but eight other French cities have also implemented the BRT mode. The Netherlands, UK, and Germany have a few other examples. There are six cities in Asia with BRT, Jakarta being the most highly studied (Wright 2006).

BRT in the U.S.

Prior to the 1990s, few U.S. cities considered BRT a viable mode of public transit. Even in the 1990s, a few U.S. cities experimented with the mode, but it was still not widely accepted as an alternative to rail based transit systems. The Federal Transit Administration sought to change this perspective with implementation of its BRT Strategic Initiative in 1999. The FTA looked to Curitiba and Ottawa's systems as strong examples of BRT's ability to serve the same purpose as light-rail transit (LRT), but at a much lower capital cost. In order to encourage use of the mode, the FTA selected ten cities to implement pilot BRT lines for which the FTA would provide technical support and a forum for cities to share questions and ideas. The FTA hoped that the success of these pilot programs would encourage other cities to seriously consider BRT as a low cost alternative to rail based transit.

Since that time, numerous U.S. cities have invested in BRT. Other than Pittsburgh's system, initiated in 1977, the projects are all relatively new and research can only demonstrate initial impacts. The most commonly cited U.S. examples of BRT are the Pittsburgh Busways, discussed in detail in the case study chapter, Boston's Silver Line, LA's Orange Line, and the Las Vegas MAX. None of these systems can be categorized as "Full BRT" according to the quality spectrum presented earlier. They do, however, have enough high quality characteristics to be considered "BRT."

Factors Influencing BRT's Ability to Promote TOD

The literature on Transit Oriented Development clearly indicates that TOD does not happen unless the government takes specific actions (in the form of policies and/or financial support) to encourage this form of development. Even then, TOD will not necessarily happen at the stations (Handy 14). In 2005 Susan Handy published *Smart Growth and the Transportation-Land Use Connection: What does the research tell us?* In this text, Handy questions the most common assumptions about the transportation- land use connection and compiles the cutting edge research in order to determine the extent to which those assumptions are accurate. Handy's research indicates that there are four primary factors that influence whether development will occur: local government land use policies, regional development trends and forces, availability of developable land, and the physical characteristics of the area. The land policies she has found

most successful in promoting TOD include parking restrictions, land assembly, high-density zoning, and financial incentives. She cites Robert Cervero's emphasis on the necessity of carefully selecting the transit system's alignment. Cervero explains that many cities choose to use existing public right-of-way or easily acquired ROW in order to save money. This, however, can be counterproductive if the right-of-way does not provide access to locations in which TOD is best suited, given the entire city landscape (Handy 2005). Handy notes that TOD does not, in fact, create new development for an area. Instead, initiatives to promote TOD shift new development that would have occurred in other locations, using different design standards. As a result, TOD will only happen if the city has a strong and growing economy and an underlying demand for high-density development (Handy 2005).

The 2004 FTA sponsored TOD report discusses the ways that joint ventures can promote TOD. The report states that the most effective joint ventures in promoting TOD are ground leases and operation-cost sharing.

In this study I use three case study cities (Ottawa, Brisbane, and Pittsburgh) to evaluate the conditions under which BRT can promote TOD. For each case study I determine whether TOD exists at any of the stations. I then identify the political, physical, and economic conditions that likely contributed to this occurrence. The primary factors I identify as contributing to the development of BRT TOD are:

- Interconnectedness of the city's public transit services.
- Location/ alignment of the busway and its stations.
- Degree to which land use and public transit decisions are integrated within the city or region's governing system.
- Existence and effectiveness of policies to promote station area development.
- Existence and effectiveness of policies to promote walkability at station areas.
- Extent of public financial investment in station area development.
- Extent of public financial investment in the rapid transit system.
- Degree of regional planning and coordination.

I evaluate each city based on these factors, then compare and contrast their experiences, ultimately recommending policies and initiatives for U.S. cities to undertake in order to most effectively promote TOD at its future BRT stations.

CHAPTER 4: Ottawa Case Study

City Context

The 19th century saw the transformation of Ottawa from a remote logging community to Canada’s capital city. Named by Queen Victoria as the seat of government in 1857, Ottawa was soon known for its multi-cultural neighborhoods and extensive urban park system. In the 1970s the high tech industry established itself in Kanata, a satellite town outside Ottawa’s greenbelt (now a part of the amalgamated City of Ottawa). It was the growth pressure of the 1970s and 80s that ultimately highlighted the need for a regional transit system and land use plan.

Table 4.1 Transportation and Urban Systems Conditions

Population	Greater area: 1,063,664
	City: 774,072
Population growth (1996-2001)	6.5%
City density	717 people per sq. mile (note: 80% of city’s land area is rural)
Median household income	US \$57,222
Average transit mode share	<ul style="list-style-type: none"> • 35% of all peak hour trips originating in urbanized area; • 70% of peak work trips to downtown; • 30% of trips to suburban employment sites near busway; • 25-30% of trips to regional shopping centers all day

Source: Canada Census 2001, Cervero 1998 (mode share info)

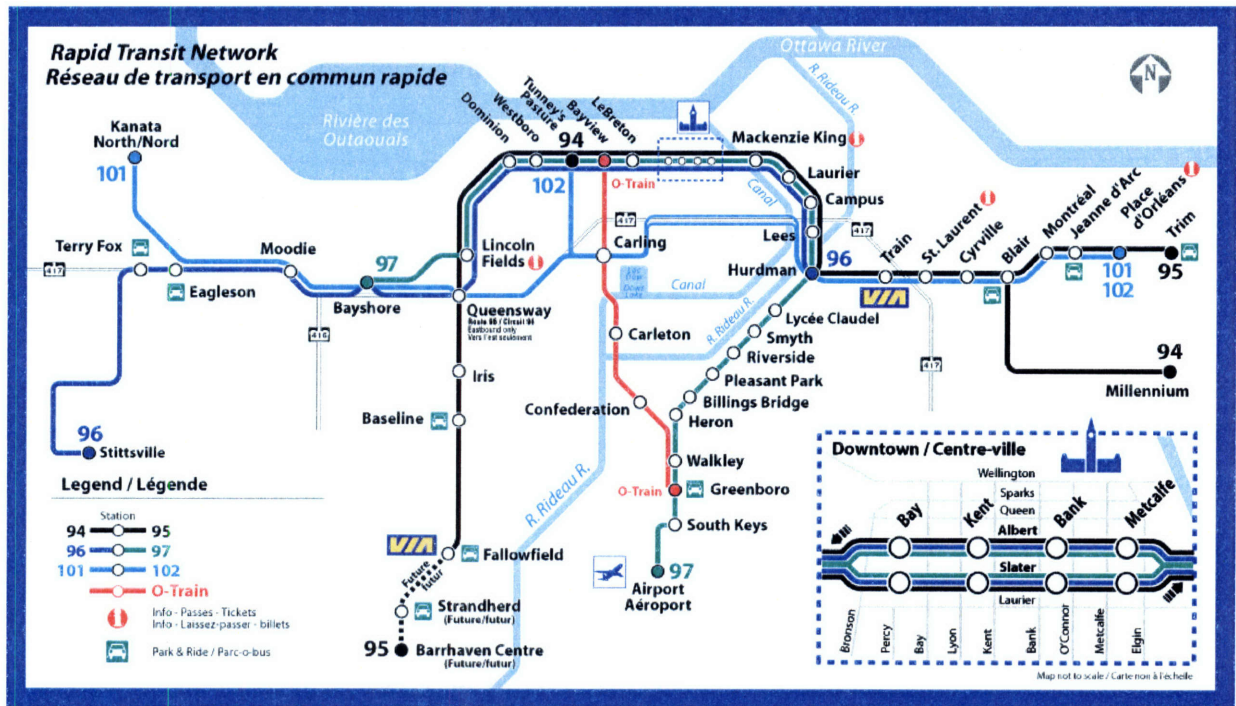
System Overview

Ottawa’s Transitway is a 19 mile (31 km), multi-corridor BRT system that was constructed between the years of 1983 and 1991 (Cervero 1998). It was the first, and is still the most extensive, BRT system constructed in North America. The busways are primarily grade separated in order to facilitate the rapid service. Ottawa leaders selected an “outside in” construction approach in order to maximize the number of busway miles they were able to construct at outset. Busways were less expensive to construct in the lower density areas further from the city (Stacey 1988, Rathwell 2002). In fact, the busway tunnels originally designed for

downtown Ottawa have never been constructed. Instead the Transitway routes use striped bus only travel lanes in the downtown area. In recent years the peak hour congestion on downtown roadways has inspired debate over moving forward with tunnel plans and/or considering other methods to more efficiently manage the high transit demand at am and pm peaks.

Transitway operates four types of BRT service: mainline, cross-town, local, and peak period (Rathwell 2002). There are no specialized bus vehicles for BRT service and there is no pre-board fare payment system. For these reasons the Ottawa system cannot be considered “Full BRT” on the spectrum presented in chapter 3. Transitway instead falls into the “BRT” category. See Figure 4.1 for a map of the Transitway trunk routes.

Figure 4.1 Ottawa Transitway Map



Source: OC Transpo, 2007

History of the System

The Ottawa Region planning history is complex in that, as the capital of Canada, it has been significantly influenced by federal, provincial, and local level planning initiatives. In the

first half of the 20th century, the many planning visions implemented at multiple tiers of government lead to disconnected decision making, territorial local governments, and a fragmented urban/ suburban landscape (Fullerton 2005). Ultimately the province of Ontario intervened by creating a middle tier of government that would control land use and transportation decision making for the entire Ottawa region. This 1969 decision led to the formation of the Regional Municipality of Ottawa-Carleton (RMOC) (Fullerton 2005). At that time, RMOC represented the City of Ottawa itself and the five surrounding municipalities. (Note: In 2001 the Ontario government amalgamated eleven municipalities, including these six, into one jurisdiction.)

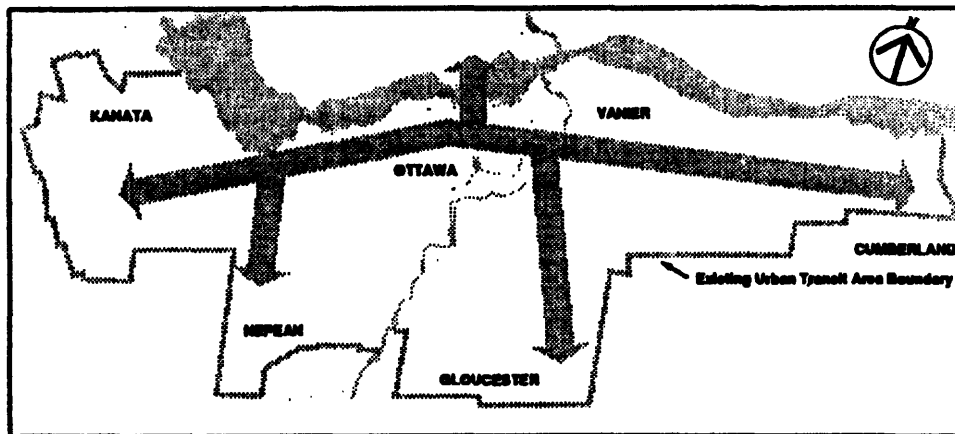
RMOC immediately recognized the upcoming development surge and responded with the Ottawa-Carleton Official Plan, a regional land use document intended to guide future development. Following a long public input process, involving much debate, the Regional Council adopted the Ottawa-Carleton Regional Plan in 1974 (Fullerton 2005). Leaders envisioned a multi nodal development pattern emphasizing job centers clustered adjacent to stations on a, yet to be designed, regional rapid transit system. Future residential development would primarily follow the existing low-density dispersed pattern and extend beyond the Ottawa greenbelt into five adjoining sub-regions (Cervero 1998).

The Official Plan vision was a compromise of public, development community, and regional planner opinions. The public was largely frustrated by two decades of auto dominated growth, their resulting dependence on the automobile, and the constant congestion on roadways (Fullerton 2005). Similar to many U.S. cities, Ottawa tore up its streetcar tracks following World War II, replaced this service with on-street buses, and, henceforth, invested its transportation resources in roadway expansion. Residents of Ottawa-Carleton were fed up with auto externalities and wanted the Regional Plan to reflect a commitment to public transportation (Fullerton 2005). The Ontario Provincial government was also pushing for public transit and offering financial incentives to construct a comprehensive system (Fullerton 2005). Many developers, on the other hand, had purchased land outside the greenbelt, in the satellite municipalities, and wished to continue construction of low-density dispersed sprawl development, a pattern which public transit could not efficiently serve. The local governments in satellite communities supported the developer opinions (Fullerton 2005).

Planners responded to these opinions by recommending a hybrid development pattern of satellite and corridor oriented growth. This was a win for developers with land outside the greenbelt and a win for citizens who wished to see development follow public transit corridors (Fullerton 2005). The RMOC adopted this concept with the 1974 Official Plan.

It was this vision for future development that then drove the regional rapid transit mode selection of Bus Rapid Transit. It is worth noting that BRT was an unusual technology choice in the 1970s and 80s when Toronto, Calgary, Edmonton, and Vancouver were all opting for rail based transit systems at that time. Ottawa-Carleton, however, felt that the flexibility of a BRT system would better serve the future growth patterns defined in the Official Plan (Cervero 1998).

Figure 4.2 Five Corridor Transit Concept Proposed in the 1974 Official Plan



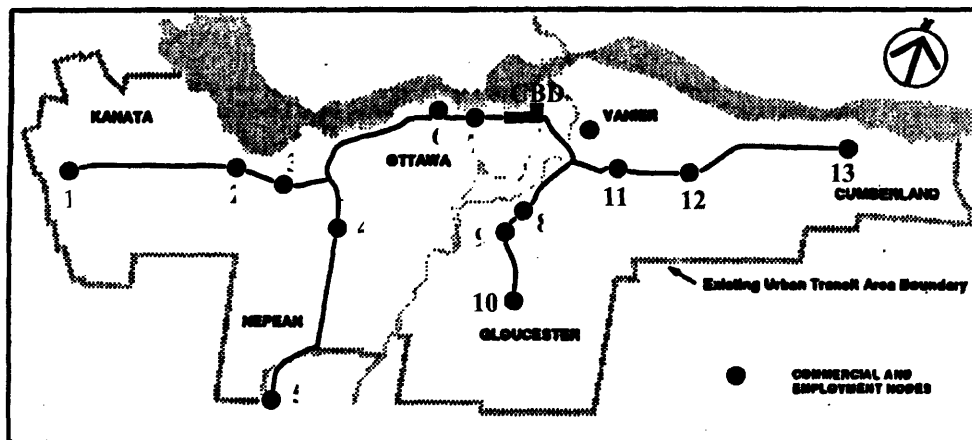
Source: Cervero 1998, from 1974 Official Plan

System Purpose

The original purpose of the system was to serve the five development corridors identified in the Official Plan. The Official Plan designated the primary locations for residential, employment, and activity areas. It also indicated that future travel demand would need to be accommodated by the transit system as transportation funds would no longer be used for increases in road capacity (Stacey 1988). As a result, the selected transit system would need to adequately serve all types of development. Ottawa-Carleton leaders determined that BRT was the ideal mode choice. The system's trunk lines, grade separated busways, could run along the

corridors designated in the Official Plan. Commercial development would be clustered along these trunks. Residential development would continue to grow in a low-density pattern. This dispersed residential growth would occur within the City of Ottawa and in the satellite communities, beginning to the west and east with Kanata and Orleans. BRT was preferable to fixed rail because of its flexibility to leave the defined busways and pick up passengers within neighborhoods. RMOC planned to make the BRT system efficient even for passengers in the low-density development by providing express services that would pick up within a specific neighborhood and then take the busway directly to a downtown destination, with no transfer required. RMOC selected BRT for Ottawa-Carleton “based on its superior level of service, its lower construction and operating costs, and its staging flexibility” (Stacey 1988, 123).

Figure 4.3 Official Plan Map of Target Growth Centers



Source: Cervero 1998, from 1974 Official Plan (numbering added)

- 1: Kanata (Terry Fox and Eagleson Stations)
- 2: Bayshore Station
- 3: Lincoln Fields
- 4: Baseline Station
- 5: Barrhaven (Fallowfield and Strandherd Stations)
- 6: Westboro
- 7: Tunney’s Pasture
- 8: Riverside Station
- 9: Billings Bridge Station
- 10: South Keys Station
- 11: St. Laurent Station
- 12: Blair Station
- 13: Orleans (Place d’Orleans Station)

Station Area Development Patterns

The RMOC's stated intent with the 1974 Official Plan was for rapid transit to achieve a 40% mode share during peak travel hours (Cervero 1998). Its method for achieving that goal was to concentrate employment development at Transitway stations. The Official Plan designates six primary employment centers (PECs) at which employment growth should occur. It also states that regional shopping centers (larger than 376,600 square feet) should be located at Transitway stations. The results of these regulations are evident in today's station area development patterns. Table 4.2 outlines these results, showing six PECs and four regional shopping malls. The Official Plan discourages residential development at the designated PEC stations in order to ensure that there is sufficient land for employment center growth. There has, however, been some high-rise station area development at several Transitway stations (Cervero 1998). The five stations that have experienced the most high density residential development since Transitway construction are presented in Table 4.3.

Transit Oriented Development was not a goal of the RMOC in 1974. As discussed below, the Official Plan and city zoning regulations did not require a development pattern consistent with TOD principles. There are, however, five Transitway stations that meet the TOD definition. These stations are noted on the development tables in this section and analyzed in the following section. TOD did not occur disproportionately at certain types of stations. In fact, one is at a designated PEC station, one is at a regional mall, and one is at a station undesignated in the Official Plan, but at which high-rise residential development has occurred. The other two TODs are at the University of Ottawa stations just outside Ottawa's central business district.

The RMOC originally hoped to see TOD at the satellite towns just outside the City of Ottawa Greenbelt. Land use controls and political will, however, were not strong enough to meet this goal. Today Kanata, Orleans, and Barrhaven have suburban, auto-oriented development patterns (Jeanes 2007).

Table 4.2 Commercial Development at Transitway Stations Identified as Growth Centers in the 1974 Official Plan

Transitway Station	Approximate Distance from CBD (in miles)	Station Area Development	Type of Growth Center Specified in Official Plan	TOD at this Station?
Mackenzie King Station	.6	Regional mall (Rideau Center)	Regional Shopping Center	Yes TOD
Tunney's Pasture	2.7	Holland Cross: 200,000 sq.ft. retail and office; 638 residential units; additional residential in neighborhood	Primary Employment Center	Yes TOD
St. Laurent	4.7	Regional mall expansion, Large office tower.	Regional Shopping Center and Primary Employment Center	No TOD
Cyrville	5.3	JDS Uniphase conversion of old grocery store into a factory. Now out of business.	Primary Employment Center	No TOD
Blair	6.7	Regional mall (Gloucester Centre), Five large office buildings, new Gloucester Town Hall	Regional Shopping Center and Primary Employment Center	No TOD
Baseline	9.5	New Nepean Town Hall, commercial construction	Primary Employment Center	No TOD
Place d'Orleans	12.8	Regional mall, Several hundred thousand square meters of office and commercial space	Regional Shopping Center and Primary Employment Center	No TOD

Sources: Cervero 1998, Stacey 1988, Jeanes 2007

Regional shopping centers are found at St. Laurent, Blair, Place d'Orleans, and Rideau Center stations. The shopping centers at St. Laurent and Blair are large indoor malls that link directly to the station. Both projects were under construction during the Transitway installation and, as a result, the developers could conveniently link to the transit service. St. Laurent's

construction was an expansion of an existing mall and mall owners gave land to Transitway so that the station could provide a complete indoor connection to the mall addition. By the late 1990s, 30% of St. Laurent's customers arrived by Transitway (Cervero 1998). The mall at Blair station was in the planning phases at the same time as Transitway. As a result, planners integrated the designs such that the mall now faces and connects, rather than turns its back, to the Transitway (Cervero 1998). The Rideau Centre, located at the edge of downtown, was also designed to facilitate Transitway customer access. Transitway drops off customers directly at the door of the centre. By the late 1990s, 60% of Rideau Centre customers arrived by Transitway (Cervero 1998). Built in 1980, Place d'Orleans is the regional mall furthest from downtown. It primarily serves the Orleans community, located east of the greenbelt, as a shopping center and a large Transitway park and ride facility. Along with station construction, Transitway built a long pedestrian bridge stretching across the Queensway Freeway to the park and ride lot. The mall is on the same side of the freeway as the station.

There is commercial development at six stations designated as Primary Employment Centers in the Official Plan. These stations are Baseline, Tunney's Pasture, St. Laurent, Cyrville, Blair, and Place d'Orleans (Cervero 1998). Tunney's Pasture is a major federal government employment center that existed prior to the Transitway and was an important destination in determining the location of the BRT line. In the late 1980s Holland Cross, a major mixed-use development featuring ground floor retail, office, and two residential towers was constructed adjacent to the Tunney's Pasture station and the high-rise federal employment center. When the Transitway first opened JDS Uniphase converted an old grocery store at Cyrville Station into a factory. The company found that its employee pool was much larger if the workplace had easy access to transit (Jeanes 2007). The factory, however, has since gone out of business. Blair Station, the site of one of the regional malls, also provides easy access to a large, five building office park. In order to encourage the developer to build in this location, Transitway built a pedestrian bridge from the station over the Queensway Freeway to the office park. St. Laurent, Baseline and Place d'Orleans Stations have also seen new office/ commercial construction since Transitway opening.

It is important to note that commercial development has also happened at other Transitway stations, such as South Keys and Terry Fox, both big-box retail shopping centers. The medical center at Riverside Station integrated its expansion into the Transitway Station and

buses now deliver customers directly to the door of the medical facility. The mall at Billings Bridge existed prior to Transitway construction; however Transitway constructed a pedestrian bridge to facilitate access to the station.

Some high rise residential development occurred at Transitway stations even though this pattern was not specified in the 1974 Official Plan. Table 4.3 identifies these stations.

Table 4.3 High-Rise Residential Development at Transitway Stations Constructed After 1974

Transitway Station	Approximate Distance from CBD (in miles)	Station Area Development	TOD at this Station?
Lees	2.1	Social housing, primarily (more than 450 units)	No TOD
Hurdman	2.6	Low income apartments and luxury condominiums. Riviera (387 units) and Classics high rises (508 units)	No TOD
Tunney's Pasture	2.7	638 units (also listed in Table 4.2, with Holland Cross description)	Yes TOD
Westboro	3.7	Luxury condominiums, 290 townhomes and apartments	Yes TOD
Cyrville	5.3	Condominiums currently under construction (not luxury) The Place de Gouverneur condominium project, 4 towers	No TOD

Sources: Cervero 1998, Holmes 2007

Additionally, Transitway construction linked many existing high-rise residential developments, such as those at Smyth Station and Lycee Claudel Station. Laurier and Campus Stations provide Transitway access for University of Ottawa students and staff.

Is the Development at the Stations Transit Oriented?

Much of the development at Transitway Stations begs the question of whether Transit Oriented Development is about form or function. As described in chapter 3, the TOD definition

for this study focuses on the physical form of the station area. This study does not look at the actual use patterns at stations.

To review, I have defined TOD for this study as development:

- Located within ¼ mile of the transit station.
- With a higher density than development beyond ¼ mile of the station.
- Containing a mix of uses.
- Providing a safe and comfortable pedestrian connection to the station.

This section analyzes twelve Transitway stations for existence of TOD. These include all of the stations designated at PECs in the 1974 Official Plan and all the stations that have seen high-rise residential development since Transitway construction. It also includes the two stations that serve the University of Ottawa, Laurier and Campus. As described in the methodology, I conducted analyses of land uses and pedestrian accommodations at all Transitway stations using Google Earth photos and site visits. None of the remaining stations on the Ottawa BRT system have TOD.

Note: The red circle in the following figures represents a quarter mile radius around the BRT station.

Figure 4.4 St. Laurent Station

The St. Laurent mall and the office tower at the site's south west corner is the only development within a safe and comfortable quarter mile walk of the station. The land uses are generally isolated with all residential development on the opposite side of multi-lane roadways. This is not TOD.

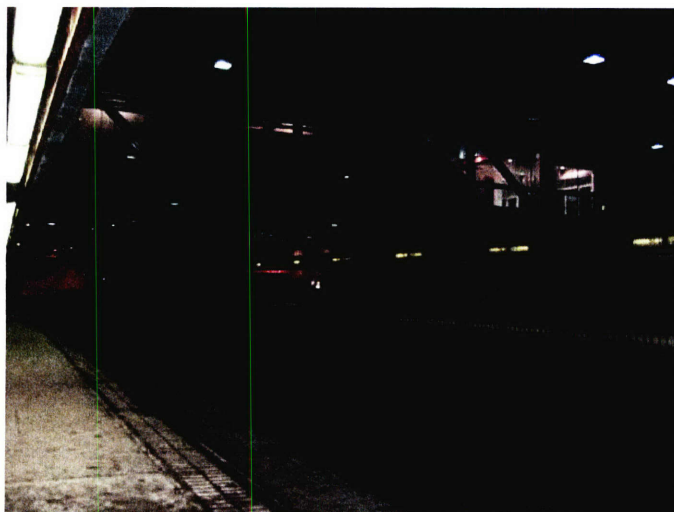
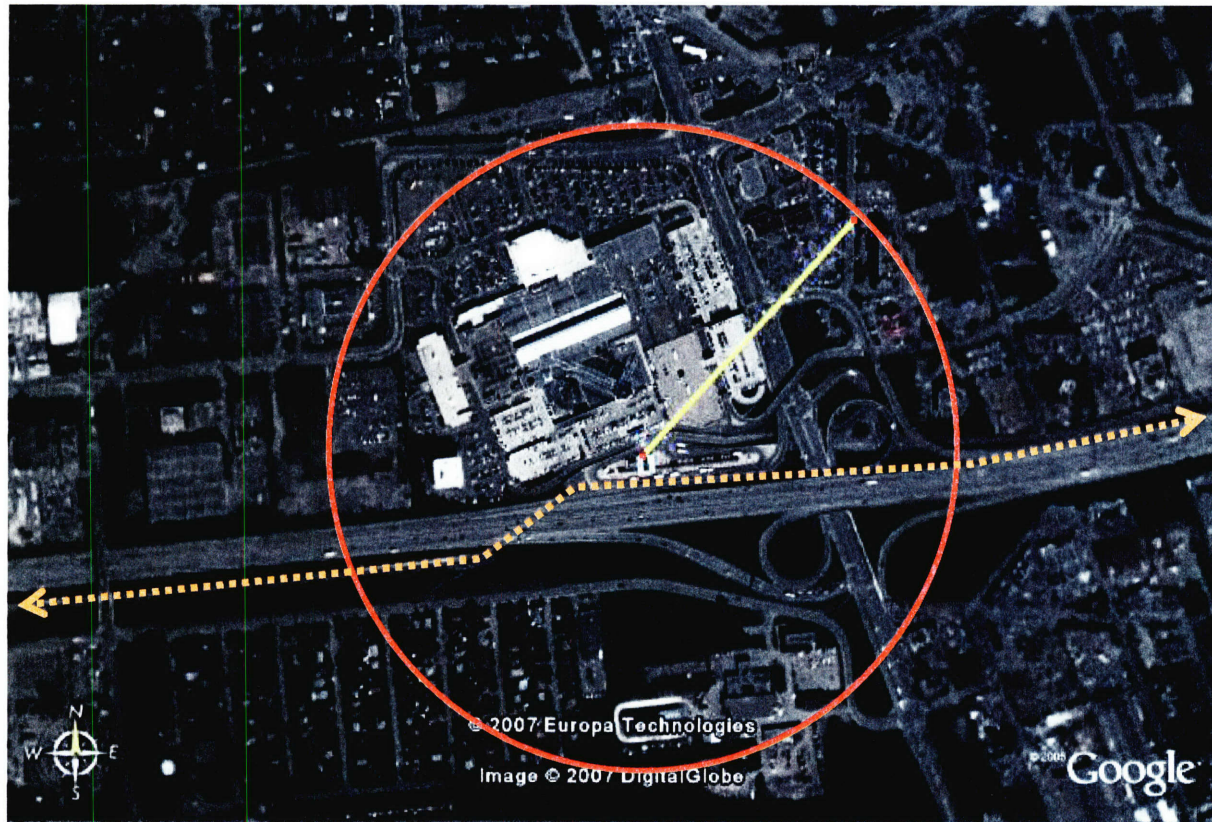


Figure 4.5

Transitway Station platform on the first level of the three tiered St. Lauren Station. Through a co-development initiative, the Transitway station was integrated into the mall's expansion.

Figure 4.6 Blair Station

The Gloucester Centre mall, two of the five office towers south of the Queensway Freeway, and a few single family residential units are within a quarter mile of the station and have safe pedestrian access. The old Gloucester City Hall, located at the western edge of the quarter mile radius, and the office towers south of the Queensway are all isolated buildings surrounded by large parking lots. This is a typical suburban site design and does not encourage pedestrian activity. Additionally, most of the residential development is outside the quarter mile radius and isolated from other uses by busy, multi-lane roadways. This is not TOD.



Figure 4.7 Place d'Orleans Station

The Place d'Orleans mall, several office structures, the Transitway park and ride, and a few single family residential units are within a quarter mile of the station. The parking lots and freeway between the station and these destinations make for an uncomfortable and potentially unsafe pedestrian environment. There is a pedestrian bridge over the freeway and another across the mall parking lot. The pedestrian accommodations between the station and the single family residential neighborhoods are very limited. This is not TOD.

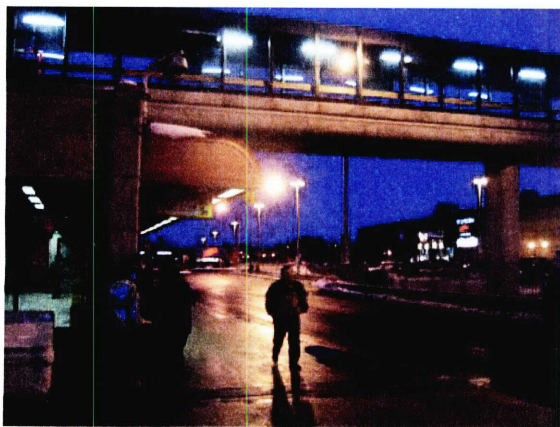
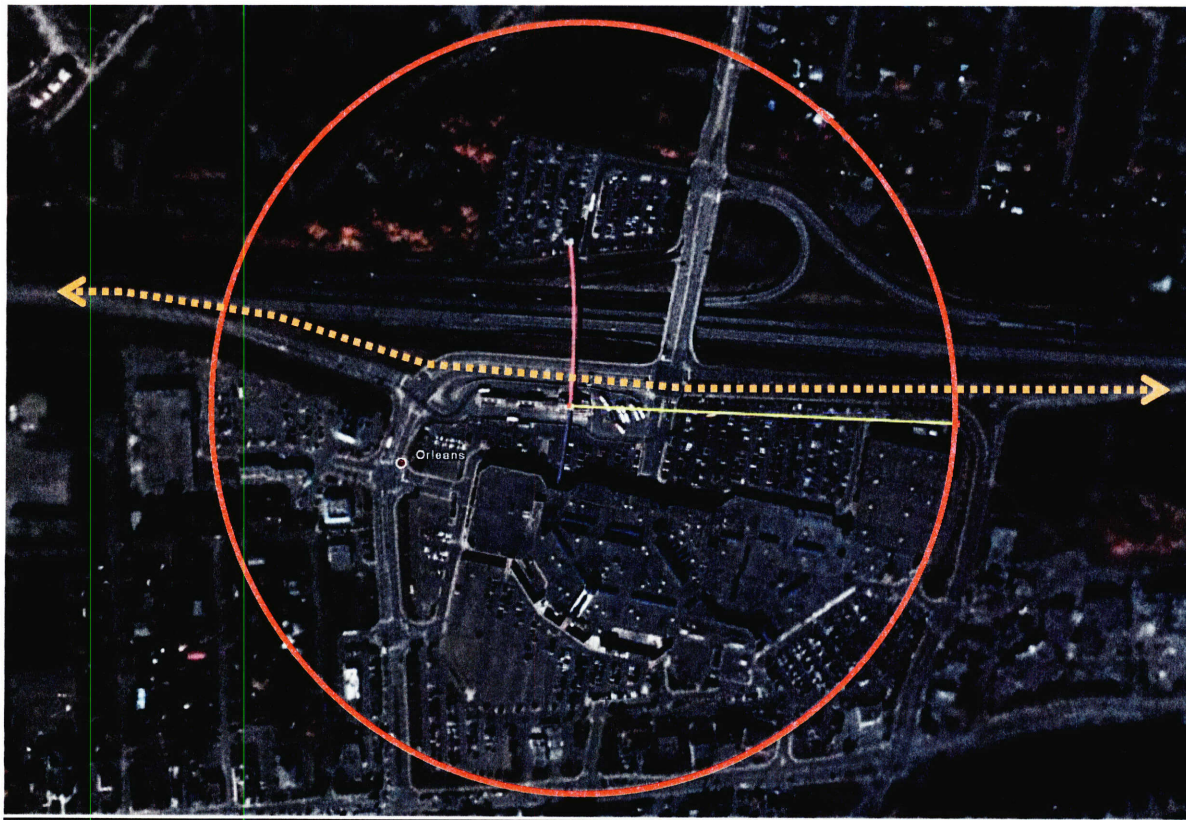


Figure 4.8

View from the Place d'Orleans Transitway Station toward the mall.

Figure 4.9 Mackenzie King Station

Mackenzie King Station is located on the edge of downtown Ottawa. The streets throughout the area are two to four lanes wide and have sidewalks on both sides of the street. The entire area is safe and comfortable for pedestrians. The Rideau Centre regional mall and the National Defense building both have their front doors at the station. There is a diverse mix of retail, office, hotel, and residential development within a quarter mile. This is TOD.

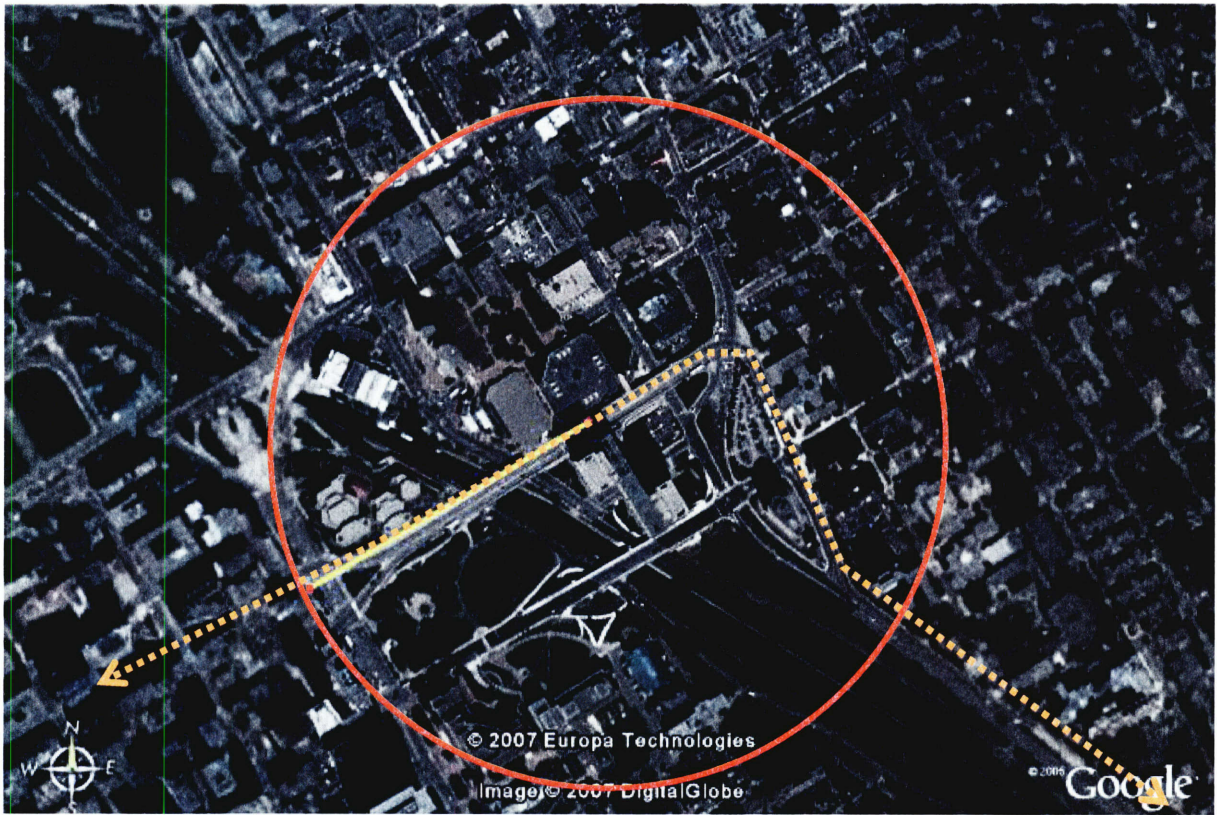


Figure 4.10

View of the Rideau Centre regional mall from the Mackenzie King Transitway Station. Photo courtesy of Colin Simpson, City of Ottawa.

Figure 4.11 Baseline Station

Algonquin College is directly across the street from Baseline Station and is within a safe and relatively comfortable walking environment. The Nepean Town Hall (prior to amalgamation with the City of Ottawa) is located southwest of the station and within a quarter mile walking distance. The building was constructed after the Transitway system; however, the designers chose to build a large parking lot between the town hall and the station. This makes a total of two parking lots through which a Transitway rider would need to walk in order to access the city hall. There are also two office buildings accessible through parking lots. The retail development north of the station can be accessed by way of sidewalks and crosswalks. Only a few single family residential homes are within a quarter mile of the station. This is not TOD.

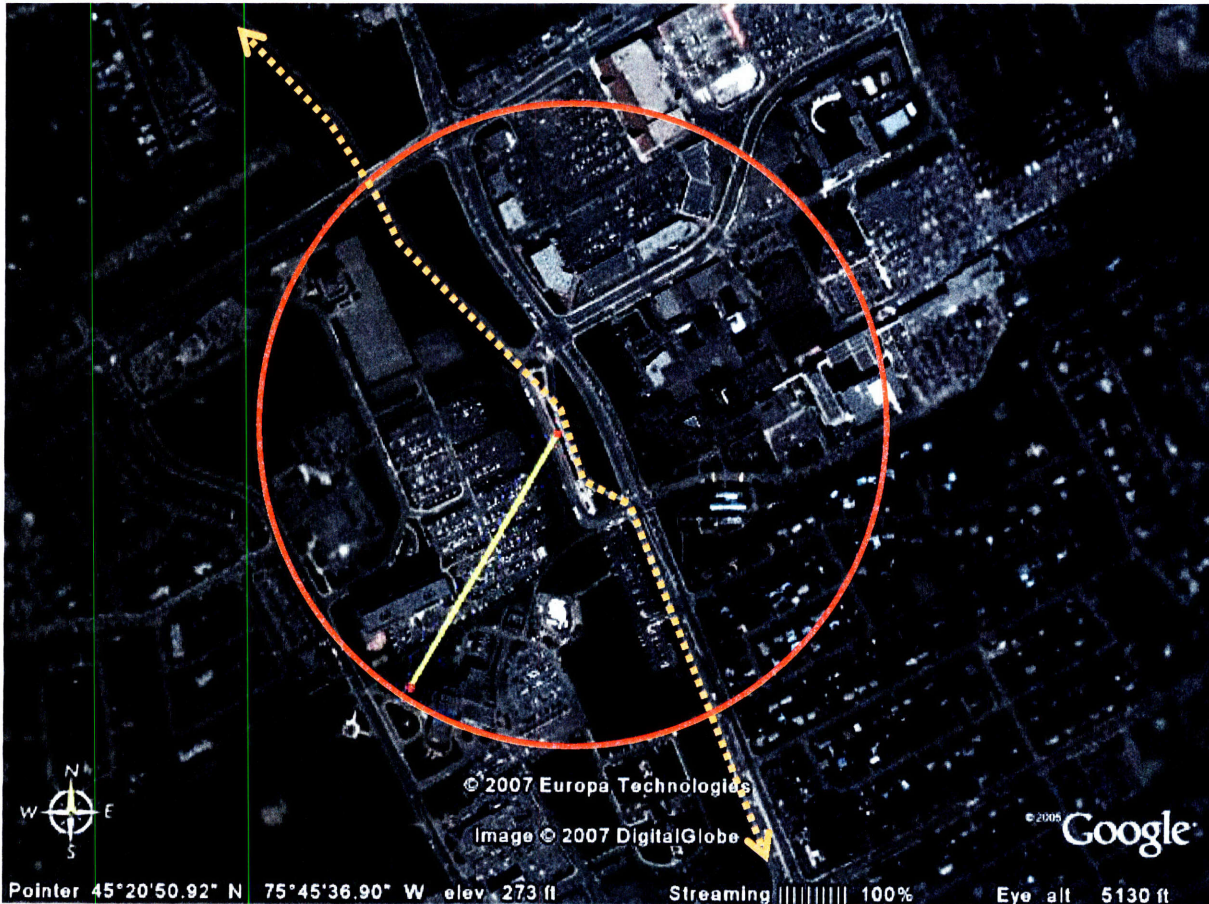


Figure 4.12 Tunney's Pasture Station

The Tunney's Pasture campus houses 10-12,000 federal government employees (Cervero 1998). Holland Cross, with a mix of retail, office, and residential uses is located directly across the street from both the federal government campus and the Transitway station. There are wide sidewalks for pedestrian travel between these destinations. Additionally, the Holland Cross building is pulled up behind the sidewalk, which defines the streetscape and creates an inviting pedestrian environment. Parking is behind and under the building. Also within a quarter mile of the station are multi and single family homes in a pedestrian safe neighborhood. This is TOD.



Figure 4.13

View of Holland Cross mixed-use development from the far side of the Tunney's Pasture Transitway station.

Figure 4.14 Cyrville Station

There is very little development around Cyrville Station that pedestrians can safely and comfortably access. There are narrow sidewalks on the bridge over the Freeway, but otherwise there are no sidewalks near the station. A middle income condominium development is currently under construction next to the station. The developer has promised to construct safe pedestrian paths between the station and the new residences. This is not TOD.

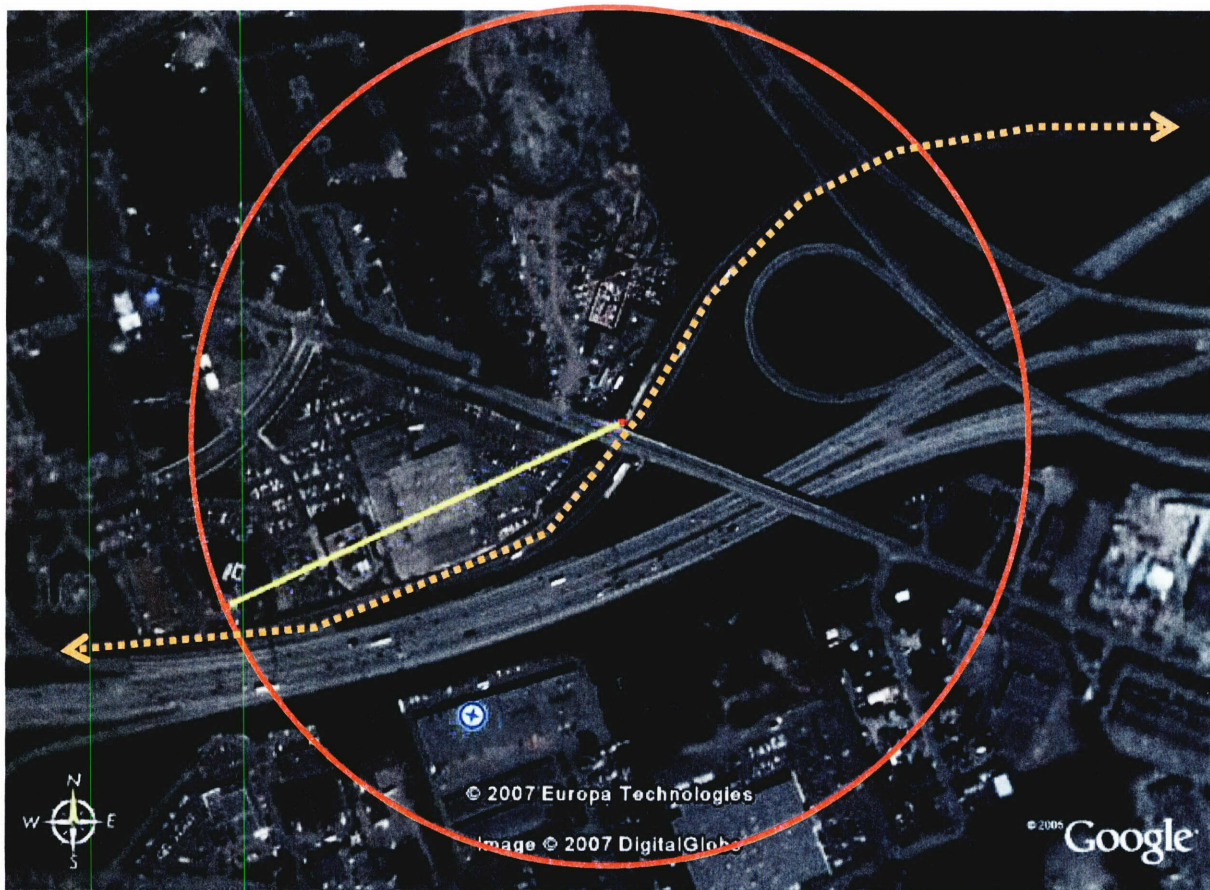


Figure 4.15

The Place de Gouverneur condominium project, under construction at Cyrville Station, is at the right in the photo. The Transitway entrance that leads to the grade separated busway is in the center.

Figure 4.16 Westboro Station

Westboro Station has a wide mix of retail, office, and residential development within a quarter mile. It is all linked with safe and comfortable pedestrian accommodations. Much of the development existed prior to the Transitway. This includes the Westboro village on Richmond Street, several blocks south of the station, the single family neighborhood through which transit riders reach the village, and some suburban style commercial development on the north side of the station. In 2004 a luxury condominium high-rise opened next to the station. This is TOD.



Figure 4.17

Single family residential neighborhood at Westboro Station. New high-rise luxury condominium in the background.

Figure 4.18 Hurdman Station

Hurdman Station is a major transfer station on the Transitway as it is the location where the south and east bound busways divert. There are two apartment complexes and one condominium complex within one quarter mile. As with the luxury residential units at Westboro, some people believe the TOD density bonuses offered by the city drew the developers to the site, but, in fact, the residents of the luxury units do not use the public transit service. The apartment complexes are primarily low income units. There are safe and comfortable sidewalks to connect the developments to the Transitway station. There is no commercial development within a quarter mile of the station. This is not TOD.

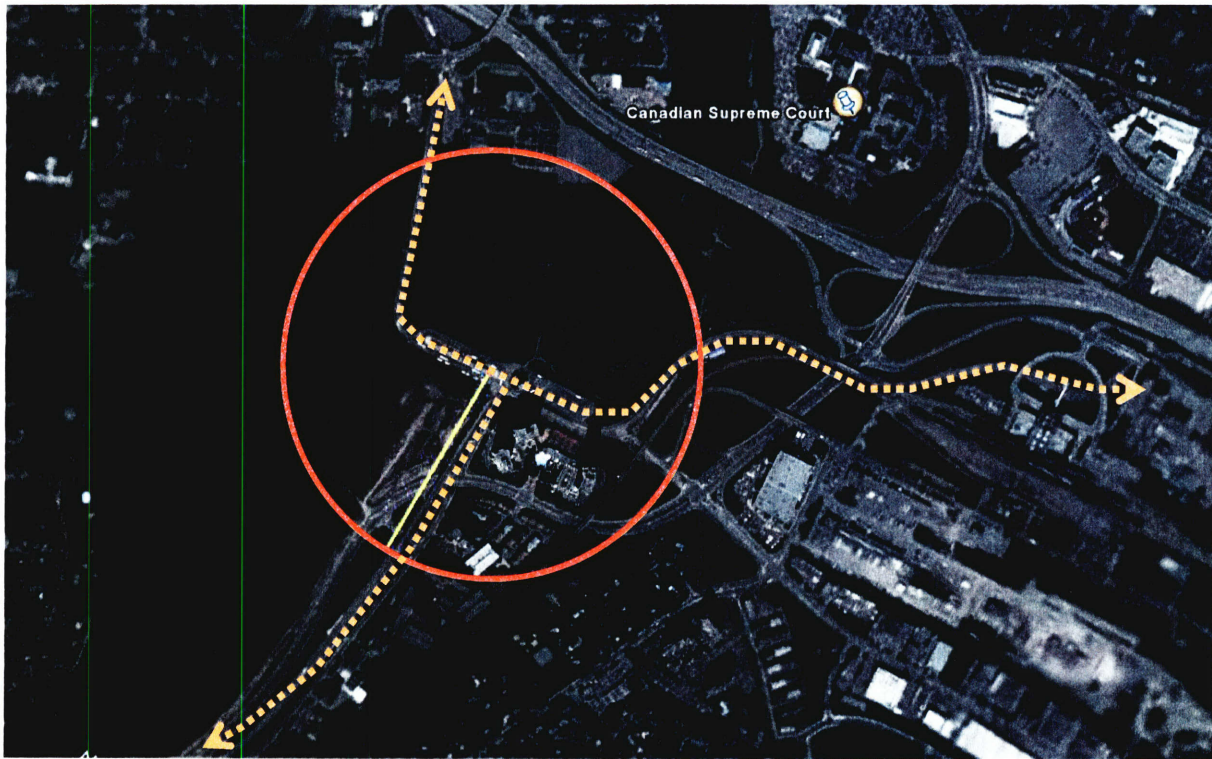


Figure 4.19

View of Hurdman Station with residential towers in the background. Photo courtesy of Colin Simpson, City of Ottawa.

Figure 4.20 Lees Station

There is high-rise residential development, primarily government built low-income housing, within a quarter mile of the station. There is also a large one-story University of Ottawa building. There are sidewalks in this area, but it is not a comfortable pedestrian environment. This is not TOD.

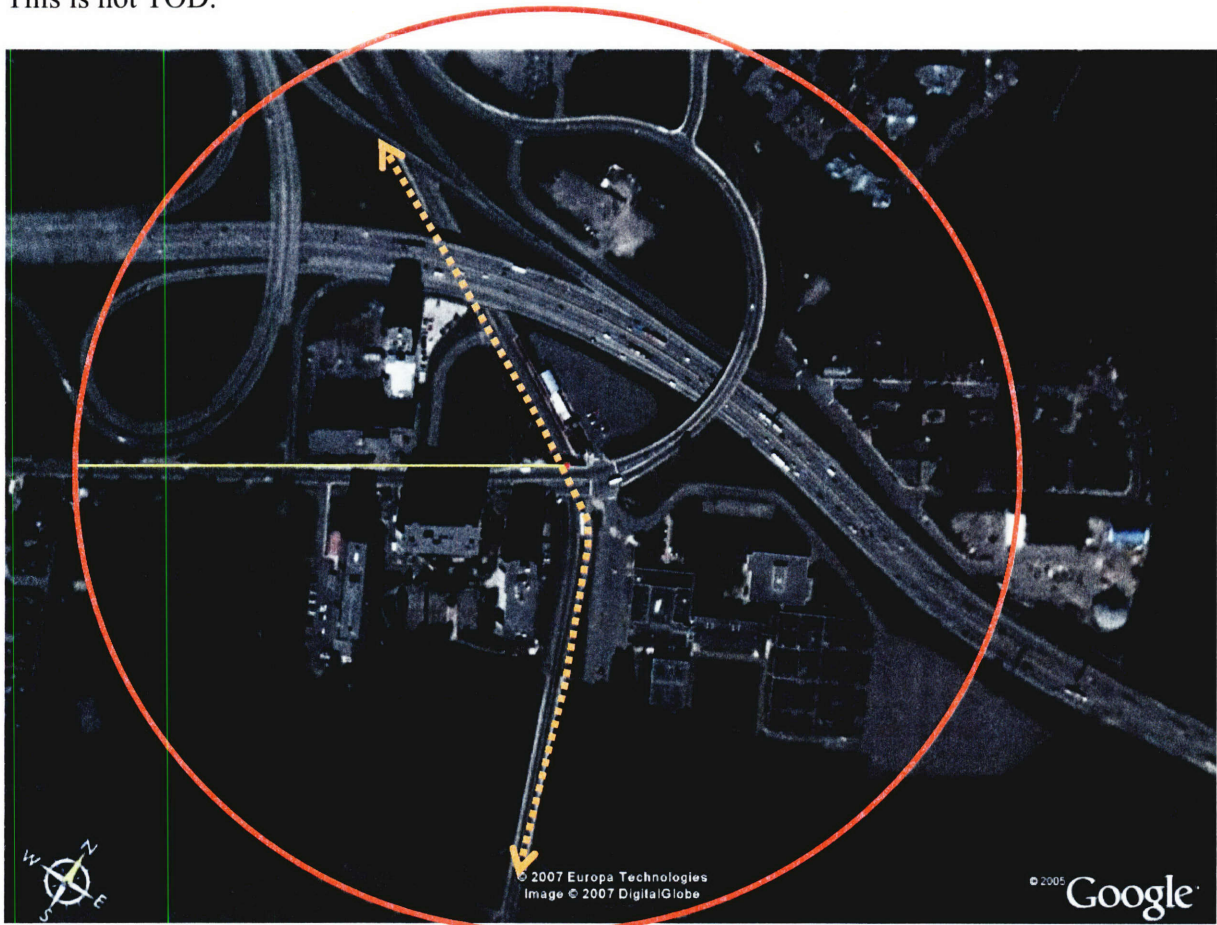
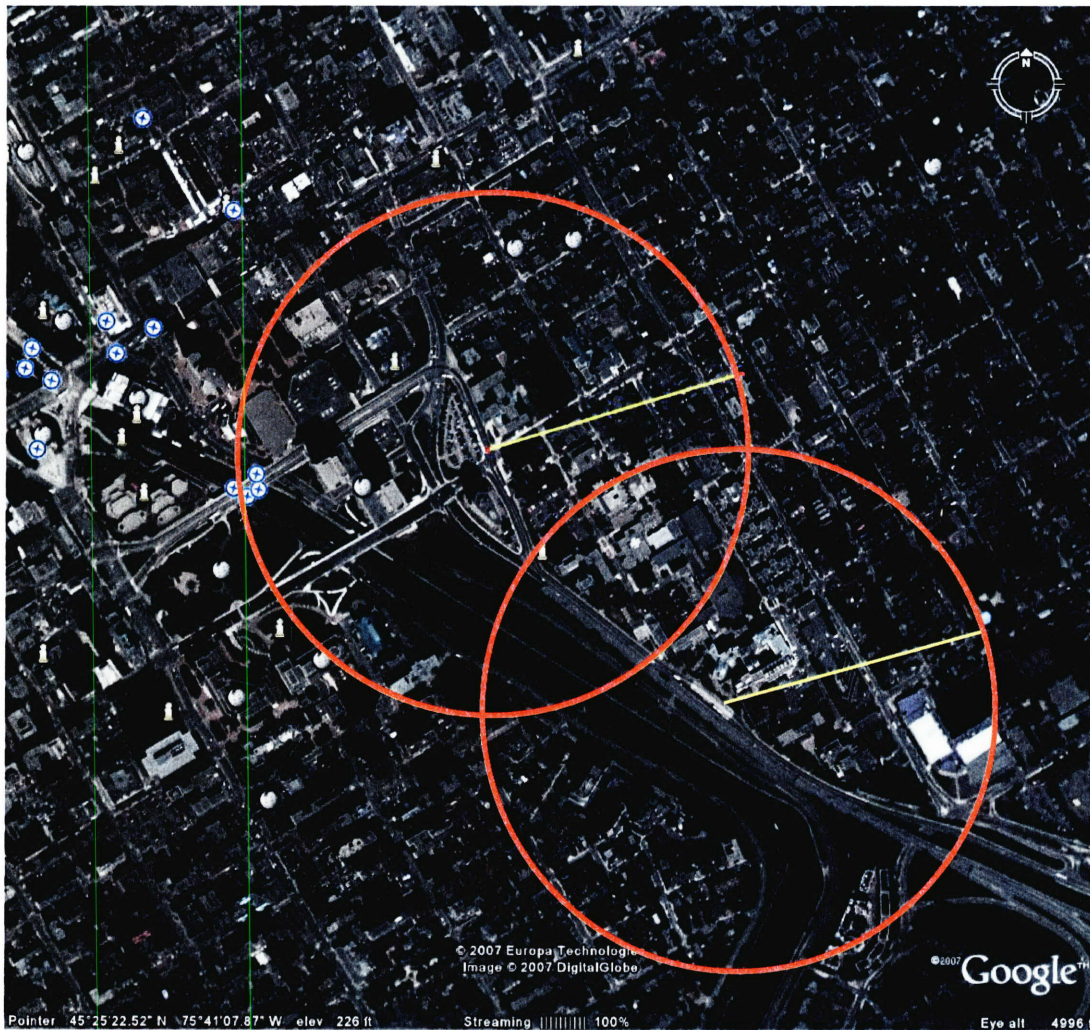


Figure 4.21

View from Lees Station of two high-rise residential buildings.

Figure 4.22 Laurier and Campus Stations

Both Laurier and Campus Stations serve the University of Ottawa campus. These stations are located near the city's downtown and within high density, mixed use neighborhoods. There are comfortable and safe pedestrian accommodations throughout the area. Since Transitway construction the University of Ottawa has constructed new buildings that promote student and staff pedestrian access to the BRT stations.



Factors Influencing Station Area Development Patterns

Interconnectedness of public transit services

The RMOC's selection of an "outside in" approach to Transitway construction allowed it to build a strong busway network at the outset. Leaders determined that the most expensive

portion of the system would be the proposed downtown tunnels and that the construction costs decreased the further the construction took place from center city. This approach meant that the tunnels originally planned for the downtown were replaced with striped bus lanes in center city and still have not been built. The “outside in” approach allowed the region to maximize busway length given a limited budget. Additionally, on-street bus routes were carefully coordinated with busway service to minimize transfer times or allow for express service from residential neighborhood to downtown.

Location/ alignment of the busway and stations

In the extensive debate about location of trunk lines, RMOC considered eight factors. These considerations included the location of existing development and growth centers identified in the Official Plan, but was primarily determined by existing rights-of-way. In an attempt to limit public conflict and reduce land acquisition costs, the RMOC located most of the Transitway trunk lines on abandoned railroad rights-of-way. Ottawa was at one time a highly industrial community served by both the Ottawa River and an extensive railroad network. Much of the railroad land was still publicly owned, so the RMOC determined that these were locations would be the paths of least resistance for the new busway service.

Coordination of land use and public transit decisions

As discussed above, integration of land use and transportation decisions is a hallmark of the Ottawa-Carleton Official Plan. The 1974 Official Plan clearly delineates the region’s future land use development pattern, specifies the need for a rapid transit mode to serve the region, and identifies the main corridors on which the rapid transit will travel (Cervero 1998). Following adoption of the plan, RMOC studied the regional transit mode options and ultimately determined that BRT would best serve the land use development pattern in the Official Plan.

Existence/ effectiveness of policies to promote station area development

The Official Plan clearly defines three major urban centers (in the satellite communities) and the Ottawa downtown located on the rapid transit trunk lines. It also identifies primary employment nodes at transit stations that can accommodate 5000 or more jobs (Fullerton 2005). The Plan requires that all shopping centers greater than 376,000 square feet (35,000 square meters) be located at Transitway stations. Shopping centers smaller than 35,000 square meters can be located away from Transitway stations, but needed to be accessible by another high

frequency transit service (Bonsall 1997). In recent years Ottawa has offered density bonuses to developers who build within 400 meters of Transitway stations.

Existence/ effectiveness of policies to promote walkability at station areas

In order to allow the continued low-density residential development pattern and also provide efficient public transit, the Official Plan calls for certain subdivision design considerations. For example, all residences must be within 400 meters (approximately one quarter mile) of a bus station linking to the rapid transit system. Collector road layouts must be designed as to facilitate ease of rapid transit access for residents (Stacey 1988). Assurance of pedestrian access, safety and comfort in accessing public transit was to be evaluated by staff through the plan review process. Walkways, sidewalks, and transit only roadways are methods by which this safety could be achieved (Bonsall 1997).

Extent of public financial investment in station area development

In addition to building all the busways and stations, the regional government has participated in two station area co-development projects. The first was a 1987 effort to incorporate the busway station into the expanding St. Laurent shopping center. The developer contributed the land and together the parties constructed a three tiered station: top level for local buses, mezzanine with direct link to the shopping center, and downstairs for Transitway platforms. Through negotiation the city agreed to reduce parking requirements in conjunction with this project, the owner saved money on parking, and instead constructed passageways from the station to the mall (Cervero 1998).

The second co-development project was with the Riverside Medical Complex. In 1991, the medical facility expanded, allowed the busway to travel through the medical complex property, and worked with planning staff to incorporate the Transitway station into the base of its new 45,200 square foot (4200 square meter) administrative building (Cervero 1998).

The City of Ottawa currently has plans to build two Transit Oriented Development model projects at property it owns near Transitway stations. The first is a high density, primarily residential development with convenience retail in Longfields Station in Barrhaven. Barrhaven is a relatively new satellite community south of the Ottawa greenbelt. The city hopes that the revenue from this project will pay for a high density, mixed-use development at Baseline Station. Baseline Station is located in the Centerpoint area of Ottawa, at Algonquin College. The roads

in this area are already to capacity, so many of the new trips produced by this proposed TOD and some of the existing trips from this area will need to be accommodated by the Transitway system. The timing for these projects is not yet determined as the city is waiting for market demand to increase (Simpson and Scrimgeour 2007). In January the city Archives decided to build their new building on city property at Baseline Station. It will be the first building in the city's Centerpoint TOD (Jeanes 2007).

Extent of public financial investment in transit system

The RMOC's transit focus is on policies and financial investments to increase ridership. It has invested millions of dollars and implemented stringent policies giving it the highest transit ridership rate of any similar size North American city (Official Plan Addendum 2001). These investments, however, are primarily in bus and busway capital costs, and policies discouraging automobile use. Policies to promote use of the system were many.

Beginning in 1972, when RMOC took over regional transit governance, it implemented a two prong approach to transit. First was an emphasis on operational improvements. It increased on-street bus frequency and implemented the express routes traveling from suburban residential neighborhoods directly to downtown locations. These actions were extremely successful and immediately increased ridership (Stacey 1988). The RMOC negotiated with the federal government, employing a large percentage of downtown Ottawa workers, to eliminate free employee parking. They also arranged for staggered work hours allowing employees to arrive over a two hour period and leave over an extended period. In this way, the transit system could accommodate the major increase in ridership following the elimination of free employee parking (Fullerton 2005). The second prong of the approach was to emphasize implementation of an effective public transit mode to meet the land use needs identified in the Official Plan.

Upon completion of the 1964 Official Plan, the Regional Council adopted a "transit first" policy. This policy required that no investments would be made in road construction or widening unless a given transportation problem could not be fixed by improvements in the public transit system (Bonsall 1997). The transit first policy was a particularly powerful measure for increasing transit ridership. Between 1975 and 1986 the number of trips to center city increased significantly, however the majority of this increase was accommodated by the public transit

system. Additionally, one third of the regional increase in total trips was absorbed by public transit (Bonsall 1997).

Degree of regional planning/ coordination

The Province of Ontario's 1969 decision to create the RMOC to govern land use and transportation planning for Ottawa and its adjoining towns allows for strong regional planning initiatives (Cervero 1998).

Findings Summary

TOD occurred at the following five BRT stations: Tunney's Pasture, Westboro, Mackenzie King, Laurier, and Campus. Analysis of development at all of Ottawa's BRT stations suggests that where TOD did occur it was because:

- The basic fabric of a mixed-use, walkable neighborhood existed prior to busway construction. For example, three of the TOD locations in Ottawa are located just outside of the downtown area: Mackenzie King, Laurier, and Campus. Much development has occurred at these stations since BRT implementation; however, there was a basic mixed-use, pedestrian oriented fabric in place on which the new development could build.
- Recent Ottawa policies have promoted dense development at BRT stations through density bonuses and parking reductions. This is the case at Westboro Station, another TOD location. The existing mix of uses existed prior to BRT completion; however it was at a very low density. The city policies have lead to high-rise, high-density residential development close to the transit station.

Analysis of development at BRT stations in Ottawa suggests that TOD did not occur at many of the stations because:

- The many Ottawa-Carleton policies to promote development at BRT stations focused on employment and retail rather than a mix of uses.
- The Ottawa-Carleton policies did not emphasize safe and comfortable pedestrian accommodations.

CHAPTER 5: Brisbane Case Study

City Context

The capital for the state of Queensland, Brisbane has a rapidly growing population and economy. Beginning in the late 1990s the Queensland government began promoting science and technology business and education development in Brisbane. The city is one of Australia's most important economic centers.

Table 5.1 Transportation and Urban Systems Conditions

Population	Greater urban area: 1.8 million City: 958,504
Population Growth (1999-2004)	11.5%
City Density	278 people per square mile
Median Household Income	US \$31,180
Average Transit Mode Share	BRT has 7% of daily trips and 13% of peak period trips, 50% of total bus share (2002)

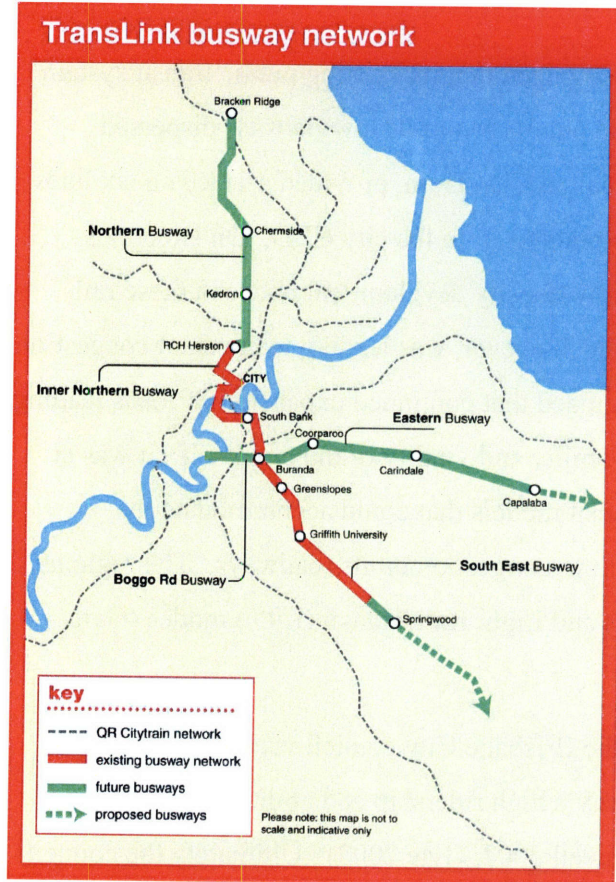
Source: Australia Bureau of Statistics 2004, Rathwell 2002

System Overview

The first line of Brisbane's proposed five corridor Bus Rapid Transit system opened in 2001. This 17 km (10.5 mile) busway extends south east from the Brisbane Central Business District (CBD), runs alongside the South East Freeway, and serves ten stations. In 2004 the 4.7 km (3 mile) Inner Northern busway, providing fast, reliable transit across the CBD, opened (Levinson 2003). Over the next six years TransLink, the South East Queensland transit agency, plans to construct all five busways proposed in the Integrated Regional Transit Plan. Figure 5.1 displays the long-term plan for the city's BRT network, fully integrated with the existing rail service. Figure 5.2 shows a more detailed picture of the existing busways, South East and Inner Northern, in relation to the rail.

On the spectrum of BRT types presented in chapter two, Brisbane's busways can be categorized as "BRT," but not "Full-BRT." Brisbane's system has most features of "Full-BRT," such as primarily segregated busways, frequent service, and rapid speed. However, it lacks pre-board fare payment (White et al 2006). By the time the full BRT plan is implemented, the South East and Inner Northern busways will be integrated with three other busway lines, the existing commuter rail service, and a system of citywide bikeways (Gyte 2007).

Figure 5.1 South East Queensland's Existing and Planned Busway Network



Source: TransLink 2007

Figure 5.2 South East and Inner Northern Busway Stations in the Context of the Regional Rail Network



History of the System

In the early 1990s the City of Brisbane recognized that its existing public transit system was not sufficient to serve the increasingly mobile population in its low-density, dispersed neighborhoods. The existing surface heavy rail, called City Train, provided service on six lines, totaling 251 miles (405 km), in a radial pattern extending from the city CBD. On street bus service and roads were, at that time, serving the low-density development between these rail lines. Heavy use of autos and on-street bus service, however, was leading to constant congestion and pressure to expand roadways. The city recognized that continued expansion of roads leading to the CBD would ultimately compromise the livability and vitality of the city itself. It was at that time that the city began to explore public transit models that could accommodate the growing South East Queensland population and limit congestion on its roadways. The regional government considered Bus Rapid Transit (BRT) and Light Rail Transit (LRT) modes (Gyte 2007).

During the mode consideration process, the Brisbane City council visited Ottawa. The councilors were impressed with Ottawa Transitway's high ridership and ability to serve the region's previously auto dependent centers (Rathwell 2002, Gyte 2007). Ultimately the council concluded that busways could best meet Brisbane's current public transit needs. A BRT system, they felt, could enhance the existing public transit system and, at the same time, provide efficient transit options for currently underserved Brisbane neighborhoods. The state transportation agency responded to this decision by hiring Toronto based BRT consultant John Bonsall to develop a busway network vision for Brisbane (Gyte 2007).

In 1995 federal, state, and local governments began collaboration on the South East Queensland Integrated Regional Transport Plan (IRTP). This multi-tiered initiative recognized the importance of coordinating state controlled busway transit planning with regional level land use planning decisions. In 2005 the regional government adopted the South East Queensland Regional Plan 2005-2026. This document is a product of the South East Queensland Office of Urban Management, a regional land use planning agency representing the 18 jurisdictions in SE Queensland. The document identifies the region's future footprint and highlights six regional centers to which local governments should target future growth (IRTP 2006 Version). Figure 5.3 is the IRTP map showing the six proposed regional centers. To ensure that transportation

infrastructure investments continue to reflect the reality of the region's growth, as required in the IRTP, the Office of Urban Management annually produces a South East Queensland Infrastructure Plan and Program. The infrastructure plan identifies the road and transit investments for the coming year and reflects the most up to date information on new and upcoming development (Office of Urban Management web site 2007). In this way the region's limited construction dollars are allocated to best respond to land use realities.

Figure 5.3 South East Queensland's Regional Growth Plan, Including Target Growth Areas

Map 2: SEQ regional land use categories (Amendment 1)

Statutory

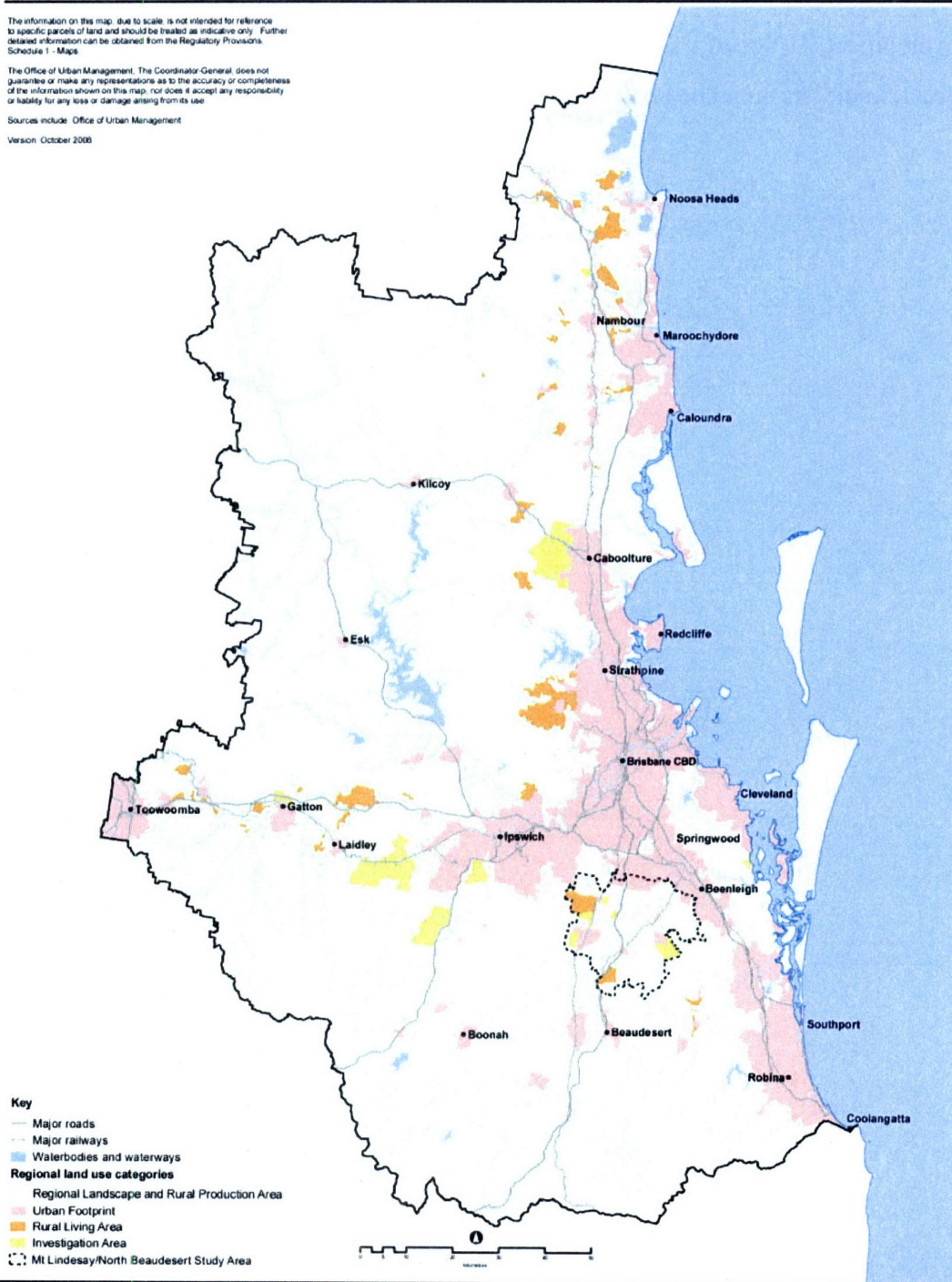
South East Queensland

The information on this map, due to scale, is not intended for reference to specific parcels of land and should be treated as indicative only. Further detailed information can be obtained from the Regulatory Provisions, Schedule 1 - Maps.

The Office of Urban Management, The Coordinator-General, does not guarantee or make any representations as to the accuracy or completeness of the information shown on this map, nor does it accept any responsibility or liability for any loss or damage arising from its use.

Sources include: Office of Urban Management

Version: October 2006



Source: Office of Urban Management, Queensland, Australia, 2006

System Purpose

According to Barry Gyte, TransLink's Busway project manager, the South East Queensland regional BRT system has two primary purposes:

1. Provide efficient public transit service to residents of the low-density, primarily single family neighborhoods that dominate the Brisbane residential sector.
2. Deliver busway riders to prime regional development nodes not previously served by rapid transit. Some of these nodes were existing centers of commercial and residential activity at BRT conception and others were identified on the Regional Plan as target growth locations.

The IRTP proposes seamlessly interconnecting the rail and BRT systems by improving bus-rail and bus-bus transfers. Ideally, this newly extended network will not only improve regional transit access, but would also make public transit more competitive with driving (Levinson 2003). BRT is a logical mode with which to extend the rapid transit system given that the most underserved areas are those in the "wedges" between rail lines. Brisbane planners envision a BRT service that allows buses to exit fixed busways, pick up "wedge" residents in convenient locations, and return to the busway for fast and reliable service (Gyte 2007).

Station Area Development Patterns

The South East busway, completed in 2001, has seen more development than the existing Inner Northern Busway or the three other planned BRT corridors. The Inner Northern busway, opened in 2004, and the Eastern Busway, scheduled to open in two to three years, have also seen significant investment at station locations (Gyte 2007). Table 5.2 gives an overview of development within walking distance (1/4 to 1/2 mile) of the ten South East Busway stations. The majority of this development either existed or was planned prior to the regional government's decisions on station locations (Couttes 2007). In fact, the regional government's system for locating stations was largely dependent on existing and planned development, in addition to the local government's willingness to provide the safe and comfortable pedestrian links necessary to promote station area walkability (Gyte 2007).

Table 5.2 Existing and Planned Development at Brisbane's South East Busway Stations (in order of closest to furthest from CBD)

Stations	Existing Development	Planned Development
Cultural Centre	Queensland Museum and Library; Gallery of Modern Art	
South Bank	Retail and residential towers up to 14 stories in height; Queensland College of the Arts; Technical and Further Education College	
Mater Hill	Major private hospital; Hospital expansion with ground level retail space (coffee shop and convenience retail)	
Wooloongabba	Major sports stadium (publicly owned); three eight-story apartment buildings with ground level retail, including grocery store	
Buranda	Transfer station with regional rail service. Primarily single family residential.	Major mixed-use center, including housing, a hotel complex, fresh food market, and cinema (Anthony John Company). Buildings up to 15 stories.
Greenslopes	Low-Density single family residential neighborhood	
Holland Park West	Low-Density single family residential neighborhood	
Griffith University	Station located in forested area between the University's two campuses.	
Upper Mt. Gravatt (Garden City Mall)	Large indoor shopping center, including major big-box retailers. Government services, including Federal Department of Taxation.	Target growth center on regional plan; Second phase of mall now being planned
Eight Mile Plains	Park and ride facility	

Source: Gyte 2007

Is the Development at the Stations Transit Oriented?

Given that much of the development on the South East Busway pre-existed the BRT system, the five stations closest to center city are surprisingly transit oriented. The five stations furthest from downtown clearly reflect suburban development patterns. At many of these suburban stations, however, there is potential for future development that could transform the area into a walkable mixed-use node.

The transit/ land use relationship on this corridor could also be considered Development Oriented Transit (DOT) in that Brisbane designed a transit system to best serve its existing development pattern. For the purposes of this study, TOD is not defined by the methods used to create the physical environment. In this way, the dense, mixed-use, walkable development adjacent to the South East corridor stations is TOD, even if it is also DOT.

The following analysis includes the five BRT stations that have TOD and the one station at which there is a proposal for TOD (Buranda Station). It does not include the four two stations located in low-density residential neighborhoods, the one station in a forested area, and the one station at a park and ride facility. I did, however, study these stations in Google Earth to ensure that their development pattern was appropriately represented in this study.

Note: The red circle in the following figures represents a quarter mile radius around the BRT station.

Figure 5.4 Cultural Centre Station

Cultural Centre, the first station outside the CBD, is adjacent to Queensland Museum and Library. The state's plans to add a new gallery of modern art to the site coincided with construction of the busway station and, consequently, the station could be located as to best serve this emerging cultural node. Gyte explains that the state's decision to expand its museum was unrelated to the busway construction, but "the point is that it [the museum] is now well served by the busway because the planners knew where to put a bus station to serve the upcoming development." TransLink planners were able to work with museum designers and Brisbane city planners to integrate the station and ensure strong pedestrian connections (Gyte 2007). This is TOD.



Figure 5.5 South Bank Station

The South Bank Station area, formerly warehouse sheds, was completely cleared in 1998 for the World Expo. Following the expo, the government owned South Bank Corporation came in to redevelop the entire area. The master plans for South Bank and the BRT system were designed at the same time, so the two entities were able to lay out road networks and development plans in conjunction with each other. Over the last six years there has been significant development and the area now has private retail and residential towers up to fourteen stories in height. Additionally the government integrated the Riverside parkway into this area. The Queensland College of the Arts found a suitable site at South Bank believing it an ideal location near the Cultural Centre. The public Technical and Further Education College was also expanding at this time and, rather than locating a new campus in the suburbs, decided to build at South Bank. The government gave a parcel of land to a private developer and, upon promise of a long-term tenant, the developer agreed to build the new college building at no cost to the government (Gyte 2007). Gyte remarks that all of these developments are now pedestrian oriented and “easily accessible by all of Brisbane.” This is TOD.



Figure 5.6 Mater Hill Station

Mater Hill Station, already the site of a major private hospital, has seen significant medical facility expansion in conjunction with the busway station development. Prior to busway construction, the government acquired excess land adjacent to the existing hospital. It then sold the land to the hospital with an agreement for joint development integrating the station into the base of a new ten story clinic. In order to ensure that the expansion contributed to street level activity and promoted pedestrian movement, the planners required first floor retail space, now housing a coffee shop and other convenience retail (Gyte 2007). This is TOD.

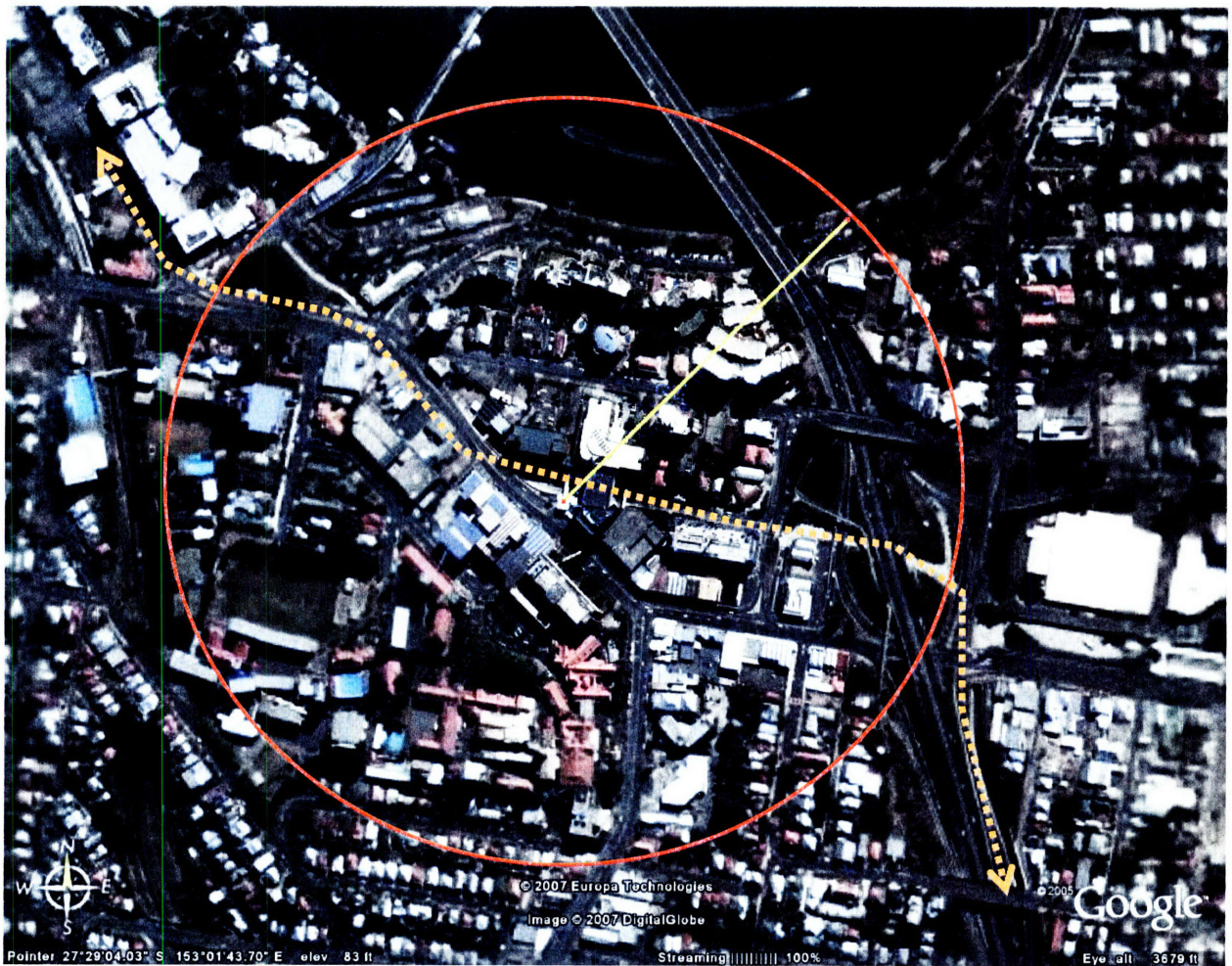


Figure 5.7 Woolloongabba Station

Woolloongabba Station was strategically located at a major government owned sports stadium soon to undergo upgrades. The station was designed as to provide convenient service to the massive new facilities. Private developers also chose this station for three eight-story apartment buildings with ground level retail, including a grocery store. The complex's marketing materials are aimed at young professionals who can use the BRT to quickly and easily access their jobs. During peak hours the buses come to this location at frequent headways. There is also a major government printing complex near the station that the government plans to relocate to allow for new apartment construction (Gyte 2007). It is important to note that the station is located at the intersection of two six-lane streets (not including the busway). This is TOD.

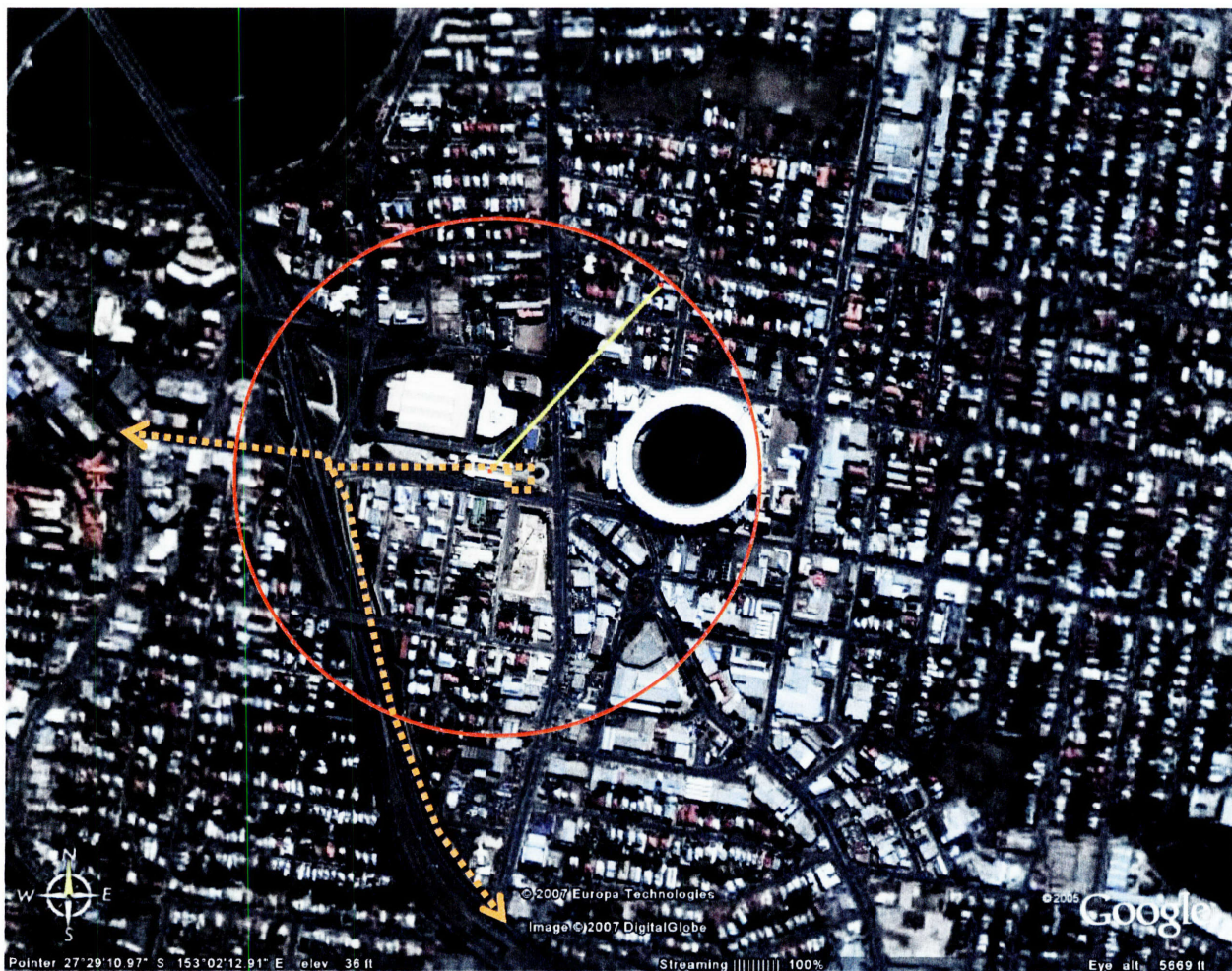


Figure 5.8 Buranda Station

The Buranda Station did not initially have any development proposals as neighbors were concerned about the impact of the busway on their quality of life. In fact, the busway was originally planned to bridge over the existing rail station, but due to resident concerns was redesigned as an underground station. The aerial photo demonstrates the distinctly low-density single family conditions around the station. This is also the first station located immediately adjacent to the highway. Without a pedestrian bridge or tunnel, the entire western side of the highway is inaccessible for safe pedestrian activity. Since construction of the station, a developer has purchased 27 properties at the station and plans a major mixed-use center, including housing, a hotel complex, fresh food market, and a cinema. His proposal includes buildings up to fifteen stories (Gyte 2007). Buranda is, not surprisingly, a major transit hub due to its intersection with the rail and the upcoming eastern busway that will extend to the University of Queensland. In the near future this location may transform into TOD.

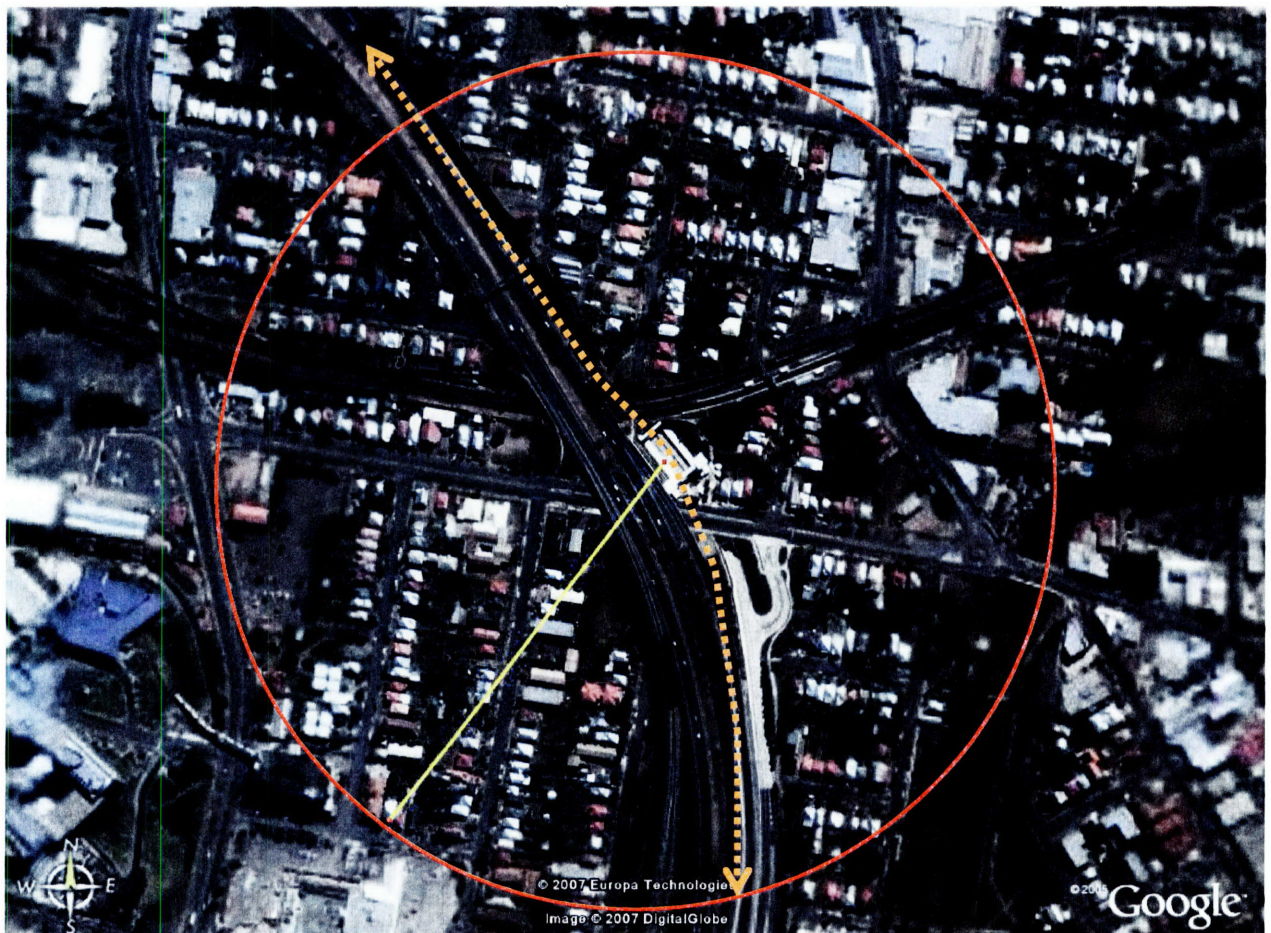
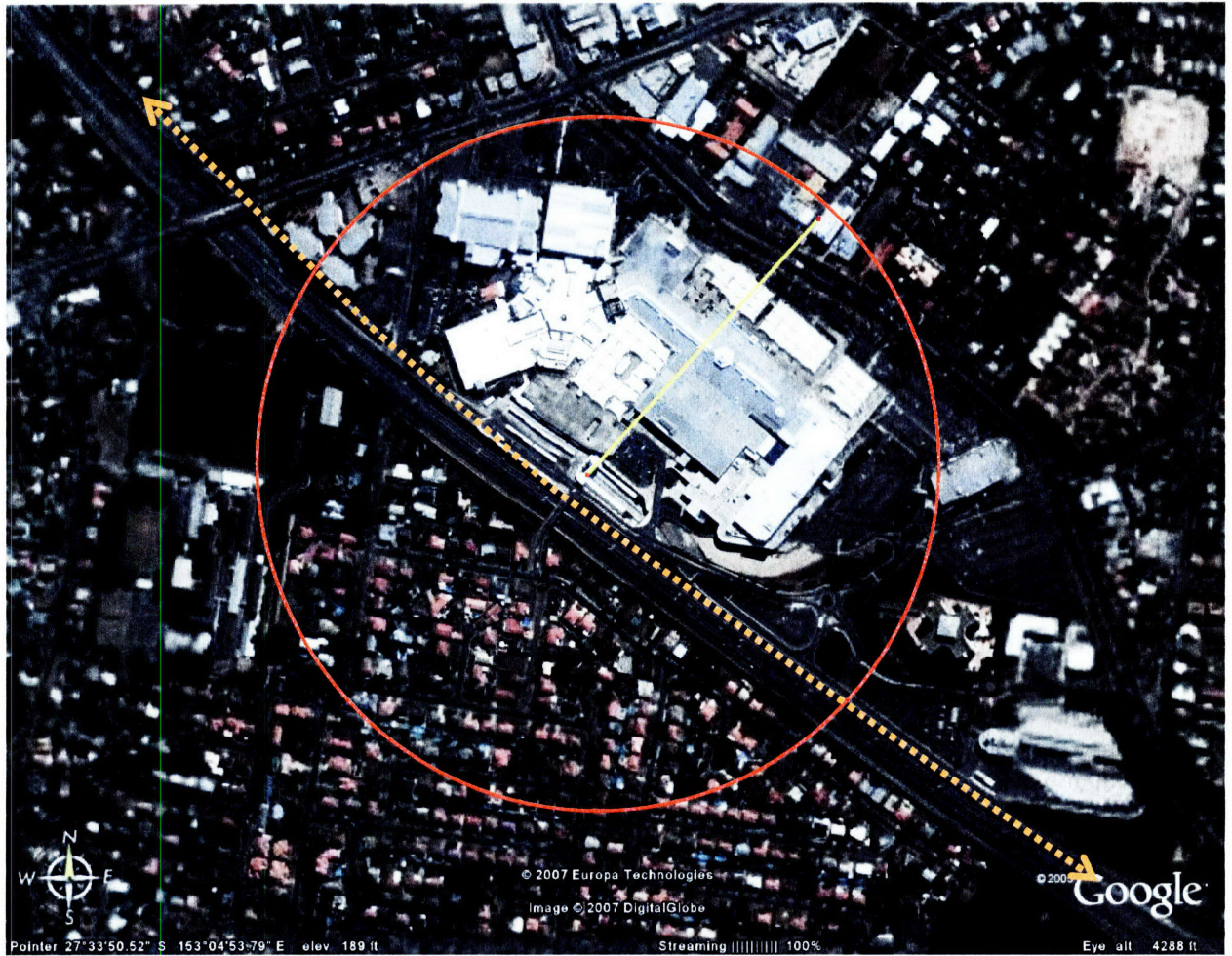


Figure 5.9 Upper Mt. Gravatt Station (Garden City Mall)

Garden City Station is one of the target growth centers identified in the SE Queensland Regional Plan. It is the site of a large shopping center, including major big box retailers. Prior to its identification as a regional center, the complex was surrounded by large parking lots and completely designed for car driving customers. Upon its selection as a regional center, the government began investing in the area to improve its function and appearance. Many government services were moved to the Garden City Station, including the Federal Department of Taxation. The private sector has since responded in turn with construction of commercial office buildings. The primary owner of the site, A&P (now Westfield) had major expansion plans, including conversion of the shopping center into a town square and accommodating outside dining. TransLink tried to coordinate its station construction with A&P, but the company ignored these efforts and the shopping center turned its back on the station. Over the past seven years of busway service the shopping center owners came to realize the importance of busway customers. The new owners, Westfield, are now trying to embrace the station with their second phase of expansion (Gyte 2007). There is low density residential development within a quarter mile of the station, across the freeway. It is accessible by way of a pedestrian bridge.

Note the marked similarities between this development pattern and that at many Ottawa Transitway stations. There is a mix of uses within the quarter mile radius, but they are distinctly isolated into retail, office, and residential sectors. In this case there is a pedestrian bridge that makes the area south of the freeway safely accessible for pedestrians. However, the residential development in this area is very low density, consistent with that outside the quarter mile radius. This is not TOD.



On the outer half of the South East busway, four of the five stations clearly do not have TOD. **Greenslopes and Holland Park West** have a distinctly low-density single family residential condition. James Couttes, Principal Planner with the Brisbane City Council at the time of SE Busway development, explains that the council recommended construction of the busway on Logan Road, 1.5 km to the west, so that it would travel through the mixed-use, walkable cores of the Greenslopes and Holland Park communities. Due to citizen concerns regarding bus pollution and noise, the regional government chose instead to locate the BRT next to the highway. Couttes believes that if the South East busway were built today, the citizens would want it on Logan Road. The past six years of busway success has made BRT a popular concept in Brisbane (Couttes 2007).

The **Griffith University Station** is the site of two extensive campuses divided by a large forested area. The busway station is in the middle of the forest and the buses must exit the busway in order to directly serve the campuses. **Eight Mile Plains Station** is the final station and sits between the Brisbane ring road freeway ramps. Eight Mile Plains Station is a park and ride facility. It is a popular station and, even with recent expansion, TransLink has been unable to keep up with parking demand (Gyte 2007).

Factors Influencing the Station Area Development Pattern

Interconnectedness of public transit services

A primary goal of the South East Queensland Integrated Regional Transport Plan (IRTP) is to ensure that construction of the new BRT system is carefully integrated into the existing network of commuter rail and bikeways. Currently, however, the existing 14 miles of busway (South East and Inner Northern) function independently of each other and the other modes.

Location/ alignment of the busway and stations

When it is time to determine the alignment for each of the corridors and locations for each of the stations, TransLink performs a detailed analysis of existing development and infrastructure. It also carefully considers future growth and improvement plans for the areas around the stations (Gyte 2007). In this way TransLink selects the locations that are most likely to offer TOD immediately or in the near future.

TransLink strategically selected the South East Busway as its first corridor to construct. It primarily parallels the South East Freeway, which means there were few grade change issues (keeping down costs) and there were fewer neighbors to voice complaints. The theory was that if this busway corridor was as successful as TransLink expected, it would serve as proof of the busway system's value to other parts of Brisbane. TransLink hoped that the South East busway's success would ease public concern with regard to constructing busways in more highly developed areas (Gyte 2007). Due to the South East Busway's location next to a freeway, some people argue that there is less development response than there would be in a more desirable location. Gyte responds that this may be true, but as land becomes scarce in the Brisbane area, these station sites may become more attractive as transit oriented development sites.

Degree to which land use and public transit decisions are integrated

In South East Queensland, the regional government produces the South East Queensland Regional Plan, of which one chapter is dedicated to an Integrated Regional Transportation Plan (IRTP). The local governments in the region are responsible taking the concepts of the Regional Plan and incorporating them into a Local Growth Management Strategy (LGMS). The local government makes land use decisions; however, the regional government can override those decisions should it decide the locality is not following the Regional Plan (Office of Urban Management web site 2007). In this way, the regional government ensures that land use decisions are made in a matter consistent with the region's integrated transportation/ land use plan.

Existence/ effectiveness of policies to promote station area development

The TransLink Busway Planning Manager, Gyte, is quick to point out that the development at these stations is not the result of TOD market forces, but the result of careful coordination between TransLink, other government agencies undergoing facility expansion, and private developers in the target growth areas. The result is not so much policies to promote TOD, but negotiation between parties and encouragement from the government.

Existence/ effectiveness of policies to promote walkability at stations areas

Parking regulation is a primary method by which the South East Queensland regional government controls walkability. One of the reasons area leaders were attracted to BRT is its ability to pick up/ drop off passengers within neighborhoods. This, they felt, would eliminate the

need for park and ride at the stations. As a result, park and ride lots are only allowed at the final station of each busway line. The elimination of park and ride facilities at busway stations makes the land available for pedestrian oriented development.

Generally local governments are also willing to reduce parking requirements for busway transit oriented development, but developers have not yet asked for such variances (Gyte 2007). Gyte's perception is that even if the developer believes that the busway station will reduce demand for parking, banks are not yet ready to adjust lending formulas to reflect the reduced need for auto accommodations.

Policies requiring pedestrian infrastructure are created and implemented at the local level. The regional planning strategy is to target specific areas for future growth and then work with local transit planners to most effectively integrate public transit into that location. Accommodations for pedestrian safety are some of the issues addressed in this process. Additionally, sidewalks, shade street trees and other pedestrian amenities are important consideration for regional planners when selecting appropriate locations for busway stations (Gyte 2007).

Extent of public financial investment in station area development

The SE Queensland regional government has contributed to station area private development through in kind contribution and station integration projects. The government did this with property at South Bank Station to encourage private construction of a building to house its public technical college. Similarly, at Mater Hill Station the government acquired land adjacent to the hospital and then worked with the hospital to construct an integrated station/ administrative office tower (Gyte 2007).

Additionally, multiple tiers of government have contributed to station area development by building for their own needs in these locations. For example, some federal government services have built new structures and moved to Upper Mt. Gravatt Station in an effort to urbanize this regional development node (Gyte 2007).

The most significant public contribution to station area development, however, was selection of station locations that had the potential for future mixed-use, high density growth. Once these stations were located, the government paid for construction of the busway system and the stations themselves.

Extent of public financial investment in transit system

TransLink commits itself to construction of the busway, each station building, and the station entry plazas. The local government is responsible for providing sidewalks, shade trees, and street furniture to appropriately link the station to existing development. This pedestrian and bicycle infrastructure is an important component of TransLink's decision as to where it locates each station. The agency realizes that station area development is only transit oriented if it provides safe and easy connections for the public (Gyte 2007).

Degree of regional planning/ coordination

As described in the history section, the federal, state, and local governments collaborated on the 1995 South East Queensland Integrated Regional Transport Plan (IRTP). This multi-tiered initiative recognized the importance of coordinating state controlled busway transit planning with regional level land use planning decisions. In 2005 the South East Queensland regional government adopted the South East Queensland Regional Plan 2005-2026. This document is a product of the South East Queensland Office of Urban Management, a regional land use planning agency representing the 18 jurisdictions in SE Queensland (Office of Urban Management 2007). The regional governments in Queensland have the policy making and regulating powers to make regional planning possible.

Findings Summary

The analysis of Brisbane's BRT system suggests that TOD has not happened at five of the ten stations on the line because:

- Some of the stations are located in existing low-density residential neighborhoods with limited opportunity for development.
- Many Brisbane residents were not familiar with the BRT concept and did not want to see it in their neighborhoods. Brisbane public opinion has shifted dramatically since the first BRT line (South East Corridor) was completed.
- Some of the stations are located adjacent to a very busy freeway.
- Brisbane uses a "carrot" approach to encourage TOD at its stations; it does not use "sticks," such as regulations to require high density development or pedestrian accommodations in certain zones of the city.

The analysis of Brisbane's BRT system suggests that TOD has happened at five of the ten stations on the line because:

- The station locations for the first five stations (those with TOD) are carefully located in areas that had existing or planned development consistent with the characteristics of TOD. In this way, Brisbane has created Development Oriented Transit (DOT).
- The region invested in very high quality busway and station designs. In some instances the busway uses underground tunnels and bridges in order to best serve the existing development pattern.
- Government, at all levels, has made an effort to build its own facilities at busway stations.

CHAPTER 6: Pittsburgh Case Study

City Context

A former heavy industry center, the City of Pittsburgh's population has been declining for the past several decades, while the region's population has remained relatively constant. Pittsburgh's geography is that of very hilly terrain at the confluence of the Ohio, Allegheny, and Mongonehela Rivers (Levinson 2003). These geographic constraints dictate much of the transportation decision making for the region.

Table 6.1 Pittsburgh Transportation and Urban Systems Conditions

Population	Metropolitan area: 2,358,695
	City: 334,563
Population Growth (1990-2000)	Metro area: -1.5%
	City: -9.5%
City Density	6,019 people per sq. mile
Median Household Income	\$28,588
Average Transit Mode Share	60% of the people entering/ leaving the CBD during peak hours use public transit.

Source: US Census 2000 and Levinson 2003

System Overview

The Pittsburgh busway system consists of three lines extending south, east, and west from the city's downtown core. The lines were opened in 1977, 1983, and 2000 respectively and cover a distance of 19 miles. Each line uses a separated busway for the length of its service, transitioning to bus lanes as the lines converge in Pittsburgh's downtown core. Figures 6.2, 6.3, and 6.4 show the busway alignments and station locations.

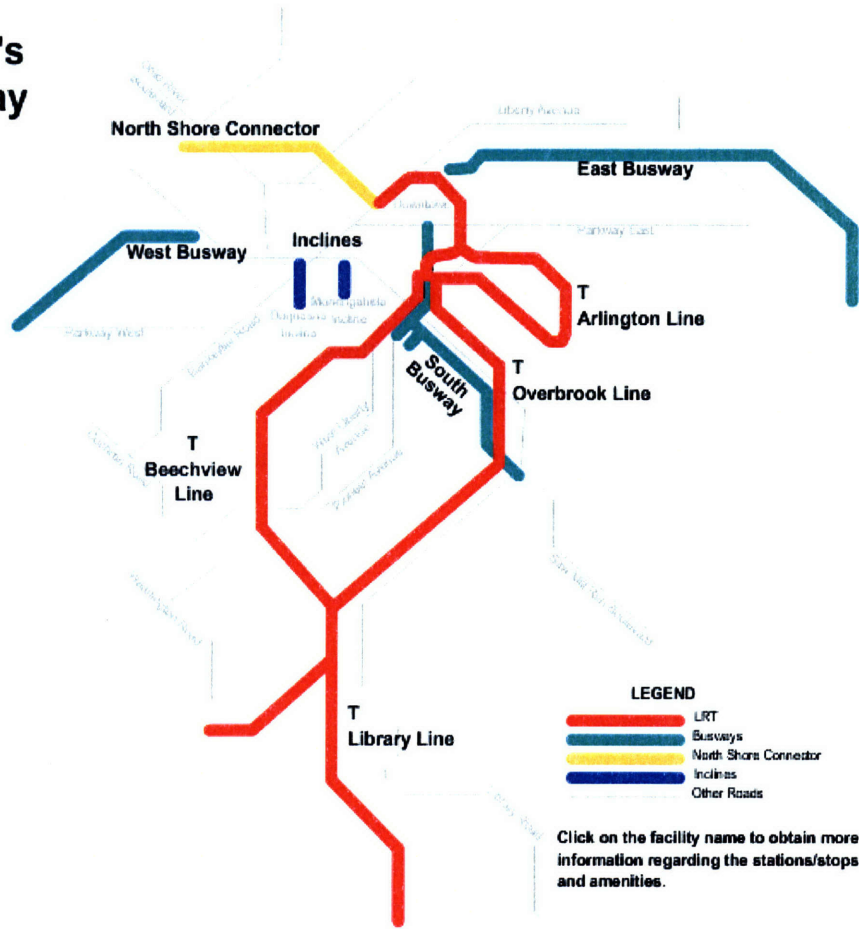
Each busway offers all-stop service and express service. Many of the routes pick up passengers at suburban residential on-street (off busway) stations, then use the busway for express service to downtown. On the spectrum of BRT services, outlined in chapter 3, Pittsburgh's system is "BRT-lite." The system primarily uses segregated busways, has high quality shelters, and provides improved travel times and frequent service. The busways do not have other typical BRT features, such as pre-board fare payment, marketing identity, and clean

vehicle technology (Wright 2006). In recent years, however, the Port Authority has begun to experiment with hybrid vehicles (Hassett 2007).

The Allegheny County Port Authority is responsible for all bus rapid transit services. It also runs a 25 mile, four line light rail transit system, the first leg of which opened in 1984. Currently under construction is the 1.2 mile North Shore Connector that will tunnel under the Allegheny River. This new light rail line is scheduled to open in 2011. Figure 6.1 highlights the difference in service areas for the busways and light rail transit (LRT) lines. The LRT and busway services intersect at a few locations south of downtown. The transfers occur not at the stations on the busway trunk corridors themselves, but rather on bus routes that use the busway for a portion of their travel. Transfers between transit modes are made easy by Allegheny County's zone based fare payment system (Port Authority Web Site 2007).

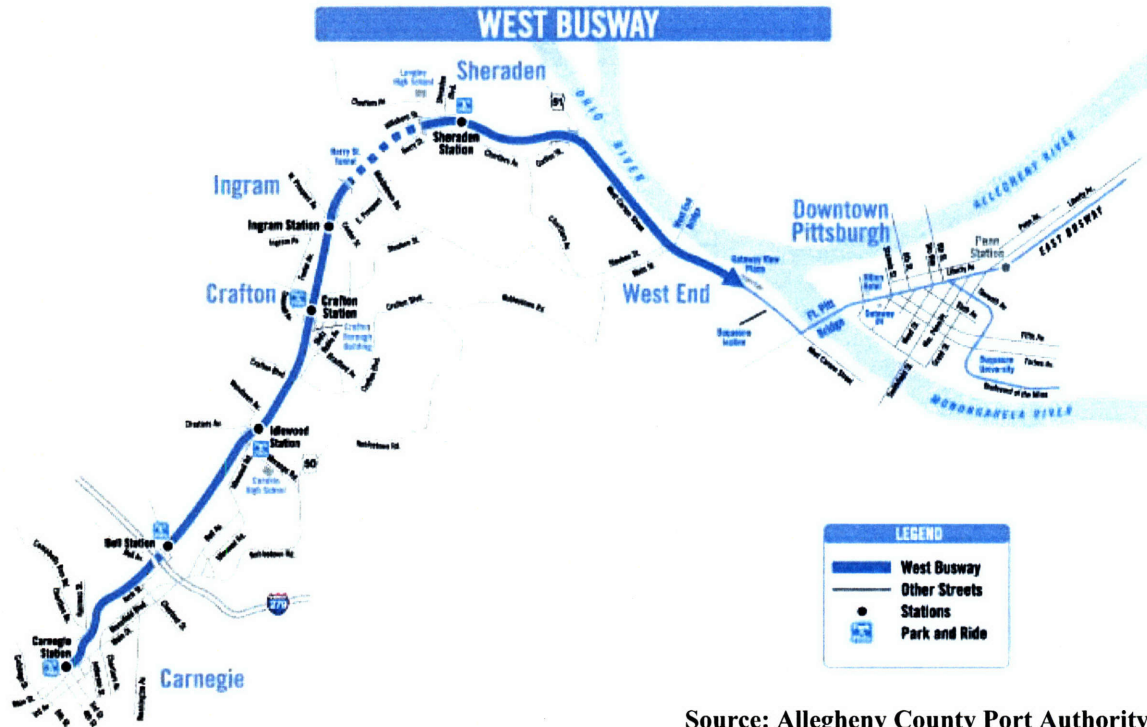
Figure 6.1 Pittsburgh Busways and Railways

Port Authority's Fixed Guideway System



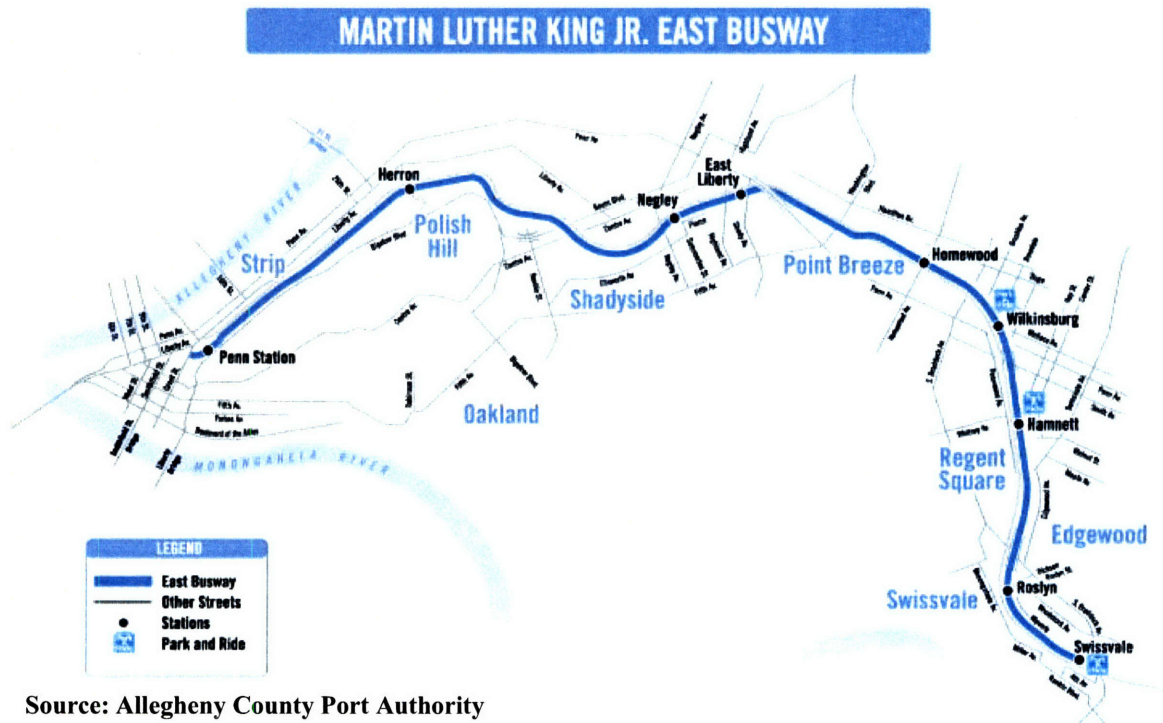
Source: Allegheny County Port Authority, 2007

Figure 6.2 Pittsburgh West Busway



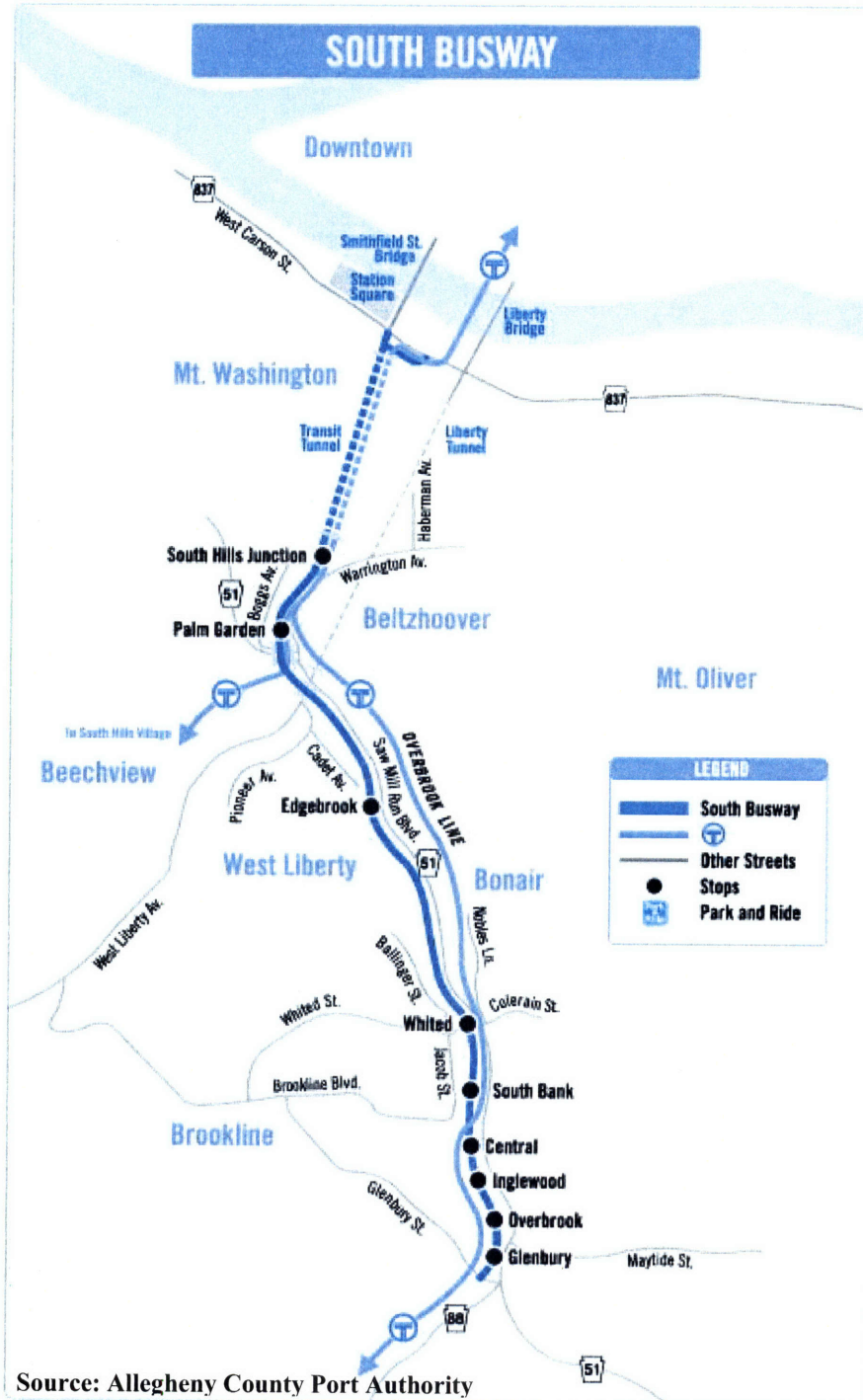
Source: Allegheny County Port Authority

Figure 6.3 Pittsburgh Martin Luther King Jr. East Busway



Source: Allegheny County Port Authority

Figure 6.4 Pittsburgh South Busway



History of the System

The Allegheny County Port Authority Transit (PAT) agency first recommended the South and East busways as a part of its 1967 Early Action Program. Established in 1964, PAT was immediately faced with the need to address increasing highway congestion with a Pittsburgh area rapid transit plan. The Early Action Program was its initial step.

The South Busway opened in 1977, providing fast and efficient travel between Pittsburgh's downtown and South Hills. This transit option allowed commuters to avoid the serious auto backups at Liberty Tunnel and today saves commuters an average of 6-11 minutes during rush hour (Wohlwill 2007). Due to steep topography, a consistent challenge in Allegheny County, PAT had limited options for the new busway alignment. PAT chose to locate the South Busway on the flat grades adjacent to the Norfolk and Western railroad tracks (PAT web site). BRT had the flexibility to exit the busway and pick up/ drop off passengers within the adjacent communities. This was a particularly important factor since the busway location had more to do with right-of-way availability than access to the population. For this reasons LRT was never a serious consideration for this corridor.

In the early 1980s Eastern Pittsburgh and its eastern suburbs were major county growth centers. Oakland, located in this area, serves as a second Pittsburgh CBD due to the large medical and university facilities in the vicinity. In anticipation of future growth and its associated mobility demands, the Port Authority decided to convert part of an existing four track railroad into a local service busway. The South Busway had proved a relatively low cost solution to that area's transit needs, so replication of the service in the East seemed a logical approach (Levinson 2003). The East Busway opened in 1983 and today commuters who use this busway rather than driving their cars the length of the busway save an average of 21-24 minutes at rush hour (Wohlwill 2007).

In 2000 the five mile West Busway opened in conjunction with a 1.1 mile reversible HOV lane, sharing the same limited width tunnel (PAT web site). This busway was the result of the 1988-89 Parkway West Multimodal Corridor Study. This study recognized the need for improved access between the airport and downtown Pittsburgh, part of which is provided with this transit corridor. The West Busway, like the South Busway, provides an alternative for commuters trying to avoid auto congestion at the Fort Pitt Tunnels (Levinson 2003). The

busway is located on an abandoned railway and reuses an old railroad tunnel. Even so, significant cuts in terrain and retaining walls were necessary for construction.

Today the busways remain a popular mode of transportation in the Pittsburgh region. The eastern busway carries 30,000 customers each day. The South busway carries 13,000 and the West Busway carries 7,000 (Levinson 2003).

System Purpose

The original purpose of all three busways was to provide alternative means of access for commuters who would otherwise face significant road congestion (Levinson 2003). The steep Allegheny County hillsides limit road, railroad, and bus locations to very specific alignments. Additionally, the area is dependent on bridges and tunnels, which are extremely expensive to expand. As a result, city and county leaders looked to rapid transit as a way to limit road widening and accommodate the increasingly mobile population within existing transportation rights-of-way (Levinson 2003).

It was not until the 1990s, well after two of the busways were constructed, that the transit/land use connection became a common consideration in the Pittsburgh transportation and planning professions (Wohlwill 2007). Today Allegheny County and the City of Pittsburgh are aware and actively promoting transit for areas in which development is envisioned (Wohlwill 2007). Land use and development potential, however, were not considerations for the Pittsburgh busway construction. Planners located busways based on availability of right-of-way, terrain constraints, and ability to reduce peak hour traffic congestion (Levinson 2003, Wohlwill 2007).

Station Area Development Patterns

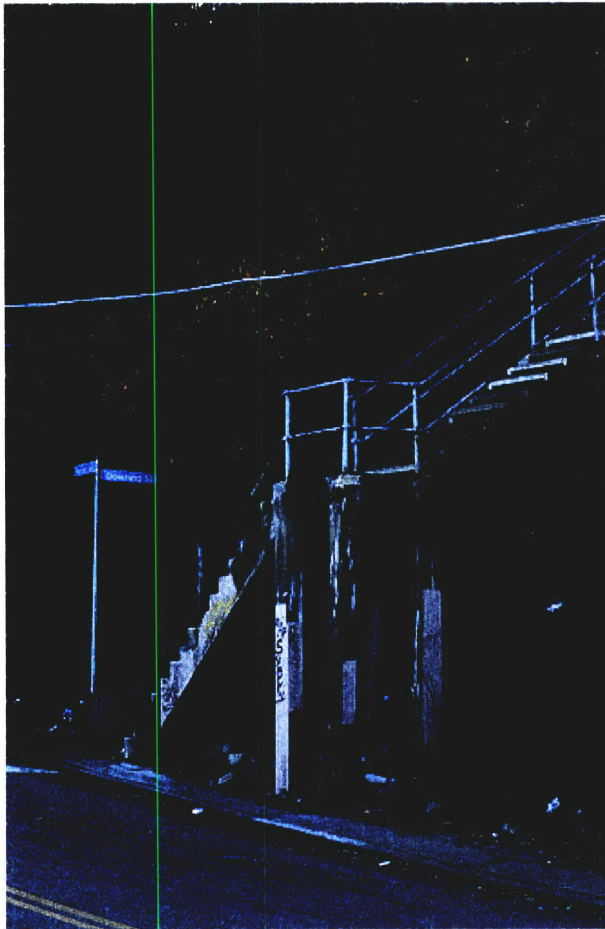
Between the 1983 East Busway opening and 1996, \$300 million worth of development was constructed along the busway, 58% of which is within 1500 feet of its stations (Wohlwill 1996, 6). This is a commonly cited fact in the literature about Pittsburgh's BRT system. Unfortunately, this fact is often misconstrued to suggest that the development is the result of the busway. Some even conclude that the location within 1500 feet of stations makes it transit oriented development. The report, from which this information comes, however, does not make either claim (Wohlwill 1996). Additionally, in the seven interviews I conducted of area planning staff, transit staff, and developers, no one felt there was proof of a link (Wohlwill, Gabhawala,

Link, Stephany). In fact, several were confident there was no relationship and that the development would have happened in its current locations regardless of the busway facility. Additionally, there is debate as to how well adjacent development is linked to the stations. Station area photographs show stations surrounded by low-density, primarily single family development, and commercial development with large surface parking lots. Sidewalk connections appear inconsistent with some providing safe pedestrian access to the stations and others non-existent or of low-quality. For reference purposes, Appendix A contains the “Inventory of Development Along the Martin Luther King, Jr. East Busway” contained in David Wohlwill’s 1996 report.

Figures 6.6 and 6.7 provide analysis of two developments currently underway on the East Busway. These projects are at East Liberty and Negley Stations, both in the neighborhood called East Liberty. Both of these projects qualify as TOD. Careful study of Google Earth maps and conversations with Pittsburgh planners indicates that there are no other locations on the East, South, or West Busways that have transit oriented development as described in East Liberty.

The first 6.8 miles of the East Busway were built without any park and ride facilities. According to Pat Hassett, Assistant Director of Pittsburgh Public Works, these stations function well for walk up passengers in the low-density adjoining neighborhoods, but cannot accommodate park and ride customers (Hassett 2007). Neha Gabhawala, City Planner, agrees that the stations are designed to primarily serve neighboring residents, but does not believe the pedestrian connections are strong enough to be deemed safe and comfortable (Gabhawala 2007). Figure 6.5 is an example of a dangerous pedestrian connection between Herron Station and adjoining neighborhoods. The lack of park and ride accommodations on the original 6.8 miles of East Busway is a concern for Pat Hassett and David Wohlwill, Head of Port Authority Transit. The East Busway extension, completed in 2002, does have stations with parking, but it is not sufficient given that many passengers drive to the busway service (Hassett 2007). The West Busway is a prime park and ride corridor. Five of the six stations on this corridor have commuter parking lots (PAT web site). The West and South Busways lack development near the stations. The lines were located not to link existing hubs, but rather wherever the railroad right-of-way was available (Levinson 2003). Tom Link, Manager of Business Development with the Urban Redevelopment Authority, explains that if there is nothing special or interesting at the stations to begin with, they are not desirable locations for further development (2007).

Figure 6.5 Sidewalk and Steps Connecting Herron Station to Adjoining Neighborhood



Source: PeterP

Is the Development at the Stations Transit Oriented?

The development at East Liberty and Negley Stations, analyzed below, is transit oriented. There are no other stations on any of the Pittsburgh busway lines that have TOD.

Note: The red circle in the following figures represents a quarter mile radius around the BRT station.

Figure 6.6 East Liberty Station

Currently there is a major mixed-use, station area development, called EastSide, underway at the East Liberty Station on the East Busway (Mickens 2006). Clear View Strategies, a local transit marketing and communications firm, claims that this is the first Transit Oriented Development in Western Pennsylvania (Clear View web site). Indeed, the new development will be integrated into the existing street grid, provide safe and comfortable pedestrian access between stores and to the transit station, include a mixture of retail, office, and residential uses, and be of higher density than the surrounding area. As of May 2007, phases one and two of three phases are complete. The project includes four national retailers (Whole Foods, Walgreens, Borders Books, and Starbucks) and other retail/ office space totaling 105,000 square feet. It also has a two level parking deck and is neighbored by new mixed-income residences. This is TOD.



Figure 6.7 Negley Station

Negley Station, also in the East Liberty neighborhood, but located one station west of East Liberty Station, is the site of another mixed-use development. Immediately adjacent to the busway ECHO developers have recently completed 54 condominiums stacked over a new 70,000 square foot Giant Eagle gourmet grocery store (McKay 2006). It too has strong pedestrian links to the busway station. Figure 6.8 is an oblique aerial photograph capturing the physical conditions around the redeveloped site. This is TOD.



Figure 6.8 Negley Station Grocery Store and Condominium Development



Giant Eagle Expansion
Shadyside, Pennsylvania



Source: ECHO Development Company, 2007

Factors Influencing Station Area Development Pattern

Interconnectedness of public transit services

Allegheny County's on-street bus service, BRT, and LRT are all under the auspices of the Allegheny County Port Authority. In this way, the fare structure easily accommodates transfers between modes. The interconnectedness of the public transit system, however, is very limited. The county's rapid transit consists of the three busways and four LRT lines, which do not provide comprehensive coverage for the area.

Location/ alignment of the busway and stations

The busway alignment is based primarily on the location of the public railroad right-of-way existing at the time of BRT construction. By using this public right-of-way, the county was able to greatly limit implementation costs and avoid community objection. As discussed earlier, existing development and land use development potential were not considerations. As a result, the West and South busways have seen almost no development in the station areas. There has been some development on the East busway, but there is debate as to whether the busway influenced the location and amount of this new construction.

In Wohlwill's report on East Busway development between 1983 and 1996, he attributes much of the development to pre-busway factors. He states, "The most important factors regarding location of development along the East Busway are development which existed prior to construction of the busway and proximity to local markets" (Wohlwill 1996, 6). Wohlwill comes to this conclusion based on his experience working with area institutions and developers. By "local markets" he means the existence of two major universities (University of Pittsburgh and Carnegie Mellon) and a large medical facility (University of Pittsburgh Medical Center) on the corridor. Over the two decades of East Busway existence, all three campuses have grown, as have their related services (Wohlwill 1996). Wohlwill also describes the Strip District, between Penn and Herron Stations, as "attractive to businesses and government agency developers because of its proximity to Downtown Pittsburgh, but with lower property costs" (7).

Wohlwill introduces availability of land as a second reason for development on the East Busway. The railroad, forming the corridor's spine, declined in value with the rise of road based passenger and freight service. It was for this reason that two of its four tracks could be replaced with a busway. The railroad decline coincided with the post World War II decline of heavy industry served by the railroad. As a result, railroad yards and industrial sites, which occupied much of the buildable land on the corridor, became available for redevelopment (Wohlwill 1996). The limited amount of flat land in Pittsburgh made these sites attractive for development.

As discussed in the last section, however, development along the busway does not necessarily mean transit oriented development. The city of Ottawa is a strong example of this phenomenon as it has seen significant investment at many Transitway Stations, yet only three fit the standards of TOD. Rob Stephany, Director of Commercial Development at East Liberty

Community Development Corporation, also known as East Liberty Development Inc. (ELDI), agrees with the distinction between transit at stations, often referred to as Transit Adjacent Development, and TOD. Drawing from his experience in Pittsburgh and study of TOD around the country, Stephany explains, “There is not a linear relationship between public transit stations and transit oriented development” (2007). The existence of the East Liberty and Negley Busway Stations were not enough to inspire the kind of vibrant, walkable, mixed-use environment that exists and is expanding in East Liberty today (Stephany 2007). There were, in fact, many factors that contributed to the transit oriented development in East Liberty. These include East Liberty’s historic, pedestrian oriented physical fabric; its location near affluent urban neighborhoods; the market shift toward urban living; strong neighborhood activism; a regional vision plan; transit agency/ developer collaboration; and city financial support (Stephany, Krahe, Colosi, 2007).

From the 1800s, when East Liberty was first established, until the 1950s, East Liberty served as a second CBD for the City of Pittsburgh (Mickens 2006). Its prime crossroads location made it a strong commercial node and affluent neighborhoods grew up all around it. The 1960s urban renewal movement led to significant demolition and the neighborhood’s subsequent decline, but “East Liberty has wonderful bones,” remarks Steve Mosites, the primary EastSide developer (Mendelson 2006). Pittsburgh developer Bill Krahe, with the ECHO Company, confirms this notion. He explains that the recent resurgence in urban living, coupled with East Liberty’s location amidst upscale enclaves, such as Shadyside and Squirrel Hill, have made East Liberty a terrific urban redevelopment setting (2007).

By the late 1990s, ELDI saw the market shift on the horizon. Rather than see the coming development pressure as a threat to the community, ELDI saw the development interest as an opportunity to benefit East Liberty residents. The challenge, however, was to make sure that the new development fit the existing community’s vision rather than allowing outside developers determine East Liberty’s future. In 1999 ELDI undertook an extensive visioning process with neighborhood residents. This effort led to the document [A Vision for East Liberty](#). The Vision reflects the East Busway’s primary importance in future area development. Even though it’s surrounded by affluent neighborhoods, East Liberty is a poor community where many residents depend on public transit to access work and other daily needs.

Soon after the vision document was completed the Mosites Company acquired land next to the busway and within the Vision study area. Steve Mosites was working with Whole Foods to establish a new store on this property. ELDI approached Mr. Mosites and suggested that they work together to bring new services to the neighborhood and stay in keeping with the Vision plan (Stephany 2007). Recognizing that a plan supported by the community would ease the process and likely create a better product, Mosites agreed (Colosi 2007).

ELDI recognized that in order to ensure that the new development follow the Vision plan, it would need to remain actively involved in every step of the process. Other big box retailers were coming to the table and ELDI was committed to incorporating the retail into the existing gridded, pedestrian oriented street pattern. The idea was to keep the new construction from turning its back on the existing community or the public transit station (Stephany 2007). Today Whole Foods, Borders Books, and Starbucks are all prominent storefronts at the East Liberty busway station. Each company embraced the East Liberty community's vision of Transit Oriented Development and realized that the thousands of busway riders that pass through this station daily would provide a strong customer base (Stephany 2007). Currently Mosites Company, ECHO developers, and ELDI are collaborating to bring Target to East Liberty.

Stephany's experience with the EastSide project is that national retailers are becoming more flexible with the big box building's physical form. In this case Borders Books agreed to locate in a multiple story structure that conforms to a street grid designed for pedestrian comfort.

Degree to which land use and public transit decisions are integrated

When the three busways were constructed in Pittsburgh, there was no land use vision associated with the system's transportation goals (Wohlwill 2007). In March 2006, however, Allegheny County Port Authority participated in a transit/ land use visioning process for Southwestern Pennsylvania. The resulting document is the 20/20 Vision Plan. An important component of this plan is the Toolbox for Transit Oriented Development, which emphasizes the importance of coordinating transportation and land use decisions in order to attain the goals outlined in the region's long-term vision.

Existence/ effectiveness of policies to promote station area development

In December 2004 the City of Pittsburgh Department of City Planning produced the Baum-Centre Corridor Vision. Baum Blvd and Centre Avenue parallel the East Busway at a distance of one to two blocks and are dominated by auto oriented strip development. The plan is an effort to redesign this corridor to improve pedestrian safety and provide better connections between emerging transit nodes. The plan specifically references the importance of supporting the East Liberty transit oriented development. Recently the City announced its plans to spend \$8 million on sidewalk and other pedestrian improvements along this corridor. As mentioned above, the Port Authority and Southwestern Pennsylvania Commission completed the 20/20 Transit Vision Study in March 2006, a document that describes the role of transit in the region's land use future. The study included extensive public input and trend analysis. Ultimately the document concludes that "focused growth" is the most cost effective and resource efficient choice for southwest Pennsylvania. Focused growth refers to "smart growth" development patterns and Transit-Oriented Centers that it defines as "using four important principles: Provide a compact and complementary mix of transit-supportive uses; provide pedestrian-friendly blocks, streets, sidewalks, and properties; reduce automobile use and lower parking requirements; and design transit to be at the core of the community" (20/20 Vision, 2006). According to Neha Gabhawala, Pittsburgh City Planner, the City is currently drafting zoning ordinance language that will facilitate use of the transit oriented development pattern at the busway and light rail stations (2007). It is documents such as the three described here that give city planners and developers the guidance and permission they need to encourage transit oriented development at all transit stations.

Existence/ effectiveness of policies to promote walkability at stations areas

To date the City of Pittsburgh has no policies to promote walkability in transit station areas. The TOD regulations currently under consideration by the City of Pittsburgh, however, will begin to address this issue.

Extent of public financial investment in station area development

The public sector role in promoting transit oriented development at the East Liberty and Negley Stations has taken three forms: direct financial investment, city and regional planning documents, and in kind infrastructure upgrades.

The Pittsburgh Urban Redevelopment Authority (UDA) has been actively involved in the development initiatives throughout East Liberty. It has used tax-increment financing (TIF) to support the East Liberty TOD and the Negley Station area development. East Liberty is a designated Mainstreets Pittsburgh business district, a PA Technology/ Enterprise Zone, and a former City Redevelopment Area (UDA Fact Sheet 2007). UDA Fact Sheets describe the value of the East Liberty Station and Negley Station developments in creating jobs and providing a regional attraction. The \$2 million in TIF financing provided by UDA required that the developer provide 54 mixed-income residential units as a part of its Giant Eagle grocery store expansion (Krahe 2007). Bill Krahe, ECHO Real Estate Co., explains that ECHO probably would have built the commercial portion of the development even without city financial support. Krahe says that the mixed-income residential component of the project, however, would not have been profitable without the UDA support and, therefore, ECHO would not have undertaken that component of the development (2007). Pittsburgh is a very old city and infrastructure upgrades are necessary and very expensive. Krahe claims that projects such as that at Negley Station are not financially feasible without city assistance (2007). Tom Link, UDA, could not comment on the Negley Station project itself, but agreed that the aging Pittsburgh infrastructure does make infill development more difficult for developers. That is one of the reasons that UDA provides financial resources for some redevelopment initiatives (Link 2007).

All three phases of the EastSide project drew on a range of public funding sources to help support the redevelopment. Tables 6.2 and 6.3 offer an overview of the project sources and uses.

Table 6.2 Sources and Uses: Whole Foods Grocery Store—EastSide Limited Partnership

SOURCES	
Private Lender	\$2,750,000
Equity	428,091
LISC Loan	2,375,000
Health and Human Services (federal grant)	500,000
UA Urban Development Fund Loan	250,000
URA Community Development Investment Fund Grant	150,000
URA Public Space Improvement Grant	150,000
URA Land Acquisition Proceeds	49,200
URA Streetface Loan (building façade improvements program associated with Main Street Program, Pittsburgh)	27,800
City of Pittsburgh District Improvement Loan	50,000
TOTAL	\$6,780,091
USES	
Acquisition	\$2,055,000
Construction	2,833,257
Soft Costs	1,891,834
TOTAL	\$6,780,091

Source: Pittsburgh URA Project Fact Sheet

Table 6.3 Funds Sources: Eastside II, LLC, July 28, 2004

Retail development adjacent to the Whole Foods Market, anchored by Borders Books, includes space for local professional services and offices.

SOURCES	
New Market Tax Credit Equity	\$5,239,149
Primary Lenders	5,611,583
Economic Investors	2,750,000
Health and Human Services (federal grant)	500,000
URA Urban Development Fund Loan	500,000
URA Community Development Investment Fund Grant	150,000
URA Streetface Loan	30,000
URA ROW Proceeds (from sale of right-of-way to the project developer)	140,000
Whole Foods Market/ Phase IIB Contribution	180,000
PA Site/ Home Town Streets (State infrastructure pedestrian bridge over East Busway (to link East L	1,000,000
PA Industrial Sites Reuse Program (for environmental clean-up in blighted areas)	28,399
General Partner Equity	1,655,758
TOTAL	\$17,784,889

Source: Pittsburgh URA Project Fact Sheet, 2004

Extent of public financial investment in transit system

Phase III of the East Liberty TOD is proposed on property currently owned by the Port Authority. It is a bus station, but also a large concrete circle used as a staging area for East Busway service. Many East Liberty residents see it as blight on its revitalizing district core (Stephany 2007). The TOD development team has designed a third phase that uses the property for mixed-use development and incorporates the busway into the design (Colosi 2007). The plan would require that the Port Authority redesign the ramps leading from the busway to the development area and use a series of dedicated bus lanes within the development to accommodate passenger boarding and stage buses. Developers and the Port Authority are not concerned about potential pollution and noise issues (Colosi, Hassett 2007). Tenants of the buildings in phase III will need to understand the philosophy of integrating the busways into the site and the developers believe they will in fact benefit from their location at the station (Colosi 2007). In order to alleviate Port Authority fears that they could lose busway access to phase III in the future, the busways would be legally dedicated to the agency. Although everyone agrees the phase III plan is a good idea in concept, developers and the Port Authority are still in negotiations as to the details of funding, construction, and long term maintenance (Colosi 2007).

Degree of regional planning/ coordination

There has been some cooperation between the City of Pittsburgh and Allegheny County, but there is no regional organization that oversees land use/ transportation planning coordination.

Findings Summary

The analysis of Pittsburgh's BRT system suggests that TOD did not happen at many stations primarily because:

- Pittsburgh does not have a strong growth economy.
- The city used existing, convenient rights-of-way for busway alignment, rather than locating the BRT to best serve existing and future land uses.
- There are very limited policies and financial incentives to develop at BRT stations or to provide pedestrian accommodations.

- The philosophy of the city government is to encourage those who would normally drive into the city to drive to busway stations and take transit to the center city. Large park and ride lots at stations do not facilitate dense, walkable development.

The analysis of Pittsburgh's BRT system suggests that where TOD is happening at stations, it is the result of:

- A local non-profit in the East Liberty neighborhood making a special effort to shape the development that is moving into its neighborhood. This low-income neighborhood has recently become a desirable place to live and develop because of its location surrounded by high-income neighborhoods.
- City support of the non-profit's work by providing economic development funds for redevelopment of sites on the busway.

CHAPTER 7: Case Studies Analysis

The case studies of Ottawa, Brisbane, and Pittsburgh demonstrate that TOD at BRT stations can happen in two ways. First, as in Brisbane, the government can choose the location of the BRT line and stations based on the existing and proposed development pattern. Brisbane selected station locations by analyzing development patterns and determining the local government's willingness to invest in pedestrian infrastructure. In this way, the city was able to ensure that certain stations would have TOD. The other way in which TOD can happen at BRT stations is through new development not planned prior to BRT implementation. Pittsburgh currently has TOD under construction at two of its BRT stations. Neither project was envisioned prior to BRT completion. In fact, the BRT line functioned for over twenty years before a local non-profit proposed a TOD vision for the stations.

The case studies also reveal that it is unlikely BRTOD would happen, under either of the previously described circumstances, without government policies and/or financial contributions to encourage the TOD development pattern. This is particularly evident in the Ottawa case. It is also apparent in the Brisbane and Pittsburgh cases. The importance of city leadership in providing political and financial support to BRTOD development can be further understood by considering eight key factors. It was some combination of these factors that ultimately lead to BRTOD in the three case study communities. Every community is unique and will require different government interventions to guide land use decisions, however, this list of factors can provide a good foundation for future governments considering BRTOD.

Eight Key Factors for Attaining BRTOD

1. Interconnectedness of public transit services
2. Location/ alignment of the busway and stations
3. Degree to which land use and public transit decisions are integrated
4. Existence/ effectiveness of policies to promote station area development
5. Existence/ effectiveness of policies to promote walkability at station areas
6. Extent of public financial investment in station area development
7. Extent of public financial investment in transit system
8. Degree of regional planning/ coordination

Table 8.1 Comparing BRT Systems According to Eight Key Factors

	Ottawa	Brisbane	Pittsburgh
City Context			
Descriptive statistics	<p><u>Population:</u> city = 774,072 (note: as of 2001 the City of Ottawa encompasses the entire region of Ottawa-Carleton) <u>greater area</u> = 1,063,664 <u>Population Growth:</u> (1996-2001) greater area = 6.5% <u>City Density:</u> 5,840 people per sq. mile (note: 80% of the city's land area is rural) <u>Median Household Income:</u> \$62,130 <u>Canadian (Approx. US \$57,222)</u> <u>Average Transit Mode Share:</u> 35% of all peak hour trips originating in urbanized area; 70% of peak work trips to downtown; 30% of trips to suburban employment sites near busway; 25-30% of trips to regional shopping centers all day (Canada Census 2001)</p>	<p><u>Population:</u> greater urban area = 1.8 million city = 958,504 <u>Population Growth:</u> (1999-2004) 11.5% <u>City Density:</u> 278 people per sq. mile <u>Median Household Income:</u> \$37,932 Australian in 2003 (approx. US \$31,180) <u>Average Transit Mode Share:</u> BRT has 7% of daily trips and 13% of peak period trips, 50% of total bus share (Rathwell 2002) (Australia Bureau of Statistics 2004)</p>	<p><u>Population:</u> metro area = 2,358,695 city = 334,563 <u>Population Growth:</u> (1990-2000) Metro area = -1.5%; city = -9.5% <u>City Density:</u> 6,019 people per sq. mile <u>Median Household Income:</u> \$28,588 <u>Average Transit Mode Share:</u> 60% of the people entering/ leaving the CBD during peak hours use public transit. (U.S. Census 2000)</p>
BRT system purpose	<p>Recognition that roadways cannot manage future growth (in 1980s and 1990s). Effort to provide alternatives to the automobile.</p>	<p>Recognition of roads inability to keep up with population growth and transportation demand. Recognition of limited resources and future need to focus on transit rather than private automobile.</p>	<p>Provide an alternative to the automobile; avoid peak hour congestion already existing on the roadways.</p>
Percentage of BRT stations with TOD	15% (5 out of 34 stations)	50% (5 out of 10 stations)	8% (2 out of 24 on all three busways)
Key Factors			
Interconnectedness of public transit services.	<p>Extensive system, well integrated with on-street bus routes. Built the system "outside in," which allowed them to build the network all at one time, therefore creating a comprehensive rapid transit network as soon as possible. Also improved on-street bus service simultaneously.</p>	<p>Not currently. Long-term plan is to integrate five BRT lines with extensive regional rail network and bikeway system.</p>	<p>Not an extensive rapid transit network. Also, the three lines were built over many years (decades of time).</p>

Comparing BRT Systems, Continued

	Ottawa	Brisbane	Pittsburgh
Location/ alignment of the busway and stations.	Primarily used existing rights-of-way, in order to avoid public conflict. In this sense, the system was restricted in its service abilities from the start. However, trunk route selection did take into account access to federal government jobs downtown and distributed throughout the region.	The SE Queensland regional government considers the location of the BRT trunk lines and the selection of stations critical for developing an auto competitive service. For the first line, however, there was widespread public concern over pollution and noise issues. As a result, much of the South East Busway is located next to the freeway rather than serving the most important urban centers.	Constructed busways on abandoned and underused railroad rights-of-way. Pittsburgh has a lot of steep topography, so it is difficult to find flat locations for roadways, railroads, etc. Also, needed to negotiate with limited number of property owners to acquire necessary right-of-way. As a result, the government avoided conflict in the community.
Degree to which land use and public transit decisions are integrated.	Well integrated land use and transportation decision making. Developed a land use vision in 1964 Official Plan, and then selected the transit mode that most appropriately served this pattern of development.	The South East Queensland regional government has both land use and transportation planning control for the entire region. The Integrated Regional Transportation Plan ensures that land use and transportation are considered together.	Land use and transportation decisions are not integrated in regard to the city's BRT system.
Existence/ effectiveness of policies to promote station area development.	Official Plan identified primary employment centers for targeted growth. Also required that major retail development (greater than 35,000 square meters) locate on the busway. Ottawa has strong policies to promote use of transit. It is debatable whether these policies also promote development at the stations. The policies include: Transit first policy, eliminate free employee parking at federal agencies, stagger working hours for businesses in downtown.	No policies to promote TOD, just guidance from plans and officials. However, the fact that the city allows this kind of dense, mixed-use development to occur at the stations is valuable.	There are no policies to promote TOD specifically. (Look into new state program.)

Comparing BRT Systems, Continued

	Ottawa	Brisbane	Pittsburgh
Existence/ effectiveness of policies to promote walkability at station areas.	The requirements to ensure pedestrian comfort and safety were limited until recently. 1974 Official Plan does call for all new residences to be located within 400 meters of bus station linking to rapid transit.	No park and ride lots at stations other than last station on the line. Will allow reductions in parking requirements for TOD. Local governments control installation of sidewalks, street trees, and other pedestrian amenities. Usually paid for through infrastructure charge on new development.	No policies to promote walkability at stations.
Extent of public financial investment in station area development.	Co-development at some stations. Provided extensive infrastructure to link stations to some malls and primary employment centers. E.g. Blair pedestrian bridge. City of Ottawa has plans to build two model TODs.	In kind contributions of land and air development rights. Government is building its structures at busway stations. E.g. Museum at Cultural Center. Also designing the system to link important existing development nodes.	There are finances available through the economic development office for projects in redevelopment zones or other projects that provide other economic development benefits. If the case can be made for a particular TOD project, then the financing is available. Ex: Tax Increment Financing, Tax abatement, etc.
Extent of public financial investment in transit system.	Construction of the busways and stations, continuing maintenance.	Construction of the busway, station, and entry plaza. Maintenance of these items. Spared no expense. System includes bridges and tunnels specifically for the BRT. Officials say it cost no less than a light rail system.	There are no additional funds beyond those available for maintenance of busways and station structures.
Degree of regional planning/ coordination	Regional Municipality of Ottawa-Carleton is a strong regional government controlling both land use and transportation.	South East Queensland regional government has ultimate say over transportation and land use decisions throughout the region. Representatives from all jurisdictions serve on the governing council.	Regional planning initiatives lack enforcement capabilities.

Eight Key Factors for Attaining BRTOD: Comparison of Case Study Cities

The eight key factors are conditions that in some way influenced the location of TOD on a case study BRT line. As is evident in the previous chart, the cities chose to implement these factors to varying degrees and using differing methods.

The cities' different approaches to designing and implementing policies and financial interventions are best characterized as "carrot" methods and "stick" methods. The City of Ottawa's BRT promotion initiatives tend to be policies that limit the ability of residents to use cars and, in that way, encourage use of public transit. Ottawa also has strong land use controls to limit the locations for certain uses. Brisbane initiatives, on the other hand, are generally government lead investment to attain public goals and visions. For example, Brisbane located its busways based on accessing important destinations. The other option would have been to require important destinations (certain land uses) to be built next to the busway. Pittsburgh's initiatives are largely neutral. It allows high density, mixed-use development at some stations, but does not encourage or discourage it. Additionally, it provides economic development funds for underserved areas, regardless of whether they are near the busways. It is also important to note that the BRT systems in each of these cities have different purposes. This likely contributes to the differing types and degrees of government policy and financial intervention.

Interconnectedness of public transit services

Theory would indicate that interconnectedness and extensiveness of the rapid transit system (all modes) is critical to promoting TOD on rail or bus rapid transit. In order for a transit system to be successful, it must provide service to the destinations to which riders wish to go. Therefore, the more extensive the network, the more stations it will serve, and consequently the more competitive the public transit service with the automobile. This, of course, assumes that the stations served by transit are desirable, an issue further addressed in the location/ alignment discussion below. Theory also suggests that TOD requires that public transit deliver a large proportion of customers and residents to its associated station. In this way, the dense, walkable urban design pattern is not replaced with parking lots. It follows then that the more extensive the rapid transit network, the easier it is for TOD to succeed.

There is some evidence for this conclusion in the case studies. Only 15% of Ottawa's stations have TOD as defined in this study, however, a much larger percentage have some commercial development that is accessible for pedestrians exiting/ boarding buses. Requiring development adjacent to stations is one of the tactics used by the city to facilitate the increase in bus use resulting from policies limiting auto use. The lack of policies ensuring mix of uses and pedestrian safety within ¼ mile of the station has led to land use patterns inconsistent with TOD even though there has been development at the stations. Regardless, the interconnectedness of the Ottawa system has helped make the station area development successful as it widens the catchment area for the businesses. Since the Ottawa policies for limiting auto use are primarily targeted to peak hour commuter traffic, it is particularly important for the transit system to be able to deliver workers to employment locations throughout the city. Federal government agencies have especially rigorous policies limiting staff parking and these agencies are purposefully scattered throughout the Ottawa-Carleton region.

Location/ alignment of the busway and stations

This factor proved to be a very important influence on TOD. Ottawa and Pittsburgh located their BRT trunk lines primarily based on availability of public right-of-way. These cities have 10% and 8% TOD at stations, respectively. Brisbane, on the other hand, has a much younger BRT system than the other two cities, but already has TOD at 50% of its stations. Brisbane's busway location philosophy is largely based on linking existing and emerging TOD type nodes. It is likely that the reason Brisbane does not have TOD at the five stations furthest from the downtown is that the busway is located adjacent to a freeway. This location is inconsistent with Brisbane's general location philosophy because city leadership was trying to implement the concept of BRT slowly. The location next to the freeway was less controversial. In the future stations will be identified in the same way as the five stations closest to downtown on the current South East corridor. It is also important to note that existing development in Brisbane is less dense and increasingly residential further from city center. This also contributes to the fact that the further stations do not have TOD to date.

Degree to which land use and public transit decisions are integrated

The case studies demonstrate the importance of land use and public transit coordination, but also show that the right kind of coordination must occur in order to obtain TOD. For

example, Ottawa is known for its strong regional government that carefully controls both land use and transportation decision (Cervero 1998). The result of this coordination, however, is significant commercial development at BRT stations without necessarily the physical form or mix of uses associated with TOD. Brisbane also has a strong regional government controlling both transportation and land use. This entity has created regulations that will guide development toward a TOD form at many stations. There has not yet, however, been time to see much new development approved at the BRT stations. Development approved prior to BRT construction is still underway. The City of Pittsburgh has not, until recently, coordinated land use and transportation planning efforts. The result has been no TOD at stations until the recent East Liberty CDC efforts to share its neighborhood growth.

Existence/ effectiveness of policies to promote station area development and walkability

The case studies suggest that policies to promote station area development and walkability are two of the most important factors for promoting TOD at stations. It is critical, however, that both elements be implemented by governments. Ottawa demonstrated that development emphasis at stations does not necessarily create TOD. There must be a method for ensuring pedestrian safety and comfort in traveling between development and stations. In Ottawa residents use the BRT, but it is likely because they are limited from using the automobiles. In Brisbane the policies were implemented together. Residents heavily use the existing BRT lines, likely incentivized by the easy pedestrian access from home, shopping, and work to stations.

Extent of public financial investment in station area development

All three case study cities have provided some financial investment in station area development. Each, however, has used a different method and contributed to a different extent. Brisbane has probably made the most public investment at stations; however, it is not in a joint development capacity, which is often used as a development incentive in the U.S. Instead Brisbane, the state of Queensland, and even the Australian federal government support TOD by building their own facilities at stations, and providing the infrastructure to guide public and private station area development into a TOD pattern.

Extent of public financial investment in transit system

The primary investment of all three cities has been in the BRT infrastructure itself. Brisbane and Ottawa, the cities with the most TOD and development at stations have invested the most. According to James Couttes, former Planning Manager for the City of Brisbane, the BRT system cost just as much as a rail system because of its high quality. The city was committed to providing the bridges, tunnels, and station amenities to best support an efficient public transit system and, therefore, a desirable alternative to the automobile. Ottawa also invested a lot of money in building pedestrian bridges across the Queensway Freeway so that Transitway riders could access employment and shopping opportunities on both sides of this major city road artery.

Degree of regional planning/ coordination

Again, the most successful cities, Brisbane and Ottawa have much stronger regional governments than that of South West Pennsylvania. These regional governments are able to implement the land use and transportation regulations necessary to meet its established goals.

Summary Findings

In summary, regional policies to promote specific transit and land use philosophies are particularly valuable in achieving established end goals. This is evident in the three case studies analyzed in this research. Ottawa's primary intent was to promote employment development and large scale retail development at BRT stations. The policies it used achieved this goal successfully. Had it also incorporated policies to promote TOD characteristics, it would have likely been able to achieve that end. TOD was not, however, the region's goal. Brisbane too has a strong regional commitment to achieving land use and transit objectives. As a result, it was able to implement a comprehensive BRT system that serves the existing development pattern. The South East corridor has 50% TOD at its stations, but the Brisbane leadership knew this would be the result, even though it would have preferred to see 90 or 100% TOD. In the future the regional government will likely have public support for locating in the busway in a more appropriate location than adjacent to a freeway. Pittsburgh has not, to this point, had a strong interest in promoting TOD at its busway stations. Even if it did, however, there is not a strong

regional governing organization that could implement land use and transportation regulations as stringently as Ottawa and Brisbane.

Paths for Future Research

There has been no other research conducted analyzing the conditions under which BRT can promote TOD. This study is an initial look at this question and sets the stage for continued research. In particular, the conclusions from this study's analyses can be further tested empirically. An example methodology for testing this study's findings using data analysis is described in the methodology section (chapter 2). Data acquisition is the biggest hurdle for analyzing the amount and type of station area development within ¼ mile of the station with development further than ¼ mile. This analysis could be taken one step further by comparing the development at BRT stations over time.

Other valuable research would include comparisons of development at BRT stations with that at light rail or heavy rail stations. Brisbane and Pittsburgh, for example, have rail systems in addition to the BRT. As a result, these could again be good case study cities. Brisbane's rail existed prior to BRT design and development. Pittsburgh's light rail has been constructed since BRT completion. The City of Ottawa is currently a particularly interesting case study of BRT versus light rail's ability to promote TOD. In December 2006 the newly elected city council cancelled plans for a new light rail line after six years of intensive government and private sector planning and investment. The public and private station area development proposals in response to plans for light rail transit were significantly different than the proposals that have been made, thus far, for existing BRT stations. This distinction warrants further investigation. Additionally, developer and community member attitudes toward BRTOD and rail based TOD is, in and of itself, an important area for further research.

CHAPTER 8: Conclusions

Recommendations for Promoting BRTOD in U.S. Cities

The three most important actions that U.S. cities can take to promote TOD at BRT stations are:

1. Develop policies that are specifically targeted to the type of development the city wishes to see at the stations. Ottawa can serve as a good example of a city with many policies to promote specific land uses on its BRT lines, but also a city that has very little TOD at BRT stations. Pedestrian considerations were particularly weak in the case of Ottawa. U.S. cities proposing BRT systems will need to have strict regulations for providing safe and comfortable walking environments between the development and the station.
2. Be prepared to make public financial investments in the station area development as well as the station itself. This is particularly true if the city is not prepared to implement very strong development policies. U.S. cities, particularly those in politically conservative locations, do not typically implement strong policies to manage growth. As a result, they may instead need to put public funds into development (joint development) in order to incentivize growth in a particular location. Much of the TOD development at Pittsburgh's BRT stations is made possible by government financial contributions to private development. The funds are targeted for economic development rather than TOD promotion; however the result, in this case, is the same. Brisbane has made significant financial investment in the BRT system so that it would best serve the existing development pattern. This is also an option for communities considering BRT. Both methods should achieve the same ultimate goal of TOD, but both also require public commitment to the goal of BRTOD.
3. Build local technical capacity with regard to BRT and BRTOD as part of the implementation of a BRT system. Ottawa did not originally intend to promote TOD at Transitway stations, but in recent years it has begun to implement policies targeted to this end goal. One of the main problems with these recent initiatives is that there are no people in the transit and land planning agencies who are specifically designated to understand and guide the implementation of BRTOD (Holmes 2007). This is particularly

important with a mode such as BRT because the image of buses as polluting, noisy vehicles is often difficult to overcome. Knowledgeable staff members need to be prepared to assist with marketing and branding initiatives, in addition to TOD design, in order to maintain an educated citizenry.

BRTOD in Low-Density, Auto Oriented, High Growth Cities

Many of the U.S. cities currently designing public transit systems are low-density, high growth, auto oriented cities that have not historically made public transit a priority. The resulting development pattern is typically sprawling and characterized by isolated land uses and dangerous pedestrian conditions. It is very difficult to serve this type of existing development with a fixed rail transit system as fixed guideway modes rely on clusters of walkable development at the stations. This limitation of rail transit is one of the reasons that many city leaders are looking to BRT as a mass transit option. BRT's flexibility to leave the designated busway to serve existing dispersed residential development has benefited communities in Ottawa, Brisbane, and Pittsburgh. It could also potentially be a valuable characteristic in promoting TOD in currently low-density urban conditions. Table 8.1 highlights the implications of BRT strengths and weaknesses for promoting TOD in the low-density, high growth city context.

Table 8.1 Implications of BRT Strengths and Weaknesses for TOD in the Low Density, High Growth City Context

Strengths and Weaknesses of Bus Rapid Transit as a Mode of Public Transportation	Implications for Transit Oriented Development in the Low Density, High Growth City Context
Strengths	
<ul style="list-style-type: none"> • Generally faster and lower cost implementation than for comparable fixed rail. 	<ul style="list-style-type: none"> • Lower cost implementation allows the city to extend rapid transit lines further. This is important in auto oriented cities where there are long distances between destinations. • Successful TOD requires that transit provide access to the rest of the city.
<ul style="list-style-type: none"> • Flexibility to extend service off of the busway, ability to minimize transfers. • Relative ease of adaptation to changes in market demand. 	<ul style="list-style-type: none"> • Flexibility allows BRT to provide TOD users with the necessary access to existing scattered development. • Ease of adaptation broadens the market for potential TOD locations.
Actual Weaknesses	
<ul style="list-style-type: none"> • Poor image due to track record of on-street bus service. 	<ul style="list-style-type: none"> • Limited exposure to public transit as a whole exacerbates the poor image of buses. Strong marketing, through education, branding, and modern vehicle acquisition, is necessary under these conditions.
<ul style="list-style-type: none"> • Lack of technical knowledge on transit and planning staffs. • Limited empirical information on the mode's use in the U.S. 	<ul style="list-style-type: none"> • It is critical to build local technical capacity in BRT and BTOD.
<ul style="list-style-type: none"> • Noise and pollution. 	<ul style="list-style-type: none"> • Externalities must be mitigated. This can be accomplished through bus technology and station design innovations. It also has implications for the design of BTOD itself.
Perceived Weaknesses	
<ul style="list-style-type: none"> • Noise and pollution. 	<ul style="list-style-type: none"> • If these externalities are eliminated or mitigated, it is critical to advertise this information through strong marketing.
<ul style="list-style-type: none"> • Systems more likely to be abandoned than fixed rail modes. 	<ul style="list-style-type: none"> • Cities can address this concern through service guarantees for specified time periods.

Appendices

Appendix A: East Busway Development Inventory from 1996 Wohlwill Article

TABLE 2
INVENTORY OF DEVELOPMENT ALONG THE MARTIN LUTHER KING, JR. EAST BUSWAY

<u>Community</u>	<u>Type of Development</u>	<u>Type of use</u>	<u>New Construction or Redevelopment</u>	<u>Value of Investment</u>
WILKINSBURG				
	Development Clustered at the Wilkinsburg Station			
	Apartments	Residential	New Construction	\$1,340,000
	Bank	Bank	New Construction	\$76,000
	Convenience Store	Retail	New Construction	\$210,000
	Drug Store	Retail	New Construction	Under Construction
	4 Fast Food Restaurants	Retail	New Construction	\$832,000
	Hospital	Medical	New Construction	\$5,526,000
Subtotal				\$7,984,000
HOMEWOOD				
	Development Clustered at the Homewood Station			
	Community College	Institutional	New Construction	\$275,000
	Farmers Market	Retail	Redevelopment	\$900,000
	Single-family residences	Residential	New Construction	\$1,871,000
	Single-family residences	Residential	New Construction	\$1,484,000
				\$4,530,000
POINT BREEZE				
	Research and Engineering Offices			
	Offices	Office	New Construction	\$32,800,000
	University Offices	Office	Redevelopment	\$1,350,000
				\$34,150,000
EAST LIBERTY				
	Fast Food Restaurant			
	Shopping Center (12 tenants)	Retail	New Construction	\$213,000
	Development Clustered at the East Liberty Station			
	Association Offices	Office	Redevelopment	\$524,000
	Bank	Bank	New Construction	\$53,000
	Condominiums	Residential	New Construction	\$548,000
	Health Club	Recreation	New Construction	NA
	Medical Offices	Medical	Redevelopment	\$397,000
	Medical Offices	Medical	New Construction	\$58,000
	Organization Headquarters	Office	Redevelopment	\$14,000,000
	Painters Store	Retail	New Construction	\$310,000
	Restaurant	Retail	Redevelopment	\$960,000
	Shopping Center (8 tenants)	Retail	New Construction	\$2,816,000
	Theatre and Shops	Theatre/Retail	Redevelopment	\$1,360,000
	Townhouses	Residential	New Construction	\$25,000,000
Subtotal				\$50,539,000
SHADYSIDE				
	Apartments			
	Apartments	Residential	Redevelopment	\$20,000,000
	Hospital, Medical Offices, and Parking Garage	Residential	New Construction	\$2,600,000
	Offices	Medical/Parking	New Construction	\$43,798,000
	Offices	Offices	Redevelopment	\$4,500,000
	Offices	Offices	Redevelopment	\$200,000

TABLE 2 (Continued)
INVENTORY OF DEVELOPMENT ALONG THE MARTIN LUTHER KING, JR. EAST BUSWAY

<u>Community</u>	<u>Type of Development</u>	<u>Type of use</u>	<u>New Construction or Redevelopment</u>	<u>Value of Investment</u>
SHADYSIDE (Continued)				
Development Clustered at the Negley Station				
	Convenience store	Retail	New Construction	\$268,000
	Dialysis Clinic	Medical	New Construction	NA
	Fashion outlet	Retail	Redevelopment	\$47,000
	Medical Offices and Shops	Medical/Retail	New Construction	\$825,000
	Medical Professional Offices	Medical	New Construction	NA
	Medical Professional Offices	Medical	New Construction	\$352,000
	Medical Professional Offices	Medical	New Construction	\$2,000,000
	Office	Office	Redevelopment	NA
	Offices and shops	Office/Retail	Redevelopment	\$600,000
	Small shopping center (4 tenants)	Retail	New Construction	\$145,000
	Supermarket	Retail	New Construction	\$1,650,000
	Subtotal			\$76,985,000
LAWRENCEVILLE				
Development Clustered at the Herron Hill Station				
	Express Delivery Company	Warehouse/Office	New Construction	\$368,000
	Industrial Products Distributer	Warehouse/Office	New Construction	\$956,000
	Manufacturer	Industrial	Redevelopment	\$1,109,000
	Night Club	Retail	Redevelopment	\$230,000
	Townhouses	Residential	Redevelopment	\$303,000
	Warehouses and Offices (22 tenants)	Warehouse/Office	New Construction	\$4,012,000
	Subtotal			\$6,978,000
STRIP DISTRICT				
	Manufacturer	Industrial	Redevelopment	\$775,000
	Warehouses and Offices (10 tenants)	Warehouse/Office	New Construction	\$6,840,000
	Warehouses and Offices (5 tenants)	Warehouse/Office	New Construction	\$8,700,000
	Subtotal			\$16,315,000
DOWNTOWN				
Development Clustered at the Penn Station				
	Amtrak Station	Transportation	Redevelopment	NA
	Apartments	Residential	Redevelopment	\$30,000,000
	Hotel	Hotel	New Construction	\$75,000,000
	Subtotal			\$105,000,000
GRAND TOTAL				\$302,481,000
NA = data not available.				

Source: Wohlwill 1996

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