FTA RESEARCH

FEDERAL TRANSIT ADMINISTRATION

Community-Oriented BRT: Urban Design, Amenities, and Placemaking

NOVEMBER 2012

FTA Report No. 0034
Federal Transit Administration

PREPARED BY
National Bus Rapid Transit Institute
Center for Urban Transportation Research
University of South Florida

U.S. Department of Transportation
Federal Transit Administration

COVER PHOTO

Lane Transit District

DISCLAIMER

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof. The United States Government does not endorse products of manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this report.

Community-Oriented BRT: Urban Design, Ammenities, and Placemaking

NOVEMBER 2012

FTA Report No. 0034

PREPARED BY

Jennifer Flynn, Senior Research Associate
Menna Yassin, Graduate Research Assistant

National Bus Rapid Transit Institute
Center for Urban Transportation Research
University of South Florida

SPONSORED BY

Federal Transit Administration
Office of Research, Demonstration and Innovation
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

AVAILABLE ONLINE

http://www.fta.dot.gov/research

Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY	2. REPORT DATE November 2012	3. REPORT TYPE AND DATES COVERED Final Report, January 2010 – August 2012

4. TITLE AND SUBTITLE Community-Oriented BRT: Urban Design, Amenities, and Placemaking	5. FUNDING NUMBERS FTA-2011-002-TRI
6. AUTHOR(S) Jennifer Flynn, Menna Yassin	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESSE(ES) National Bus Rapid Transit Institute Center for Urban Transportation Research University of South Florida 4202 E. Fowler Avenue, CUT100, Tampa, FL 33620	8. PERFORMING ORGANIZATION REPORT NUMBER FTA Report No. 0034
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Department of Transportation Federal Transit Administration East Building 1200 New Jersey Avenue, SE Washington, DC 20590	10. SPONSORING/MONITORING AGENCY REPORT NUMBER FTA Report No. 0034
11. SUPPLEMENTARY NOTES http://www.fta.dot.gov/research	
12A. DISTRIBUTION/AVAILABILITY STATEMENT Available from: National Technical Information Service (NTIS), Springfield, VA 22161 Phone 703.605.6000, Fax 703.605.6900, email [orders@ntis.gov]	12B. DISTRIBUTION CODE TRI-20

13. ABSTRACT

The purpose of this report is to provide a useful resource for communities that wish to learn how others have successfully used BRT as a tool for enhancing the public realm. Information for this effort was gathered through a literature review, in-depth profiles of three BRT systems, and a detailed questionnaire that was administered to transit agencies in the United States, Canada, and Australia. While the literature review provides historical background on the relationship between transit projects and the public realm, the questionnaire focuses specifically on the interaction between BRT and public space. The system profiles provide a detailed account of the Los Angeles Orange Line, Cleveland's HealthLine, and the EmX in Eugene, Oregon, along with recommendations and lessons learned. It should be noted that this report does not attempt to offer detailed instructions of the type that would be found in design manuals or other highly technical literature. Rather, the focus is on sharing the experiences of agencies that have been successful in designing and building community value into BRT projects.

14. SUBJECT TERMS Bus rapid transit, BRT, urban design, placemaking, public space, streetscape, permanence, pedestrian, amenities, community, revitalization, livability, identity, Eugene, EmX, Cleveland, HealthLine, Los Angeles, Metro Orange Line	15. NUMBER OF PAGES 144

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT None

TABLE OF CONTENTS

LIST OF FIGURES

PHOTO CREDITS

Figure 2-1, www.you-are-here.com
Figure 2-2, Los Angeles County Metropolitan Transportation Authority (LACMTA), www.metro.net
Figure 2-3, LACMTA, www.metro.net
Figure 2-5, LACMTA, www.metro.net
Figure 2-16, LACMTA, www.metro.net
Figure 2-18, LACMTA, www.metro.net
Figures 2-19–2-23, LACMTA, www.metro.net
Figure 3-1, Lane Transit District (LTD), www.ltd.org
Figure 3-4, LTD, www.ltd.org
Figure 3-6, LTD, www.ltd.org
Figure 3-7, LTD, www.ltd.org
Figure 3-8, Pivot Architecture, www.pivotarchitecture.com
Figure 3-9, http://flic.kr/p/9U6Xz4
Figure 3-10, http://flic.kr/p/9U6XxR
Figure 3-11, LTD, www.ltd.org
Figure 3-12, Pivot Architecture, www.pivotarchitecture.com
Figure 3-16, http://flic.kr/p/aovK1q
Figure 3-20, LTD, www.ltd.org
Figure 4-1, http://flic.kr/p/aLmryx
Figure 4-3, Urban Land Institute (ULI), www.uli.org
Figure 4-4, Victoria Perk, National Bus Rapid Transit Institute (NBRTI), www.nbrti.org
Figure 4-5, Land Studio, www.land-studio.org
Figure 4-6, Greater Cleveland Regional Transit Authority (GCRTA), www.riderta.com/
Figure 4-7, World Resources Institute, www.embarq.org
Figure 4-8, GCRTA, www.riderta.com/
Figure 4-9, GCRTA, www.riderta.com/
Figure 4-10, Victoria Perk, NBRTI, www.nbrti.org
Figure 4-11, Victoria Perk, NBRTI, www.nbrti.org
Figure 4-13, Victoria Perk, NBRTI, www.nbrti.org
Figure 4-14, ULI, www.uli.org
Figure 4-15, GCRTA, www.riderta.com/
Figure 4-16, Victoria Perk, NBRTI, www.nbrti.org
Figure 4-17, GCRTA, www.riderta.com/
Figure 4-19, ULI, www.uli.org
Figure 4-20, Victoria Perk, NBRTI, www.nbrti.org
Figures D-1–D-3, Translink Transit Authority, http://translink.com.au/
Figure D-4, Capital District Transportation Authority, www.cdta.org
Figure D-5, Minnesota Valley Transit Authority, www.mvta.com
Figure D-6, Brampton Transit, www.brampton.ca/en/residents/transit
Figure D-7, Translink Transit Authority, http://translink.com.au/
Figure D-8, Community Transit, www.commtrans.org
Figures D-9–D-12, Translink Transit Authority, http://translink.com.au/

ACKNOWLEDGMENTS

The authors would like to thank all the transit agencies that completed our questionnaire and provided background information on their BRT projects. In particular, we wish to recognize Hitesh Patel and Kathleen Sanchez of the Los Angeles County Metropolitan Transportation Authority; Elaine Carbrey of Gruen Associates; Stefano Viggiano and Graham Carey, both formerly of Lane Transit District; and Joseph Calabrese and Maribeth Feke of Cleveland Regional Transit Authority for sharing their time and insights.

The authors also wish to thank the Federal Transit Administration for sponsoring the research, as well as FTA Project Manager Helen Tann for providing technical guidance.

ABSTRACT

The purpose of this report is to provide a useful resource for communities that wish to learn how others have successfully used BRT as a tool for enhancing the public realm. Information for this effort was gathered through a literature review, in-depth profiles of three BRT systems, and a detailed questionnaire that was administered to transit agencies in the United States, Canada, and Australia. While the literature review provides historical background on the relationship between transit projects and the public realm, the questionnaire focuses specifically on the interaction between BRT and public space. The system profiles provide a detailed account of the Los Angeles Orange Line, Cleveland's HealthLine, and the EmX in Eugene, Oregon, along with recommendations and lessons learned. It should be noted that this report does not attempt to offer detailed instructions of the type that would be found in design manuals or other highly technical literature. Rather, the focus is on sharing the experiences of agencies that have been successful in designing and building community value into BRT projects.

EXECUTIVE SUMMARY

Beyond the obvious goal of providing transportation benefits, a rapid transit project is a long-term investment that can shape and enrich a community for years to come. Indeed, when rapid transit projects are treated as valuable opportunities for creating or enhancing public space, they can become a driving force for city building and design. More vibrant public spaces may, in turn, leverage additional benefits relating to public health, the environment, economic development, crime prevention, historic and cultural preservation, and community stewardship. In many respects, "placemaking" through rapid transit is a matter of urban design, which blends architecture, landscaping, and planning concepts to purposefully shape the public realm. Transit facilities that are designed to the scale of people and provide safe, comfortable, and attractive environments encourage people to walk and use transit and can serve as focal points for community life. In addition, transit's ability to draw pedestrians to an area may activate adjacent land uses, support business, and encourage development.

Unfortunately, while these benefits are routinely considered an essential part of major rail projects, they are frequently overlooked with respect to bus facilities. This may be due, in part, to the fact that bus service in the U.S. suffers from an image problem and most bus facilities lack the sense of permanence enjoyed by rail-based transit. However, because bus rapid transit (BRT) generally involves greater investment with more permanent infrastructure than that of conventional bus service, it can play a major role in creating and revitalizing the public realm. For instance, well-defined running ways, attractively-designed stations, streetscape enhancements, and ample pedestrian amenities can create a more welcoming, accessible environment and engender a stronger sense of community ownership. These improvements also convey a sense of permanence and demonstrate a strong public commitment to quality in the corridor, which may, in turn, attract private investment and contribute to the revitalization of existing neighborhoods and downtowns. Therefore, BRT presents a powerful opportunity to decisively shift urban development in a positive direction.

The purpose of this report is to provide a useful resource for communities that wish to learn how others have successfully used BRT as a tool for enhancing the public realm. Information for this effort was gathered through a literature review; a detailed questionnaire that was administered to transit agencies in the United States, Canada, and Australia; and in-depth profiles of the following BRT systems:

- **Metro Orange Line, Los Angeles**—The Orange Line was designed to be more than just an improvement over conventional on-street bus service and is similar to a rail alignment in terms of design. The corridor design was conceptualized as a "greenway ribbon" that would convey a unified design theme while also beautifying and blending into the San Fernando Valley. Design features include architectural stations, pedestrian linkages, extensive public art, bicycle and pedestrian paths, and an ambitious landscape beautification project.

- **Emerald Express ("EmX"), Eugene, Oregon**—The EmX was guided by an overarching vision of "greening the corridor," with community integration, concern for the environment, and appreciation of Eugene's history and natural beauty identified as primary design goals from the outset of the project. To incorporate these goals into the design of the EmX, the Lane Transit District consulted arborists, urban foresters, concrete specialists, architects, and landscapers during every phase of the project. Agency staff also worked closely with cycling groups and people with disabilities to design a system that would be accessible to everyone.
- **HealthLine, Cleveland, Ohio**—The HealthLine used long-term investments in transit and other public infrastructure as a mechanism for private investment along the corridor, and has been credited with catalyzing more than $4 billion in investments along the Euclid Avenue corridor. Part of this investment is likely attributable to the fact that the project included a complete streetscape renovation of Cleveland's historic Euclid Avenue, a once-grand boulevard that had fallen into a decades-long state of decline and disrepair. The design approach was to bring an active and engaging street life to Euclid Avenue by creating open space amenities and developing the corridor into a linear park.

While the literature review provides historical background on the relationship between transit projects and the public realm, the questionnaire that was used to gather data from transit agencies focused specifically on the interaction between BRT and public space. The system profiles provide a detailed account of agency experiences, along with recommendations and lessons learned. It should be noted that this report does not attempt to offer detailed instructions of the type that would be found in design manuals or other literature of a highly technical nature. Rather, the focus is on sharing the experiences of agencies that have been successful in designing and building community value into BRT projects. While every project detailed within this report is unique, there emerged some key lessons and recommendations that can be generalized to nearly any U.S. city.

- **Community Outreach**
  - Use educational outreach and community visioning to build initial support for the project and effectively communicate the project's goals and benefits; follow through with ongoing and transparent communication during the design and construction phases to maintain the community's trust and confidence.
  - Perform urban design outreach to address the concerns of stakeholders and community groups as early as possible.
  - Use photo simulations or other advanced visualization tools to communicate ideas and help the public get a mental picture of the project.
  - After visioning exercises are complete and the community has identified the desired goals for the project, create concrete plans to maximize those benefits sooner rather than later.

- Create separate boards with which the community can consult regarding specific issues or concerns, such as public art projects or disruption of businesses during construction.

- **Stakeholder Engagement**
  - Use early and continuous stakeholder engagement to garner support and clarify expectations, constraints, risks, and assumptions.
  - Secure the support of property owners and the local business community as soon as possible, and pursue every opportunity for strategic partnerships among public, private, neighborhood, and non-profit stakeholders.
  - Include the staffs of local community development and land-use agencies in the planning and development phases to facilitate effective communication between government and agency stakeholders and to help educate elected officials regarding project design issues.
  - Use memoranda of understanding and intergovernmental agreements to delineate responsibilities and clarify the working relationships among public, private, and non-profit parties.
  - Get a strong project champion from the outset of the project. If possible, identify champions from the public, private, and non-profit sectors.

- **Infrastructure and Public Space Enhancements**
  - Use BRT as an opportunity to improve and enrich the streetscape by (1) reconstructing or replacing elements such as lighting, sidewalks, and street furniture that may have been displaced by the construction of the running way and (2) integrating the BRT corridor into the urban fabric with new amenities such as landscaping and recreational paths. Although difficult to fund as standalone projects, these improvements may become financially viable if they are incorporated into the BRT project.
  - Combine transit infrastructure and public space improvements into one integrated project that conveys a corridor brand identity that is clear and distinct, but that also fits into the existing fabric of the city. The more permanent the elements of the system, the more value the community will place in it.
  - Aim to strike a balance between "doing just enough" and "doing too much," particularly with regard to landscaping.
  - Build principles and practices of sustainability into the project infrastructure from the very beginning, as part of a comprehensive design and development process that produces cost savings; otherwise, sustainable design options may end up as "wish list" options that are cut from a project at the end because of financial constraints.
  - Do not lose sight of the fact that the project is first and foremost a transit project. Unless the service is user-friendly and improves travel times, reliability, passenger comfort, accessibility, and safety, it will be an expensive investment that fails to reach its full potential.

- **Safety and Maintenance**
  - Do not underestimate the importance of image. Keep the system clean, well-lighted, and safe at all times and attend to any observed damage or vandalism immediately.
  - Come up with a detailed plan in advance for how facilities will be maintained over time.
  - Seek out partners, such as a local business improvement district (BID), for ongoing cleaning and maintenance of landscaping, sidewalk art, and other public realm improvements, or pursue other creative approaches such as implementing an "Adopt a Shelter" program or selling the rights to name the service or individual stations.
  - Use memoranda of understanding and intergovernmental agreements to delineate maintenance responsibilities.
  - Keep landscaped areas free of overgrowth and prevent plants from encroaching into other areas of the corridor by restricting dense landscaping to the edge of the right-of-way (ROW) or avoiding dense landscaping altogether.
  - Consider the logistics of maintenance when designing the landscaping configuration to avoid the possibility of interference with BRT operations.
  - Make certain that recycled materials such as rubberized asphalt are durable enough to withstand high-frequency bus traffic to avoid expensive replacements.
  - Locate boundary elements such as sound walls in a manner that does not create fragmented tracts of land or areas where ownership and authority are unclear.

SECTION 1

Introduction

Background

Beyond the obvious goal of providing transportation benefits, a rapid transit project is a long-term investment that can shape and enrich a community for years to come. Transit facilities that are designed at the human scale and provide safe, comfortable, and attractive environments can serve as focal points for community life. Indeed, when rapid transit projects are treated as valuable opportunities for creating or enhancing public space, they can become a driving force for city building and design. Unfortunately, public space is an asset that is often neglected in the design of transportation projects, where the primary focus is moving people around. In many respects, "placemaking" through rapid transit is a matter of urban design, which blends architecture, landscaping, and planning concepts to purposefully shape the public realm. Because the infrastructure dedicated to rapid transit comprises a significant public space component, elements of urban design contribute a great deal to how transit passengers, residents, and visitors will experience a transit system and the surrounding area.

Creating an attractive public realm with comfortable, accessible pedestrian environments is important for generating ridership. Aside from creating a more welcoming atmosphere in general, transit corridors that incorporate streetscape improvements, public amenities, and pedestrian-scale urban design encourage people to walk and use transit. In addition to potential ridership benefits, environments that attract pedestrians may, in turn, activate adjacent land uses, support business, and encourage development. The urban design and placemaking aspects of transit projects also have important quality-of-life implications, as more vibrant public spaces can foster a synergistic string of benefits relating to public health, the environment, economic development, crime prevention, historic and cultural preservation, and community stewardship. In this respect, a well-designed rapid transit project can serve as more than a transportation resource—it can be a vital civic resource that serves as functional, aesthetic, and social facility in one.

Unfortunately, while these benefits are routinely considered an essential part of major rail projects, they are frequently overlooked with respect to bus facilities. This may be due to several interwoven factors that work together to create a bias in favor of rail investments. Foremost, conventional bus service in the U.S. suffers from an "inferiority complex," and there is a general impression that rail-based transit delivers distinct "image" and land development benefits that a bus service simply cannot provide. These opinions likely have some parallel with

the fact that, historically, most bus facilities have lacked the sense of permanence enjoyed by rail-based transit. In addition, municipal land use policies and practices have the ability to influence whether or not development occurs near transit and if it is successful. Thus, a local transit culture that undervalues the potential benefits of bus investments can become somewhat of a self-fulfilling prophecy and may have a stronger impact on bus corridor development patterns than the issue of permanence.

However, because bus rapid transit (BRT) infrastructure generally involves greater investment with more permanent infrastructure than that of conventional bus service, it can play a major role in creating and revitalizing the public realm. Well-defined running ways and attractively-designed stations have the potential to convey a sense of permanence and project a strong identity while also reflecting the unique culture and history of the communities they serve. Consistent design elements such as signage, station beacons, and enhanced lighting have the ability to further strengthen the system identity along the entire corridor. Amenities such as landscaping, sidewalks, public art, street furniture, and recreational paths can create a more welcoming, accessible environment and engender a stronger sense of community ownership. Additionally, these public space enhancements contribute to neighborhood continuity and demonstrate a strong public commitment to quality in the corridor, which may, in turn, attract private investment. Indeed, when other factors such as the development market and local land use policies are supportive, BRT facilities have demonstrated the ability to catalyze new development and contribute to the revitalization of existing neighborhoods and downtowns. Thus, BRT presents a powerful opportunity to decisively shift urban development in a positive direction.

The purpose of this report is to provide a useful resource for communities that wish to learn how others have successfully used BRT as a tool for enhancing the public realm. Information for this effort was gathered through a literature review, in-depth profiles of three BRT systems, and a detailed questionnaire that was administered to transit agencies in the United States, Canada, and Australia. While the literature review provides historical background on the relationship between transit projects and the public realm, the questionnaire focuses specifically on the interaction between BRT and public space. The system profiles provide a detailed account of the Los Angeles Orange Line, Cleveland's HealthLine, and the EmX in Eugene, Oregon, along with recommendations and lessons learned. It should be noted that this report does not attempt to offer detailed instructions of the type that would be found in design manuals or other highly technical literature. Rather, the focus is on sharing the experiences of agencies that have been successful in designing and building community value into BRT projects.

Literature Review

Rapid transit projects are long-term investments that can be designed to improve a community beyond transportation benefits alone. Such projects can have a dramatic effect on how communities develop and evolve by acting as a driving force for city building and design. A key element in transit's ability to influences the built environment is placemaking [1, 2]. Placemaking is a holistic approach to the planning, design, and management of public spaces that has been described as "not just the act of building or fixing up a space, but a whole process that fosters the creation of vital public destinations: the kind of places where people feel a strong stake in their communities and a commitment to making things better" [2, p. 43]. Simply put, placemaking is both a process and a philosophy that strikes a balance between the physical and social qualities of a place to create lively neighborhoods and inviting public spaces that promote the health, happiness, and well-being of people [3]. The placemaking approach takes advantage of rapid transit projects as opportunities for improving the public realm and can also provide an avenue for realizing longer-term visions, such as the creation of more transit- and pedestrian-oriented environments [1, 2].

In many ways, placemaking through rapid transit is a matter of urban design, which applies a blend of architecture, landscaping, and planning concepts to give form, shape, and character to the built environment [2, 4]. Because the ROW and supporting infrastructure dedicated to rapid transit projects comprise a significant public space component, elements of urban design can contribute a great deal to how transit passengers, residents, and visitors will experience a transit system and the surrounding vicinity [5, 6]. An attractive public realm with high-quality pedestrian amenities encourages people to walk and use transit and also promotes transit-oriented and transit-supportive development. Furthermore, when transit facilities are designed to the scale of people and provide public amenities such as comfortable waiting places, pleasant walking environments, artwork, shade trees, and other streetscape amenities, they can become engaging public spaces that serve as focal points for community life. The design and placemaking aspects of transit projects also have important quality-of-life implications, as more vibrant public spaces can bring about a synergistic string of benefits relating to the environment, economic development, public health, crime prevention, and greater social cohesion. On the whole, more people walking about and enjoying public space creates a livelier city and stronger neighborhoods [1, 7, 8]. In this respect, a well-designed rapid transit project can be more than a transportation resource- it can be a vital civic resource that serves as functional, aesthetic, and social facility in one.

A large portion of the academic and planning literature focuses on the significance of the built environment in influencing individual travel behavior, particularly the decision to drive versus walk, bike, or use public transit.

Advocates of smart growth and new urbanism propose that changes to the built environment may lead to increases in non-motorized travel [9]. Indeed, since all transit users will invariably become pedestrians at some point in their journey, the design quality of the pedestrian realm is particularly important [1, 10]. Along with proximity to rapid transit stations, a high-quality pedestrian environment encourages walking and transit use. Research indicates that the distances people are willing to walk to access transit can be extended considerably by creating pleasant, interesting urban spaces and corridors. Expanded sidewalks, street furniture, green spaces, shade trees, public art, play areas, and other amenities can be used to create safe, attractive urban spaces that are enjoyable to traverse [2, 10, 11].

Safety and comfort are also important factors and should be treated as basic amenities. If people perceive rapid transit as unsafe, they are more likely to seek other means of transportation [2, 8, 12]. Research shows that perceptions of transit safety depend, in part, on characteristics of the environments surrounding the transit system. Stations located in desolate environments that necessitate long walks through areas of limited interest create safety concerns for passengers [1, 2, 13]. Therefore, stations should be located in existing built-up areas when possible and should make waiting time as safe and comfortable as possible by minimizing exposure to passing traffic and providing sufficient weather protection, enhanced lighting, public phones, and other such amenities [12]. In addition, provisions such as expanded sidewalks, continuous awnings, bicycle racks, and street trees afford a safer and more accessible experience for people using active modes of transportation [2, 8, 12]. It is worth noting that women, children, people with disabilities, and older adults may be more sensitive than others to qualities such as comfort, safety, and accessibility [7].

Additionally, research indicates that travel time costs are quite sensitive to qualitative factors such as safety, comfort, and convenience. Travel time costs tend to be higher for uncomfortable, unsafe, and stressful situations, and waiting time tends to have relatively high unit costs, particularly if conditions are unpleasant. Transit travel time unit costs have been found to be highly variable. Under uncomfortable, unsafe, or stressful conditions, transit travel time costs are much higher than for driving, while under pleasant conditions, transit has lower unit travel time costs than automobile travel because riders experience less stress and are able to use their time more productively for activities such as reading or studying. Thus, providing vehicles and waiting areas that are comfortable, clean, and safe can significantly reduce transit travel time costs. Moreover, such improvements may attract travelers from automobiles at a lower cost than travel speed improvements achieved through grade separation. Indeed, much of the apparent preference for rail transit over bus transit may actually reflect convenience and comfort features such as better user information, improved bicycle and pedestrian facilities, less crowded vehicles,

and clean, comfortable waiting areas that offer amenities such as restrooms and concessions [14, 15].

In addition to travel behavior, a number of recent studies also have established a connection between public space and quality-of-life indicators such as greater social interaction, reduced crime rates, public health, and economic vitality. For instance, researchers have examined how the built environment affects interactions among individual community members, and by extension, the formation of social networks and community ties. Contemporary new urbanists maintain that the street environment is a cornerstone of effective civic engagement and that poor-quality street environments deter an array of cooperative and trust-building activities. Decades earlier, planning critic and urban sociologist Jane Jacobs identified a direct relationship between the built environment and social capital with her now-famous assertion that more "eyes on the street" translates into less crime and other social benefits [7, 9]. According to Calthorpe, accessible and convenient public facilities and spaces can promote safety through a "strong sense of community, participation, identity, and conviviality" [16, p. 59]. More recently, Demerath and Levinger [17] characterize being on foot as a uniquely valuable opportunity for sensory experience and social interaction, and Leyden [18] finds that people living in "walkable" neighborhoods are more likely to know their neighbors and to be socially and politically active.

In terms of public health, the built environment also shapes our willingness to be on the street as a pedestrian or cyclist [9]. According to New York's PlaNYC, environments that maximize the comfort, ease, and practicality of walking, including the availability of transit, promote physical activity. PlaNYC further argues that open space improvements such as public plazas can help lower obesity and asthma rates. Indeed, several studies have shown that people who live in safe, walkable communities will walk more often and are less likely to be overweight, while other studies have shown that people who live in walkable areas are less likely to drive and thus less likely to contribute to harmful air pollution [7, 19, 20]. Additionally, although it has been found that people choose to live in pedestrian-oriented urban environments in part because of the desire to walk, Handy, Cao and Mokhtarian concluded that "the built environment has an impact on walking behavior even after accounting for attitudes and preferences" [21, p. 55].

The ability of attractive transit environments to draw foot traffic to an area may also encourage development and support business. The idea is to induce private investments through public funding commitments. Although the transit line itself may promote development, a comfortable pedestrian environment with strong urban design components and public amenities signals to developers a public commitment to quality in the corridor beyond the functionality of

the transit routes alone. Furthermore, up-front public improvements such as parks and plazas, street furniture, sidewalks, and attractive bus shelters provide tangible, affirmative results that can help to build future support for transit [1, 2, 8]. High-quality streetscapes and other public space improvements are crucial for development potential. However, cities rarely have the ability to fund such improvements as standalone projects; thus, they should be implemented as part of a transit investment plan whenever possible. In addition, a transit agency can garner direct economic benefits by developing its properties and facilities to incorporate uses that generate income while providing a needed service to transit patrons [2].

The following quality-of-life themes were identified throughout the literature as ways that rapid transit projects can support and enhance communities:

- Creating places for community life
- Catalyzing downtown and neighborhood renewal
- Creating opportunities for local economic development
- Improving safety and amenity
- Making communities accessible and convenient
- Shaping community growth

Common features of these types of projects include:

- Design that accommodates a diversity of people and prioritizes all their activities—sitting, strolling, resting, shopping, and observing city life
- Stations as community hubs, both functionally and symbolically
- Several popular destinations or "public life magnets" that act as neighborhood anchors, integrated into a wider network of attractive and pedestrian-friendly public space
- Intermodal design that allows efficient, sometimes seamless connectivity between transit access/egress modes, including buses, cars, walking, and cycling
- An accent of livability, showcased by attractive landscaping and public amenities such as street furniture, shade trees, and pleasant walking and milling environments [1, 2, 7, 8]

Unfortunately, while these benefits are routinely considered an essential part of major rail projects, they are frequently overlooked with respect to bus facilities. This may be due, in part, to the "second-class" stigma associated with bus service in the U.S., as well as the fact that most bus facilities lack the sense of permanence enjoyed by rail-based transit. Also, as previously noted, much of the apparent preference for rail transit over conventional bus service may actually reflect a preference for amenities and service attributes related to convenience and comfort. However, because it generally involves greater investment with

more permanent infrastructure than that of conventional bus service, BRT can play a major role in creating and revitalizing the public realm [1, 2, 14, 15, 22].

BRT systems with superior urban design quality and amenities can project a strong and appealing system identity while also reflecting and enhancing local culture and signature neighborhood characteristics [12, 22]. Attractively-designed BRT stations have the potential to become multi-functional community anchors that literally put a neighborhood "on the map." Stations and transfer points, along with prominent busways and consistent design elements such as signage, streetlights, station beacons, and landscaping, can reinforce system identity and convey a sense of permanence which, in turn, contributes to neighborhood stability and may encourage public and private investments along the corridor [12]. When integrated with progressive land use policies, BRT has demonstrated the ability to generate positive development and redevelopment and to encourage high-density, mixed-use development corridors [15, 22]. Bent, Hiatt, and Singa [6] used the following urban design criteria to assess the ability of proposed BRT projects to improve neighborhood livability and commercial vitality:

- Support for a distinctive, recognizable design identity
- Integration with adjacent land uses
- Ability to create useable public open space
- Quality of green space throughout the corridor
- Quality of sustainable storm water management

By bringing together the goals of transportation agencies and the quality-of-life goals of communities, the more integrated "placemaking" approach can channel the role of transit as a centerpiece for community building and re-building [8, 23]. Using transit facilities as catalysts for achieving broader quality of life goals such as neighborhood safety, historic preservation, economic development, and traffic calming requires a shift from the conventional transportation paradigm to a more holistic model that conceptualizes transit corridors as connected systems [1, 5, 23]. In recognition of these issues, the Federal Transit Administration (FTA) recently announced changes to its funding guidelines for major transit projects. In addition to the existing travel time savings and cost-effectiveness criteria in place since 2005, FTA now evaluates environmental, community, and economic development benefits when selecting projects for federal funding under the New Starts and Small Starts programs. According to FTA Administrator Peter Rogoff, "This new approach will help us do a much better job of aligning our priorities and values with our transit investments. No longer will we ignore the many benefits that accrue to our environment and our communities when we build or expand rail and bus rapid transit systems" [2, 24].

SECTION 2

Los Angeles Orange Line

Introduction

In October 2005, the Los Angeles County Metropolitan Transportation Authority (Metro) opened the Metro Orange Line, one of the first projects in the U.S. to incorporate a comprehensive set of BRT features. The 14.5-mile Orange Line runs east-west through the San Fernando Valley, almost entirely along an at-grade, dedicated busway within an abandoned railroad right-of-way. The line features high-capacity articulated vehicles, permanent stations, near-level boarding, off-board fare payment, and headway-based schedules. However, the Orange Line was intended to be more than just an improvement over conventional on-street bus service, and was planned with a strong urban design vision of the corridor as a "greenway ribbon" weaving through the San Fernando Valley [25].

All Orange Line stations are consistent in architectural design, with canopied platforms, covered seating, enhanced lighting, bicycle parking, and spacious sidewalks. To provide an element of variability for individual stations, distinctive works of art that reflect the surrounding neighborhood's unique culture and history are featured at each station. Additional urban design improvements include 14 miles of bicycle and pedestrian paths, sound walls, and extensive native landscaping along the corridor and at stations. Aside from bringing aesthetic and recreational value to the community, these features buffer nearby areas and soften the look of the busway, helping to successfully integrate the Orange Line into the surrounding landscape. Through urban design, the Orange Line has achieved success not only as a transportation facility, but as a community resource that fits into the unique neighborhoods of the San Fernando Valley. Features such as pedestrian linkages, recreational paths, public art, and an ambitious landscape beautification project helped transform a once contaminated railroad brownfield into a neighborhood amenity with a distinctive Southern California flavor.

Project Overview

The Metro Orange Line debuted in 2005 as the first exclusive busway in Los Angeles and one of the first full-service BRT lines in the U.S. The project is the culmination of more than 20 years of planning for rapid transit in the San Fernando Valley, an effort that began in 1980 with Proposition A, a voter-approved half-cent sales tax dedicated to funding a regional rail system. In response to rapidly-increasing travel demand and congestion both in the Valley and the region, the San Fernando Valley East-West Transit Corridor was

designated as one of six high-priority transit corridors. An abandoned portion of the Southern Pacific Railroad right-of-way (ROW) paralleling the congested US 101 Freeway was recommended as the preferred alignment for the corridor. In the years that followed, transit planners began developing concepts for a light rail line along this ROW, which was purchased by Metro in 1991. However, legislative restrictions on rail funding soon halted the pursuit of either heavy or light rail in the Valley. After a 1997 scanning tour of the renowned BRT system in Curitiba, Brazil, Metro undertook a major investment study (MIS) to evaluate feasible alternatives. In February 2000, the busway concept was proposed as a solution that would provide a premium, high-capacity rapid transit service in the under-served San Fernando Valley, at a lower cost than a light rail or subway line. In July 2001, the Metro Board of Directors officially adopted BRT as the Locally Preferred Alternative.

Prior to the construction of the Orange Line, the San Fernando Valley was served exclusively by local bus routes, with the Red Line subway terminating east of the Valley in North Hollywood. Travelers throughout the Valley are now able to access the Metro Red Line via the 14.5-mile Orange Line, which begins at the Warner Center mall and office complex, the third largest employment center in Los Angeles County. From Warner Center, the line extends east through the Valley communities of Tarzana, Encino, Sherman Oaks, and Van Nuys, and terminates at the North Hollywood Station, providing a connection to the Metro Red Line subway. In addition to North Hollywood and Warner Center, major destinations throughout the corridor include Pierce College, the Sepulveda Basin Recreation Area, the Van Nuys Civic Center, the Valley Government Center, and Valley College. The corridor is primarily a single-family residential zone, with some three- and four-story multi-family housing. Most commercial activity is clustered around the line's two termini, Warner Center to the west and the North Hollywood neighborhood to the east.

The Orange Line travels almost entirely along a two-lane, dedicated busway within the abandoned Southern Pacific Railroad ROW, entering mixed traffic for only half a mile between the last station and the route's western terminus at Warner Center. The busway is not grade-separated and passes through 38 signalized intersections, including 31 street crossings, 4 pedestrian crossings, and 3 limited-access road easements. Loop detectors are installed at all intersections to give signal priority to Orange Line vehicles. The generous ROW width, typically 100 feet, provides the space needed to accommodate stations, other infrastructure, and passing capability in the event of a breakdown. The line's 14 stations, spaced approximately 1 mile apart at major intersections and high-density locations, are similar in design to light rail stations and provide canopied seating, enhanced lighting, bicycle parking, public art, and automated fare collection machines. In addition, real-time information at stations is communicated to customers by way of visual message signs and a public address

system. Six of the stations have park-and-ride lots, providing a total of 3,800 free parking spaces. In keeping with the project's urban design vision of a busway within a linear "greenway," the facility also includes a 14-mile recreational path, native and drought-tolerant landscaping along the corridor and at stations, and an extensive public art component [25].

The Orange Line uses a pre-paid, proof-of-payment fare system and operates 22 hours per day, seven days per week on a headway-based schedule. Weekday headways are 4 to 5 minutes during peak travel times and 10 to 20 minutes during the early morning, late night, and on weekends. The service employs several forms of intelligent transportation systems (ITS) technology to enhance performance, including transit signal priority (TSP) along the route and global positioning systems (GPS) onboard the vehicles for automated vehicle location (AVL). GPS and AVL technologies enable the transit passenger information system (TPIS) at stations, which communicates real-time information to customers by way of visual message signs and a public address system.

The ridership performance of the Orange Line has dramatically exceeded forecasts. Before the Orange Line opened, Metro estimated 5,000 to 7,000 average weekday boardings for the first year of service and 22,000 average weekday boardings by the year 2020. By May 2006, the line had attracted nearly 22,000 average weekday boardings, achieving its 15-year ridership target in just 7 months. Current ridership on the Orange Line remains commensurate with, if not above, the projections for 2020 [28]. A four-mile extension of the Orange Line northward from Canoga Station to the Chatsworth Metrolink commuter rail station opened in June 2012. The extension is expected to generate 9,000 new average weekday daily boardings by the year 2030, contributing to a projected 45,000 average weekday boardings for the full alignment [27].

Design Characteristics

Although the Orange Line was planned to emulate many of the features that have made BRT efficient and successful in Curitiba and elsewhere around the world, it was also designed to be more than just an improvement over conventional on-street bus service. The corridor was conceptualized as a "greenway ribbon" that would convey a unified design theme while also beautifying and blending into the San Fernando Valley [25]. Through urban design, the Orange Line has achieved success not only as a transportation facility, but also as a community resource that fits into the unique neighborhoods of the Valley. Design features including pedestrian linkages, public art, recreational paths, and an ambitious landscape beautification project helped transform a contaminated railroad brownfield into a useable community asset. The project received the 2007 Transportation Award from the American Institute of Architects, Los Angeles (AIALA); a 2003 Rail-Trail Design Recognition Award from Rails-to-Trails Conservancy and the American Society of Landscape Architects (ASLA); and

a 2000 Focused Issue Planning Award from the Los Angeles Section of the American Planning Association.

Community Integration and Sense of Place

Station Design and Public Art

The Orange Line project included the development of 13 new stations with passenger amenities such as canopies for shade and shelter, enhanced lighting, spacious sidewalks, bike racks and lockers, emergency telephones, and security cameras. To create a sense of place, each Orange Line station features artwork created by a different California artist. A lead artist worked with the design team to identify opportunities for artwork commissions and to develop elements of station continuity including standardized colors and materials, canopies, and seating elements.

Each station prominently displays large, elliptical terrazzo pavement designs and colorful panels of porcelain and steel that reflect the cultural or ecological heritage of the surrounding communities and incorporate aspects of San Fernando Valley history. Art pieces are positioned in the same locations at each station to create a consistent design theme, while also giving each station its own unique personality. Other artist-designed amenities include sculpted seating and various landscaping designs. To illustrate some examples of artwork along the Orange Line, selected stations are described below.

Figure 2-1
Valley College Station

Laurel Canyon Station

The art panels and pavings at Laurel Canyon Station display Chinese cherub pilots in a surreal atmosphere of airplanes, birds, and flying oranges and Chinese cherubs with California poppies . These symbols were chosen to suggest the idea of travel through imagery that is symbolic of California.

Figure 2-2

Terrazzo pavement design at Laurel Canyon Station

Figure 2-3

Porcelain and steel art panel at Laurel Canyon Station

Pierce College Station

To reflect Pierce College's emphasis on agricultural programs, station artwork makes references to nature and horticulture. Leaves and tree limbs represent the natural landscape, and the lattice design of overlapping branches refers to espaliering, a traditional method of pruning and training fruit trees. The art panels also feature images of common species of birds that have been cited on campus.

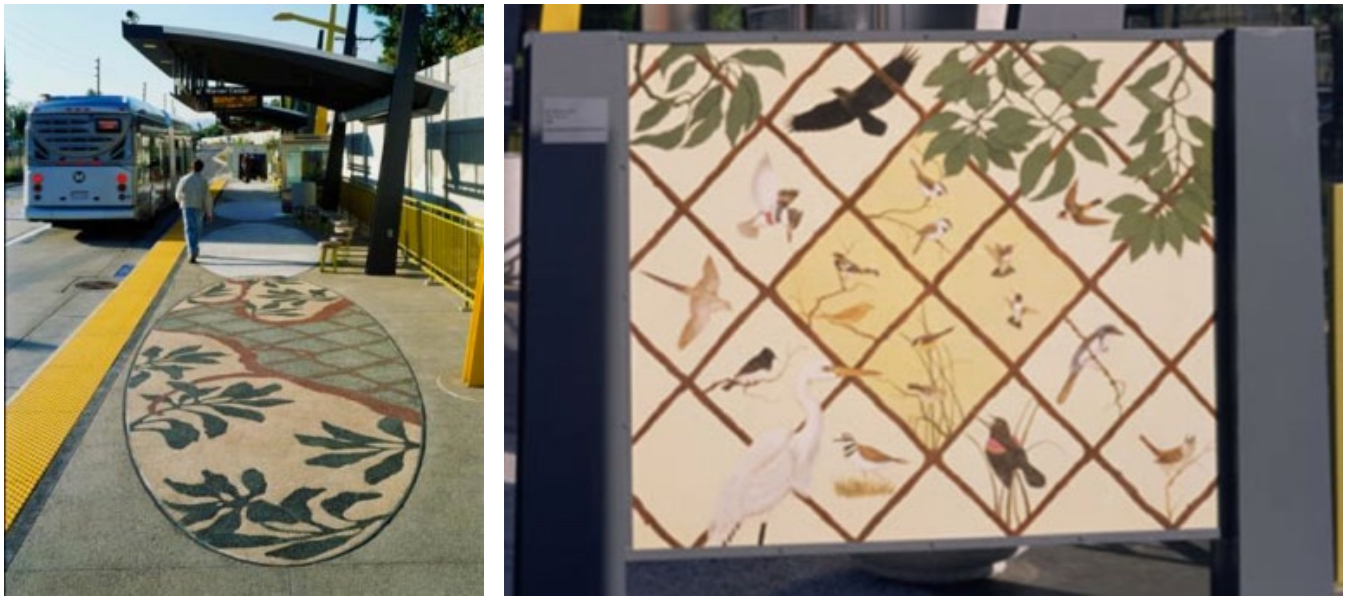


Figure 2-4 *Terrazzo paving (left) and art panel (right) at Pierce College Station*

Sepulveda Station

The pavings and art panels at Sepulveda Station were designed as a tribute to the Sepulveda Wildlife Reserve and the efforts of people who strive to protect natural habitats. A map of the west coast of North America and the monarch caterpillar on a double spiral are a reference to the migratory path of the monarch butterfly from Canada to central Mexico.

Figure 2-5
Terrazzo pavement design at Sepulveda Station

Figure 2-6

Art panel at Sepulveda Station

Woodley Station

Inspired by the geological strata of the Van Nuys, Sepulveda, and San Fernando Valley area, artwork at Woodley Station uses a gradient of light to create the illusion of a geologic cavity, with mud cracks indicating the flood plain fed by water from ancient aquifers.

Figure 2-7

Terrazzo pavement design at Woodley Station

Woodman Station

Terrazzo paving areas and porcelain enamel steel panels at Woodman Station were designed to reflect the long history of quilting in the United States. Many designs are centuries old and have descriptive names that correspond to important events. The selected pattern, "Journey to California," references both California and travel.

Figure 2-8

Terrazzo pavement design at Woodman Station

Landscape Beautification

In keeping with the project's urban design vision, Metro undertook a landscape beautification project to transform the vacant Southern Pacific railroad parcel into a "greenway ribbon" stretching from North Hollywood to Woodland Hills, recognizing it as a one-time opportunity to add thousands of plants and trees to the urban landscape. The $20 million project was one of the largest plantings ever in Southern California, with 850,000 plants, 5,000 trees, and six landscape art areas installed on 80 acres along the Orange Line busway [28]. The landscape project team created design concepts for plantings and landscape architecture along the entire corridor and at stations. To reflect the San Fernando Valley's heritage, California native and other water-wise plants were selected for the corridor landscaping, including some trees and shrubs found in the Valley before it was developed. As well as enhancing the overall appearance of the corridor, native plants help to create habitat for native wildlife and lend a unique, Southern California feel to the Orange Line corridor.

Figure 2-9

Landscape design at Hollywood Station

Figure 2-10

Native plants, trees, and shrubs along the Orange Line corridor

Figure 2-11

Native landscaping along the Orange Line corridor

As an added benefit to the community, the Orange Line is flanked by artist-designed sound walls and 14 miles of landscaped multi-use recreational paths, complete with fencing, crosswalks, and lighting to ensure safety. To add greenery and deter graffiti, the sound walls are planted with leafy, climbing vines. At some transfer points and junctions of regional bike paths along the corridor there are small plaza areas with artist-designed seating. In addition to their recreational and aesthetic value, these additional features soften the look of the busway and buffer adjacent homes and businesses.

Figure 2-12

Orange Line multi-use recreational path

Figure 2-13

Native landscaping adjacent to Orange Line bike path

Figure 2-14

Artist-designed sound walls with native shrubs and trees

Figure 2-15

Plaza area with sculpted seating

Public Health and Environmental Quality

Environmental quality encompasses a variety of indicators that gauge a region's quality of life in terms of public health and well-being, as well as the attractiveness and sustainability of both the natural and urban environment. Although the most direct impact on environmental quality stems from the reduction of emissions of local air pollutants, BRT investments also can have similar positive impacts on other forms of pollution (such as noise), other environmental objectives, and overall livability [22].

Vehicle Technology

The Orange Line's "Metro Liner" vehicle is an articulated, low-floor bus designed specifically for use in BRT service. The Cummins L-Gas Plus engine is powered by clean-burning compressed natural gas (CNG). Unlike most CNG engines, which are diesel conversions, the Metro Liner engines are designed from the ground up to run on CNG. The L-Gas Plus was designed specifically for large transit vehicles and is certified ultra-low emissions to U.S. Environmental Protection Agency (EPA) 2005 standards. At the time of the Orange Line fleet purchase, the L-Gas Plus engine offered the best-in-class emissions performance, emitting 40 percent less nitrous oxide and non-methane hydrocarbons and 90 percent less particulate matter than the levels required by EPA standards [29].

Figure 2-16

Orange Line's "Metro Liner" vehicle

Noise

Noise impacts, which result from both the engine noise and the sound of the tires on the running way, may be intensified by the larger engines needed to power high-capacity articulated buses. Per Metro's vehicle design requirements, the Metro Liner vehicle has a substantially lower noise requirement than the agency's other transit buses. To further reduce noise and vibrational impacts on adjacent neighborhoods, sound walls were built along some portions of the busway and rubberized asphalt paving was installed along residential sections. However, noise was still an issue for many two-story buildings, and for areas where the sound wall could not be built due to safety concerns regarding driver visibility. To further combat noise pollution, Metro modified vehicle exhaust pipes to open to the rear of vehicles and also met with residents to find other ways to buffer homes along the corridor from busway noise. Sound walls were extended where feasible, and several homes were retrofitted with additional insulation and dual-pane, sound-rated windows and doors.

Figure 2-17

Sound walls planted with climbing vines to add greenery and deter graffiti

Brownfields and Other Pollutants

Metro purchased the former Southern Pacific Railroad ROW with the goal of transforming the abandoned brownfield into usable property that would provide an attractive transportation alternative to the highway gridlock of the San Fernando Valley. Shortly after construction began, it was discovered that soil at the site was contaminated with lead and arsenic, likely originating from chemicals used to preserve the wooden railroad ties, herbicide and pesticide sprays, and motor vehicle emissions. Under a voluntary cleanup agreement, staff of the Department of Toxic Substances Control (DTSC) supervised the identification and removal of the contaminated soil. Periodic air monitoring and dust control measures were implemented during soil excavation activities to ensure that the public was protected from particulate emissions. The site was certified as clean in May 2004 after Metro's excavation and transport of approximately 55,000 cubic yards of contaminated soil for proper disposal [30].

Also, prior to the Orange Line, many sites along the Southern Pacific ROW, if not contaminated, had been used for industrial purposes or were neglected to the point of becoming neighborhood eyesores. Some of the images below show how some of these areas were greatly improved with the construction of the busway.

Figure 2-18

Commercial area before Orange Line construction

Figure 2-19

Commercial area after Orange Line construction

Figure 2-20

ROW near west end of Oxnard Street before Orange Line construction

Figure 2-21

ROW near west end of Oxnard Street after Orange Line construction

Figure 2-22

ROW adjacent to Chandler Boulevard before Orange Line construction

Figure 2-23

ROW adjacent to Chandler Boulevard after Orange Line construction

Sustainable Materials and Practices

The sustainable design elements of the Orange Line include drought tolerant landscaping, recycled materials, non-structural storm water treatment methods, reclaimed water use, and energy conservation building techniques. For the landscape beautification project, California native and other drought-tolerant plants were selected because they need little water, fertilizer, or maintenance, and there is less use of gasoline and less air pollution since no mowing is required. Also, instead of traditional curb and gutter drainage, an environmentally-friendly "bio-retention" drainage system is used along certain portions of the busway. This system uses drainage swales planted with special grasses that filter contaminants from storm water and allow the run-off to percolate back into the soil, rather than flowing into pipes that would direct it to the ocean. Metro also installed a special irrigation system capable of using recycled water from a nearby wastewater treatment facility. In the drought-prone desert environment of the San Fernando Valley, these water conservation measures are of particular importance.

Metro has also started incorporating sustainability design guidelines using Leadership in Environmental Energy and Design (LEED) principles in major capital projects, beginning with the extension of the Metro Orange Line. LEED design principles are intended to improve performance in energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and resource conservation.

Accessibility

As previously mentioned, accessibility and connectivity to the broader urban fabric are vital elements of contextual design. After all, BRT can make a significant contribution to community integration only when the system is accessible for all who wish to use it. Because transit facilities serve as a transition between different modes, they must be carefully tailored to balance the needs of pedestrians, bicyclists, transit riders, and motorists. Moreover, in addition to providing access for all, facilities must be designed to protect the most vulnerable users [31]. The Americans with Disabilities Act (ADA) requires adequate circulation space within a bus shelter, provision of sidewalks, bus stops that are connected to streets and sidewalks by an accessible path, and readable bus route and schedule information.

Accessibility refers to how easily individuals with disabilities can use the transit system. The implementation of many BRT elements can significantly improve the accessibility of transit for people with disabilities, as well as for the general public. The accessibility of a transit system can be assessed based upon whether it has been designed to meet the overall mobility needs of all customers, including people with disabilities and older adults.

In terms of physical accessibility, the Orange Line is configured for "near-level" boarding, with low-floor entries and exits that align with the raised curb of the station platforms, minimizing the step-up into vehicles. To facilitate boarding for passengers who use wheelchairs or other mobility aids, ramps at the front door of the vehicle can be deployed in 25 seconds. Access and circulation is enhanced by three extra-wide doors and unobstructed, low floors throughout the interior of the vehicle. To ensure accessibility for everyone, vehicles also provide space for two wheelchairs onboard, five fold-down priority seats for older passengers and people with disabilities, and automated visual and audio station announcements inside and outside the vehicle. All station features are compliant with ADA (Americans with Disabilities Act of 1990) regulations.

According to Metro staff, the project team made an effort to incorporate bicycle accessibility into the design of the Orange Line early on in the project. The Orange Line recreational path, which parallels the busway from North Hollywood to Warner Center, provides residents of the San Fernando Valley with a dedicated environment for cycling and walking while connecting to rapid transit. To facilitate bicycle access to the Orange Line, bike racks or lockers are provided at every station except Warner Center. Cyclists using the Orange Line can lock their bicycles at stations or store them on the Metro Liner's external bike rack, which has room for two bicycles.

Figure 2-24

Bicycle storage and multi-use recreational path adjacent to Orange Line station

Safety treatments at stations include enhanced lighting, emergency telephones, and security cameras, as well as visual and audio "bus approaching" warning messages communicated via the Transit Passenger Information System. Tactile warning strips (detectable by cane or underfoot) are used to alert people with vision impairments of their approach to the edges of boarding and alighting areas. The recreational path also includes safety features such as fencing, crosswalks, and lighting.

Transit-Oriented and Joint Development

The long-term development plan for Los Angeles includes high-capacity transit at certain major activity centers to promote transit oriented development (TOD). In keeping with this goal, Metro's Joint Development Program encourages intensive, high-quality development at station sites and along transit corridors. By directly linking Metro's transportation network with retail, commercial, and housing opportunities, joint development aims to reduce auto use, increase transit ridership, and provide a more enjoyable experience for Metro patrons. Many of the developments also include new and upgraded transit facilities that further benefit Metro and its patrons.

During the initial planning of a transit corridor project, Metro creates conceptual urban design strategies to integrate station sites with surrounding communities and evaluates proposed station sites for their development potential. With community input and in consultation with local jurisdictions, Metro prepares development guidelines detailing the intensity and type of land use for each joint development site, as well as any desired transit and urban design features. To enhance the overall economic development and smart growth goals for the surrounding community, land use and station area development are planned in cooperation with local jurisdictions, redevelopment agencies, developers, and other public and private sector agencies.

Land use in the San Fernando Valley was a key consideration in selecting the Orange Line running way and stations over a simpler BRT configuration. In addition to the higher investment in infrastructure for the route, there is also a greater amount of undeveloped land along the corridor than in more dense areas. According to Metro staff, the economic downturn has hindered development along the Orange Line, despite an interest in property located along the corridor. However, studies regarding TOD development at Canoga, Balboa, and Sepulveda Stations are currently underway, and planning officials expect development to accelerate as the economy recovers.

Also, although no formal plans have been established, Metro is considering the sale of a parcel of land that could bring approximately 31,000 square feet of new office space to a joint development site at Balboa Station. If Metro decides to go through with the sale, the developer intends to construct a two-story office building surrounded by approximately 150 surface parking spaces. The new building and parking would become part of the developer's existing four-building, low-rise Encino Office Park at the southwest corner of Balboa and Victory Boulevards.

Public Involvement and Community Outreach

From the initiation of environmental studies through completion of preliminary engineering, an extensive public and agency outreach effort was undertaken to identify and involve various stakeholders in the project. Throughout the development of the Draft Environmental Impact Report and Environmental Impact Study (DEIR/EIS), a comprehensive community outreach program was conducted, including two formal public hearings. In addition to public hearings and open houses that were held to solicit citizen input during the planning process, the DEIR/EIS was released to private citizens, community groups, the business community, elected officials, and public agencies for a 45-day public review and comment period. Copies were made available at libraries near the corridor, and the DEIR/EIS was also published online. To respond to concerns voiced during the public review period, Metro held additional community meetings and included refinements and enhancements to the project in its Final Environmental Impact Report (FEIR) [25].

During the preliminary engineering and final environmental phases of the Orange Line, Metro staff held a series of community meetings to address the concerns of adjacent neighborhoods and to refine project design features accordingly and where appropriate. One noteworthy example of Metro's community outreach efforts regarding the Orange Line can be seen in its response to strong objections from an Orthodox Jewish community in the Chandler/Burbank neighborhood. Since Orthodox religious law prohibits the use of electricity on the Sabbath and some holidays and requires Orthodox observers to walk, not drive, to religious services, the community has a pedestrian-oriented character. Residents were concerned that the busway, which in Chandler is located in the median of Chandler Boulevard, would disrupt their community with high-speed buses and tall sound walls, and that a reduced number of crosswalks would hinder pedestrian access to the synagogue.

To address this community's pedestrian safety concerns, special accommodations were made to facilitate movement across several informal pedestrian crossings that already existed in the corridor. Along Chandler Boulevard, all existing crossings of the busway were retained. In addition, a number of pedestrian amenities were developed and refined during preliminary engineering of the project. Two signalized mid-block crossings were constructed along Chandler Boulevard, and pedestrian paths were constructed in the median where previously there were no sidewalks. On the Jewish Sabbath and Jewish holidays, pedestrian signals operate on a timer that automatically signals buses to stop, creating a safe crossing for pedestrians.

In addition to the public outreach associated with the environmental documents, more than 200 meetings were held and nearly 11,000 contacts were identified in a public outreach database. This effort included station and landscape design workshops, newsletters, and meetings with a wide range of groups, organizations, and elected officials. Throughout the construction period, staff also worked closely with the contractor and Los Angeles City officials to effectively communicate street closures and minimize closure periods that would impact traffic flow. Status updates were also provided regularly through Metro press releases. To build upon local community input regarding the landscape beautification along the Orange Line corridor, Metro created a Landscape Advisory Committee to help oversee the project. The Metro Art Program also involved the community through an Arts Advisory Group, artist workshops, and various art program-related events.

Recommendations and Lessons Learned

Corridor Noise and Asphalt

As an added measure to reduce ambient noise levels near homes, rubberized asphalt paving was installed along residential sections of the busway. However, significant deterioration of the rubberized asphalt in the form of cracking and rutting occurred during the line's first year of service. These maintenance issues, along with test results indicating that noise reduction from the rubberized asphalt was negligible, led to a decision by Metro to repave these portions of the busway with thicker, stronger "Super Pave" asphalt [32].

Safety

During initial months of operation, the Orange Line experienced a series of collisions and near-miss incidents, primarily due to motorists running red lights at busway intersections. As of April 2010, the Orange Line has been involved in 58 crashes at busway intersections since beginning operation. Only one was due to negligence on behalf of an Orange Line operator; all other crashes were the fault of the other party involved. In response to the initial collisions, Metro reduced running speeds from 25 mph to 10 mph at all intersections. Enhanced signage and warning signals were also added, and photo-enforcement cameras were installed at many of the Orange Line's intersections to deter red-light running [26].

In addition, Metro convened a Safety Task Force composed of key members from Metro, the City of Los Angeles, and the Los Angeles Police and Sheriff Departments. Upon the recommendation of the Task Force, Metro installed red-light photo-enforcement cameras at 12 high-risk intersections to deter red light running. To further improve bus visibility and clarify roadway rules, other improvements included additional warning signs for motorists and

pedestrians, increased signal timing at red lights to give buses more time to clear intersections, and green-arrow right-turn signals to decrease confusion on the part of motorists.

These additional safety measures appear to have had a positive impact on the overall safety of the busway by substantially lowering the occurrence of accidents and near-miss incidents. Over the course of the Orange Line's inaugural year, the number of near misses declined steadily, from 709 in October 2005 to only 72 by October 2006. Since June 2006, the Orange Line has maintained a lower accident rate than the Metro system as a whole. This experience reinforces the notion that safety incidents are likely to occur on at-grade systems soon after deployment, when drivers are not yet accustomed to the busway, but that educational outreach and comprehensive safety measures can effectively address these issues [26].

Landscape Maintenance

The initial plan for the native landscaping between stations along the Orange Line ROW was to implement a temporary, two-year irrigation system, followed by no irrigation after the two-year establishment period. Inasmuch as the alignment traverses a suburban environment, many community members were concerned with the perceived image of dead plants during the hot summer months, which would contrast dramatically with residential yards. After re-evaluating the plan for a self-sustaining, drought-tolerant landscape, Metro redesigned the project to include a permanent irrigation system capable of using recycled water and the addition of some plant species that could tolerate more water.

In addition, some users of the recreational path have had safety concerns regarding overgrown areas, not only because of the encroaching plants, but also because of some cases where homeless people have used the overgrowth as shelter. According to Metro, many property owners insisted that the sound walls be located 10–12 feet from property lines, with the unintended consequence of creating a sort of "no man's land" between the sound walls and property lines that offers the possibility for encampment. Another problem area occurs along the portion of the busway near Van Nuys, where there is an extra-wide, densely landscaped area adjacent to the recreational path. As possible solutions to this problem, Metro suggests using less dense landscaping or, in cases where dense vegetation is used, restricting it to the edge of the ROW. According to Metro's Public-Private Partnership Program Manager, Kathleen Sanchez, "It can be a real challenge to find the balance between doing just enough and doing too much" [34].

Community Involvement, Planning, and Design

According to Metro staff, it is essential to consider the unique needs of the community and perform urban design outreach early on. "Even with good

outreach, arriving at a final design amid numerous stakeholders and community groups will be a challenge, so it's best to tackle it early on," said Hitesh Patel, Metro's director of construction management [34]. To get the most out of outreach efforts, Metro personnel suggest using visualization tools for communicating ideas and creating separate boards that the community can consult with regarding specific issues or concerns, such as schools or favorite stores that can't be disrupted during construction.

With regard to sustainability, Patel emphasized the importance of working to capture opportunities for sustainable options from the very beginning. Too often, options such as rain gardens and solar power end up as "add-ons" that are cut out of a project at the end because of budget constraints. However, if addressed during the planning stages, sustainable design elements can be built into the supportive infrastructure of the project in a manner that actually produces cost savings [34].

SECTION 3

Eugene EmX

Introduction

Operated by Lane Transit District (LTD) in Eugene, Oregon, the Emerald Express (EmX) made its debut in January 2007. One of the first full-featured BRT systems in the United States, the EmX uses a variety of BRT elements, including dedicated lanes with specialized paving, signal priority, high-capacity vehicles, level boarding with off-board fare collection, advanced computer monitoring systems, specially designed stations with real-time information, and a unique brand identity. Stations have a consistent design theme and are located predominately in the median of the street to emphasize the rail-like nature of the service. Station features include raised platforms, enhanced lighting, information displays, bike racks, and real-time passenger information. Service is provided by 60-foot articulated vehicles that have a sleek silhouette and use clean, quiet hybrid-electric propulsion technology.

BRT was chosen as the preferred transit strategy in Eugene not only for its significant enhancements to transit service, but also because it is appropriate in scale and cost for the surrounding community [35]. With an overarching theme of "greening the corridor," the EmX was designed to have a consistent look while beautifying surrounding areas and complementing the character of the community. Thus, concern for the environment and appreciation of local culture and ecology are central to the hallmark "green" image of the EmX [36]. With less than a year in operation, LTD's commitment to the environment was recognized with a 2008 Sustainable Transport Honorable Mention from the Institute for Transportation and Development Policy.

Project Overview

The EmX commenced service as one of the first full-featured BRT systems in the United States. Discussion of a rapid transit system began in 1996 as part of the update to the Eugene-Springfield Regional Transportation Plan. Out of several transit options that were considered and analyzed over the course of the plan update, including conventional bus, enhanced bus, and rail options, the BRT concept emerged as the locally preferred transit strategy. It was seen as a way to significantly enhance transit service and attain many of the benefits of light rail but at a lower cost. BRT was also favored as the option that 1) was appropriate in scale and cost for the Eugene-Springfield region, 2) would result in more efficient transit operation, and 3) could be developed one line at a time, according to community demand and available funding. These combined factors

led to a 2001 decision by Eugene, Springfield, Lane County, and LTD to approve BRT as a key element of the new transportation plan [35].

The Franklin Line was launched in January 2007 as the first operational route in what is planned to be a 60-mile network of EmX corridors. The four-mile line travels primarily on Franklin Boulevard, providing a link between LTD's two major hubs, downtown Eugene and downtown Springfield. By linking these two hubs, the Franklin Line forms the "backbone" of the EmX. The high traffic volume, population density, and heavy transit ridership on this section of Franklin Boulevard also contributed to its selection as the pilot EmX corridor. The Franklin Line serves the University of Oregon, Northwest Christian College, and Sacred Heart Medical Center [35].

The Gateway Extension, which opened in January 2011, extends the Franklin EmX approximately 5.5 miles north from its eastern terminus in downtown Springfield to the new Peace Health medical complex and the Gateway Mall area of Springfield. Each EmX vehicle now travels the entire route from downtown Eugene to downtown Springfield to the Gateway area, and back again. The remaining lines of the EmX system will be implemented in priority order according to a number of factors including availability of funds, projected demand, and regional growth strategies.

The EmX uses three different lane types. Along the Franklin and Gateway corridors, vehicles operate in exclusive single and dual busway lanes as well as general-purpose travel lanes. Busway lanes are for buses only and penalties are assessed for vehicles operating or parking in the bus lanes. Where a single, bi-directional busway lane is used, "block signaling" indicates when it is safe for a bus to enter the lane, allowing eastbound and westbound buses to use the same lane. The dual busway lanes are 10–11 feet in width and are separated by an 18-inch curb. The third lane type, which was implemented for the first time with the Gateway Extension, is called a Business Access and Transit lane, or BAT lane. The BAT lane is reserved for EmX vehicles and is shared with general-purpose traffic making right turns into businesses or onto cross streets. When operating in mixed traffic, queue jump lanes are used at selected high-congestion intersections and EmX vehicles are given signal priority via ground-loop or GIS-based detection systems. Other Intelligent Transportation Systems (ITS) components include Automated Vehicle Location (AVL), Automated Passenger Counters (APC), computer automated dispatching (CAD), and Real-Time Passenger Information.

The EmX uses a pre-paid, proof-of-payment fare system and operates seven days per week on a fixed schedule. Weekday service runs approximately from 5:30 AM to 11:30 PM, with 10-minute headways throughout most of the day and 15–30 minutes in the early morning and late at night. During the weekend, service operates at 15–30 minute intervals within a more limited service span.

The EmX's 26 stations (including Eugene Station and Springfield Station) are spaced approximately every one-third to one-half mile and serve a total of 24 stops along the route. Stations have raised platforms and a consistent shelter design and are located either in the median or curbside. Passenger amenities at stations include seating, trash receptacles, enhanced lighting, bike racks, and real-time schedule information. The 60-foot articulated vehicles are powered by a hybrid electric-diesel propulsion system and feature doors on both sides, space for two wheelchairs and three bicycles, and next stop voice and text announcements. Bicycle and pedestrian paths, public art, and native landscaping along the corridor and at stations are some of the urban design improvements included as part of the project.

Ridership on the EmX has surpassed expectations. LTD estimated that ridership over the 20-year design period would increase by approximately 40 percent over conventional local bus service, equating to approximately 3,780 average weekday boardings over the 2,700 average weekday boardings previously provided by the local bus. Ridership on the Franklin EmX surpassed the 20-year projection within its first month of service, with approximately 4,000 average weekday boardings. By the end of the first year of service, ridership had grown to nearly 6,000 average weekly passenger boardings, a more than twofold increase over the previous conventional bus service [35]. After the opening of the Gateway Extension in January 2011, average weekday ridership on the combined two corridors grew to approximately 9,500 boardings [37]. LTD plans to eventually provide EmX service along a 61 mile network that includes most of the main transportation corridors in the metro area. The third EmX project, currently in the planning phase, is an extension to West Eugene.

Design Characteristics

Eugene is known as a progressive, environmentally-conscious community that takes pride in its cultural and ecological heritage. Accordingly, the design concept for the EmX was guided by an overarching vision of "greening the corridor," with community integration, concern for the environment, and appreciation of the Eugene-Springfield area's history and natural beauty identified as primary design goals from the outset of the project [36]. To incorporate these goals into the design of the EmX, LTD consulted arborists, urban foresters, concrete specialists, architects, and landscapers during every phase of the project. Agency staff also worked closely with cycling groups and people with disabilities to design a system that would be accessible to everyone. With less than a year in operation, LTD's commitment to the environment was recognized with a 2008 Sustainable Transport Honorable Mention from the Institute for Transportation and Development Policy.

Community Integration and Sense of Place

Station Design

According to Stefano Viggiano, former Assistant General Manager and Planning and Development Manager at LTD, "Creating a well-integrated transit corridor that would feel like a part of the community required delivering a system that would be recognizable and appealing to potential riders, while fitting in with the character of the corridor" [38]. To accomplish this, stations were emphasized as important locations that would stand out and be recognized with EmX branding. The station design theme of "masted sails" evolved out of the need for stations that would look substantial and offer comfort and protection from the rainy Eugene weather, while also providing transparency at eye level so that views would not be blocked. The airy, open design also minimizes the potential for vandalism and enhances the perception of safety [36].

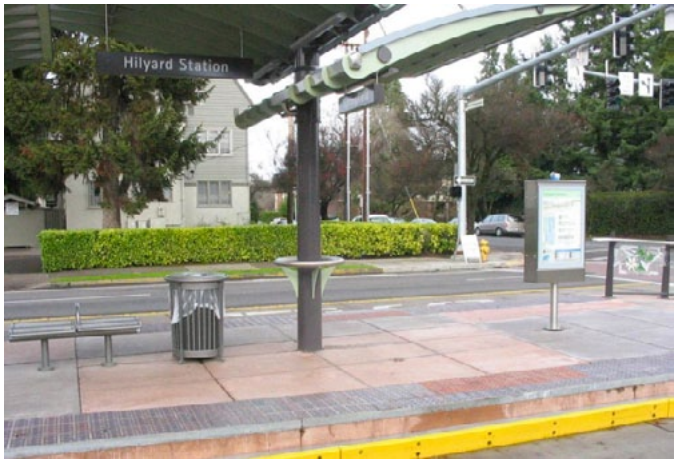
To prevent rainwater from cascading off roof edges onto waiting passengers, the angle of the roof directs rainwater to a central gutter while a single, centrally located column on the station platform acts as a downspout to the storm system. The more open design of the central station column minimizes obstacles for the free movement of passengers on the platform, while also maximizing visibility to improve customer safety. In addition, stations are constructed of small components to further reduce the surface area available for graffiti. For durability and strength, station components are constructed of steel and coated with high-quality paint. Although the theme of masted sails is consistent throughout the corridor, the stations are designed in a modular fashion that allows them to be scaled according to neighborhood conditions and ridership demand.

Figure 3-1

Dad's Gate Station on Franklin Corridor EmX

Figure 3-2

Platform at Hilyard Station on Franklin Corridor EmX



EmX terminal stations were designed to be quality public facilities that would complement their surroundings, both in function and with a strong architectural presence. According to Graham Carey, the project engineer for the Franklin Line, "We always thought of end terminals as essential locations for defining the EmX route- we didn't want the route to just peter out in the neighborhood so you didn't know where it had started or ended" [36]. Eugene Station, designed by a local architectural firm, is an integral part of downtown Eugene. While the facility was already opened as a central LTD transfer point prior to the implementation of the EmX, "It was always known that Eugene Station was going to be the end point for the EmX, so it was designed with the idea that the EmX was coming," said Carey [36]. The station extends over more than 2.5 acres of LTD property, about three-quarters of a block. Amenities include open shelters, bicycle parking, and an indoor customer service center with restrooms, seating, and information kiosks. Arches of fused glass span across the entryways at each of the station's four faces, and a clock tower is decorated with fused glass prisms that shift with the changing daylight.

Figure 3-3

Eugene Station in downtown Eugene

The other hub of the Franklin Corridor EmX, Springfield Station, was the first major new development in downtown Springfield in nearly 25 years. Springfield Station provides a number of indoor amenities including restrooms, information kiosks, telephones, and an ATM. Outside, the station offers open shelters, bicycle parking, an attractive "bioswale" rock garden to filter and cool storm water, and a sculptural rainwater funnel decorated with glasswork and lighting. Adjacent to the shelters on the western side of the station runs a 50-foot mosaic wall made of recycled glass and ceramic tile. In addition, a restaurant that rents space from LTD is located on the property.

Figure 3-4

Springfield Station in downtown Springfield

Figure 3-5

Glass mosaic wall at Springfield Station

Public Art and Places of Interest

To avoid uniformity in station design and appearance, the EmX was designed to reflect the cultural and ecological heritage of Eugene through artwork and places of interest along the corridor. For the Franklin Corridor, LTD commissioned the work of a local metal artist who created laser-cut and cast aluminum forms of native foliage to hang within the frames of station handrails. Each station highlights a different plant species and some stations showcase species that have significance to the surrounding area.

Figure 3-6

Public artwork in station handrails

Figure 3-7

Detail of cast aluminum artwork in station railing

It was important to LTD that the stations on the Gateway Extension have the same brand identity as the Franklin Corridor, while representing some of Springfield's unique qualities. To continue the EmX brand at the macro level, the same iconic shelters and railings of the EmX system were used for the new stations; however, new paving patterns and different art installations give the stations their own unique character at the micro level. In a departure from the botanical theme of the Franklin Corridor, history is the focus along the Gateway Extension. Three sculptural interpretations of Springfield's early fishing,

logging, and milling industries, described below, were created by a local artist and installed near EmX stations along Pioneer Parkway. To further highlight the historic elements that inspired the sculptures, LTD developed interpretive signs to accompany them.

- *McKenzie Drift*, adjacent to the Gateway EmX Centennial Station: An illuminated glass and stainless steel sculpture of the popular "double ender" drift boat used for fishing the nearby McKenzie River in the 1940s.

Figure 3-8

McKenzie Drift sculpture, adjacent to Gateway EmX's Centennial Station

- *Splashdam*, adjacent to the Gateway EmX Hayden Bridge Station: This steel sculpture portrays one of the most common scenes of early logging history: logs tumbling through a splash dam.

Figure 3-9

Splashdam sculpture, adjacent to Gateway EmX's Hayden Bridge Station

Figure 3-10

Interpretive sign accompanying Splashdam sculpture installation

- *Snowball*, adjacent to the Gateway EmX Q Street Station: This sculpture draws from the history of a grist mill that operated from 1854–1930 in Springfield, producing "Snowball XXX" brand flour from Willamette Valley wheat.

Figure 3-11

Snowball sculpture, adjacent to Gateway EmX's Q Street

Similar to the Franklin Corridor, artwork was also incorporated into the stainless steel handrails of the Gateway EmX stations, which are cut in patterns that echo the river and water themes depicted in the sculptures.

Figure 3-12

Stainless steel art railings at a Gateway EmX station

Landscape Beautification

The goals of minimizing visual impacts and complementing the natural beauty of the area along the EmX corridor led to several unique design elements. According to LTD staff, the community was very attached to the green area along the median of Franklin Boulevard, which is the only true boulevard in Eugene. To replace some of the greenery that was lost to the EmX running ways, and to make the areas between stations as green as possible, LTD used the inventive approach of planting grass down the middle section of the running way. In addition to softening the look of the corridor, the added greenery also absorbs noise from the vehicles and reduces the amount of impervious surface that creates stormwater runoff. This approach was also used to preserve some of the greenery in the Pioneer Parkway median, where the running way of the Gateway Extension parallels a local rail-trail preserve, the Rosa Parks Path [36].

Figure 3-13

Grass strip in center of Franklin EmX running way

To benefit the ecosystem and further beautify the area along the Franklin EmX, LTD's landscape architecture plan included native landscaping along the corridor and at stations. Trees, shrubs, and other vegetation were selected for their beauty and ability to thrive in the local climate. Hardwood trees include varieties of oak, elm, ash, maple, dogwood, and ornamental pear, while evergreens include redwood, cedar, and sequoia. The Gateway EmX also included a landscape plan designed to enhance the attractiveness of the Pioneer Parkway median.

Another innovative design move was the decision to pave the sight triangles at intersection corners along the EmX. Development of sight triangles, which are formed by the sight lines of the intersection, is not permitted because of possible interference with visibility down the roadway. The goal was to visually improve these small, otherwise unused pieces of the corridor by using attractive brick pavers to create a plaza effect. Construction of the Franklin Line also included undergrounding of utilities along one stretch of the corridor, rebuilding much of the roadway, tree pruning, and curb realignments [36].

Figure 3-14

Native landscaping at EmX Station

Figure 3-15

Native landscaping along EmX corridor, adjacent to running way

Pedestrian and Bicycle Enhancements

LTD worked with the City of Eugene and the Bicycle/Pedestrian Advisory Committee (BPAC) to consider pedestrian and bicycle enhancements that could be incorporated into the design of the EmX project. To improve conditions for walking and biking in neighboring areas, bike lanes and sidewalks were constructed along sections of the Franklin Corridor where they did not previously exist. The Gateway Extension project was also designed to preserve and enhance bicycle and pedestrian amenities. For instance, the popular multi-use Rosa Parks Path in the Pioneer Parkway median was preserved, while the former 5-foot sidewalks on International Way (along the loop of the Gateway Extension) were widened to create 10-foot multi-use paths on both sides of the street. To encourage bicycle travel and multi-modalism, bicycle storage is provided on EmX vehicles and at stations.

Figure 3-16

Multi-use path adjacent to Gateway EmX

Additionally, the EmX project included several pedestrian and bicycle safety enhancements that have improved conditions for walking and biking in the adjacent neighborhoods. At the south end of the Pioneer Parkway median, where the southbound EmX lane crosses the Rosa Parks Path, a carefully designed crossing with a "walk/don't walk" signal protects path users and alerts them to the approach of EmX vehicles. LTD has also provided lighting along the path, as well as shrubs and fencing to protect cyclists and pedestrians in places where the EmX lane is within 10 feet of the path.

The location of the original station at Gateway Mall required bus operators to navigate through crowded pedestrian areas and travel along parking aisles into the interior of the mall's parking lot. A new Gateway Station was constructed at a more central location within the Gateway Mall area that required less circuitous travel on the mall property, and features an enhanced pedestrian crossing and a covered walkway that shelters people as they walk between the station and the mall. New signalized pedestrian crossings were also added on Gateway Street, Harlow Road, and International Way, along the loop of the Gateway Extension.

Public Health and Environmental Quality

Vehicle Technology

EmX vehicles are powered by the GM Allison hybrid-electric propulsion system. A 12-month study by the National Renewable Laboratory (NREL) found the fuel economy of the GM Allison hybrid-electric buses to be 27 percent higher on average when compared to standard diesel buses [39]. The GM Allison hybrid-electric propulsion system also reduces noise and emissions compared to conventional diesel buses [35].

Sustainable Materials and Practices

The sustainable design elements of the EmX include native landscaping, energy efficient lighting, non-structural storm water treatment methods, recycled materials, environmentally responsible construction techniques, and alternative energy sources. Throughout the corridor and at stations, native plants were introduced because they need little water, fertilizer, or maintenance, and therefore result in less use of gasoline and less air pollution. The strip of grass in the center of the running way absorbs possible fluid leaks and much of the noise that would otherwise echo off the bare pavement. Also, by reducing the amount of impervious surface, the grass strip allows more water to flow back into the groundwater table instead of being lost as storm water run-off. To conserve energy, special lighting at stations is sensitive to the surrounding brightness and adjusts its own level of illumination accordingly.

At Springfield Station, a platform rock garden functions as a natural rainwater drainage system, or bioswale, that keeps rainwater run-off out of storm drains and removes pollution from the water before it enters back into the groundwater table. A ground-source geothermal heat pump is used to heat and cool the station buildings, and the mosaic artwork at Springfield Station is made of recycled glass. However, although Springfield Station incorporates concepts of green building and is built to LEED standards, it is not LEED certified due to a seven percent increase in construction costs that would have been necessary

to pay for certification [35]. Similar to Springfield Station, Gateway Station uses energy-efficient lighting, is landscaped with native vegetation, and was constructed of durable, low-maintenance materials that contain recycled content.

Figure 3-17

Bioswale at Springfield Station

Accessibility

A primary design goal for the EmX was to create a system that would be accessible to all. To ensure that the EmX would meet the overall mobility needs of all customers and be easy for anyone to use, LTD consulted cyclists and people with disabilities during the design of the project. Prior to developing vehicle specifications, a mock-up of a section of the bus was created and used to evaluate the positioning of the wheelchair bays and the access pathways to those bays [38]. LTD partnered with New Flyer Industries, a North American vehicle manufacturer, to create a unique vehicle that was designed specifically for accessibility, easy boarding, and bicycle boarding.

A unique feature of the EmX vehicles, explains Stefano Viggiano, is the ability to accommodate persons in wheelchairs in a rear-facing, unsecured position. "Through engineering studies, it was determined that a rear-facing wheelchair bay with a padded headrest and strategically placed stanchions would provide for a safe ride, even without the use of securing straps. The EmX vehicles include both a front-facing secured wheelchair bay, as well as a rear-facing unsecured bay. Operating experience has demonstrated an overwhelming preference for the rear-facing wheelchair position. As a result, the newer EmX buses were designed in such a way that the front-facing wheelchair bay can also be used in a rear-facing manner" [38].

In terms of physical accessibility, the EmX is designed for "near-level" boarding, where low-floor vehicles align with raised platforms designed to minimize the step-up into the vehicles. To facilitate boarding for passengers who use wheelchairs or other mobility aids, a ramp at the middle door can be deployed to bridge the narrow gap between the bus and the curb. Seating in the front of the vehicle is reserved for older passengers and people with disabilities, and vehicles are able to accommodate two wheelchairs on-board. Access and circulation is further enhanced by the vehicle's extra-wide middle and rear doors and the careful placement of seats and stanchions to provide a clear, open pathway for persons in wheelchairs [38].

Figure 3-18

Low-floor vehicle aligns with raised station platform for near-level boarding

Central median stations afford shorter, safer crossings for customers with disabilities, and all station features are compliant with ADA regulations. Ramps and grab rails at stations aid passengers with mobility aids, while centrally located columns on station platforms minimize obstacles that can cause danger to disabled passengers. Tactile warning pavers (detectable by cane or underfoot) are used to alert people with vision impairments of their approach to the edges of boarding and alighting areas, and audible count-down crossing signals were installed at busy intersections. For enhanced access of information, automated voice messages and bus header screens at the front of the bus alert passengers of the next station stop and which side of the vehicle should be used to exit. In addition to these system features, training on how to ride the EmX is available for people with disabilities.

Figure 3-19

Median station with ramp and crosswalk

For bicycle access, bike storage is provided at EmX stations and near-level boarding allows cyclists to walk their bikes onto EmX vehicles, where there is room on board for three bicycles. LTD staff worked with the local cycling community to test the best way to secure bicycles once inside the vehicle. The result was a decision to allow cyclists to board through the rear door and place their bikes in a rack in a designated bicycle bay. Velcro straps are available to secure bicycles.

Figure 3-20

Bicycle boarding EmX vehicle through rear door

Public Involvement and Community Outreach

LTD has always valued public participation in transit planning, and the planning and design of the EmX was no exception. LTD's public outreach efforts included staff and Board members meeting with hundreds of community members, including civic leaders, business owners, environmental groups, neighborhood groups, and service groups. These public hearings, workshops, and open houses were also supplemented by working groups of elected officials and stakeholders. In addition, LTD employed newspaper and television advertising, printed brochures, and postcards as part of a campaign to raise public awareness of the EmX.

To involve the community in the planning and design of the corridor, LTD used a separate, more focused public involvement process that included numerous public meetings, design workshops, and open house events. Public participation in the conceptual design of the project was encouraged through a series of intensive planning sessions, or "charrettes," that were open to the public. "Those attending the design workshops had the opportunity to offer ideas for lane configurations and station locations, and then be invited back to a second design workshop about two weeks later to see how their ideas had been translated into design concepts," said Stefano Viggiano [38]. LTD staff also worked closely with cycling groups and people with disabilities to design a system that would be accessible to everyone.

To ensure that constructing the EmX would cause as little inconvenience as possible, LTD liaised with local contractors, adjacent businesses, local governments, and other specialists over the course of construction. A construction approach was employed that limited the amount of time any one section of the corridor was under construction, and made sure that access to businesses was maintained at all times [38]. LTD also kept in close contact with all property owners and occupants along the corridor to discuss the concept of the system and to provide information on any potential impacts. In addition to these one-on-one communications, LTD provided weekly email updates, held press releases, engaged in media interviews, and organized informal "coffee and chat" engagements at various locations along the corridor.

Recommendations and Lessons Learned

LTD's experience with the EmX underscores that the benefits of BRT are accomplished through a variety of elements and features, some of which have not typically been evaluated in transportation analysis. "While improvements in transit service frequency, reliability, and travel time are critical to a successful BRT project," said Viggiano, "EmX improvements in those factors were projected

by the transportation model to lead to a 40 percent ridership gain. However, the Franklin EmX more than doubled ridership. Clearly, items such as system branding and image, the comfort and convenience of stations and buses, and the ease of understanding the system contributed a great deal to ridership" [38].

According to Graham Carey, public involvement during initial planning was one of the biggest obstacles to the success of the project. "Citizens and elected officials didn't really understand what BRT was, and there were no visual examples for them to see, so it was hard to get them involved and familiar with the concept" [36]. To provide as much information as possible and help the public visualize the project, LTD employed a variety of mock-ups and photo simulations, which were fairly new at the time. "In particular, a video simulation of the Franklin corridor was instrumental in communicating the BRT concept and helping the community visualize BRT stations and busways," said Viggiano [38].

While the initial public outreach efforts were focused on communicating a concept, once project planning started, the focus changed to outreach in regard to a specific project. "Although the community may understand and support a concept, there will be concerns, particularly by those most directly impacted by a project, to issues such as access to business, property acquisition, or construction impacts," said Viggiano. "A high level of communication with those most impacted by the project was critical to understanding and addressing their concerns, and allowing the decision-makers the comfort level to move forward with the project. It was also critical that the high level of communication continued throughout project planning and construction, even if there was nothing new to communicate, to reassure the community that the project was proceeding as planned" [38].

With regard to community impacts, it should be noted that LTD went to great lengths to preserve trees along the corridor. A City of Eugene ordinance requires a city-wide vote in order to remove or encroach upon a tree that is more than 50 years old. To avoid this process, LTD planners designed the Franklin Corridor route around the trees. One downside to this solution is that drivers must slow down to maneuver through the curves of the narrow busway. Nonetheless, the trees do enhance the visual appeal of the corridor and the overall "green" image of the service. It was necessary to remove some trees to make way for the Gateway EmX lanes in Springfield, where no tree ordinance is in effect; however, new trees were planted to replace those that were removed. On both the Franklin and Gateway corridors, more new trees were planted than were removed for the project. Concerning landscaping, however, Carey emphasized the importance of planning for future maintenance. "We tried to get in as much landscaping as possible—maybe we tried a little too hard. There are some really narrow landscaping strips with traffic on either side, and these areas are very difficult to maintain without having to practically shut down a lane" [36].

LTD notes that the flexibility of BRT provides opportunities for creative mitigation of impacts, and the EmX system's varying lane configuration is an excellent example of that flexibility. A critical issue for any transit corridor project is the need to balance transit enhancements with cost and impacts to access, property, and traffic flow. "BRT, due to its flexibility, provides an opportunity to address or mitigate impacts that would not be available with a rail project," explained Viggiano. "For example, the Franklin corridor includes two bridge crossings that would have been very expensive to widen to accommodate busways. In those situations, the EmX merged into the mixed traffic lane. Because this was a higher speed section of the corridor, it would have been very challenging to achieve the same result with a rail line. Similarly, the single, bi-directional EmX busways were a compromise to reduce property impacts along portions of the corridor." However, Viggiano cautioned that BRT's inherent flexibility has the potential to be a double-edged sword. "While it provides opportunity to address impacts and concerns along the corridor, it also may make it easy to compromise to such an extent that transit priority and enhancements are dramatically reduced. LTD retained a focus on transit priority and securing transit right-of-way where possible, only compromising on that in cases where the busways had significant adverse impacts" [38].

SECTION 4

Cleveland HealthLine

Introduction

The Cleveland HealthLine, operated by the Greater Cleveland Regional Transit Authority (RTA), commenced service in October 2008 as the nation's first BRT system to secure funding from the Federal Transit Administration's (FTA) New Starts program, which was originally intended to finance only rail projects. The project received an $82.6 million New Starts grant, along with other federal, state, and local funding sources, totaling approximately $200 million for vehicles, station infrastructure, roadway reconstruction, and streetscape renovation. The HealthLine is also one of the few BRT systems to operate in an exclusive running way on an urban thoroughfare and the only BRT project in the country specifically designed as a model "complete street" to simultaneously support multiple transportation modes. The project is one of 10 BRT demonstration projects selected by FTA to evaluate the viability of BRT in the U.S. transit market. Due to its success, the HealthLine serves as a model for the development of urban BRT corridors across the U.S. and has helped to shape federal policy concerning FTA's Small Starts and Very Small Starts programs.

The 7.1-mile HealthLine runs on the city's historic main street, Euclid Avenue, from Public Square in downtown to East Cleveland, linking the city's two largest employment centers, the central business district and University Circle, as well as major cultural, medical, and academic institutions along the corridor. Originally called the "Silver Line," the name of the service was changed to the HealthLine after naming rights were sold to University Hospitals and the Cleveland Clinic, two prominent medical establishments located along the corridor. As a "full-service" BRT system, the HealthLine incorporates a range of advanced technologies and infrastructural elements to enhance performance, including dedicated lanes, TSP, low-floor vehicles, off-board fare collection, platform stations, and level boarding with precision docking. Other key design features of the project include expanded pedestrian amenities, bicycle lanes, public art, and streetscape improvements at stations and along the corridor. Since opening, ridership on the HealthLine has increased by more than 60 percent over the bus route that previously operated in the corridor [40].

The development strategy for the HealthLine was to use long-term investments in transit and other public infrastructure as a mechanism for private investment along the corridor. The project has been credited with catalyzing more than $4.7 billion in spin-off investment and 11.4 million square feet of new and planned development along the corridor, offering a successful example of BRT's economic

leverage potential [41]. Part of this investment can likely be attributed to the fact that, in addition to constructing a busway, the project included a complete streetscape renovation of Cleveland's historic Euclid Avenue, a once grand boulevard that had fallen into a decades-long state of decline and disrepair. Thus, the HealthLine has been an investment not only in public transit, but in Cleveland's downtown core.

Project Overview

In its heyday during the latter half of the 19th century, Euclid Avenue was known as "the showplace of America" and had garnered international attention for its concentration of wealth and splendor, including a string of grand mansions belonging to some of the nation's wealthiest industrialists. However, under the pressure of encroaching commercial development from downtown Cleveland and massive property tax increases during the early decades of the 20th century, this once prestigious avenue declined rapidly and was devastated by the end of the Great Depression. In the 1950s, plans to revitalize the corridor included a proposed subway under Euclid Avenue that would link the region's two largest employment centers, Public Square and University Circle, but the project languished without adequate financial support. By the 1960s, Euclid Avenue was reduced in some places to a stretch of vacant lots, abandoned storefronts, and substandard housing, and large areas of the corridor were cleared as part of urban renewal programs. Due to lack of funding for the subway, as well as for a subsequent 1980s proposal for light rail, plans for rapid transit in the Euclid Corridor remained at an impasse. Decades later and still without a connection between the city's two employment hubs, a delegation of local officials and business leaders made a trip in 1998 to Curitiba's acclaimed BRT system to assess the viability of BRT in Cleveland. Impressed by its low cost and rail-like quality and efficiency, the delegation embraced the BRT concept and, after an evaluation of transportation alternatives in the early 2000s, it became the locally preferred alternative for public transit along Euclid Avenue [40, 42].

The HealthLine runs east along Euclid Avenue from downtown's Public Square to East Cleveland, fulfilling the longstanding goal of connecting the region's two employment hubs- the central business district and University Circle. Land uses are composed of mixed-use neighborhood districts along the entire corridor. Traveling east from Public Square, the line passes through many areas of historic and architectural significance, including downtown, the Gateway District, the Playhouse Square Theater District, Midtown, the Fairfax/Renaissance Neighborhood, University Circle, and the suburb of East Cleveland. The HealthLine also serves Cleveland State University, the Cleveland Clinic, Case Western Reserve University, and University Hospital.

The HealthLine uses a fleet of 21 high-capacity, stylized articulated RTVs (rapid transit vehicles). The 63-foot RTVs, which are powered by a clean hybrid diesel-

electric propulsion system, have three doors on each side of the vehicle for fast and easy boarding and alighting and use horns that produce the same sound as RTA's light rail vehicles. The fleet operates in median-aligned, bus only lanes through the corridor's Midtown section, transitioning to dedicated curbside bus lanes through University Circle and finally to mixed-traffic curbside lanes to the Stokes/Windermere Rapid Transit Station in East Cleveland, one of RTA's most heavily-used facilities.

The HealthLine uses a pre-paid, proof-of-payment fare system and operates 24 hours per day, 7 days per week, with service arriving every 5 minutes during the morning and afternoon peak periods, 10–15 minutes through the mid-day, evenings, and weekends, and 30 minutes overnight. The service incorporates many of the full-service BRT elements designed to reduce travel times and expedite the boarding process, including TSP, low-floor vehicles with multiple-door entry on both sides, off-board fare collection, greater service frequency, consolidated stops, and platform stations coupled with precision docking for level boarding. Signal timing/phasing optimization provides transit vehicle prioritization along the route, GPS and AVL enable real-time arrival information at stations, and lateral guidance technology in the form of a mechanical guide-wheel is used to help achieve precision docking at median stations.

Passenger-friendly stations offer features to enhance comfort, convenience, and safety, such as seating, real-time passenger information (RTPI), touch-screen kiosks, security cameras, emergency telephones, and arched glass partitions for protection from the elements. In addition, the project included a complete streetscape renovation of Euclid Avenue, including comprehensive sewer and water system upgrades, new sidewalks with benches and brick inlay, crosswalks, pedestrian-scale lighting, an extensive public art initiative, landscape plantings, bicycle lanes, and the planting of 1,500 new street trees along the line. Approximately 2.3 miles of adjoining streets were also refurbished, for a total project length of more than 9.3 miles.

Three years after its opening, the HealthLine was carrying over 15,000 passengers per day, exceeding the project's ridership goals as well as outperforming RTA's light rail service, which carried 11,000 passengers per day [43]. To date, ridership on the HealthLine has expanded by more than 60 percent over the previous bus route in the corridor, and the approval ratings of riders have consistently ranked above 90 percent [40].

Design Characteristics

As an investment in the core urban infrastructure of Euclid Avenue, the HealthLine was designed to reshape the identity of Euclid Avenue by bringing an active and engaging street life to the corridor. The design approach was to use transit and other urban infrastructure to create open space amenities and

develop the corridor into a linear park. And while unified as a single street, the HealthLine corridor was envisioned as a sequence of several distinctive districts. Accordingly, urban design goals were established to ensure that the project would provide the necessary continuity for a strong corridor identity, while remaining flexible enough to preserve and even enhance the character of individual neighborhoods. Design features include modern, permanent stations, multiple pedestrian enhancements, exclusive bicycle lanes, integrated and stand-alone public art, and the restoration of the urban forest. By combining improvements in transit, infrastructure and the public realm into one integrated project, the HealthLine has re-established many of the cultural and historic sites along Euclid Avenue and unified some of Cleveland's oldest urban districts into a cohesive downtown destination. The project received an Award for Excellence from the Urban Land Institute, a National Recognition Award from the American Council of Engineering Companies, a Merit Award from the International Downtown Association, an Engineering Excellence Award from the American Council of Engineering Companies of Ohio, and designation as a Hub of Innovation by the State of Ohio.

Community Integration and Sense of Place

Station Design

The HealthLine corridor traverses a diverse group of neighborhoods and districts with buildings of varying sizes, styles, and uses, including numerous historic structures and major educational, medical, and cultural facilities. To create a cohesive fabric along the corridor while still allowing the character of unique neighborhoods to show through, certain landscape and urban design elements are consistent along the entire corridor, while others are applied according to the locale. For instance, to contrast but not compete with the range of historic and architectural design influences along Euclid Avenue, RTA chose a family of distinct station types to be located in various districts. Rather than attempting to replicate a certain period or architectural style, the station design employs concrete, stainless steel, and arched glass to achieve a modern, translucent effect that complements each district.

Stations also follow different design patterns depending upon location, visibility, available space, and ridership demand. From downtown into Playhouse Square, median stations are combined, with one station serving both eastbound and westbound travel. These stations are also slightly smaller to accompany the area's historic downtown architecture and narrow streets. From the theater district through the Midtown region, which has a wider streetscape, stations are still located in the median but are larger and no longer bi-directional; instead, a separate station serves each direction of travel. While stations are clearly

marked as eastbound or westbound, the slope of the roofline also designates the direction of travel. For the last stretch of the route through University Circle and East Cleveland, separate stations continue to be used for each direction of travel, but are integrated into the sidewalk and are located at the curbside instead of in the median.

Figure 4-1

Bidirectional median station in downtown Cleveland

Figure 4-2

Eastbound median station near Cleveland State University

Figure 4-3

Westbound curbside station in University Circle

Public Art

Public art is also used to differentiate specific districts, enhance neighborhood character, and provide historical references along the HealthLine corridor. To assist with the development of a public art master plan for the project, RTA hired Cleveland Public Art (CPA), a local non-profit organization that works to improve public spaces. As a result, $1.2 million of public artworks were woven into the landscape to symbolize Cleveland's past and future.

The first of three independent art installations along the corridor, *Chorus Line Luminaries*, is a freestanding stainless steel structure near the East 14th Street station in the Playhouse Square theater district. In tribute to the district's theatrical history, the piece uses light patterns and changing colors to emulate the kicking legs of a Broadway chorus line. At night, the lighting scheme alternates in a motion reminiscent of the vertical marquees and lights on the Playhouse Square buildings.

The second installation, *Osmosis*, includes several sandstone sculptures in the University Circle area that were inspired by the ancient structures of the prehistoric mound cultures of the Midwest. The third, *Poetry Walking Sculptures*, is a series of three interactive poetry sculptures located at the end of the HealthLine in East Cleveland. The artists wished to create a place for people to walk, stop, read, and hear poetry. The three granite sculptures have embossed lettering to resemble imprints of poetic texts and use motion sensors to recite the works of admired Cleveland poets to passersby.

Figure 4-4

Chorus Line Luminaries steel sculpture near East 14th Street Station

Figure 4-5

Osmosis sandstone sculpture in University Circle

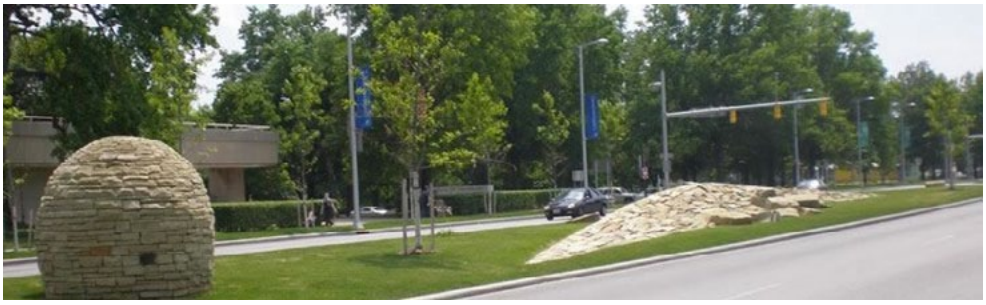


Figure 4-6

Poetry Walking sculptures in East Cleveland

In addition to stand-alone installations, integrated artworks include functional seating, ornamental paving, pedestrian signage, and oral history "sound portraits." Functional seating elements are formed from extruded concrete letters that rise from the sidewalk. For example, two benches are formed out of the words "change" and "things," with the text morphing across the sidewalk between the benches. By pairing these two words, which can be read as the passive observation "things change," or as a more active call to "change things," the piece conveys multiple meanings of time and transformation.

Figure 4-7
Functional artwork seating

In homage to the region's cultural history, 11 variants of the Hopewell sign language, used during trade by the ancient Hopewell mound cultures of the Great Lakes Region, were fashioned out of rendered granite pavers and set into the sidewalk at various sites along the HealthLine corridor. Imagery reflecting Cleveland's cultural and industrial heritage was incorporated into the design of standard items such as crosswalks, benches, litter receptacles, lighting elements, and tree grates, which also serve as integrated art pieces throughout the entire corridor.

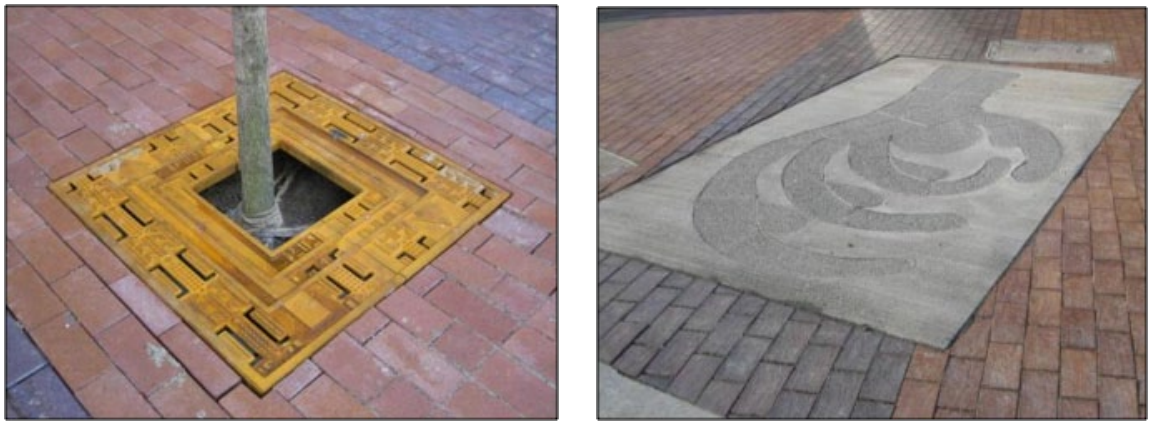


Figure 4-8 *Cast iron decorative tree grate and rendered granite sidewalk art*

To create a more engaging corridor experience and educate Clevelanders about civic history, RTA partnered with Cleveland State University's Center for Public History and Digital Humanities to create artist-designed oral history kiosks at 19 high-traffic stations along the corridor. In addition to providing transit timetables and RTA news, each kiosk is an interactive "sound portrait" that uses sound content, historic and contemporary images, and brief essays to curate more than 60 of Cleveland's historic people, neighborhoods, and events. Historic signage, area maps, and other graphic-oriented approaches to way finding are also used to create a stronger bond between Euclid Avenue and the neighborhoods through which it passes. For instance, a family of color-coded district markers and pedestrian-scale neighborhood signs provide cohesion throughout the corridor and a unique graphic identity for each district.

Figure 4-9

Downtown district marker sign and examples of other district markers

Landscape Design and Pedestrian Orientation

Other elements such as landscape design, illumination, and pavement patterns also distinguish different neighborhoods and bring a new pedestrian orientation to the street. Seasonal flowers planted in raised beds near station platforms and in large concrete planters add bright splashes of color to medians and sidewalks.

Figure 4-10

Raised flower beds on median station platform

Figure 4-11

Concrete planters on sidewalk along HealthLine corridor

In addition, each corridor district features three to seven different tree species, chosen according to available soil volumes and context. Slender trees were used in the smaller planting zones, while trees with more volume were planted in larger areas, and new plantings were matched with existing trees whenever possible. Ginkgoes are planted throughout the narrower streets of the city center, while outside of downtown, where the roadway broadens, tree plantings were introduced into the medians: oaks through the Midtown district, rows of blossoming crabapples on the street and clusters of evergreens at intersections in the area of the Cleveland Clinic, and elms in University Circle. Tree species were also combined within neighborhoods for seasonal variety and to avoid creating a monoculture.

Figure 4-12

Newly-planted trees on downtown sidewalks

Figure 4-13

Median tree plantings

To minimize intrusion into the sidewalks, station platforms were located in the median whenever possible, and where vehicles travel curbside in the University Circle neighborhood, medians were added to create a boulevard effect. To add visual interest and lend pedestrian rhythm and scale to the streetscape in the downtown district, clay brick pavers are arranged in an alternating pattern of brown and orange stripes on sidewalks, while heavier concrete pavers are used in the crosswalks. In University Circle, where stations are located at the curb, sidewalks are constructed of scored concrete to resemble large square pavers. Working in tandem with the pavement design, distinctive lighting along the corridor is also used as a signature design element. To distinguish the downtown district, custom dual-arm lights are positioned in the median and pedestrian-scale lamps are located on the sidewalk. Outside of downtown, the medians are illuminated by small bump lights and smaller, single-arm lights begin to appear on the sidewalks at the edge of Cleveland State University. Columnar pedestrian

lights are used in the vicinity of the Cleveland Clinic, while ground lighting illuminates the trees at night in sections of Midtown and University Circle.

Figure 4-14

Clay brick pavement pattern on downtown sidewalk

Figure 4-15

Downtown crosswalk paved in concrete brick pattern

Figure 4-16

Scored concrete sidewalks in University Circle

Public Health and Environmental Quality

Specific attention was given to integrating sustainable solutions into the project. The HealthLine's hybrid-electric RTVs are powered by clean diesel engines and electric transmissions with 100 kW motors and 600-volt nickel hydride battery packs. This unique power train diminishes noise and vibration, decreases particulate emissions by 97 percent, and reduces fuel consumption by 25 percent compared to RTA's standard vehicles [40].

Figure 4-17

HealthLine's high-capacity rapid transit vehicle (RTV)

In a commitment to replenish the urban forest, the City added nearly 1,500 new street trees to the corridor landscape. The trees were planted in soil designed specifically for Cleveland's severe winters and harsh urban environment, and are irrigated from water lines installed during the street's renovation. In the downtown district, soil trenches running beneath the sidewalks provide the amount of soil necessary for maximum root growth, while in many areas trees are placed in raised planters to protect them from the sidewalk salt of the winter street. Twenty-six different species were planted along the corridor, with several varieties mixed in each district to avoid creating a monoculture.

Figure 4-18

Newly-planted trees in raised beds along the HealthLine corridor

Accessibility and Complete Streets

The HealthLine project was the fulfillment of the civic vision to create a multi-modal "complete street" corridor for motorists, bicyclists, pedestrians, and transit users alike. According to RTA staff, the inclusion of four miles of designated bicycle lanes was an integral part of this realization. The Euclid corridor bicycle lanes, the longest contiguous bike lanes in Cleveland and the first commuter bike lanes in the city, provide the community with a safe route from Downtown Cleveland and Cleveland State University to University Circle and Case Western Reserve University, the region's two largest centers of education and employment, as well as a connection to shopping, the lakefront, and other recreational destinations. To facilitate bicycle access to the HealthLine, bike racks are provided at stations and cyclists are able to board through the rear door and remain with their bicycles in the articulated section of the vehicle.

Figure 4-19

Euclid Corridor bicycle lanes with tree plantings in median

Prominent station platforms located in the median of the street where possible offer shorter, safer crossings for all customers. Sidewalk lighting, brick-paved crosswalks with countdown signals, and wide, landscaped sidewalks and medians create a more pedestrian-friendly environment, while concrete bollards at stations safely corral passengers at signalized intersections to discourage jaywalking in the downtown area. The exclusive median bus lane allows on-street parking to be reintegrated into sections of the corridor in the downtown district, supporting efforts to revitalize vacant storefronts.

Beyond providing access for multiple modes, truly accessible transit facilities must be carefully designed to meet the overall mobility needs of all users, including people with disabilities, older adults, and parents with children. Euclid Avenue is home to several institutions that serve people with disabilities and the elderly, including the local chapter of Paralyzed Veterans of America, the Cleveland Sight Center, University Hospital, and the Cleveland Clinic, as well as Circle Vista, an accessible apartment complex for people with mobility impairments. Not surprisingly, the HealthLine is heavily used by people with disabilities and has the highest wheelchair lift use in the RTA system. To meet this community's needs and to ensure that accessibility requirements are met, ADA and other special features were incorporated into the design of the project.

At median stations, low-floor vehicles that align with raised platforms provide level boarding to ensure safety and ease of boarding for all passengers, including those who use wheelchairs or other mobility aids, while precision docking and bridge plates further minimize the horizontal gap between the vehicle and platform. A ramp is extended from the vehicle to the curb for wheelchair access at curbside stations. In addition, stations have accessible sloped pathways that extend down to the crosswalk and out to the sidewalk. To assist the sight-impaired community, stations have tactile signage and tactile pavers that define the station location and platform edges, while crosswalks have audible countdown signals and push buttons that use sound and vibration to indicate when it is safe to cross.

Figure 4-20

Low-floor vehicle aligns with raised station platform for level boarding

The low floors and extra-wide middle and rear doors of the RTVs further enhance access and circulation throughout the vehicle interior, while automated visual and audio station announcements are provided both inside and outside of the vehicle. In addition, the HealthLine RTVs, Like the EmX vehicles, are equipped with both a front-facing secured wheelchair bay and a rear-facing unsecured bay. Although front-facing wheelchair bays with securement straps are required by ADA, the HealthLine's operating experience mirrors that of the EmX by showing a clear preference for the rear-facing unsecured bays. According to RTA General Manager Joseph Calabrese, "The rear facing units are much preferred as they can be safely used with no assistance from the operators and therefore do not slow down the trip for the person with a disability or anyone else on the vehicles" [44].

Real Estate and Economic Development

Since opening, the HealthLine has been recognized for its influence on economic development and is considered a model example of how urban BRT can be used to channel corridor reinvestment. The roughly $200 million invested in the HealthLine project has been accompanied by more than $4 billion in investments along the Euclid Avenue corridor in the form of commercial development and housing rehabilitation by private developers, as well as improvements, expansion projects, and new developments by local institutions such as the Cleveland Clinic, University Hospitals, and the Cleveland Museum of Art. In addition, the three-mile stretch of Euclid Avenue between downtown and University Circle has received designation as a State of Ohio Hub of Innovation, and is being promoted as the "Health-Tech Corridor" to attract biomedical, health care, and technology firms to the area.

To reach consensus and build financial support, numerous creative partnerships were formed between multiple agencies and organizations. Perhaps the most unexpected of these alliances was formed when two rival medical institutions, The Cleveland Clinic and University Hospital, joined together to buy the rights to name the BRT service the HealthLine. RTA also worked continuously with the cities of Cleveland and East Cleveland and the local development corporations operating along the corridor to maximize the economic impact of the project and achieve the optimal land use configuration. As a result, zoning along the HealthLine corridor was modified to require greater density, building fronts that face Euclid Avenue, three-story minimum building heights, and ground-floor retail, all with the goal of complementing the urban character of the revitalized corridor and encouraging TOD.

The project's development strategy was to use investments in transit and other public infrastructure to transform the identity of the public realm and, in so

doing, create a conduit for private investment along the corridor. While the HealthLine was not the sole reason for this new investment, many developers say the project helped change the perception of Cleveland as a place to live, work, and invest, and was a major contributing factor in their decision to launch projects along Euclid Avenue. In addition to representing a highly visible aesthetic and infrastructural improvement, the project created a focal point for Cleveland's revival as a cultural, medical, and educational center, which helped foster a vision for growth that developers could embrace [45].

Public Involvement and Community Outreach

Because the HealthLine corridor links nine distinct neighborhoods and districts, an extensive community involvement process was required to build consensus among numerous public, private, non-profit, and neighborhood organizations regarding the project's goals and design approach. A six-month public workshop process was conducted to engage all the stakeholders, including RTA, the cities of Cleveland and East Cleveland, the Ohio Department of Transportation (ODOT), the local universities, hospitals, and development corporations, and individual property owners. Goals for the project included establishing a clear brand identity for the corridor, improving the pedestrian environment, and promoting economic development.

The design team met with local property owners, businesses, and residents and held workshops and design charrettes to gather ideas on station design, landscaping, parking, bike lanes, and other design-related issues. Many 3-D renderings were developed to communicate design intent to the city, stakeholders, and the public. To ensure that the disabled community's special needs were met, RTA held public meetings devoted specifically to ADA issues such as wheelchair access, pedestrian traffic signals, vehicle and station design, signage, and other related topics.

In anticipation of the significant disruption to businesses that would result from the reconstruction of Euclid Avenue, RTA dedicated a full-time staff member to coordinating construction activities with adjacent property owners. This community liaison had daily interaction with the construction manager and engaged directly with affected businesses and other interested parties during the planning, engineering, and construction phases of the HealthLine project. During construction, RTA also promoted local businesses along Euclid Avenue and provided information to the public to encourage community understanding and support of the project, while public meetings continued to be held through completion of the project.

Recommendations and Lessons Learned

The HealthLine provides a model for developing urban BRT systems to promote reinvestment in neglected urban corridors. Moreover, since Euclid Avenue is like so many downtown streets trying to recover from post-industrial decline and disinvestment, the lessons learned can be applied to nearly any other U.S. city. Some key elements for success include strong public outreach and promotion, creative partnerships for funding, and combining transit and public space improvements into one unified project that conveys a concise and distinctive corridor identity.

According to RTA Programming and Planning Director Maribeth Feke, "It's important that everybody understands what BRT is and what the benefits of the project are" [48]. Multiple promotional campaigns and strong public outreach were critical in educating the public about BRT and effectively communicating the project's goals and benefits. The HealthLine had great political support because it was an investment not just in public transit, but also in infrastructure improvements including new water and sewer lines, sidewalks, bicycle lanes, landscaping, street lights, tree plantings, and other streetscape upgrades. The project's focus on stimulating economic development, increasing safety, and improving the pedestrian environment also won many supporters. According to RTA General Manager Joseph Calabrese, "The development and use of the 63-foot stylized articulated RTVs was crucial in creating the rail-like brand that attracted non-traditional riders, encouraged economic development, and allowed us to sell a 25 year naming rights agreement" [44].

However, Feke stressed the importance of remembering that the project is first and foremost a transit project, and that success or failure depends on whether the service improves travel times, reliability, passenger comfort, safety and security, and overall customer satisfaction. "Pick the right corridor and do everything you can to maximize access, awareness and user-friendliness. The more permanent you make [the system], the more value the community will place in it. And don't forget to make plans for facility maintenance- figure out in advance how the system will be kept clean, well-lighted, and safe over time" [46].

With regard to funding, the HealthLine required strategic partnerships between public, private, neighborhood, and non-profit stakeholders. "You will have to sell [the project]," said Feke. "Your best advocates are the political and business communities. Work with them and make them your allies. And be realistic about how long the process takes- it takes a long time. In our case, the project spanned across three different mayors and three planning directors" [46]. Also, as previously mentioned, much of the support for the HealthLine could be attributed to the project's numerous infrastructure and

public space enhancements. Although these improvements would have been difficult to fund as standalone projects, they were made possible in large part by being incorporated into the HealthLine project. With regard to public space improvements, RTA also emphasizes the importance of creating a corridor brand identity that is clear and distinct, but that also fits into the existing fabric of the city.

SECTION 5

Other Agencies

Additional information from other agencies that have used BRT as a tool for enhancing the public realm was gathered through a detailed questionnaire. The questionnaire contained 45 questions and was administered to 36 transit agencies in the United States, Canada, and Australia. A total of 14 agencies replied. The questionnaire and list of respondents can be found in Appendices A and B, respectively. The results of the questionnaire document the current state of "placemaking" practice with regard to BRT and expound upon the relationship between BRT and the urban landscape. Following is an overview of the questionnaire responses. To see responses in their entirety, please refer to Appendix C.

Beyond mobility benefits alone, responding agencies identify a host of community and public realm improvement goals, from the general to the specific, which were incorporated into the design of their BRT projects. Although the projects were guided by a wide variety of design visions, some common objectives emerged, including:

- Creating vibrant public spaces
- Promoting accessibility and interacting with other modes of travel
- Creating a more pedestrian- and bicycle-friendly landscape
- Catalyzing economic development and neighborhood revitalization
- Providing better connectivity to recreational areas and green spaces
- Creating a strong system identity while maintaining context sensitivity
- Providing community amenities such as native landscaping, rain gardens, public art, improved streetscaping, and recreational paths

Station designs range from enhanced modular shelters to architectural structures with raised platforms, custom landscaping, and public art. Station amenities also vary greatly across the different projects, and some cases were reported in which station designs vary within a project according to neighborhood context, ridership demand, and operational needs; nonetheless, stations were consistently designed to communicate a distinguishing brand identity or theme through features such as logos, color palettes, iconic station markers, and unique architectural forms and materials. In many cases, station designs incorporate art and other historic, archaeological, or cultural resources to mark specific neighborhoods and provide points of interest along the corridor.

Regarding improvements to the pedestrian environment, agencies reported using ramps, sidewalks, and pedestrian bridges to create walkable environments

with effective linkages to BRT stations. To increase space for walking and reduce crossing distances, agencies employed other design tools such as widened sidewalks, curb bump outs at intersections, and larger crosswalks. A variety of amenities such as enhanced seating, pedestrian-scale lighting, custom sidewalk pavement design, attractive landscaping, public art, and multi-use recreational paths were provided to improve the pedestrian experience.

To enhance recreational or green space, several projects included landscape design elements along the BRT corridor and at stations, construction of linear parks and recreational paths adjacent to the corridor, and pedestrian and bicycle linkages between BRT facilities and regional recreational areas. A small number of systems also reported incorporating public plazas or community gathering places into the BRT project design. These spaces, typically located in high-profile areas such as central stations, include amenities such as seating and enhanced lighting. A more elaborate transit plaza in Kansas City includes a rain garden, public art, expanded sidewalks, landscaping, and a high level of lighting. Interestingly, TransLink Transit Authority in Brisbane, Australia, reports using busways outside of peak times for community events such as bike races and fun runs.

Many projects incorporate sustainable practices into station designs, including passive heating and cooling, solar panels to provide power and feed back into the electrical grid, LED and other energy-efficient lighting, and stations pre-fabricated from recyclable materials. In addition, several agencies have used recycled asphalt to pave running ways. To reduce stormwater run-off and filter pollutants from the water, agencies report using special pervious concrete at stations and park-and-ride lots, erosion-control landscaping, and rain gardens or bioswales. Extensive native and drought-tolerant landscaping was often selected to reduce the need for water and maintenance. In addition, some systems use reclaimed water or rainwater captured by collection tanks at stations for landscape irrigation, restrooms, and station maintenance and cleaning.

Nearly all of the projects were consistent with a comprehensive plan and many were designed to dovetail with other community oriented planning initiatives. Indeed, several cases were identified in which the BRT project itself significantly influenced city planning, rather than the other way around. For instance, some BRT projects have initiated the revision of existing neighborhood and master plans to adopt new parking restrictions and density standards for TOD or to create development nodes at station areas. Similarly, capital and planning-related projects have sometimes been dovetailed into BRT projects rather than vice versa. For example, some communities have developed station area plans to capitalize on the development attraction potential of BRT.

Local governments and private sector developers have also used BRT projects as leverage for further initiatives that deliver community-oriented benefits such

as enhanced pedestrian environments and streetscaping. According to staff at TransLink Transit Authority, the unprecedented success of the first busway sparked changes to the city plan that increased the density and diversity of land uses adjacent to BRT stations and infrastructure. Since then, developers have been eager to capitalize on the level of convenience brought by the BRT stations. As a result, property values close to busway stations have increased at a faster rate and close proximity to busway stations is often a major selling point.

With regard to funding, the majority of agencies indicated that the community enhancements and placemaking aspects of projects were financed with traditional federal, state, and local funding sources. Additional funding sources that were identified include American Recovery and Reinvestment Act (ARRA) funds, a federal Urban Partnership Agreement (UPA) grant award, transit revitalization investment districts (TRID), and donations and grants from private and foundation sources.

Agencies identified several challenging aspects with regard to the community-oriented features of BRT projects. These include the need to eliminate certain features of the project due to financial constraints, coordinating a large-scale capital project across multiple jurisdictions with differing priorities and organizational structures, meeting the demands of numerous stakeholders and community organizations, and effectively educating communities about the benefits of BRT and its potential for shaping the public realm.

While each project is unique, there are successes and lessons learned that can be generalized for other systems. For instance, as a key to the success of the project, most agencies recommended early and continuous stakeholder engagement to clarify expectations, constraints, risks and assumptions. In particular, educational outreach and community visioning were emphasized as necessary for building initial support for the project, while open and transparent communications during the design and construction phases were recommended for maintaining the community's trust and confidence. With regard to community and stakeholder support, several agencies noted the importance of having a strong project champion from the outset, and some suggested identifying several champions, including one each from the public, private, and non-profit sectors if possible.

Likewise, open communication between all government and agency stakeholders was strongly encouraged. For instance, staff of Valley Metro in Phoenix, Arizona recommended including the staffs of local community development and land use agencies in the planning and development of the project to help educate elected officials on the need to incorporate TOD into the corridor planning process and to identify existing and planned activity centers that need to be addressed through project design. Several agencies also suggested using memoranda of understanding and intergovernmental agreements for delineating responsibilities

and clarifying the working relationships between public, private, and non-profit stakeholders.

In light of funding constraints, and simply as good practice, many agencies advised securing the support of property owners and the local business community as soon as possible and pursuing every opportunity for partnerships. Several agencies reported partnering with local business improvement districts (BID) to fund and maintain landscaping, sidewalk art, and other public realm improvements. In Cleveland, private property owners added additional public space amenities to replace those that were eliminated by RTA due to funding constraints.

Several agencies emphasized the importance of the system's image and appeal to customers, cautioning that unless the system is safe, clean, and easily accessible, it will be an expensive investment that fails to reach its full potential. Accordingly, regular maintenance and prompt remediation of any observed damage to facilities or vehicles is critical. As mentioned, it may be helpful to seek out partners, such as a local BID, for ongoing cleaning and maintenance, or to pursue other creative approaches such as implementing an "Adopt a Shelter" program or selling the rights to name the service or individual stations.

APPENDIX

A

Questionnaire

If your agency operates more than one BRT line, and there are significant differences between the lines in terms of urban design or amenities, please fill out a different form for each. Please do not leave any questions blank; mark N/A if the question does not apply to your agency's BRT project.

1. Please list your name and title, agency, and contact information.

System Basics

2. How many BRT lines does your agency operate?

3. What type of running way does the BRT use? (Please check all that apply.)

- ☐ Mixed-traffic lanes
- ☐ Bus-only lanes, curbside
- ☐ Bus-only lanes, located to the left of parking lane with bus bulb-outs at stations
- ☐ Bus-only lanes, median-running
- ☐ Bus-only lanes, contra-flow
- ☐ Bus-only streets, such as a "bus mall"
- ☐ Exclusive busway, at-grade
- ☐ Exclusive busway, grade-separated
- ☐ Managed freeway/HOV lanes

4. Which of the following best describes the BRT stops?

- ☐ Traditional bus shelter
- ☐ Enhanced shelter
- ☐ Station

5. What is the BRT operating environment? (Please check all that apply.)

- ☐ Small town
- ☐ Suburban
- ☐ Urban
- ☐ Central business district
- ☐ Commercial area
- ☐ Residential area
- ☐ New development
- ☐ Established development

Planning and Development

6. Beyond mobility benefits, were there specific community, livability, or place-making goals (i.e., "community-oriented" goals) incorporated into the urban design of the project? If so, were there particular problems or opportunities within the existing site conditions that were identified in the process of defining and realizing these goals?

7. Was the project consistent with a comprehensive plan for the area?
8. Was the project designed to dovetail with other community-oriented initiatives or incentives, or did the project coincide with any initiatives that already existed at the time of project planning? Were any new incentives or initiatives put into place to catalyze the project's goals? Please briefly describe the nature of each initiative.
9. In terms of the community-oriented aspects of the project, has there been a primary champion, such as a general manager or others in your agency, local elected officials, employers, or other private-sector interests? Please describe.
10. Please describe any community/stakeholder involvement, such as visioning or design charrettes, in the project's planning and design process. Please note the phases of the project (from conception to construction) in which the community or stakeholders were involved.
11. Please describe any citing criteria, such as pedestrian-friendliness, density requirements, grid street patterns, land use mix, or proximity to public gathering points or other major public amenity, that were used in the decision of where to locate the BRT.

Elements of Design

12. Was there an urban design "vision" for the project? If so, please describe.
13. Which of the following objectives informed the design approach? (Please check all that apply.)

- ☐ Create strong identity/high visual impact
- ☐ Minimize visual impact
- ☐ Improve attractiveness of the corridor
- ☐ Reflect, preserve, or enhance community identity
- ☐ Increase transit ridership
- ☐ Enhance rider comfort/convenience
- ☐ Enhance rider safety/security
- ☐ Encourage economic development
- ☐ Enhance property values
- ☐ Encourage more dense development patterns
- ☐ Create or improve public space
- ☐ Create community gathering places
- ☐ Create bicycle/ped-friendly environment
- ☐ Create an asset for the entire community
- ☐ Other (Please describe.)

14. Please describe any non-traditional or non-transit uses of the BRT facilities that were included in the planning and design of the project.
15. Were any of the BRT facilities designed to serve as a community or neighborhood "gateway"? Please describe.

16. Please describe the way in which any historic, archaeological, or cultural resources were incorporated into the project's design.

17. Please describe any features, such as greenways, pocket parks, recreational paths, play areas, native landscaping, water features, or other such amenities, that were designed into the BRT project in order to provide enhanced recreational or green space.

18. Please describe any accessibility treatments, such as universal design, ADA access, or any special accommodations for bicyclists, parents with children, older adults, or people with disabilities that were incorporated into the project design.

19. Were pedestrian zones incorporated into any part of the BRT project's design? If so, please describe, and include a description of any amenities that were provided specifically for pedestrians?

20. Were public plazas or other community gathering places incorporated into any part of the BRT project's design? If so, please describe, and include a description of any amenities that were provided to create a safe, attractive, comfortable environment for people to sit, gather, or stroll.

21. Please describe any elements of the project that were designed to mitigate vehicle-generated noise, vibration, or exhaust (including characteristics of the vehicle itself).

Station Design

22. Please describe the architecture and design of the stations/stops, and include a description of whether they are modular shelters, specially-designed canopies, architectural stations, etc.

23. Does the design, theme, or scale of the stations change, depending on the surrounding context? Please briefly describe.

24. Which of the following amenities are provided at BRT stations/stops? (Please check all that apply.)

- ☐ Seating
- ☐ Bike racks/lockers
- ☐ Signage/way-finding
- ☐ Attractive lighting
- ☐ Fencing
- ☐ ADA access
- ☐ Newsstand
- ☐ Concessions
- ☐ Other retail
- ☐ Wi-fi
- ☐ Drinking fountains
- ☐ Clean restrooms
- ☐ Station artwork
- ☐ Special landscaping treatments
- ☐ Other (please describe.)

25. Which of the following safety/security measures are used at BRT stations/stops? (Please check all that apply.)

- ☐ Enhanced Lighting
- ☐ Video monitoring
- ☐ Alarms
- ☐ Call boxes
- ☐ Bollards or other safety guards
- ☐ Emergency call phones
- ☐ Crime prevention through environmental design (CPTED)
- ☐ Other (please describe.)

26. Please describe any climate considerations, such as canopies or heat lamps, that were incorporated into the station design.

27. If bus bulb-outs are used at stations/stops, was the extra space provided by the bus bulb-outs used to provide extra amenities?

Running Way Design

28. Please describe the design techniques that were used to differentiate the BRT running way and/or strengthen the identity of the BRT project.

29. Please describe any unique or special integration of running way design elements and way-finding.

Sustainable Materials/Practices

30. Please describe any project elements that were designed for sustainable storm-water practices, such as rain gardens or permeable construction materials.

31. Please describe any other energy conservation or sustainable design practices, such as natural or low-power lighting, solar panels, recycling features, native or drought-tolerant landscaping, LEED-certified facilities, or otherwise, that were included in the project's design.

32. Please describe any elements of the project constructed of recycled materials.

Incentives and Financing

33. What were the methods used to fund the community-oriented aspects of the project? For instance, were special financing tools used to support construction and infrastructure investment along the BRT corridor (e.g., tax increment financing or special designation as a revitalization or improvement district)? Were any special funding programs used, such as FTA's Livable Communities Initiative? Please provide a brief description of each financing tool or funding program that was used.

34. Did your agency partner with the private sector to help build, fund, or maintain the community-oriented elements of the BRT project? Please provide a brief description of the nature of the private partnership.

Zoning and Land Use

35. Was there a change in zoning, land use designations, density restrictions, or parking management strategies along the BRT route prior to or during its construction/implementation? If so, please describe the changes and the reason(s) they were made.

36. Was there a change in zoning, land use designations, density restrictions, or parking management strategies along the BRT route after its construction/implementation? If so, please describe the changes and the reason(s) they were made.

Maintenance Considerations

37. Is the transit agency responsible for maintaining all elements of the BRT project, or are certain amenities such as recreational paths, green spaces, or other amenities at stations or along the alignment maintained by another entity? If so, please describe, noting any maintenance problems or issues that your agency has encountered.

38. Please describe any design strategies used to reduce graffiti/vandalism and/or the need for maintenance.

Obstacles

39. Were there any obstacles or barriers (financial, organizational, political, or otherwise) that your agency encountered in regard to the community-oriented aspects of the BRT project?

40. How were these barriers addressed or overcome?

Impacts

41. Are the project's community-oriented goals being tracked or benchmarked? How does your agency measure success? Are any specific quantitative or qualitative metrics used?

42. Has your agency conducted any studies or rider surveys that examine the impacts of the community-oriented aspects of the project? If so, could you please share the results or report?

Additional Information

43. Do you have any other comments or observations that would benefit other transit agencies that are considering the implementation of community-oriented BRT? Lessons learned? Opportunities realized or missed?

Thank you for your participation!

APPENDIX
B

List of Respondents

Albany, NY
NY 5 BRT

Deputy Executive Director of Business Development, Capital District Transportation Authority

Bloomingston, MN
Cedar Avenue Bus Rapid Transitway

Project Manager, Minnesota Valley Transit

Brampton, ON
Züm

Project Leader, Brampton Transit

Brisbane, Australia
Brisbane Busway Network

Director, Translink Transit Authority

Cleveland, OH
Euclid Avenue Corridor and HealthLine

Director, Programming and Planning, Greater Cleveland Regional Transit Authority

Eugene, OR
EmX

Former Assistant General Manager and Planning and Development Manager, Lane Transit District

Everett, WA
SWIFT

Manager of Strategic Planning & Grants, Community Transit

Los Angeles, CA
Metro Orange Line

Chief Executive Officer, Los Angeles County Metropolitan Transportation Authority

Oakland, CA
San Pablo Rapid, East Bay BRT, and International Rapid

Transportation Planning Manager, Alameda County Transit

Phoenix, AZ
LINK

Transit Planning Manager, Valley Metro RPTA

Pittsburgh, PA
South Busway, East Busway, West Busway, and MLK East Busway Extension

Manager of Extended-Range Planning, Port Authority of Allegheny County

Seattle, WA
RapidRide

Manager, Metro Transit

Sydney, Australia
T-way network

Project Development Managers, Roads and Traffic Authority (RTA)

Kansas City, MO

General Manager, Kansas City Area Transportation Authority

APPENDIX

C

Survey Responses

C-1: Project Basics

Q 1: Please list your name and title, agency and contact information.

City	Response
Albany, NY	Kristina Younger, Deputy Executive Director for Business Development Capital District Transportation Authority (CDTA), 110 Watervliet Ave., Albany, NY 12205 (518) 437-6852; main office: (518) 437-8300, kristinay@cdta.org
Bloomington, MN	Sam O'Connell, Sr. Transit Specialist, Physical Development Division Dakota County, 14955 Galaxie Ave., Apple Valley, MN 55124 (952) 891-7105, sam.oconnell@co.dakota.mn.us
Brampton, ON	Shawn De Jager, Züm Project Leader – Planning and Engineering Brampton Transit, The Corporation of the City of Brampton, Canada, 130 Sandalwood Pkwy., L7A 0L1 (905) 874-2750 ext. 62620, shawn.dejager@brampton.ca
Cleveland, OH	Maribeth Feke, Programming & Planning Director, mfeke@gcrta.org James DeRosa, Real Estate Manager, jderosa@gcrta.org Danielle Willis, Planning Team Leader, dwillis@gcrta.org Greater Cleveland Regional Transit Authority
Eugene, OR	Stefano Viggiano, former Lane Transit District (LTD) Assistant General Manager and Planning and Development Manager viggianosm@pbworld.com
Everett, WA	June DeVoll, Manager of Strategic Planning & Grants Community Transit, 7100 Hardeson Rd., Everett, WA 98203 (425) 348-2337, June.devoll@commtrans.org
Kansas City, MO	Kansas City Area Transportation Authority 1200 E. 18th St., Kansas City, MO 64108 (816) 346-0200
Los Angeles, CA	Kathleen Sanchez, Public-Private Partnership Program Manager Los Angeles County Metro (213) 922-2421, sanchezk@metro.net
Oakland, CA	Jim Cunradi, Bus Rapid Transit Project Manager AC Transit, 1600 Franklin St., Oakland, CA 94612 (510) 891-4841, jcunradi@actransit.org
Phoenix, AZ	Stuart R. Boggs, AICP, ICMA, Manager of Transit Planning Valley Metro/RPTA (602) 523-6039, sboggs@valleymetro.org
Pittsburgh, PA	David E. Wohlwill, AICP, Program Manager – Long Range Planning Port Authority of Allegheny County, 345 Sixth Ave., Third Floor, Pittsburgh, PA 15222 (412) 566-5110, dwohlwill@portauthority.org
Seattle, WA	Paul Roybal, Transportation Planner, Transit Route Facilities King County Metro Transit Division, KSC-TR-0413, 201 South Jackson St., Seattle, WA 98104 (206) 684-1599, paul.roybal@kingcounty.gov
Brisbane, Australia	Paul Schmidt, Director, Busway Infrastructure, Dept. of Transport and Main Roads Queensland Government, paul.a.schmidt@tmr.qld.gov.au Ben van Wegen, Principal Advisor, ben.vanwegen@translink.com.au TransLink Transit Authority, 420 George St., Brisbane QLD 4000, GPO Box 50 Brisbane QLD 4001 +61 07 3338 4265
Sydney, Australia	Graham Richards and David Payne, Project Development Managers, Bus Network Development Section Roads and Traffic Authority of New South Wales, Sydney, Australia +61 02 8849 2268, David_Payne@rta.nsw.gov.au

Q 2: How many BRT lines does your agency operate?

City	Response
Albany, NY	One.
Bloomington, MN	We are a planning agency for the Cedar Avenue Bus Rapid Transitway. The transitway will be operated by the Metropolitan Council, potentially through a third-party transit operator.
Brampton, ON	Currently, we only operate one. The Queen Street corridor officially opened in September 2010 with 5 more BRT lines planned to launch through to 2016. The Queen Street Corridor is approximately 29 kms (18+ miles) long connecting downtown Brampton to York University in the Region of York. There are 14 station stops at major intersections in Brampton with 28 Station Stop Shelters. The next five BRT lines to be launched are: • Main Street - fall 2011 launch • Steeles Avenue East – fall 2012 launch • Bovaird Drive – fall 2014 launch • Steeles Avenue West – fall 2015 launch • Queen Street West – fall 2016 launch
Cleveland, OH	One, the HealthLine
Eugene, OR	Two projects, now operating as one single line (second corridor was an extension of the first).
Everett, WA	One.
Kansas City, MO	Two.
Los Angeles, CA	One.
Oakland, CA	None yet. One in planning.
Phoenix, AZ	Two routes: Main Street LINK in Mesa, Arizona Avenue/Country Club Drive LINK in Chandler, Gilbert, and Mesa
Pittsburgh, PA	Port Authority owns and operates three busways and operates service on an HOV lane owned and maintained by the Pennsylvania Department of Transportation: South Busway (opened for service in 1977), Martin Luther King, Jr. East Busway (opened for service in 1983 and extended in 2003), West Busway (opened for service in 2000).
Seattle, WA	One currently in operation (since October 2010), one scheduled to begin operations October 2011, 4 others in planning. Responses below indicate conditions that will apply to the currently planned BRT network of 6 routes.
Brisbane, Australia	The Department of Transport and Main Roads (TMR), plans, delivers and owns the busway network in Brisbane. The busway is operated by the TransLink Transit Authority (TTA). Brisbane's busway is made up of corridors radiating from the CBD; however, for the purposes of this questionnaire, it is considered as one network made up of the following sections: Existing Busway: • South East Busway, 17.7km (first 3.0km completed in 2000, remaining 14.7km completed in 2001) • Inner Northern Busway 3.6km (first 2.5km completed in 2005, remaining 1.1km completed in 2008) • Northern Busway 1, 1.2km (completed in 2009) - this is an extension of Inner Northern Busway • Eastern Busway 1, 2.1km (completed in 2009), • Total 24.6km Under construction: • Northern Busway 2-5, 4.4km* (due for completion by April 2012) • Eastern Busway 2, 1.05km (due for completion by late 2011) • Total 5.45km *includes bus priority (1.4km) plus segregated busway (3km) Planning: • South East Busway, 4.5km • Northern Busway, 11.5km • Eastern Busway, 16.8km

	The BRT network is an open, flexible system based primarily around 'same seat' journey. Transfer between local and rapid transit services can occur but is not a prerequisite of passengers using the services like those BRT networks of South America. It enables any bus (12m-18m plus) to use the BRT network should the vehicle be deemed suitable for the types and levels of services. Currently single front door boarding occurs. However, all doors boarding is in use on high frequency routes using TransLink go (smart) card. The stations are designed as unstaffed rapid transit facilities. Busway customer service representatives and safety officers are active on an as needs basis. The stations form the cornerstone of the BRT network. They are used to provide the networks recognition and act as emblems. This is because buses as rubber tired vehicle use road pavements and unlike rail with track offer few clues that the vehicle and pavement form a public transit network with exclusivity and priority over private vehicles. There are hundreds of bus routes that operate on and off the busway network configured as all stops, skip stop and express services.
Sydney, Australia	The Roads and Traffic Authority (RTA) does not operate the services that use the T-ways. The RTA has created a position to manage/maintain the infrastructure that forms the T-way network. The T-ways were constructed by the RTA. There are 3 T-ways in metropolitan Sydney: • Liverpool to Parramatta – LPT (31km) – opened February 2003 • Blacktown to Parklea – NW T-way (8km) – opened 2007 • Parramatta to Rouse Hill NW T-way (20km) – opened 2007

Q 3: What type of running way does the BRT use?

City	Response
Albany, NY	Mixed-traffic lanes and short sections of bus-only lanes at congested intersections (queue jump lanes).
Bloomington, MN	BRT service will use bus-only shoulders, located on the outside lanes of an arterial roadway with bus bulb out at stations.
Brampton, ON	We currently operate mixed-traffic operation with queue jump lanes and far side bus bays at designated stop locations. Inclusive of: • Limited stops – reduces travel time • Advanced technologies – keep traffic moving (TSP) • Real-time information – digital displays at station stops • Same fare – no additional cost to ride Züm, seamless transfers
Cleveland, OH	Bus-only lanes, median-running; bus-only lanes, curbside (peak hour); mixed-traffic lanes.
Eugene, OR	Exclusive busway, at-grade; bus-only lanes, median-running; bus-only lanes, contra-flow; bus-only lanes, curbside; mixed-traffic lanes.
Everett, WA	Bus-only lanes, curbside; mixed-traffic lanes.
Kansas City, MO	Bus-only lanes, curbside; mixed-traffic lanes.
Los Angeles, CA	Exclusive busway, at-grade.
Oakland, CA	Mixed-traffic lanes.
Phoenix, AZ	Mixed-traffic lanes.
Pittsburgh, PA	Exclusive busway, grade-separated; managed freeway/HOV lanes.
Seattle, WA	Bus-only lanes, located to the left of parking lane with bus bulb-outs at stations; bus-only lanes, curbside; mixed-traffic lanes.
Brisbane, Australia	Exclusive busway, grade-separated; exclusive busway, at-grade; bus-only lanes, median-running; bus-only streets, such as a "bus mall;" bus-only lanes, curbside.
Sydney, Australia	Exclusive busway, grade-separated; exclusive busway, at-grade; bus-only lanes, median-running; bus-only lanes, contra-flow; bus-only lanes, curbside.

Q 4: Please describe the type of BRT stops used?

City	Response
Albany, NY	Enhanced shelter.
Bloomington, MN	Stations, as they are a significant element of Cedar Avenue BRT.
Brampton, ON	Station.
Cleveland, OH	Station.
Eugene, OR	Station.
Everett, WA	Station.
Kansas City, MO	Enhanced shelter; station.
Los Angeles, CA	Station.
Oakland, CA	Station.
Phoenix, AZ	Station.
Pittsburgh, PA	Station.
Seattle, WA	Enhanced shelter; station.
Brisbane, Australia	Station.
Sydney, Australia	Major station; enhanced shelter; traditional bus shelter.

Q 5: What is the BRT operating environment?

City	Response
Albany, NY	Suburban, urban; central business district; commercial area; residential area; new development; established development.
Bloomington, MN	Suburban; commercial area; residential area; established development.
Brampton, ON	Urban; central business district; commercial area; residential area; new development; established development.
Cleveland, OH	Urban; central business district; commercial area; residential area; new development; established development.
Eugene, OR	Urban; central business district; commercial area; established development.
Everett, WA	Suburban; urban; central business district; commercial area; established development.
Kansas City, MO	Urban; central business district; commercial area; established development.
Los Angeles, CA	Suburban.
Oakland, CA	Urban; commercial area.
Phoenix, AZ	Suburban.
Pittsburgh, PA	Suburban; urban; central business district; residential area; university/medical center area; new development; established development.
Seattle, WA	Suburban; urban; central business district; commercial area; residential area; established development.
Brisbane, Australia	Suburban; urban; central business district; commercial area; residential area; new development; established development.
Sydney, Australia	Suburban; urban; established development.

C-2: Planning and Development

Q 6: Beyond mobility benefits, were specific community-oriented goals incorporated into the design of the project? If so, were there particular problems or opportunities within the existing site conditions that were identified in the process of defining these goals?

City	Response
Albany, NY	Yes. Biggest issue goes back to NYS "home rule" and lack of state requirements for comprehensive planning and consistent zoning. Project began more than a decade ago (2000) with a land use study (NY5.org - The Road Ahead) that laid out a preferred land use future for the corridor. The slow upstate NY economy and other factors have made implementation of things like TOD at stations go slower than would be desirable in an ideal world.
Bloomington, MN	Goals developed during the alternatives analysis included: 1. Improve corridor mobility. 2. Maximize the movement of people within the corridor across the Minnesota River. 3. Provide cost-effective and efficient transit element of the transportation system. 4. Provide flexible, adaptable, and expandable transportation choices. 5. Enhance/promote transit-oriented development and economic development that are compatible with community planning goals. 6. Provide a convenient, desirable, and safe travel alternative. 7. Minimize adverse social, economic and environmental impacts, and pursue opportunities to enhance these qualities within the Corridor. On-going pedestrian and bike planning allowed for opportunities for multi-modal connections as well as enhanced wayfinding signage, improved streetscaping, and enhanced landscaping. The project also created a stronger connection between four suburban communities.
Brampton, ON	Yes, "community – oriented" goals where incorporated. Since the corridor is approximately 29kms (18+miles) long, there were a number of problem/opportunities based on the local existing site conditions for in particular station stops i.e downtown narrow right-of-way to wide 6-lane arterial free flow conditions. Each area was treated differently in terms of design, size and scale of the infrastructure installed and how it fit/complemented the local site conditions.
Cleveland, OH	One of the goals of this project was keeping a unified systemic look and feel (modern, fast, and sleek) while being sensitive to the differing urban context/neighborhood surrounding the corridor. To achieve this goal, RTA chose a "family of stations" based upon size, incorporated neighborhood signage and landmarks, selected 3 special public art pieces in special places, and incorporated overall systemic art along the corridor.
Eugene, OR	The project was intended to support existing development as well as new development in planned Mixed-Use Centers. EmX station locations were sited to serve both the existing and planned developments, and efforts were made to connect the station to the surrounding area by consideration of improved crosswalks and other pedestrian improvements.
Everett, WA	N/A
Kansas City, MO	There were some locations where community livability and place-making goals were identified. No real "problems" were encountered due to wide community support. There was, however, significant work required to acquire property and easements necessary to achieve the goals.
Los Angeles, CA	Our BRT project design included drought tolerant, and as much as possible, California native landscaping; the color schemes were selected to compliment the native landscaping; several sites were identified as artist-designed site-specific landscaping; each of the 13 stations have art panels and mosaics in the platform surfaces that were designed by 13 individual artists, who created their art based on the specific history, geology, culture, etc. inspired by the station locations. Each of the 13 stations has bike lockers and bike racks, encouraging multi-modality and recreational use of the adjacent bike path.

Oakland, CA	Traffic safety. Better walking and cycling environment. Catalyst for development and neighborhood revitalization. No problems.
Phoenix, AZ	An attempt was made to involve local land use and community development planning staffs in preliminary study efforts in order to identify existing and planned activity centers that should be served by LINK stations.
Pittsburgh, PA	Port Authority's three busways were planned and designed prior to the Obama Administration's livability initiatives. Improving transportation was the primary focus. In more recent years, local and county governments and the Southwestern Pennsylvania Commission have conducted community planning and revitalization initiatives to improve connections between the busway stations and the communities in which the stations are located.
Seattle, WA	Stations and stops were designed with three pillars of "frequent," "simple," and "best of Metro," and are viewed as an enhancement above standard bus stops seen throughout the rest of the system, with additional amenities such as benches, lighting, and customer information (both static and electronic). Consistent branding was applied across all locations to strengthen the introduction of the new BRT service. Placement of passenger facilities responds to local site conditions, but the facilities are not tailored in their design to specific community goals.
Brisbane, Australia	The "community-oriented" goals described above underpin the major bus and rail infrastructure projects in Queensland. The implementation of transit-oriented developments is increasing in South East Queensland along with 'connected and compact communities.' The busway network is a key contributor to the success of the broader whole-of-government community-oriented goals, by offering an effective, efficient, and reliable travel option that either integrates with existing communities or establishes/supports new communities. The busway connects to our key activity centers, including hospitals, universities, retail/commercial hubs, and key rail stations. The design of the carriageway and stations is carefully integrated into the surrounding urban landscape and is highly considerate of community expectations regarding accessibility, air, noise, and visual pollution, anti-social behavior, green-space, and community severance. Site conditions, urban constraints, community feedback and operation requirements are key drivers for the busway network's form and how it supports other social/community facilities. Generally we have undertaken a concept design and impact management plan (CDIMP or similar to an Environmental Impact Statement) for each section of busway. It is recognized that transport is an enabler and not an end in itself. There are too many to list as it is different for each station and busway. Generally there is a neighborhood plan done for each area around proposed and existing busway stations to help to improve the urban environment and maximize the benefit to the community of the new infrastructure and to integrate it into the urban fabric. As all our busways are developed within established developed environments, there are often many constraints such as heritage listed buildings, etc.
Sydney, Australia	Aim was to link major activity centers (shopping, education, employment) along corridors. The LPT is not an 'end to end' journey as such but operates as a shorter journey service providing a link for people to access the activity centers. The trips at either end of the LPT are mainly to access major heavy rail interchanges. There are more end to end journeys on the NW T-way (Rouse Hill to Parramatta) as the Rouse Hill terminus is a major shopping centre in a recently developed urban release area. The Rouse Hill 'station' is the first/last public major transport node. Feeder services operate from the terminus. The NW T-way (Blacktown to Paklea) connects a regional CBD (Blacktown) that has a bus/rail interchange and a market based shopping center, travelling through residential precincts adjacent to an arterial road corridor. Both T-ways have parallel bicycle.pedestrian paths.

Q 7: Was the project consistent with a comprehensive plan for the area?

City	Response
Albany, NY	With the Regional Transportation Plan by the MPO – absolutely. It is a cornerstone major initiative (NY 5 Bus Rapid Transit Current Efforts including the NY 5 Access Management Plan) and a partnership effort. To the extent that the local municipalities are doing comprehensive planning (there is no NYS requirement to do so, or to regularly update) and zoning updates, the project is incorporated and consistent.
Bloomington, MN	Yes.
Brampton, ON	Brampton's BRT plan is citywide with 6 BRT lines connecting the whole city into a grid of local and inter-regional transit lines including rail, i.e. GO Transit inter-regional services. At the local level, City Planning staff documents developed these broad "community-oriented" goals into more defined comprehensive plans for specific areas, i.e. historic downtown core, Queen Street urban growth district. The Queen Street Urban Growth area saw the reconstruction of the entire roadway with the introduction of BRT services from being auto dominated to a more multi modal character with enhanced pedestrian treatments i.e. wider sidewalks, enhanced street lighting, driveway consolidation and green landscaping elements to soften the edges.
Cleveland, OH	Yes.
Eugene, OR	Yes. EmX was developed as part of an update to the Regional Transportation Plan (RTP), and the Metro Area Comprehensive Plan was updated to incorporate the Transportation Plan.
Everett, WA	Yes.
Kansas City, MO	Yes.
Los Angeles, CA	Yes.
Oakland, CA	Yes. Project supports all local plans. New TOD plan approved by Oakland is centered on BRT stations.
Phoenix, AZ	Projects were consistent with local comprehensive plans as well as regional transportation plan.
Pittsburgh, PA	N/A.
Seattle, WA	Yes.
Brisbane, Australia	Yes and vice versa. The project was part of a series of numerous transport and growth management plans for the area over different time horizons and different levels of detail. Further busway planning has either integrated with, or driven amendments to local neighborhood plans, with a focus on increased residential density and commercial activity along the corridor and at station nodes. The busway network is also a key element of TMR's draft Integrated Regional Transport Plan (Connecting SEQ 2031). The IRTP incorporates the goals of the latest South East Queensland Regional Plan which focuses on land use and growth management. The busway has in some cases been a catalyst for urban renewal and increased density. The busway was included in city plans and busway planning has influenced significantly city planning. There is a regional plan for South East Queensland that goes out to 2031 through to neighborhood plans.
Sydney, Australia	A section of the LPT was constructed in a dedicated public transport corridor that was "reserved" in the 1970s. Both sections of the NW T-way were constructed within arterial road corridors (some additional land was required).

Q 8: Was the project designed to dovetail with other community-oriented initiatives or incentives, or did the project coincide with any initiatives that already existed at the time of project planning? Were any new incentives or initiatives put into place to catalyze the project's goals?

City	Response
Albany, NY	Yes. See the link above to the access management efforts, in particular. We have also partnered with the City of Albany, which is doing its first Comp Plan (ever) to insure that their zoning update includes TOD overlay zones in transit corridors. This involved both rewriting zoning codes and putting together a guidebook for development in the overlay zones.
Bloomington, MN	The project has allowed communities to use the BRT service as an amenity for redeveloping areas near stations. Communities are/have developed station area plans to maximize the opportunities BRT brings to attracting new and/or redevelopment.
Brampton, ON	Because the project was established through the comprehensive Transportation, Transit Master Plan (TTMP) other City lead projects, capital or planning related, were dovetailed into it- not the other way around.
Cleveland, OH	Our BRT project initiated revision of existing neighborhood and CBD master plans to include the station areas as nodes of development as well as spurred additional third party resources to enhance the pedestrian environments and streetscaping. This included (1) downtown business owners creating a fund with which to commission the design and construction and maintenance/ plantings of large artistic sidewalk planters to be placed in areas of the CBD where BRT project landscaping was eliminated due to underground vaults or utility conflicts, (2) City of Cleveland enhancing sidewalks on E. 14th Street with the same striped brick pattern that we installed as part of our project along Euclid Avenue. The intent was to unify the Playhouse Square area with the same upscale design elements from the BRT project, and (3) the community development corporation in the University Circle neighborhood attained grant funding to enhance pedestrian elements along the BRT route with such amenities as recycling containers, larger caliper trees, additional seating elements, and landscaping. The project also spurred Cleveland Foundation grants to enhance housing opportunities, schools, safety, economic development in the University Circle neighborhood, and the State of Ohio named the Midtown and University Circle portion of the corridor a HUB of Innovation, which brings specific state loans and grants to businesses in the health-tech industries located in or near these areas of the corridor.
Eugene, OR	The RTP that created the BRT system strategy also included policies and plans for Mixed-Use Centers, which are higher-density, mixed use areas designed to be pedestrian, bicycle and transit-friendly. The plan made an effort to co-locate the Mixed-Use Centers on planned EmX lines.
Everett, WA	No, however, since implementation of Swift, all jurisdictions along the corridor have undertaken major planning initiatives to adopt new zoning and density standards for TOD around the station locations. Rather than incentives to catalyze BRT, the BRT is being used to catalyze redevelopment.
Kansas City, MO	Yes, Troost Bridge over Brush Creek: about midpoint in the Troost BRT route, this City of Kansas City bridge replacement project included significant pedestrian access and livability improvements that are related components to BRT. This project was well into the planning and design phase when Troost BRT planning began. There was significant coordination between the bridge and BRT projects. Kansas City Overflow Control Plan and Rain Garden Initiative: the City of Kansas City, Missouri has instigated an overflow program to reduce the amount of stormwater infiltrating into the city's combined sewer system. One of the initiatives is a rain garden program. The BRT project in cooperation with the city added numerous rain gardens at or near BRT stations.
Los Angeles, CA	N/A
Oakland, CA	No.
Phoenix, AZ	No.

Pittsburgh, PA	The South Busway and original East Busway were planned, designed, and constructed prior to my employment at Port Authority and I had very minor involvement in the planning for the West Busway. All three busways were planned primarily to improve transit service. Additionally, the West Busway was built to improve access to the new Pittsburgh International Airport terminal.
Seattle, WA	No.
Brisbane, Australia	The busway network was designed as part of major planning for the region. It connected major activity centers and different modes of transport to maximize people's opportunity to travel and to cater for all movements. All stations are accessible for mobility impaired people. Many of the attractors such as existing universities and hospitals have redeveloped existing sites to integrate the Busways into the urban area through the planning stages and have now realized significant benefits. Other state and local government initiatives/projects have been supported, serviced, or connected as a result of the current operational busway network. These include: bikeways, pedestrian pathways, hospital expansions, urban villages, compact mixed use developments, and end-of-trip facilities. Transit oriented developments/communities have also developed around these stations. Major new cycle centres have also been built at key stations that include world class end-of-trip facilities for 420 cyclists: secure parking, showers (with a fresh towel every day), lockers, plus a laundry and ironing service. Future busway stages are used as leverage by other state departments, local governments, and private sector developers for further initiatives that deliver community-oriented benefits.
Sydney, Australia	The LPT was aimed at providing a high-frequency public transport service where none previously existed. The NW T-way is designed as a "corridor" where feeder bus services can collect passengers from a dispersed area and then join the corridor to access the services at the corridor ends.

Q 9: In terms of the community-oriented aspects of the project, has there been a primary champion, such as a general manager or others within your agency, local elected officials, employers, or other private-sector interests?

City	Response
Albany, NY	We have had a number of supporters and champions, both internal and external. The strong role that our MPO (CDTC) has playing in the corridor cannot be overstated. In the business community, both Anthony Capece from the Central Avenue Business Improvement District and Ray Gillen from Schenectady Metroplex Authority have been with us from the beginning, promoting the project and the line in funding proposals and in the day-to-day operations.
Bloomington, MN	Yes. The County Board of Commissioners has lead the project since 1999 and the commissioners have been outspoken supporters of the project. There are also other public officials (local mayors) that are in support of the project as well. The private sector has recently gotten on board and is beginning to tout the benefits of the BRT service.
Brampton, ON	No, because this program involved the whole city. The primary champion was the City and its residents. If one group had to be acknowledged as the primary champion it would have to be Brampton Transit and its Züm BRT Project Office, which was created to "make it happen."
Cleveland, OH	Our general manager and senior management are very involved in championing the community-oriented aspects of this project, as well as the architecture critic in the Plain Dealer, the Cleveland Foundation, the Mayor of Cleveland, and the Downtown Cleveland Alliance.
Eugene, OR	Both Eugene and Springfield have initiated efforts to developed Mixed-Use Centers around the first two EmX corridors. As for Champions, the Mayor of Eugene, Kitty Piercy, is likely the biggest champion for EmX and tying it to development strategies.

Everett, WA	The general manager of Community Transit was the champion of the project. We took care to ensure strong communication with all of the city and county councils along the corridor throughout the project. The station locations were chosen with each of the individual jurisdictions affected; generally, we worked with the Planning Divisions, Public works, and Economic Development staff. All jurisdictions were represented on a Technical Advisory Committee, who reviewed the design and look of the stations. While we were interested in a single branded look for all stations, we also recognized the desire by each jurisdiction to have their individual "thumbprint" on the station. Therefore, we gave the horizontal plane for personalization, including an 8ft x 8ft art area. Thus, the respective Cultural Arts Managers became very big advocates for the project.
Kansas City, MO	Yes. There have been numerous people and organizations ranging from ATA staff and board, city council members, local business organizations, neighborhood groups, and individual transit supporters.
Los Angeles, CA	One of our Board members, who is also an elected County Supervisor, was an ardent advocate of the project.
Oakland, CA	Agency board members and city council members support the project. There is no primary champion.
Phoenix, AZ	No.
Pittsburgh, PA	The new Pittsburgh International Airport was a key project for Allegheny County Commissioner Tom Forester. He was also an advocate for the West Busway.
Seattle, WA	No.
Brisbane, Australia	The primary champion/s for our integrated transport network is the Minister for Transport and Minister for Main Roads. TMR's Senior Responsible Owner (SRO) for the busway and related community-oriented initiatives is the Associate Director-General. The SRO is also responsible for TMR's policies and plans. Generally, everyone involved in the implementation of the busway network become champions for the project and the community-oriented elements that match their interest. Local elected officials also play a key role in the promotion of project benefits and engage heavily with their community and private sector.
Sydney, Australia	Major driver and funder was the State Government transport agency.

Q 10: Please describe any community/stakeholder involvement in the project's planning and design process.

City	Response
Albany, NY	The ny5.org link above describes in detail the early stakeholder involvement in conceptual design. The subsequent phase can be found at Capital District Transportation Authority (CDTA). There were steering committees and stakeholder interviews, public meetings, websites, newsletters…
Bloomington, MN	Through planning to construction there have been public meetings/open houses, focus groups, newsletters, list-servs, web site updates, speakers bureau, and one-on-one meetings. Particular to construction, a suburban community will be holding a charrette this summer.
Brampton, ON	The TTMP went through the public consultant process with a number of public information centres. When the project itself became a reality, it too went through a number of public information centres, and still to this day continues to do so as we roll out each new line. For the Queen Street Corridor, the process began with the EA (Environmental Assessment). This process established the preferred draft functional plan/layout and right-of-way requirements. Throughout the EA process there were a number of public information centres, where both public and private stakeholders were invited to comment on:

	• Establish the need • Establish the alternatives • Establish the evaluation criteria • Establish the preferred concept • Develop the impacts and draft functional plan/layout. Because our BRT program was dovetailed into this process, the overall City capital works program included our needs, which in turn were vetted through the public lens prior to construction. Throughout the construction period there were a number of avenues of communication used to keep the public informed and involved, from construction notices, signage, and events, in addition to the ongoing public awareness campaign involving the launch of the city's first BRT line.
Cleveland, OH	GCRTA had a very extensive community/stakeholder involvement process and had a staff member dedicated specifically to community outreach, liaison with affected businesses along the corridor, and acting as a spokesperson to anyone who wanted to learn more about the project and/or we wished to engage directly. Design charrettes were held on project design issues, including station design, and public meetings were held from design phase until completion of project.
Eugene, OR	There was extensive community involvement as part of the RTP development, and much of that focused on the BRT strategy. There was also extensive outreach as part of EmX corridor planning. This included design workshops in which the public could meet with architects, engineers, and planners to discuss EmX lane configurations, station placement, and other design issues.
Everett, WA	Community involvement was focused on education. Stakeholder involvement was more formalized – there were several Technical Advisory Committees to help steer the project. A Transit Technical Advisory Committee – comprised of representatives of all regional transit partners (Everett Transit, Sound transit, King County Metro), met monthly to understand and coordinate all aspects of the proposed BRT service. Additionally, an Agency Technical Advisory Committee – comprised of representatives of all jurisdictions along the corridor as well as representation from the State DOT – also met monthly to review and steer the project success. Of particular concern to the Agency TAC were the design elements of the stations. The Technical Advisory Committees were formed at the very inception of the project, and met monthly until the construction phase. At that point, the committees met quarterly to review progress. At the inception of the construction phase, monthly meetings were held with the individual jurisdictions that were specifically impacted at that point.
Kansas City, MO	From planning to construction, numerous community and stakeholder meetings occurred, including an Advisory Committee made up of approximately 30 community members and stakeholders. Multiple public meetings were held and one-on-one meetings with major stakeholders were held throughout the duration of the project.
Los Angeles, CA	Over 300 community/stakeholder meetings were held during the course of the planning of this project. Numerous additional meetings were held during the design and construction phases. A charrette was held to get input on the design of one of the stations, as the site was to be jointly used by municipal bus lines. A stakeholder committee was established during the final design to make landscaping selections.
Oakland, CA	Hundreds of meetings with stakeholders. Began at "goals & objectives" phase, mode & route selection, environmental review. Will continue into design.
Phoenix, AZ	Extensive public outreach was undertaken as part of each project, including public open houses, technical advisory groups, and coordination with existing neighborhood meetings. Both projects included public outreach to assist in the design of the station structures to maximize passenger comfort and improved way-finding. Stations feature low heat gain materials, integrated shade structures, audio and visual real time bus arrival information.
Pittsburgh, PA	During the planning and environmental phases, a charrette was convened for a new bridge which was designed to tie in with the West Busway. Due to community opposition just after ground-breaking, the bridge was never built.
Seattle, WA	The conceptual design phase included outreach with permitting jurisdictions to ensure the design met local code requirements.

Brisbane, Australia	Community and stakeholder engagement is key to the success of our busway network. Our community is involved in many levels of planning, from the strategic conceptual planning through to alignment and construction options. Generally the community was involved through public participation and working groups. In some cases, the local communities were responsible for voting on the type of engineering, such as if the busway was built on structure or if fill was used, different types of sound barrier treatments, and in some cases the colours. The local community was also involved in corridor alignment options. Extensive workshops are conducted during the early phases to develop a Concept Design and Impact Management Plan (CDIMP) for government approval. Most of our projects are designed and constructed using alliances. The community and stakeholder engagement continues through the design and construction phase, as many of the risks and opportunities are best addressed by those who are "in the trenches." If there are moderate departures from the approved CDIMP, a change report is produced and consulted with key stakeholders before being released to the community. The community and stakeholder engagement continues right through to the completion of the project when we have a public open day to view and celebrate the project outcomes. These events are also important to reintroduce the benefits of the project to the community after years of planning and construction.
Sydney, Australia	Community involvement was through consultation associated with the exhibition of a detailed Environmental Impact Statement. The community was invited to provide feedback about the proposal and the project was modified where possible to take into account the community feedback.

Q 11: Please describe any citing criteria that were used in the decision of where to locate the BRT project.

City	Response
Albany, NY	Station site selection criteria can be found at http://ny5.org/images/h-k.pdf, where page two shows the selection criteria that were applied in an easy to follow format.
Bloomington, MN	For stations, they needed to be located in areas that served activity areas (employment, commercial/ retail centers) as well hold the possible of development or redevelopment potential. In addition, some stations were sited on their ability to host park and ride facilities in suburban communities.
Brampton, ON	Züm BRT corridors are planned for major arterials within the City of Brampton with all of the above cited criteria. Brampton is laid out in a typical grid pattern and the 6 BRT corridors identified under Phase 1 and 2 of this plan cover the City N/S and E/W connecting "people to places." Some additional criteria included: • Major Roadway • High existing transit ridership • Connected to major origins and destinations. • Connected to Urban growth centres – major transit terminals etc • Connected to other transit systems, i.e. inter-regional rail. With the introduction of BRT to these particular corridors, the City made the commitment to enhance the local connection services to a 10 min peak frequency at the major station stop intersections. This provided a high level of service options to those outside the minimum walk distance to a major station stop with no additional cost to the transit rider.
Cleveland, OH	These items were all used when determining the station locations for the BRT system. The BRT corridor itself was determined based upon the high ridership of the bus service traveling this corridor, the congestion in the corridor, the economic development potential, and the fact that it connected the two largest employment centers in Northeast Ohio.
Eugene, OR	The RTP includes a BRT System Plan that would place EmX along most of the major transit corridors in the community. The priority for EmX corridor development considered current and future employment and population, student population, the location of Mixed-Use Centers, and transit and auto travel times.

Everett, WA	Station locations included a number of specific citing requirements as follows: • Stations should be located between 1 to 2 miles apart. • Stations should be located to serve existing and future concentrations of population and employment. • Stations should be located to serve existing and future transit connections. • Stations should possess good line of sight characteristics to assist drivers. • Stations should provide pedestrians safe street crossing opportunities via close proximity to signalized intersections. • Stations should be located on the far side of signalized intersections, whenever possible. • Stations should not detract from the operation of an intersection. • Stations should minimize any safety risk to passengers. • Stations should allow for platform boarding higher than current sidewalk heights. • Stations should augment local economic development. • The agency should require appropriate mitigation for any station placed at a less than optimal location. • The agency should take into consideration the overall development cost per station.
Kansas City, MO	The first BRT route was located in a corridor with the highest employment concentration in the region. The second BRT route was located along the highest ridership corridor in the system.
Los Angeles, CA	N/A
Oakland, CA	Major cross streets and connecting transit. Centers of employment, schools (middle, high, and colleges) senior housing, social services, medical facilities and hospitals. Stations spaced 0.3 mi.
Phoenix, AZ	Initial corridor identification occurred during development of the Regional Transportation Plan and the Regional Transit System Study in 2003. Five BRT corridors were identified during this study effort that would provide enhanced transit services in five identified high travel corridors. Four of the identified corridors also provide a direct connection the METRO light rail transit line.
Pittsburgh, PA	The South Busway was built to allow buses to bypass heavy traffic congestion on Route 51 and the Liberty Tunnel. The East Busway was built to improve transit service from some of Pittsburgh's most densely developed communities to Oakland and Downtown in the City of Pittsburgh. The West Busway was built so buses could bypass heavy congestion on the Parkway West. The East and West Busways were located along active and abandoned railroad lines.
Seattle, WA	Design principles and functional requirements attached.
Brisbane, Australia	The primary criteria for the location of the busway network are to connect key health, business, retail, and education precincts to develop a 'knowledge corridor' and connect with the communities not serviced by the heavy rail network. The community-oriented criteria outlined in the question above are critical to the location of stations and other supporting infrastructure. The alignment of our busway network generally joins major attractors such as universities, hospitals and shopping centres to our CBD (down town) alongside major arterial roads where we have significant volumes of buses. This ensures that the investment is not just used for peak periods but has significant contra flow demand. Generally very strong existing travel demands exist to support the decision. There are many citing criteria, especially for the alignment. Most are engineering criteria such as maximum curves and grades. Many of the criteria are also operation, i.e. where can we get an operational advantage over the private car in terms of travel time and reliability. Bus station alignments were generally governed by the principal intent of the station. That is, an end of line station can be large park and ride lots where the walk up catchment in minimal. Given we run bus services 24 hours a day on Friday and Saturday, these stations need to be accessible during operations. This becomes challenging when locating these stations in private property and needs to be worked around. Our major sporting stadiums do not have car parking facilities and people are expected to arrive by public transport. This means that some of our stations are also used for special sporting stadium events and we need to clear crowds of 50,000 people in no longer than one hour by public transport.

	In partnership with our local government and other state governments and private companies, we generally enhance the pedestrian friendliness, increase densities close to station through the town plan. One of the key objectives of the BRT is to make bus travel reliable and fast so as to attract people out of cars and onto public transit. This has an impact on station spacing and design. Due to the level of service offered by our BRT (frequency of service, travel time competitiveness, and reliability), we have found that acceptable passenger walkup distances are significantly larger. We attempt to make the most of the walk up catchments with station spacing at between 800m to just over 1km. Pedestrian friendliness is very important; however, we have many access points for local buses to join the busway, allowing people to benefit from the busway from their local stop, not just the busway station.
Sydney, Australia	The LPT corridor was designed to link as many activity centres (shopping, employment and education) as possible.

C-3: Elements of Design

Q 12: Was there an urban design "vision" for the project?

City	Response
Albany, NY	Yes. It varied by "typology" (urban core, urban, suburban) and is shown in the www.ny5.org study in great detail. Context sensitivity was important, as this 17-mile corridor traverses a variety of existing urban land use forms. We respected that, and did not envision or implement a rigid approach.
Bloomington, MN	Yes in relationship to the streetscaping, landscaping, and stations. Both needed to reinforce the sense of community while also tying the corridor together among four communities.
Brampton, ON	Yes, for the Queen Street Corridor within the Urban Growth Central Area, a design vision was created by the Cities Urban Design group that focused on urbanizing the once auto dominated landscape into a more pedestrian friendly fabric that was conducive to future higher density – transit orientated development. A large part of this program focuses on addressing the street by pulling uses to the property line and creating a landscape that interacts and promotes accessibility with other modes of travel.
Cleveland, OH	The original urban design concept was very public transit oriented to the exclusion of on-street parking. The final urban design vision included more public parking than existed prior to the start of the project, added bike lanes between the two universities, and united the two sides of the Cleveland Clinic campus through elimination of left turn lanes. This was a building face to building face project. All design decisions from sidewalks, public art, seating, stations, burying overhead utilities, and each other design element were meant to enhance the pedestrian environment, enhance safety, and afford more efficiency of public transportation travel times.
Eugene, OR	The EmX vision centered on creating a new image for transit in the community, and one that would serve existing and planned development. The vision also included connections of EmX to neighborhoods via improved bike and pedestrian connections and using neighborhood connector shuttles.
Everett, WA	The design vision for the stations included the following attributes: something to be proud of; easily maintainable; sense of movement & openness; not confined; speed and motion; fluid; futuristic; a positive addition to the corridor; inviting and attractive; distinctive. Further refined design incorporated the following statement: Each station is envisioned to be of a single design for continuity of branding, and will include such components as enhanced seating and shelter, ticket vending machines for fare collection, dynamic passenger signage, raised platforms, customer information, an iconic marker for way-finding, platform graphics, and enhanced lighting.
Kansas City, MO	To improve the appearance, accessibility and safety of transit on Troost. Help give vibrancy to the public spaces, and make riders feel welcome. Create substantial and permanent stations yet not have them overwhelm the streetscape.

Los Angeles, CA	All the stations are consistent in design, all signage is uniform, and the entire BRT was fully landscaped, to create a "greenway ribbon" throughout the valley, easily recognizable as the BRT line, no matter where along the alignment the viewer happened to be.
Oakland, CA	N/A
Phoenix, AZ	Service was "branded" through the adoption of a unique transit vehicle and station architecture that allows riders to easily identity the route and what centers can be accessed from the service. LINK also features real time bus arrival information that is available via Dynamic Message Signs (DMS) at the stations, as well as via computer or cellphone through a web address.
Pittsburgh, PA	The West Busway was designed with attractive stations.
Seattle, WA	Refer to design principles and functional requirements.
Brisbane, Australia	Yes. The busway network is woven through unique and varied urban environments. The structural and architectural elements of the busway and stations generally remain constant; however, there are subtle enhancements to integrate into the surrounding landscape. There was an architectural design vision- a new typology for stations that was developed to provide BRT network recognition, a consistent building form that can sit in a diverse range of different environments from inner city, suburban and outer urban, produce station structures that are responsive to the subtropical climate to SE Queensland and an 'architectural language' that can inform the overall public transport network for new rail, light rail, and ferry building structures. The busway's urban designers work closely with key stakeholders, including the community and the Board of Urban Places. The Board for Urban Places, lead by the Queensland Government Architect, is intended to champion high-quality urban design and help foster a holistic approach to land use and infrastructure planning to create vibrant and adaptable urban places for people in Queensland. The board provides general and project-specific advice on urban design, planning, architecture, landscape architecture, sustainability, and built environment issues. It is a non-statutory body and does not have any formal decision making role. It is intended solely as an advisory body.
Sydney, Australia	The vision for the LPT was for a 'branded' highly visible, priority public transport facility. The vision for the NW T-way was for an efficient high frequency public transport corridor in a high car dependency sector of Sydney's north-west.

Q 13: What were the objectives that informed the project's design approach?

City	Response
Albany, NY	Create strong identity/high visual impact; reflect, preserve, or enhance community identity; improve attractiveness of the corridor; increase transit ridership; enhance rider comfort/convenience; create or improve public space; enhance rider safety/security; encourage economic development; enhance property values; encourage more dense development patterns; create bicycle/ped-friendly environment; create an asset for the entire community.
Bloomington, MN	Create strong identity/high visual impact; improve attractiveness of the corridor; reflect, preserve, or enhance community identity; increase transit ridership; encourage economic development; encourage more dense development patterns; create or improve public space; create community gathering places; create bicycle/ped-friendly environment; create an asset for the entire community.
Brampton, ON	Create strong identity/high visual impact; improve attractiveness of the corridor; reflect, preserve, or enhance community identity; increase transit ridership; enhance rider comfort/convenience; enhance rider safety/security; encourage economic development; enhance property values; encourage more dense development patterns; create or improve public space; create bicycle/ped-friendly environment.
Cleveland, OH	Create strong identity/high visual impact; minimize visual impact; improve attractiveness of the corridor; reflect, preserve, or enhance community identity; increase transit ridership; enhance rider comfort/convenience; enhance rider safety/security; encourage economic development; enhance property values; encourage more dense development patterns; create or improve public space; create community gathering places; create bicycle/ped-friendly environment; create an asset for the entire community.

Eugene, OR	Create strong identity/high visual impact; improve attractiveness of the corridor; reflect, preserve, or enhance community identity; increase transit ridership; enhance rider comfort/convenience; enhance rider safety/security; encourage economic development; encourage more dense development patterns; create or improve public space; create bicycle/ped-friendly environment; create an asset for the entire community.
Everett, WA	Create strong identity/high visual impact; improve attractiveness of the corridor; increase transit ridership; enhance rider comfort/convenience; encourage economic development; encourage more dense development patterns; create an asset for the entire community.
Kansas City, MO	Create strong identity/high visual impact; improve attractiveness of the corridor; increase transit ridership; enhance rider comfort/convenience; enhance rider safety/security; create or improve public space; create bicycle/ped-friendly environment; create an asset for the entire community.
Los Angeles, CA	Create strong identity/high visual impact; minimize visual impact (where adjacent to private property); improve attractiveness of the corridor; reflect, preserve, or enhance community identity; increase transit ridership; enhance rider comfort/convenience; enhance rider safety/security; create or improve public space; create bicycle/ped-friendly environment; create an asset for the entire community.
Oakland, CA	Create strong identity/high visual impact; increase transit ridership.
Phoenix, AZ	Create strong identity/high visual impact; increase transit ridership; enhance rider comfort/ convenience; enhance rider safety/security; encourage economic development; encourage more dense development patterns; create or improve public space; create bicycle/ped-friendly environment; create an asset for the entire community.
Pittsburgh, PA	Improve attractiveness of the corridor; increase transit ridership; enhance rider comfort/ convenience; encourage economic development; reduce travel times for transit users; reduce operating costs of providing transit service.
Seattle, WA	Create strong identity/high visual impact; improve attractiveness of the corridor; increase transit ridership; enhance rider comfort/convenience; enhance rider safety/security; create bicycle/ped-friendly environment; create an asset for the entire community.
Brisbane, Australia	Create strong identity; minimize visual impact; improve attractiveness of the corridor; reflect, preserve, or enhance community identity; increase transit ridership; enhance rider comfort/ convenience; enhance rider safety/security; encourage economic development; enhance property values; encourage more dense development patterns; create or improve public space; create bicycle/ ped-friendly environment; create an asset for the entire community; design excellence and high levels of construction quality.
Sydney, Australia	Create strong identity/ high visual impact; improve the attractiveness of the corridor; increase transit ridership; encourage more dense development patterns; create bicycle/ ped-friendly environment.

Q 14: Please describe any non-traditional or non-transit uses of the BRT facilities that were included in the planning and design of the project.

City	Response
Albany, NY	Incorporation of public art is included in the project.
Bloomington, MN	N/A
Brampton, ON	N/A
Cleveland, OH	N/A
Eugene, OR	The project included improvements to bicycle and pedestrian facilities along the corridor, traffic safety improvements, undergrounding of utilities in one segment, and improved landscaping.
Everett, WA	N/A
Kansas City, MO	N/A
Los Angeles, CA	N/A

Oakland, CA	N/A
Phoenix, AZ	N/A
Pittsburgh, PA	Busways are used by police and fire vehicles. Access for railroad service vehicles was incorporated into the design for the East Busway.
Seattle, WA	Facilities for on-street bicycle parking were planned into the project and implemented on the initial corridor, but will be provided upon request on subsequent corridors due to budget constraints.
Brisbane, Australia	Cycleways, cycle – end of trip facilities, public art and third-party advertising panels have been included at some stations. Many of our busways include improvements to bikeways and significant improvements to pedestrian paths to improve mobility in general. Transit orientated developments/communities have also developed around these stations. Major new cycle centers have also been built at key stations that include world class end-of-trip facilities, for example King George Square busway station caters to 420 cyclists with secure parking, showers (with a fresh towel every day), lockers, plus a laundry and ironing service. We have a limited number of events that utilize our busways outside of peak times to facilitate community events such as bike races and fun runs. Our busways are also used by emergency services. Retail space is also allowed for in some stations. A proportion of the total infrastructure cost is also allocated to public art to be displayed at the busway stations or along the corridor.
Sydney, Australia	Bicycle/pedestrian paths for the full length of the T-ways.

Q 15: Were any of the BRT facilities designed to serve as a community or neighborhood "gateway"?

City	Response
Albany, NY	A key part of the BRT facility design was the naming of each station with the neighborhood and/or landmark and presentation as if it were a rail line – this is a key way of communicating both the limited stop nature of the service and the neighborhoods through which it traverses.
Bloomington, MN	Yes. Original designs for the 140th Street Station (its overhead pedestrian bridge), for which 70,000 vehicles travel by, incorporated strong design elements to signify a gateway into the City of Apple Valley.
Brampton, ON	The station stops entering the downtown Brampton historic district were designed to emulate elements of the history of the area. These six unique stops were redesigned to include a different color, roof line, pedestal base and naming convention more representative of this historic area.
Cleveland, OH	Yes, public art elements mark specific neighborhoods and provide historical references along the corridor.
Eugene, OR	Franklin Boulevard is considered gateway entrance to Eugene, though that was not a major factor in the system design.
Everett, WA	No.
Kansas City, MO	Many BRT stations have been given neighborhood names (e.g. Marlborough, Squire Park, etc.).
Los Angeles, CA	No.
Oakland, CA	N/A
Phoenix, AZ	Two art shelters were included in the projects to provide a visual gateway to downtown Mesa and downtown Chandler. The art stations included design references that were relevant to the history or the character of the surrounding area.
Pittsburgh, PA	N/A
Seattle, WA	No.

Brisbane, Australia	Some stations which interface important venues and places of importance provide 'front door' access to facilities, but they aren't really considered as community or neighborhood gateways. Generally, the Busway has a consistent look and feel so that the travelling public knows what to expect with regard to a high level of service and facility with distinctive public architecture. Each station is however customized to the individual sites and to have access to the main entry of adjacent buildings and places. This is to ensure passengers using the stations have seamless access. Each station design is relevant to locality and form of civil infrastructure required. They also exhibit the standards of adjacent buildings and reflect an overall network typology.
Sydney, Australia	Nothing specific.

Q 16: Please describe the way in which any historic, archaeological, or cultural resources were incorporated into the project's design.

City	Response
Albany, NY	Probably the most interesting example of this is the Capitol/Hawk station, where the State Capitol is on the National Register of Historic Places. The Capitol Architect did not want a shelter on the inbound side, next to the historic building where there are many more people getting off the bus than on – because it would get used as a smoking shelter more than for transit purposes. He had leftover granite from a renovation project, and CDTA used this granite to fashion benches for these stations. They match the historic building and the smoking issue was avoided.
Bloomington, MN	The sweeping curves of the stations replicate the topography of the corridor.
Brampton, ON	See above.
Cleveland, OH	Through public art – integrated artwork and stand-alone artwork to reflect our American Indian history and industrial past, as well as significance of history in the neighborhoods (through oral history project and special information at station kiosks). The project won an Ohio History award for the integration of the local history into the project. In addition, design elements were "lightened" up so as not to disturb view sheds, etc. Efforts were taken to restore the historic landscape content to the area around the Cleveland Museum of Art and to soften the area around the Historic Dunham Tavern.
Eugene, OR	The Gateway EmX public art reflects significant historic characteristics of Springfield.
Everett, WA	As part of the design of the stations, the individual jurisdictions were given the horizontal plane for personalization. In the personalization package, entities were given an 8x8ft square for art. Each jurisdiction held a call for artists and included different design directions. One entity chose a tile re-creation of the geography of their city; another incorporated tile mosaics of a compass rose at each station, with historic naming of the stations. Another jurisdiction inlaid concrete art panels with a 'living' theme.
Kansas City, MO	Three original public art pieces were commissioned for the project. They are located at 31st, 39th, and 75th & Troost. All three pieces were inspired by local historical and/or cultural elements including Native American and African American histories and Kansas City jazz history.
Los Angeles, CA	In the station art work (see above).
Oakland, CA	N/A
Phoenix, AZ	See answer to question 15.
Pittsburgh, PA	A Pennsylvania Railroad station in Edgewood Borough was served by commuter trains until 1964. It is located along the Martin Luther King East Busway Extension. Port Authority secured federal Transportation Enhancement funds to renovate the station. Although the station is not incorporated into the East Busway, it is a significant structure in Edgewood Borough.
Seattle, WA	None.
Brisbane, Australia	Any indigenous or European Heritage artifacts or local history that is discovered by a project is typically celebrated and sensitively incorporated into the station, by way of mural, art, monument, or landscaping.

	In one of our busway stations a World War 2 war control room was discovered. This was extensively photographed and made into a display at the station with many photos and stories of the facilities that had been forgotten about. One of the first ever water/sewer drains for Brisbane was uncovered; part of this was then made into a display within the station with a story of how and when the drain was constructed.
Sydney, Australia	On the LPT, a memorial to the first Aboriginal land owner in the Liverpool area (south-western Sydney).

Q 17: Please describe any features that were designed into the BRT project in order to provide enhanced recreational or green space.

City	Response
Albany, NY	Not as a major component. Project had low capital costs and in general, lived within the available public right-of-way without additional acquisitions. We did put major investment into civil work that provided and enhanced a continuous pedestrian network and improved the ADA accessibility of the corridor as a whole.
Bloomington, MN	Yes. The corridor will include four miles of trails for pedestrian and biking mobility.
Brampton, ON	Along the Queen Street line, signature landscape elements were included by enhancing the green space around the station stop shelter. No other features where uniquely designed into the BRT project but were already part of the City's landscape, recreational path programs.
Cleveland, OH	Medians were created in the University Circle neighborhood where RTVs travel curbside. A landscape architect was commissioned to create stately stone artwork where the BRT cuts through Rockefeller Park.
Eugene, OR	No new public spaces were created by EmX, although existing public spaces adjacent to the corridor were enhanced with improved landscaping and lighting. This included lighting of the Rosa Parks ped/bike path in Springfield.
Everett, WA	N/A
Kansas City, MO	KCATA built a bike-walk path to connect MAX to the 17-mile, bi-state Indian Creek Trail and ultimately to the cross-state Katy Trail. Both Main St. MAX and Troost MAX were designed to connect with KCATA's popular 6-mile Trolley Track Trail and the Brush Creek Trail.
Los Angeles, CA	Native landscaping was used as much as possible, and the BRT right of way is fully landscaped. The BRT connects several regional recreational areas, and pedestrian/bike access was provided from the BRT right of way for these areas.
Oakland, CA	N/A
Phoenix, AZ	Stations include landscape elements (trees) that provide shade and passive cooling. Landscaping also provides a visual transition to adjacent land uses.
Pittsburgh, PA	A linear park was built along the East Busway Extension.
Seattle, WA	None.
Brisbane, Australia	Project teams work closely with community groups where the busway is constructed alongside green space and recreational paths. Recreational paths are generally enhanced and landscaping is always enhanced as part of these stations and infrastructure. New bike facilities are included. The busway is also a catalyst for other state and local government initiatives that enhance the community's "green assets."
Sydney, Australia	Native landscaping has been provided around stations/stops where space has permitted. Some stations are located adjacent to green space areas (parks).

Q 18: Please describe any accessibility treatments that were incorporated into the project design.

City	Response
Albany, NY	As noted above, ADA accessibility, including ramps with detectable surfaces, were a major civil site component of the project. Bicycle parking is also included, to be compatible with the vehicle bike rack component.
Bloomington, MN	All facilities are ADA compliant per federal investment of transit facilities.
Brampton, ON	For all transit facilities the design process includes input from the City of Brampton's Accessibility Coordinator, who using ODA Ontario Disability Association Standards and ensures all new infrastructure adheres to these standards and guidelines. The following elements have been included: • Terminals – way finding, tactile surfaces, and coloured walkways. • Station Stops – way finding measures – tactile guide strip along roadway, inclusion of visual elements to the glass. • Bike racks on all buses to accommodate bicyclists. • Wheel chair accessible buses and platforms designed to accommodate ramp and wheel chair/ assisted device turning radii. • On-board wheel chair restraint device to secure the device in travel - new Q-straint wheelchair restraint system. • Kneeling buses to reduce slope for boarding and alighting passengers. • Wider aisle-ways and doors to accommodate strollers and young children. • Automated Vehicle Annunciation equipment has been installed on board, which automatically announces and displays each stop along the route. This benefits customers requiring audible or visual reference as well as those new to the route and/or unfamiliar with Brampton. • Digital displays are located at all Züm station stops and Brampton Transit terminals, providing "next bus" information in real time. Additionally, new software technology provides real-time arrival and "Next Ride" information to customers via the Brampton Transit website, cell phones, and other mobile devices. With these technologies, customers now know with certainty the departure times of the Züm buses at their station stop and all Brampton Transit buses at the terminals. • An Interactive Voice Response system has also been acquired. This service provides real-time and scheduled information to customers over the phone using their four-digit bus stop number.
Cleveland, OH	These considerations were taken into account and elements were added into the project to accommodate ADA access, including ramps, audible walk signals, addition of bike lanes between the two universities, and other technological advances to assist with disabled pedestrians or riders.
Eugene, OR	People with disabilities were involved in the station and bus design to improve navigation and access by people with various disabilities. EmX stations have bicycle parking, and bikes can be brought on-board EmX buses. A rear-facing, unsecure wheelchair bay was designed into the EmX bus and has proven to be very popular. The near-level boarding greatly facilitates access by people with disabilities and those with bikes or strollers.
Everett, WA	With a raised platform of 10 inches for easy boarding, each station included gentle sloping ramps to access the platform area. Tactile edges, and identified "welcome mats" identify specifically where the doors of the BRT vehicle will align. Platform graphics show exactly where wheelchairs board (at the front door) and also where bicycles board (at the rear door). All Swift coaches include on-board bike racks for customers to take their bicycles with them.
Kansas City, MO	ADA compliant real time arrival signs were installed at all BRT stations. Several intersections were improved with new ADA compliant sidewalk ramps to make access to adjacent BRT stations easier.
Los Angeles, CA	All our facilities are designed to comply with ADA access requirements, including access ramps and handicap-designed parking. All our stations have bike racks and lockers, and the bike path includes space for pedestrians. One segment of the BRT travels through a specially designated religious zone forbidding the use of mechanical devices, so the pedestrian crossing signals are programmed to change automatically on certain days of the week.
Oakland, CA	N/A

Phoenix, AZ	Stations feature raised platforms that allow for near level boarding at bus doors. Platform edge includes tactile strip to warn visually impaired riders of the platform edge. Real time bus information is not only displayed on DMS at each station, but is available as a rider actuated audio announcement at the stations. The audio announcement is activated by a push button that is labeled in braille. Some stations will feature fare vending machines that will include braille labeling to allow use by visually impaired riders.
Pittsburgh, PA	Ramps for wheelchair users were incorporated into the original East Busway. As this facility opened prior to the Americans with Disabilities Act of 1990, they may not meet ADA standards. Several East and West busway stations have bicycle racks. By the end of 2011, all buses in Port Authority's fleet will be equipped with bike racks.
Seattle, WA	All facilities meet ADA requirements; bicyclists were accommodated through the installation of on-street bike parking along the initial corridor. All stops include benches and passenger initiated stop request beacons. At stations, real time arrival information is provided in visual and audio formats.
Brisbane, Australia	All busway stations are fully compliant with the national Disability Standards for Accessible Public Transport and the Disability Discrimination Act. Station platforms are easily accessed by escalators, lifts, or ramps and also include hearing loops and tactile directional and hazard tiles for those with impaired hearing or sight.
Sydney, Australia	All stations are designed to allow mobility for all passengers under Australian Building standards. It is a legislated requirement that all people with disabilities have equitable, dignified access to public transit services. This legislation requires architects, engineers and transport planners to design for the full range of disabilities including mobility, aural, and vision impairments. Specific stations adjacent hospitals also take account of non-physical impairments. All stations have lifts and stairs, suitable 'white' lighting, audio loops for hearing impaired, public announcements, CCTV, tactile paving to guide visually impaired, significant way finding signage, and emergency help buttons. Some of the busiest stations also have escalators. They also exhibit high levels of visual transparency because they are unstaffed stations. In addition, both T-ways have bicycle paths running the full length of the project, buses have access ramps or have height adjustable suspension for the front door, all T-way stations have seating, and the major station at the mid-way point on the LPT has lifts and a covered grade separated pedestrian bridge.

Q 19: Were pedestrian zones incorporated into any part of the BRT project design? If so, please include a description of amenities that were provided specifically for pedestrians.

City	Response
Albany, NY	All stations are located curbside in a mixed traffic environment within the sidewalk area. There were a number of places where we widened the sidewalk, put in larger than normal crosswalks, or did a bump out to make sure there was sufficient pedestrian space. We also invested a fair amount in pedestrian level LIGHTING – particularly in the suburban part of the corridor where the street lighting is auto oriented.
Bloomington, MN	Yes. A pedestrian bridge was constructed to facilitate the movement of transit riders from the southbound station to the northbound station and park and ride facilities. More pedestrian bridges are planned when demand thresholds are met or when safety is a factor.
Brampton, ON	N/A
Cleveland, OH	Yes, the station areas include benches, information kiosks, real time signage, trashcans, etc. Along the corridor art trashcans and sidewalk art and special seating sculptures were added outside of the station areas. Special brick sidewalk design was incorporated in the downtown area to designate the CBD as well as at key crosswalks throughout the corridor.
Eugene, OR	Didn't create specified pedestrian zones.

Everett, WA	The Swift stations were built on a 10x60 ft pad, behind the public sidewalk. This creates an automatic pedestrian zone at each station.
Kansas City, MO	A few station locations included widening of sidewalks to create larger pedestrian zones and space. Amenities at these areas include new sitting walls, extra benches, landscaping, and as mentioned previously public art.
Los Angeles, CA	See above. The bike path was designed in accordance with California DOT specifications, allowing separate lanes of travel for east and west traveling bicycles, as well as a designated lane for pedestrians.
Oakland, CA	N/A
Phoenix, AZ	Curb side station design included accommodation for pedestrians that use the sidewalk to travel through the area and not to access the station.
Pittsburgh, PA	Most of the busway stations are located in residential areas. The busway stations are linked to local pedestrian networks through bridges, ramps and sidewalks built for the stations.
Seattle, WA	Pedestrian access to and through the stops was considered.
Brisbane, Australia	Pedestrian connections through or around the stations and corridor are important to communities. As with green space, these connections are generally enhanced as a result of the busway.
Sydney, Australia	No specific zones provided. At all traffic signals, light controlled pedestrian crossings are provided.

Q 20: Were public plazas or other community gathering places incorporated into any part of the BRT project's design? If so, please include a description of any amenities that were provided to create a safe, attractive, comfortable environment for people to sit, gather, or stroll.

City	Response
Albany, NY	Right of way restrictions in general did not allow for this component.
Bloomington, MN	Not within the station areas themselves; however, communities are identifying areas adjacent to stations where such activities can occur.
Brampton, ON	N/A
Cleveland, OH	Seating elements that spelled out "things change" were incorporated for public seating in some areas of the corridor. These were the only elements that the project included.
Eugene, OR	No.
Everett, WA	No.
Kansas City, MO	A "transit plaza" was constructed at 31st & Troost and includes a pervious concrete park & ride lot. The community occasionally uses the lot as a gathering and event space. This high profile location includes a rain garden, public art, very wide sidewalks, landscaping, and a high level of lighting.
Los Angeles, CA	Several stations have small plaza areas, with specific artist-design seating provided. They are typically located in areas which serve as transit transfer points, or junctions of regional bicycle paths.
Oakland, CA	N/A
Phoenix, AZ	Terminal stations were incorporated into existing transit stations and park & rides that include lighting, fare vending machines, real time bus arrival information, and pedestrian connections to adjacent land uses. Line stations include lighting and CCTV cameras to provide for enhanced safety at the stations. All stations were designed to be visually open and to avoid the creation of hiding spaces.
Pittsburgh, PA	N/A
Seattle, WA	Additional seating for transit patrons above the level typically provided at bus stops is provided. Additional pedestrian-scale lighting is added at many locations.
Brisbane, Australia	Yes. At central stations, public plazas have been established to allow people to sit and eat lunch, gather, or stroll. These areas are monitored by CCTV and are modern and attractive areas.

	Although most stations are designed for the commuter and not for community gatherings, if large open space is created as a result of a station's layout or environment, these areas have seating, landscaping, security monitoring, and in some cases, toilets. CPTED (Crime prevention through environmental design) principles are applied and improved for all stations. Actively monitored CCTV is at all stations and along the busway with emergency help points at all platforms and plazas. Cameras automatically move to focus on the help points and staff are able to communicate with the person through the PA.
Sydney, Australia	N/A

Q 21: Please describe any elements of the project that were designed to mitigate vehicle-generated noise, vibration, or exhaust.

City	Response
Albany, NY	Service uses hybrid vehicles.
Bloomington, MN	N/A
Brampton, ON	The most recognized feature of Züm is its uniquely-branded, European-styled buses. These vehicles are manufactured by New Flyer Industries in Winnipeg and feature state-of-the-art technologies, increased passenger comforts and are powered by fuel efficient, clean, hybrid diesel-electric technology. The Züm buses are also 10% lighter than conventional vehicles, resulting in increased fuel savings. Brampton Transit is the first public transit provider in North America to use these new Xcelsior model buses. Züm vehicles feature plush, Züm-branded high back seats, two skylights, larger windows, four on-board security cameras, and reduced noise levels. Advanced accessibility features include a wider door and entryway, a lower floor, improved wheelchair ramp, and a new Q-straint wheelchair restraint system to assist the elderly and persons with disabilities when using public transit.
Cleveland, OH	Vehicles used were diesel hybrid electric and dramatically reduced noise, vibration, and air pollution.
Eugene, OR	The separated busways include a grass strip in the middle (between the wheel tracks) that helps absorb engine noise (along with visual and environmental benefits). The hybrid-electric propulsion system used by EmX buses is quieter than a conventional diesel engine.
Everett, WA	Noise and vibration were mitigated by the agency's purchase of hybrid diesel-electric vehicles for the BRT project.
Kansas City, MO	Five new hybrid electric BRT buses were acquired for the project
Los Angeles, CA	We installed artist-designed, precast sound walls along approximately 80% of the busway alignment, where the buses traveled adjacent to residential areas. The right of way passes behind residential homes in many areas of the project. Vibration wasn't a problem, but the bus vehicle was a new product and required some retooling of the exhaust system to mitigate noise. Also, we replaced windows in several residential locations (typically multi-story apartments), which did not benefit from the sound walls.
Oakland, CA	N/A
Phoenix, AZ	BRT vehicles were designed to include additional sound-deadening materials to reduce noise levels within the vehicle.
Pittsburgh, PA	Sound walls were built along the East Busway Extension and West Busway.
Seattle, WA	None.
Brisbane, Australia	Sound barriers, low-noise asphalt, flat grades, jet fans, and ventilation tower with air scrubbers are elements used on the current busway network. At elevated stations the pedestrian platform is separate to the vehicle pavement to stop transmission of the vibration to the platform. The bus operators are continuously improving their fleet's noise and exhaust emissions.
Sydney, Australia	Sound walling has been provided in residential areas along the NW T-way (Blacktown to Parklea section). Vibration testing was done during the design phase along the frontage of a hospital on the NW T-way (Parramatta to Rouse Hill section).

C-4: Station Design

Q 22: Please describe the design/architecture of the stations/stops.

City	Response
Albany, NY	[Please see figures D.4 in Appendix D.]
Bloomington, MN	[Please see figures D.5 in Appendix D.]
Brampton, ON	[Figure D.6 in Appendix D] shows the modular Züm design, with its one-of-a-kind Züm branding and colour scheme, improved functionality and size. Additionally, the Züm station stops were designed to allow for on-site flexibility and future growth and transit development. Züm station stops have large, heated waiting areas, increased lighting, security cameras, and comfortable street furniture. Electronic digital displays notify waiting passengers of the arrival of their next bus. This next bus information is delivered in real time. Züm station stops also provide an information centre for riders with up-to-date route and customer service information. This is the major station design: the structure is 18 metres (59 feet) long by 2 metres (6½ feet wide) and sits on a 20 m (65 feet) long by 4.5 m (16¾ feet) wide pad. It contains both an enclosed sheltered area which is heated and an outside canopy area with glass on one side to provide semi-protection from the elements.
Cleveland, OH	Architectural stations were designed and fabricated specifically for this BRT project. Complimentary shelters were purchased for the transit zone (bus lanes on adjacent downtown streets).
Eugene, OR	The shelters were custom designed and used a consistent color/design throughout the corridors to create a visual brand and identity for the system. The canopies were modular, with one to five units located at each station depending on passenger loads. Also, variations of the shelter design were created through two-sided or one-sided stations.
Everett, WA	[Please see figures D.8 in Appendix D.] Swift stations are built on a 60x10 ft platform, behind the sidewalk. Each station includes a 16 ft tall "iconic" roadside marker to identify the station from a distance. There are 2 Smart Card readers (one at each end) as well as 2 ticket vending machines for single ride tickets. The station includes a large customer information kiosk, with signage showing the entire BRT route, as well as individual area maps for each station. Glass wind screens are designed so customers can sit on either side of the shelter in order to minimize prevailing winds and rain. Overhead shelter and lighting is also provided. The stations include 10 inch raised platforms for easier boarding/alighting, with tactile edging. "Welcome mats" are located along the platform to show customers exactly where the doors will be for faster/easier boarding. Art elements include a lightly stenciled design on the station, as well as an 8x8 ft art piece on each platform.
Kansas City, MO	BRT stations are generally 60' long and 12' wide concrete sidewalk with special architectural features such as exposed aggregate and decorative grooving. They include 4' wide custom designed and fabricated pedestrian protection or shelters ranging in length from 15 feet to 25 feet, with oversized roof protection (approx. 8' wide). Each station includes an 18' tall marker with a real time arrival sign and identifying "MAX" logo. Many locations include landscape areas at each end of the station.
Los Angeles, CA	Our stations were specially designed for this project, but all stations on the line are alike. They contain canopies and artist-designed seating. The design repeats an elliptical theme in canopy and terrazzo art panels, initially inspired by our Metro Rapid Bus symbol, because the original concept of this line was to be an "enhanced Rapid Bus" line.
Oakland, CA	N/A
Phoenix, AZ	Station design was the result of a shade analysis that sought to maximize shade at all times of the day and year. Station finishes included low heat gain materials and shade trees to increase rider comfort. Arizona Avenue/Country Club LINK station shelters were also designed to allow for off site fabrication and assembly. This reduced the need for lane closures during construction of the stations.
Pittsburgh, PA	Please review the attached PowerPoint presentation.
Seattle, WA	A distinct brand for the RapidRide lines was established using unique architectural forms, colors, and materials. Passenger facilities are envisioned as a unified "kit of parts" that can be implemented as modular components depending on site conditions or specific site needs.

Brisbane, Australia	The stations are architecturally designed and have maintained a similar look and feel since the first section of busway was completed in 2000. The stations are high quality, easy to maintain, and include steel-framed modular cantilevered shelters with extensive use of glass and anodized aluminum battens for weather protection and surveillance. Station platforms are either connected by steel framed bridge with glass façade or underpass (for elevated stations). Each platform is connected to a bridge or underpass by a lift and stair tower. The lift shaft and car are predominately glass. Each platform also includes an additional area away from the boarding zone for ticket and refreshment vending as well as timetable information. Real-time passenger information displays are suspended from the shelter and located half-way along each platform. Each station has extensive CCTV coverage and is operated centrally at Busway Operations Centre.
Sydney, Australia	Station design is light weight modular shelters.

Q 23: Does the design, theme, or scale of the stations change, depending on the surrounding context?

City	Response
Albany, NY	Scale (within basic design) changed with available ROW and passenger boarding loads.
Bloomington, MN	Yes. There are three station prototypes depending on the setting and ridership demand.
Brampton, ON	There are four shelter designs, major (preferred or constrained) or minor (major or constrained) the only difference between these four types is in size.
Cleveland, OH	Yes, depending on the part of the BRT system and neighborhood, buses dock on different sides of the station. Stations are designed to designate which direction buses are traveling based upon the roofline. The glass and stainless steel stations are modern, clean, and fresh. They were chosen to contrast but not detract from the historic buildings that are found all along the corridor.
Eugene, OR	The basic station design does not change, though special features, such as public art, vary from station to station.
Everett, WA	No, all stations are identical for a strong brand that customers understand.
Kansas City, MO	The station scale is generally the same throughout the route but some locations have been scaled down as determined by anticipated ridership activity.
Los Angeles, CA	Only the art motifs change for each station, but all components are same size, scale, color, etc. As described above, the surrounding context informed the art installations at each station.
Oakland, CA	N/A
Phoenix, AZ	Line stations are uniform in order to reinforce the LINK brand. This improves way finding for riders that may be unfamiliar with an area but know about the LINK service and will respond to the visual cues supplied by the stations and the LINK vehicles. Only exception is the two art stations that were designed as visual gateways to downtown Mesa and downtown Chandler and include design elements that relate to the character or history of the surrounding area.
Pittsburgh, PA	On South and West Busways, most stations are of similar design and scale. On the East Busway, the stations on the 2.3-mile extension differ in design from those on the original 6.8-mile facility. The East Busway stations also vary in size according to the number of riders being served.
Seattle, WA	Yes. Larger shelters and a greater complement of passenger amenities can be built at a specific location depending on patronage needs. Modular components can be combined were needed. Placement of amenities in the public right of way responds to site conditions such as business access points, the configuration of the existing pedestrian circulation network, and presence of existing landscape elements.
Brisbane, Australia	Yes the scale, form, and footprint do change based on service levels and operational configurations; however, to achieve network recognition and ensure the customer experience is consistent, the stations generally have the same 'look and feel' and branding and signage are consistent throughout the network. Examples of stations that deviate from the standard theme include King George Square (KGS) and Royal Brisbane & Women's Hospital (RBWH) stations. We provide a tasteful contemporary design that can be used in all contexts and that is responsive to our climate. We provide a very high level of facility.

Sydney, Australia	The design is constant. However the modular system allowed longer stations (shelters) to be built at higher patronage stations, such as shopping centers and education facilities.

Q 24: What amenities are provided at stations/stops?

City	Response
Albany, NY	Seating, bike racks/lockers, signage/way-finding, attractive lighting, wi-fi, ADA access, station artwork, and real time next bus arrival information.
Bloomington, MN	Seating, bike racks/lockers, signage/way-finding, attractive lighting, fencing, ADA access, restrooms, station artwork, special landscaping treatments, and sustainable features such as passive heating and cooling in the pedestrian bridge.
Brampton, ON	Seating, signage/way-finding, attractive lighting, ADA access, and special landscaping treatments.
Cleveland, OH	Seating, bike racks/lockers, signage/way-finding, attractive lighting, ADA access, station artwork, and special landscaping treatments.
Eugene, OR	Seating, bike racks/lockers, signage/way-finding, attractive lighting, fencing, ADA access, leaning rails, station artwork, special landscaping treatments, and real-time passenger information (recently added).
Everett, WA	Seating, signage/way-finding, attractive lighting, fencing, ADA access, and station artwork.
Kansas City, MO	Seating, bike racks/lockers, signage/way-finding, attractive lighting, ADA access, station artwork, special landscaping treatments, and trash & recycling receptacles.
Los Angeles, CA	Seating, bike racks/lockers, signage/way-finding, attractive lighting, fencing, ADA access, station artwork, special landscaping treatments, ticket vending machines, CCTV security cameras, "next bus coming" scrolling text screens, and emergency phones.
Oakland, CA	Seating, signage/way-finding, attractive lighting, ADA access, wi-fi, station artwork, and special landscaping treatments.
Phoenix, AZ	Seating, bike racks/lockers, signage/way-finding, attractive lighting, fencing, ADA access, wi-fi, station artwork, special landscaping treatments, dynamic message signs (DMS), and fare vending machines.
Pittsburgh, PA	Seating, bike racks, signage/way-finding, attractive lighting, ADA access, special landscaping treatments, station area and bus route maps, and waste receptacles.
Seattle, WA	Seating, bike racks/lockers (initial corridor only, then only upon request), signage/way-finding, attractive lighting, ADA access, wi-fi (on buses, not at stops), real time passenger information signage, off-board fare collection, and passenger initiated stop request beacons.
Brisbane, Australia	Seating, bike racks/lockers, signage/way-finding, attractive lighting, fencing, ADA access, newsstand (informal provision at some stations), concessions (not operational yet), retail, drinking fountains, restrooms (at key stations only), station artwork, special landscaping treatments, transport information center, cycle end-of-trip facilities at key stations (showers, lockers, secure bike racks, mechanic, laundry service), and add-value vending machines (smart card tickets).
Sydney, Australia	Seating, bike racks/ lockers at selected locations, signage/way-finding, attractive lighting (security based), ADA access, station artwork (community based), and real time passenger information (bus arrivals).

Q 25: What safety/security measures are used at stations/stops?

City	Response
Albany, NY	Enhanced lighting, video monitoring (in cooperation with local law enforcement), bollards or other safety guards, and emergency call phones (in the future).
Bloomington, MN	Enhanced lighting, video monitoring, alarms, call boxes, and bollards or other safety guards.
Brampton, ON	Enhanced lighting, video monitoring, emergency call phones, and crime prevention through environmental design (CPTED).
Cleveland, OH	Enhanced lighting, video monitoring, call boxes, bollards or other safety guards, emergency call phones, and crime prevention through environmental design (CPTED).
Eugene, OR	Enhanced lighting, video monitoring (at major stations), bollards or other safety guards, and crime prevention through environmental design (CPTED).
Everett, WA	Enhanced lighting.
Kansas City, MO	Enhanced lighting, bollards or other safety guards, crime prevention through environmental design (CPTED), and security cameras at select locations.
Los Angeles, CA	Enhances lighting, video monitoring, call boxes, emergency call phones, and crime prevention through environmental design (CPTED).
Oakland, CA	Enhanced lighting, video monitoring, alarms, call boxes, bollards or other safety guards, emergency call phones, and crime prevention through environmental design (CPTED).
Phoenix, AZ	Enhanced lighting, video monitoring, bollards or other safety guards, and crime prevention through environmental design (CPTED).
Pittsburgh, PA	Enhanced lighting, call boxes, and police vehicles operating on the busways.
Seattle, WA	Enhanced lighting and crime prevention through environmental design (CPTED).
Brisbane, Australia	Enhances lighting, video monitoring, alarms, call boxes (taxi only), bollards or other safety guards, emergency call phones (two-way communication with automated CCTV coverage), crime prevention through environmental design (CPTED), and public address speakers.
Sydney, Australia	Enhanced lighting, video monitoring (Liverpool to Parramatt T-way), emergency call phones, and crime prevention through environmental design (CPTED).

Q 26: Please describe any climate considerations that were incorporated into the station design.

City	Response
Albany, NY	Windbreaks, especially in longer arcade shelters.
Bloomington, MN	Large canopies to protect customers, level platforms that are enclosed and within inches of arriving vehicles.
Brampton, ON	Station stops shelters include infra-red heating which is climate controlled, were if someone wants to turn on the heater they push a button and it only activates if the temperature is below a set standard (which is adjustable).
Cleveland, OH	Canopies are included in station design but stations are not closed boxes, allowing wind to travel through stations. No heating elements.
Eugene, OR	Stations have canopies (for rain and shade).
Everett, WA	Overhead shelter and windscreens were incorporated to mitigate wind and rain. The windscreens were designed to allow customers to sit on either side of the screen to get out of prevailing weather.
Kansas City, MO	Shelter designs include multi-directional wind protection.
Los Angeles, CA	We provided canopies to shield patrons from the hot summer sun. These canopies are made of a translucent material, minimizing the need for extra lighting.

Oakland, CA	None.
Phoenix, AZ	Stations were designed with input from a shade analysis and incorporate low heat gain materials and landscaping to enhance rider comfort during hot summer months.
Pittsburgh, PA	All stations on the East and West Busways have canopies.
Seattle, WA	Extended roofs and glass side and back panels for rain and wind protection.
Brisbane, Australia	Large awnings to provide shade and shelter and cross ventilation for summer; levels of protection from cool and windy conditions in winter; extensive use of glass to allow for visibility and to provide wind protection; platform shelter louvers/screens for some east/west facing platforms; tropical landscaping; air conditioning in the underground station (King George Square station); rainwater collection and storage for garden maintenance, station cleaning and toilet flushing (key stations only).
Sydney, Australia	No special features.

Q 27: If bus bulb-outs are used at stations/stops, was the extra space provided by the bus bulb-outs used to provide extra amenities?

City	Response
Albany, NY	N/A
Bloomington, MN	N/A
Brampton, ON	N/A
Cleveland, OH	N/A
Eugene, OR	N/A
Everett, WA	N/A
Kansas City, MO	N/A
Los Angeles, CA	N/A
Oakland, CA	No.
Phoenix, AZ	No.
Pittsburgh, PA	N/A
Seattle, WA	At some locations bulbs enable additional passenger amenities to be provided that would not fit in the public right of way without the bulbs.
Brisbane, Australia	Bus bulb-outs aren't used at any stations. The stations consist of one through-running lane, an indented stopping bay, and generally a 60m x 5m platform with full shelter for each direction.
Sydney, Australia	No.

C-5: Running Way Design

Q 28: Please describe any design techniques that were used to differentiate the BRT running way and/or strengthen the identity of the BRT project.

City	Response
Albany, NY	Some pull-outs have red treatment. Big ones are the queue jump lanes. One is a shared RT lane and the other is in the center of a complicated intersection.
Bloomington, MN	Buses will operate in bus-shoulder only lanes. Transit signal priority will be deployed in the corridor.
Brampton, ON	N/A
Cleveland, OH	Dedicated bus lanes are branded through most of the corridor but curbside service is used in University Circle where the right of way was not wide enough to accommodate bus only lanes.
Eugene, OR	BRT running ways are paved in concrete (rest of street in asphalt) and marked with a solid yellow line and signage.

Everett, WA	N/A. The BRT has approx 6.7 miles of BAT (Business Access & Transit) lanes. These are located along the curb lane, and require all vehicles except Transit to turn right. There is signage posted along the corridor, but no other treatments.
Kansas City, MO	"Bus Only" street markings and MAX street logos with curbside signage.
Los Angeles, CA	Separate right of way, not a part of the street right of way.
Oakland, CA	Stripes and rumble strip.
Phoenix, AZ	Both BRT lines utilize traffic signal priority treatments. The Arizona Avenue/Country Club LINK route also uses signal actuated queue jumpers at mile street intersections.
Pittsburgh, PA	No design techniques to differentiate the busways from streets are needed as all three busways are grade separated. Busway identity occurs primarily at stations.
Seattle, WA	Segments with bus lanes are clearly marked in pavement with HOV symbol, and signed at the curb, although does not reflect the specific RapidRide branding.
Brisbane, Australia	Red painted pavement at entry/exit points with extensive signage to make it clear that the running way is busway only. Busway logos used.
Sydney, Australia	Buses using the Liverpool to Parramatta T-way (LPT) had the T-way logo painted on the buses and red T-way logo patches were added to the road pavement at major road junctions. The T-way stop markers (blades) also carry the T-way logo.

Q 29: Please describe any unique or special integration of running way design elements and way-finding.

City	Response
Albany, NY	N/A
Bloomington, MN	N/A
Brampton, ON	N/A
Cleveland, OH	Rail traffic signals are used for the RTVs so as not to confuse drivers in cars.
Eugene, OR	N/A
Everett, WA	N/A
Kansas City, MO	N/A
Los Angeles, CA	The landscaping and signage help to integrate the right of way into the community while, at the same time, identifying it as the busway roadway.
Oakland, CA	N/A
Phoenix, AZ	Both LINK routes utilize real time bus information that is communicated by DMS, audio announcement and through a web address that is accessible by smart cell phone and personal computer. All LINK buses feature WiFi that allows riders to access email and work files while they are in transit on LINK.
Pittsburgh, PA	N/A
Seattle, WA	N/A
Brisbane, Australia	Standard traffic and directional signage, pavement marking and emergency management signage is used on the busway. Additional signage and barriers/fences are used at stations to deter pedestrians from crossing the running way.
Sydney, Australia	Nothing special.

C-6: Sustainable Materials and Practices

Q 30: Please describe any project elements that were designed for sustainable storm water practices.

City	Response
Albany, NY	N/A
Bloomington, MN	Stations and park and ride lots filter water before entering storm-water infrastructure.
Brampton, ON	N/A
Cleveland, OH	N/A
Eugene, OR	Busways have grass strip in the middle to reduce impervious surface. Springfield Station (built separately from EmX but design for EmX) has special stormwater treatment and ground-source heat humps.
Everett, WA	The station design was a bit unique in that the major structural beams of the station were used for water runoff. The top beam across the station is a 40 ft "I" beam, laid on its side to create an "H". The top of the beam becomes a perfect gutter for runoff. The water then flows down the vertical beams into the underground waste water system.
Kansas City, MO	Over 8,000 square feet of new rain gardens and an approx. 10,000 sf pervious concrete parking lot constructed.
Los Angeles, CA	Bioswales, erosion control landscaping, and other materials.
Oakland, CA	None.
Phoenix, AZ	Landscaping utilizes rainwater collected off the station shelter structures as well as treated wastewater.
Pittsburgh, PA	N/A
Seattle, WA	None.
Brisbane, Australia	Our climate can be water poor with long periods of drought. Rainwater tanks have been retrofitted to earlier stations and are now a standard feature of new stations. These tanks are used for station maintenance, garden watering, and toilet flushing, where required.
Sydney, Australia	Nothing special.

Q 31: Please describe any other energy conservation or sustainable design practices that were included in the project's design.

City	Response
Albany, NY	LED lighting in shelters, solar powered trash cans.
Bloomington, MN	Stations incorporate passive heating and cooling elements, native plantings, low-power lighting, and priority parking for hybrid vehicles.
Brampton, ON	N/A
Cleveland, OH	Hybrid vehicles were included in the design of the project.
Eugene, OR	Lighting is controlled by timer and photo cell so it is only on when needed and system in use. Drought-resistant landscaping using native plants was used.
Everett, WA	N/A
Kansas City, MO	All LED lighting used at stations, solar powered lighting used at local bus shelters along the route, solar powered bollards installed at 75th & Troost layover facility, IPE wood benches used extensively throughout the project.
Los Angeles, CA	Energy efficient traffic signal lighting, use of reclaimed water in selected areas and plumbing of all landscaping irrigation for future reclaimed water use, extensive drought-tolerant landscaping.

Oakland, CA	Solar parking covers, native and drought-tolerant landscaping.
Phoenix, AZ	Drought tolerant landscaping, energy conserving lighting.
Pittsburgh, PA	N/A
Seattle, WA	Some locations incorporate solar panels to provide shelter lighting were conventional hard-wired lighting is not feasible. Passenger initiated stop beacons are solar powered. The RapidRide stations are pre-fabricated from durable steel frames that will be used over and over again. Refurbished and repainted every eight years, the RapidRide shelter frames have an estimated life of 35 to 40 years. Green cleaning methods include pressure washing the shelters with water only, using no chemicals. Approximately 395 cubic yards of asphalt & cement concrete and 20 tons of steel from construction materials will be recycled. Green and renewable resources are expected to include reusable cement concrete forms, recycled cement concrete for base material, cement concrete using fly ash, and recycled steel for reinforcing steel bars.
Brisbane, Australia	Native plant species are used to minimize water usage. Stations are generally open air to reduce power required for air-conditioning, exhaust extraction and lighting. Low-power lights and electricity control systems are being used more and more to reduce energy consumption. Where escalators are used at stations, they go into standby mode when not in use. Since 2009, solar cells are installed on platform shelters to feed energy back into the electricity grid to offset mains electricity use.
Sydney, Australia	All landscaping consisted of drought tolerant Australian native species.

Q 32: Please describe any elements of the project constructed of recycled materials.

City	Response
Albany, NY	N/A, primarily because of cost differential.
Bloomington, MN	N/A
Brampton, ON	N/A
Cleveland, OH	N/A
Eugene, OR	N/A
Everett, WA	N/A
Kansas City, MO	Asphalt pavement used for overlay improvements along route; included 25% recycled asphalt.
Los Angeles, CA	We tried rubberized asphalt and had to replace it within months, because it could not stand up to bus traffic.
Oakland, CA	All pavement is recycled.
Phoenix, AZ	N/A
Pittsburgh, PA	N/A
Seattle, WA	See question 31.
Brisbane, Australia	All new materials because of life cycle requirements, robustness, and anti-vandalism. Sustainable environmental design has included water harvesting for station landscaping and cleaning, solar power for emergency backup and supply to electrical grid to offset period of peak power demand, waste management in the form of separate rubbish bin compartments. A high focus is put onto recycling of construction materials, spoil, and demolition waste. Some projects report more than 90% of construction related waste is recycled.
Sydney, Australia	None.

C-7: Incentives and Financing

Q 33: What were the methods used to fund the community-oriented aspects of the project? Were special financing tools used to support construction and infrastructure investments along the BRT corridor? Were any special funding programs used?

City	Response
Albany, NY	No special financing tools. Applied for many smaller grants and programs.
Bloomington, MN	No. Majority of the project costs were funded by traditional state and federal transit projects. However, some funds were accessed through a federal Urban Partnership Agreement (UPA) grant award to the region that enabled three stations to be constructed faster.
Brampton, ON	N/A
Cleveland, OH	No special financing was used for the BRT project proper, but additional funding was incorporated through private/foundation donations/grants.
Eugene, OR	The Gateway Corridor used state funding through a program called Connect Oregon for most of the required federal match. Connect Oregon is for non-roadway projects that assist in economic development. Gateway EmX was also the first project to secure an FTA Small Starts Project Construction Grant Agreement.
Everett, WA	All corridor jurisdictions are currently underway on modifying their zoning and land use codes to incentivize redevelopment and densification around BRT stations.
Kansas City, MO	N/A
Los Angeles, CA	N/A
Oakland, CA	None.
Phoenix, AZ	The LINK lines used a mix of local tax supported Public Transportation Funds (PTF), Federal Transit Administration 5307 capital grants, and American Recovery and Reinvestment Act (ARRA) funds.
Pittsburgh, PA	To date, no special methods have been employed for financing community-oriented elements on the busways. The City of Pittsburgh is currently undertaking a planning study for a Transit Revitalization Investment District (TRID) centered around the East Liberty Station of the East Busway. TRIDs are similar to TIFs, except revenues generated by the TRIDs can be used to fund local transit improvements.
Seattle, WA	None.
Brisbane, Australia	State or local governments fund all capital investments in community-oriented aspects of projects. Recurrent funding from state and local governments is also used for operations and maintenance of these facilities.
Sydney, Australia	All funding by stage government (New South Wales).

Q 34: Did your agency partner with the private sector to help build, fund, or maintain the community-oriented elements of the BRT project?

City	Response
Albany, NY	Partnership with the Central Avenue BID on public art and ongoing cleaning/maintenance.
Bloomington, MN	No.
Brampton, ON	N/A
Cleveland, OH	Yes, downtown streetscaping was enhanced by private sector donations. Sidewalk planters are maintained by private sector. Downtown BID maintains the cleanliness of the sidewalks and pedestrian areas that are outside of the station areas.
Eugene, OR	No.
Everett, WA	N/A

Kansas City, MO	We partnered with Rockhurst University to construct a BRT station integrated with a new school parking garage and retail facility.
Los Angeles, CA	N/A
Oakland, CA	No.
Phoenix, AZ	No.
Pittsburgh, PA	Port Authority, the City of Pittsburgh, and a private developer are partnering to develop near the East Liberty Station. The partnership primarily involves coordination among parties with Port Authority making land available for new development through reconfiguration of facilities at the East Liberty Station.
Seattle, WA	No.
Brisbane, Australia	No, not yet.
Sydney, Australia	Capital funding and maintenance funding by state government.

C-8: Zoning and Land Use

Q 35: Was there a change in zoning, land use designations, density restrictions, or parking management strategies along the BRT route prior to or during its construction/implementation? If so, please describe the changes and the reason(s) they were made.

City	Response
Albany, NY	Yes, changes to land use designations in plans, but no resulting development projects that have changed the landscape.
Bloomington, MN	No. However, cities have relaxed some of their signing requirements during construction so businesses can still attract patrons during construction.
Brampton, ON	Within the Central Area (includes the historic downtown and the area generally straddling the east-west Queen Street corridor between McLaughlin and Bramalea Roads) lands had already been designated for redevelopment in the City planning documents. The City has been active in seeking the transformation of the area and in particular the transformation of Queen Street into a pedestrian-oriented, transit-supportive, mixed-use district. Therefore much of the fundamental policy structure to allow for mixed-use, high-density development was already in place. As part of a multi-pronged approach, financial support tools through the implementation of a Community Improvement Plan are also available. Prior to BRT project, portions of the area were rezoned to eliminate non-desired uses (e.g auto-oriented type, highway commercial type land uses). A Community Improvement Plan was approved prior to the BRT project, which provided a Development Charges Incentives aimed in particular at providing assistance to support the transformation of the area. The Official Plan was also amended during the project timeframe, to adjust policies to the Provincial Growth Plan. Although a separate City-wide exercise, that was not triggered by the BRT project, it did designate a portion of the historic downtown and Queen Street Corridor as Brampton's "Urban Growth Centre". The "Urban Growth Centre" designation represents the location of the most significant intensification/transformation within the City with substantial density targets. Where development applications along the corridor were submitted, site-specific parking reductions were approved in the zoning by-laws. The current Official Plan policies allow for reduction to parking standards. Within the historic downtown an additional new City underground parking garage was opened. The City has also continued to extend its parking exemption program for development within the historic downtown. This exempts new commercial development from providing parking up to a certain floor area.
Cleveland, OH	Yes, the midtown area changed its zoning to require transit orientation, retail on ground level, building front on sidewalk, multiple story structures, etc. to enhance the urban fabric of new construction in this area. The City of Cleveland enhanced its design review criteria and review process for neighborhoods along the BRT corridor.

Eugene, OR	The Mixed-Use Centers, which were planned in conjunction with the BRT planning, included land use designations for higher density and mixed uses.
Everett, WA	No.
Kansas City, MO	No.
Los Angeles, CA	N/A
Oakland, CA	Yes. TOD plan.
Phoenix, AZ	No changes in zoning, land use designation, or density restrictions occurred prior to or during construction of the two projects.
Pittsburgh, PA	I am not aware of any such changes in the three busway corridors.
Seattle, WA	No.
Brisbane, Australia	Yes. The proposed busway corridors have sparked local government changes to neighborhood plans including zoning changes, density increases, and reduced parking allocations in new developments. These changes are intended to support the investments in busways and to manage congestion on the overall transport network. Densities have generally been increased and re-development has occurred prior to, during, and after construction. Initially local government politicians and agencies were reluctant to lead changes in amending mix-use zoning and land uses. However, subsequent to the unprecedented success of the first busway corridors with significant increases in bus patronage and the acceptance by the community of the busway infrastructure and stations, changes were made to the city plan. In particular neighborhood plans now allow increased diversity and density of land uses adjacent to BRT stations and infrastructure. Parking management strategies had to be enforced to reduce the impact of park 'n' riders on the local community.
Sydney, Australia	Part of the LPT corridor was zoned for dedicated public transport in the 1970s. Some private land (residential and industrial) was purchased and rezoned for public road. The T-ways are a permissible use on land zoned public road.

Q 36: Was there a change in zoning, land use designations, density restrictions, or parking management strategies along the BRT route after its construction/implementation? If so, please describe the changes and the reason(s) they were made.

City	Response
Albany, NY	We continue to work on zoning and development proposals as opportunities arise.
Bloomington, MN	Construction will be completed in fall of 2012. Cities are planning to make some changes in zoning, land use and development after construction.
Brampton, ON	The City is continuing to actively work on initiatives to support the transformation of the Central Area, in particular the Queen Street corridor. The BRT is planned for expansion. The current land use policies already align with these transportation goals. However, to ensure an appropriate and supportive urban form is created, the City is working on detailed "Precinct Plans" for specific locations within the Central Area. A "Precinct Plan" provides a vision for how the area will unfold. It works as a "feedback mechanism" which allows adjustment to the Official Plan to be made (land use policy, urban design policy, transportation network policy) to support the vision. It can then also be used to guide development applications so that they can fit into an overall framework. The City is also looking at use of different tools under the Community Improvement Plan to support redevelopment from a financial standpoint. The City may "prezone" areas if it deems it would facilitate redevelopment.
Cleveland, OH	Zoning exemptions for lesser parking than required by code is approved on a case-by-case basis by City of Cleveland due to public transit access.
Eugene, OR	No.
Everett, WA	Underway by multiple jurisdictions.

Kansas City, MO	No changes in development regulations were required. New "No Parking" areas were designated at BRT station locations. BUS ONLY lanes required changes to no parking in the AM and PM peak hours.
Los Angeles, CA	Since the Orange Line has begun operations, we have received numerous expressions of interest for opportunities to develop Metro-owned station area properties along the route. The facility has also spurred private property development. However, no intentional change of zoning or general or specific plans have been implemented by Metro or the city (as far as I know).
Oakland, CA	N/A
Phoenix, AZ	No.
Pittsburgh, PA	I am not aware of any such changes in the three busway corridors.
Seattle, WA	No.
Brisbane, Australia	Yes. Initially with the first busway the politicians and local community were generally against increased densities and didn't understand the benefits that the busway could bring. Since then the concept has been well proven as a valued community asset. Since then densities have been increased and developers are keen to capitalize on the level of convenience that a busway station brings to residents. Property values close to busway stations have also increased at a faster rate and it is often a major selling point if a property is close to a busway station. Due to the success of the busways, additional parking restrictions have been put in place to further reduce the impacts on surrounding local neighborhoods. The distance people were prepared to walk from their car to use a busway station was possibly also underestimated by the local council.
Sydney, Australia	Over time, adjacent land use densities have increased – single dwelling properties are transitioning to medium density. This is a general trend in metropolitan Sydney. However, the proximity to reliable public transport is a contributing factor.

C-9: Maintenance Considerations

Q 37: Is the transit agency responsible for maintaining all elements of the BRT project, or are certain amenities or infrastructure at stations or along the alignment maintained by another entity. If so, please describe, noting any maintenance problems or issues that your agency has encountered.

City	Response
Albany, NY	Higher quality service demands a higher level of maintenance, which is expensive. Within the Central BID boundaries, their "Clean Team" (http://www.centralbid.com/) does everything from vacuuming up cigarette butts to maintaining street banners and hanging baskets. CDTA also plans to pilot an "Adopt a Shelter" program in this corridor.
Bloomington, MN	The county will maintain the running way. The cities are in charge of the trails. The transit operator is in charge of station maintenance.
Brampton, ON	Station stops, buses, terminals, and bus flags are the responsibility of the transit agency. On-road infrastructure is the responsibility of the local road authority.
Cleveland, OH	The city of Cleveland maintains the sidewalks, roadways, and trees. GCRTA maintains the stations and median waiting environments. No special issues have been encountered. Selling naming rights to our system allowed for a fund to be created to pay for the landscaping needs of the corridor that is borne by GCRTA (station-area planters).
Eugene, OR	There is some shared maintenance responsibility with the cities for maintenance of landscaping and running ways.
Everett, WA	Community Transit maintains most aspects of the BRT project. We do not have jurisdiction on the roadways themselves, and the Transit Signal Priority (TSP) is maintained by the City of Lynnwood.
Kansas City, MO	The ATA is responsible for maintaining all the BRT improvements except the new rain gardens. They will be maintained by the City's Water Services Department. The trail improvements made at the south end of the route will be maintained by the City's Parks & Recreation Dept.

Los Angeles, CA	The parallel, adjacent bike path is maintained by the City of Los Angeles, while all other components of the BRT are maintained by Metro. A fence separates the two facilities, helping to minimize confusion as to areas of responsibility. However, small strips of unimproved City-owned street right of way had to be landscaped as well, and those areas tend to be overlooked by City maintenance crews. Interestingly, the project is so thoroughly landscaped that areas of wider right of way quickly became overgrown and were a safety concern for users of the bike path, both because of encroaching plants and because of the potential for shelter for homeless persons.
Oakland, CA	Yes. None.
Phoenix, AZ	Responsibility of station maintenance is vested with the host cities. Responsibility for maintenance of the LINK vehicles, the fare vending machines, and the DMS is vested with Valley Metro/RPTA. Responsibilities are delineated through Intergovernmental Agreements (IGA).
Pittsburgh, PA	Port Authority is responsible for maintaining all three busways and its associated stations and landscaping on its property. The key issue is a sufficient number of employees during a time of severe budget constraints.
Seattle, WA	All elements of the BRT program are maintained by King County Metro Transit.
Brisbane, Australia	The Queensland Department of Transport and Main Roads (TMR) maintains the majority of the busway, including structural elements of the corridor and fittings/fixtures at the stations. The TransLink Transit Authority (TTA) is the operator of the busway and is responsible for service contracts related to cleaning of the stations including amenities and maintenance of the landscaping at stations. A simple analogy is like rent-free tenant/landlord relationship. The busway's cleaning and maintenance regime is quite rigorous to ensure the customer experience is positive. Community-oriented assets adjacent to busway are generally maintained by the original funding agency.
Sydney, Australia	One authority is responsible for maintenance and security within the corridor. Grass cutting is the most intensive activity. Security and operating costs of an underground station/interchange is one of the highest cost components of the maintenance budget.

Q 38: Please describe any design strategies used to reduce graffiti/ vandalism or the need for maintenance.

City	Response
Albany, NY	The biggest is getting some pride of ownership through the neighborhood naming scheme, the incorporation of public art, and the use of video surveillance and partnerships with law enforcement. We also used graffiti-resistant paint, and vandal resistant design of IT components in shelters themselves, designed seating so that laying down is not an option, and posted rules signs.
Bloomington, MN	Security cameras have been installed at transit stations.
Brampton, ON	Highly visible locations with enhanced lighting and security cameras help deter vandalism, but beyond this there were no specific design strategies.
Cleveland, OH	Design of station was specifically crafted to reduce ability of people to get onto the roof of the station. Use of glass inhibited vandalism as did a higher degree of illumination of the stations A higher transit police presence and cameras were installed to increase security.
Eugene, OR	The stations have few vertical surfaces (no windscreens) that would provide a canvas for graffiti. Canopies and lighting were designed to be inaccessible to vandals. Crime Prevention Through Environmental Design (CPTED) principles were used which provide for more visibility of the station area, which discourages vandalism. Also, the inclusion of nice design features and public art have been shown to reduce graffiti and vandalism.
Everett, WA	During the design phase of the actual station structural components, our maintenance crew was invited by the manufacturer to "test" various materials to minimize vandalism or facilitate repair. Further, the windscreens were redesigned to incorporate smaller panes of glass that are easy to replace rather than an initial desire for larger open spaces (that may have become an inviting "canvas" for someone).

Kansas City, MO	Currently looking at transparent graffiti film applications for shelter panels. These are thin removable sheets that can be peeled away if marked with graffiti.
Los Angeles, CA	All station surfaces are constructed of materials intended to minimize the potential for vandalism and to allow for efficient cleaning and maintenance. The sound walls are landscaped with vines to discourage graffiti and have an anti-graffiti coating on them to facilitate cleaning while the vines grew.
Oakland, CA	N/A
Phoenix, AZ	Use of materials that are resistant to graffiti/vandalism. CCTV surveillance. Use of regular maintenance and prompt remediation of any observed damage to stations and vehicles.
Pittsburgh, PA	The East Busway stations have special coatings along the walls to reduce graffiti.
Seattle, WA	Shelter glass is designed to deter graffiti through the inclusion of a specific design pattern into the shelter glass. Shelters are designed to be removable for off-site refurbishment and repainting if needed.
Brisbane, Australia	Glass is used at the stations to allow high levels of passive surveillance and for ease of maintenance. Sacrificial film is also used over the glass in high vandalism sites to reduce maintenance costs of replacing glass panels. The busway stations have extensive CCTV coverage and warning signs of offenses and fines to deter vandalism. If graffiti occurs, it is dealt with in 3 key ways: 1) photographed, recorded, and reported; 2) immediate removal – within 12 hrs of identification; 3) the design of surfaces which can be painted easily
Sydney, Australia	Graffiti removal patrols are used on a contract basis. Initially, glass replacement was an issue (strengthened panels were imported from Italy). However, glass breakage (through vandalism) has declined.

C-10: Obstacles

Q 39: Were there any obstacles or barriers (financial, organizational, political, or otherwise) that your agency encountered in regard to the community-oriented aspects of the BRT project?

City	Response
Albany, NY	Insufficient funding to do everything people wanted; ongoing issues with local municipalities on sidewalk snow clearing responsibilities.
Bloomington, MN	Yes. Getting communities to see the BRT as a catalyst for developing in a more compact, human scale environment.
Brampton, ON	N/A
Cleveland, OH	Some elements of the project were eliminated due to financial constraints. Additional artwork, landscaping, and other elements were reduced to maintain the budget.
Eugene, OR	The added cost for those elements was an obstacle. With more funding, there would likely have been more pedestrian amenities in the vicinity of stations, as well as other design enhancements.
Everett, WA	No.
Kansas City, MO	Not really any obstacles but certainly a lot of opinions as to what the community-oriented aspects should include. In the end the decisions were nearly unanimous.
Los Angeles, CA	Our initial vision of the greenway aspect of the BRT was to implement a self-sustaining drought tolerant landscape scheme, with a temporary 2-year irrigation system and no irrigation along the right of way between the stations after the two year establishment period. Inasmuch as this alignment traverses a suburban environment, many community members were concerned with the perceived image of "dead" plants during the hot summer months, which would contrast dramatically with residential yards.
Oakland, CA	Political opposition in Berkeley.
Phoenix, AZ	Challenges associated with doing a capital project that involved three different municipalities with different priorities and different organizational structures.

Pittsburgh, PA	The major obstacle encountered for the East Busway Extension was substantial opposition by Edgewood Borough to the extension. Consequently, the station proposed for Edgewood was eliminated. Focusing specifically on community-oriented aspects, planning has just begun in recent years. The biggest barrier is financial, which has not been overcome.
Seattle, WA	N/A
Brisbane, Australia	Yes, all of the above, plus the demands of community/action/user/lobby groups, and other challenges and obstacles generally in the area of personal property impacts, access, noise, and air quality. Bipartisan support was sought by the TMR for the planning and design of the BRT network from all levels of government. BRT was promoted as a "smart" road.
Sydney, Australia	No.

Q 40: How were these barriers addressed or overcome?

City	Response
Albany, NY	These are ongoing concerns.
Bloomington, MN	Through education, research, and community visioning.
Brampton, ON	N/A
Cleveland, OH	In some cases, private owners added additional amenities to their own projects to supplement this loss. In other cases, the eliminations were so minor, they were not missed.
Eugene, OR	We did what we could within the project budget. Also, looked for assistance from the cities on some elements (such as the lighting of the Rosa Parks ped/bike path).
Everett, WA	N/A. It helps to have a strong project champion.
Kansas City, MO	Many meetings and group discussions were held to work out the best solutions.
Los Angeles, CA	The project was redesigned to include permanent irrigation (piped for future reclaimed water, when it becomes available), and where appropriate, landscape plants that could tolerate more water.
Oakland, CA	No BRT in Berkeley.
Phoenix, AZ	Project team included municipal representatives that allowed us to identify any issues early on and deal with them. What was critical was maintaining good lines of communication throughout the process with all agency stakeholders.
Pittsburgh, PA	Port Authority built the extension along the railroad right-of-way through the borough.
Seattle, WA	N/A
Brisbane, Australia	Close and constant representation was made to Federal, State and Local government representative in the electorates impacted by the BRT network. Formal meeting were held with the premier of the state and local lord mayors. Memorandums of understanding have been used to recognize the working relationship of government departments and with large private companies such as shopping centre owners. Early and continuous consultation with stakeholders to clarify expectations, constraints, risks, and assumptions was also a major contributor to overcoming/addressing barriers. Community communication officers accompanied by technical officers held regular formal and informal meetings with stakeholders. Open and transparent presentations were conducted during the design and construction process. A concept design and impact management plan was prepared and was formally gazetted by the state government. Follow-up meetings were undertaken if post construction works were formally agreed upon with property owners.
Sydney, Australia	N/A

C-11: Impacts

Q 41: Are the project's community-oriented goals being tracked or benchmarked? How does your agency measure success? Are specific qualitative or quantitative metrics used?

City	Response
Albany, NY	Project as a whole is being closely monitored, with primary benchmarks being ridership and productivity (riders/revenue hour). We are also closely monitoring comments that come in regarding the service and its operations.
Bloomington, MN	Yes. We are tracking neighborhood perceptions of BRT service before implementation and will be tracking afterwards.
Brampton, ON	N/A
Cleveland, OH	N/A
Eugene, OR	Not tracked.
Everett, WA	No.
Kansas City, MO	Not currently, but tracking and benchmarking techniques are being evaluated.
Los Angeles, CA	We track ridership numbers, origin/destination, etc.
Oakland, CA	N/A
Phoenix, AZ	N/A
Pittsburgh, PA	N/A
Seattle, WA	Community Impacts • Supports pedestrian activity? Number of pedestrian improvements in corridor from the Transit Route Facilities Records. • Encourages partnerships between Metro and local businesses? Pass sales and employer programs at Commute Trip Reduction (CTR) employers from CTR records, surveys. • Encourages partnerships between Metro and local jurisdictions? TDM program participation levels, website hits, requests for information; Vanpool/vanshare participation in corridors from TDM program evaluations, rideshare records. • Encourages private investment and development along corridors? New development along corridors from Rate of Investment; King Co Growth Report, Local Growth Reports.
Brisbane, Australia	Bus patronage and service reliability is generally the measure of success. A yearly survey of passengers is also undertaken to understand customer satisfaction and this includes facilities.
Sydney, Australia	Main measure is increase in ridership.

Q 42: Has your agency conducted any studies or rider surveys that examine the impacts of the community-oriented aspects of the project? If so, could you please summarize the results or share the report?

City	Response
Albany, NY	We do general customer satisfaction surveys, and will be conducting one specifically on this corridor later this year and would be happy to share the results.
Bloomington, MN	N/A
Brampton, ON	N/A
Cleveland, OH	N/A
Eugene, OR	No.
Everett, WA	Customer surveys will be conducted in October 2011.
Kansas City, MO	Rider surveys are conducted regularly, but none to date specifically related to community-oriented aspects of BRT.

Los Angeles, CA	N/A
Oakland, CA	N/A
Phoenix, AZ	While we are currently conducting an origins and destinations survey of our entire rail and bus system, it does not include questions regarding the community-oriented aspects of the project. A separate regional effort is currently underway that is bringing together local and regional stakeholders to discuss sustainable community design and the tools that can be utilized in furthering that effort.
Pittsburgh, PA	N/A
Seattle, WA	None at this time.
Brisbane, Australia	No.
Sydney, Australia	N/A

C-12: Additional Information

Q 43: Do you have any other comments, observations, or insight that would benefit other transit agencies that are considering the implementation of community-oriented BRT?

City	Response
Albany, NY	Pursue every opportunity for partnerships. They may not have immediate payoff, but they do help in the long run. We have been gratified by the support of the business community, and the partnership with the BID, in particular, is a strong and vital one, including us now having a seat on their Board.
Bloomington, MN	Identify champions early at a corridor level and station level. Identify a champion from the public, private and non-profit sector. Get cities to envision the benefits of BRT during planning and create concrete plans to maximize those benefits sooner than later. Have the business community on your side on day one.
Brampton, ON	N/A
Cleveland, OH	We are very pleased with the success of this project both in terms of increased riders and in economic development along the corridor that has been spurred by our investment. We host visitors from around the world who are interested in seeing our BRT project and how it's possible to make BRT work in the United States (and disprove that it's not possible in the US to get people out of their cars to ride a "bus"). We are very pleased that the holistic approach to our project, which considered not just travel times, but also the latest technology and pedestrian comfort and amenities, really worked to create a cohesive fabric along the corridor which looks and feels like you have arrive somewhere special, somewhere that is worth taking a minute to check out and explore.
Eugene, OR	Often, it is these types of "extra" benefits and enhancements that can help sell a BRT project in a community. It makes the project attractive for those who may not place great value on the transit improvements.
Everett, WA	No.
Kansas City, MO	Success of the ATA's efforts is directly tied to close coordination and communication with the community and all stakeholders.
Los Angeles, CA	N/A
Oakland, CA	N/A
Phoenix, AZ	It is important that local land use and community development staffs be included in the planning and development of the BRT project. They can help identify existing and planned activity centers that need to be addressed through station location and design. They can also help educate local elected officials on the need to incorporate transit oriented development tools in the corridor planning process to insure that development types and intensities will complement the BRT investment.
Pittsburgh, PA	N/A
Seattle, WA	None.

Brisbane, Australia	Brisbane's Busway carries more than 2.27 million passenger trips per week on 24.6km of busway. It has proven to be a successful system and wise investment choice for the Queensland Government. However, that doesn't mean it will work as well elsewhere. Other transit agencies considering a community-oriented BRT system must focus on the system's appeal to your customers. Unless the system is safe, clean, easily accessible, serviced frequently, and connected to a broader integrated transport network, it will be an expensive investment that fails to reach its full potential.
Sydney, Australia	N/A

APPENDIX

D

Supplementary Photographs

Figure D-1

Boggo Road Cycleway Cycle Center, Brisbane

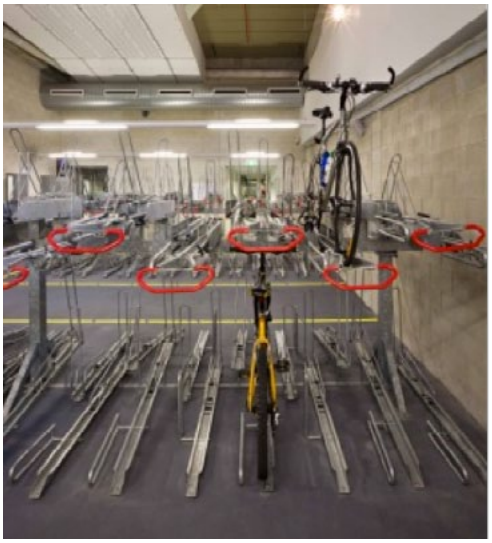


Figure D-2

King George Square Cycle Center, Brisbane

Figure D-3

Royal Brisbane and Women's Hospital Cycle Center, Brisbane

Figure D-4

BusPlus station design, Capital District Transportation Authority (CDTA), Albany, NY

Figure D-5

Apple Valley BRT Station, serving Cedar Avenue Transitway, Apple Valley, MN

Figure D-6

Züm BRT Station, Brampton, ON

Figure D-7

Future Kedron Station (under construction), Brisbane

Figure D-8

SWIFT BRT station design, Everett, WA

Figure D-9

King George Square Station, Brisbane

Figure D-10

King George Square Station concourse, Brisbane

Figure D-11

King George Square Station platform, Brisbane

Figure D-12

Royal Brisbane and Women's Hospital Station, Brisbane

REFERENCES

1. Project for Public Spaces, Inc. 1997. *TCRP Report 22: The Role of Transit in Creating Livable Metropolitan Communities*. Washington, DC: Transportation Research Board of the National Academies.
2. Baker, Christopher. 2010. Testing the benefits of on-street and off-street rapid transit alignments: implications for Winnipeg's Southwest Rapid Transit Corridor. Practicum submitted in partial fulfillment of the requirements for the Degree of Master of City Planning. Winnipeg: University of Manitoba.
3. Project for Public Spaces, Inc. What is placemaking? http://www.pps.org/reference/what_is_placemaking/, accessed August 21, 2011.
4. Montgomery County Planning Department. 2009. Planning terms glossary. Maryland-National Capital Park and Planning Commission.
5. Capital District Transportation Committee, Capital District Transportation Authority. NY5 corridor land use & transportation study. http://cdtcmpo.org/ny5/2back_frame.html, accessed at May 16th, 2011.
6. Bent, Elizabeth M., Rachel Hiatt, and Krute Singa. 2008. Full-featured bus rapid transit in San Francisco, California: Toward a comprehensive planning approach and evaluation framework. *Transportation Research Record* 2072(1): 89-100.
7. Lusher, Lindsey, and Mark Seaman. 2008. Streets to live by: How liveable street design can bring economic, health and quality-of-life benefits to New York City. New York: Transportation Alternatives.
8. Cervero, Robert, Christopher Ferrell, and Steven Murphy. 2002. Transit-oriented development and joint development in the United States: A literature review. *TCRP Research Results Digest*. 52.
9. Ryan, Sherry, and Lawrence F. Frank. 2009. Pedestrian environments and transit ridership. Journal of Public Transportation 12(1): 39-57.
10. Bernick, Michael, and Robert Cervero. 1997. Transit Villages of the 21st Century. New York: McGraw-Hill.
11. Guo, Zhan, and Joseph Ferreira. 2008. Pedestrian environments, transit path choice, and transfer penalties: Understanding land-use impacts on transit travel. Environment and Planning B: Planning and Design 35(3): 461-79.
12. Kroll, Joern. 2007. Advancing public transport through ITS and urban design: Essential design principles for BRT. San Francisco Municipal Transportation Agency.
13. Yavuz, Nilay, Eric W. Welch, and P. S. Sriraj. 2007. Individual and neighborhood determinants of perceptions of bus and train safety in Chicago, Illinois: Application of hierarchical linear modeling. *Transportation Research Record* 2034(1): 19-26.
14. Litman, Todd. 2007. Build for comfort, not just speed: Valuing service quality impacts in transport planning. Victoria Transport Policy Institute.
15. Wright, Lloyd. 2009. Latin American busways: Moving people rather than cars. Natural Resources Forum 25(2): 121-34.

16. Calthorpe, Peter. 1993. The Next American Metropolis: Ecology, Community, and the American Dream. Princeton: Princeton Architectural Press.
17. Demerath, Loren, and David Levinger. 2003. The social qualities of being on foot: a theoretical analysis of pedestrian activity, community, and culture. *City and Community* 2(3): 217-37.
18. Leyden, Kevin. 2003. Social capital and the built environment: The importance of walkable neighborhoods. *American Journal of Public Health* 93(9): 1546-51.
19. Frank, Lawrence. 2006. Many pathways from land use to health. *Journal of the American Planning Association* 72(1): 75-87.
20. New York City Department of Transportation. 2007. PlaNYC: A Greener, Greater New York. New York: City of New York.
21. Handy, Susan, Xinyu Cao, and Patricia Mokhtarian. 2006. Self-selection in the relationship between the built environment and walking. *Journal of the American Planning Association* 72(1): 55-74.
22. Diaz, Roderick B. (ed.), and Dennis Hinebaugh. 2009. *Characteristics of Bus Rapid Transit for Decision-Making*. Washington, DC: Federal Transit Administration, U.S. Department of Transportation.
23. Davies, Stephen. 1999. How transportation and community partnerships are shaping America. New York: Project for Public Spaces.
24. U.S. Department of Transportation, Federal Transit Administration, FTA News Release Archives. Last modified 2010. http://www.fta.dot.gov/printer_friendly/12288_11036.html.
25. Los Angeles County Metropolitan Transportation Authority. 2002. Final environmental impact report for the San Fernando Valley East-West Transit Corridor.
26. National Bus Rapid Transit Institute. 2011. Metro Orange Line BRT project evaluation. Washington, DC: Federal Transit Administration, U.S. Department of Transportation.
27. Los Angeles County Metropolitan Transportation Authority. 2009. Final environmental impact report for the Canoga Transportation Corridor.
28. Cavanaugh, Kerry. 2005. Looking back in time: Pre-urban era gardens planted along busway. *The Daily News of Los Angeles*, October 26.
29. Cummins Westport, Inc. (CWI). 2004. Cummins Westport launches L Gas Plus engine at WasteExpo. *Business Wire*, May 17.
30. California Department of Toxic Substances Control. 2006. MTA Orange Line Busway success story. April, http://www.dtsc.ca.gov/SiteCleanup/Brownfields/upload/MTA.pdf.
31. Forsyth, Ann, Justin Jacobson, and Katie Thering. 2008. *Moving Design: Spaces of Transportation*. Washington, DC: The American Institute of Architects.

32. Los Angeles County Metropolitan Transportation Authority Metro to repave portions of Metro Orange Line Transitway beginning Monday, Oct. 6. News release, October 1.
33. Doyle, Sue. 2006. Busway woes seemingly run deep. *The Daily News of Los Angeles*, December 22.
34. Personal correspondence with Hitesh Patel, Director of Construction Management, Los Angeles County Metropolitan Transportation Authority; Kathleen Sanchez, Public-Private Partnership Program Manager, Los Angeles County Metropolitan Transportation Authority; and Elaine Carbrey, Associate Partner, Gruen Associates, July 2011.
35. National Bus Rapid Transit Institute. 2009. The EmX Franklin Corridor BRT project evaluation. Washington, DC: Federal Transit Administration, U.S. Department of Transportation.
36. Personal correspondence with Graham Carey, former BRT Project Engineer, Lane Transit District, July 2011.
37. Lane Transit District. EmX frequently asked questions. http://www.ltd.org/search/showresult.html?versionthread=4017071cab003ebfa01c57c65304a91f, accessed November 8, 2011.
38. Personal correspondence with Stefano Viggiano, former Assistant General Manager and Planning and Development Manager, Lane Transit District, July 2011.
39. Chandler, Kevin, and Kevin Walkowickz. 2006. King County Metro Transit Hybrid Articulated Buses: Final evaluation results. National Renewable Energy Laboratory.
40. Greater Cleveland Regional Transit Authority. RTA HealthLine. http://www.rtahealthline.com/healthline-what-is.asp, accessed October 18, 2011.
41. Urban Land Institute gives RTA award for HealthLine project. *RTA News*, May 24, 2011, http://www.riderta.com/newsroom/releases/?listingid=1589.
42. International Downtown Association. Euclid Avenue Corridor bus rapid transit: Rebirth of a grand avenue. https://www.ida- downtown.org/eweb/docs/2010 Awards Docs/Transportation/Sasaki Associates, Euclid Avenue BRT Corridor.pdf, accessed November 8, 2011.
43. Institute for Sustainable Communities. 2012. The Cleveland HealthLine: Transforming an historic corridor. Sustainable Communities Leadership Academy.
44. Personal correspondence with Joseph Calabrese, General Manager, Greater Cleveland Regional Transit Authority, August 2012.
45. Litt, Steven. 2008. Euclid Corridor Health Line is a strong RX for Cleveland's once and future Main Street. The Cleveland Plain Dealer, November 9.
46. Personal correspondence with Maribeth Feke, Director of Planning, Greater Cleveland Regional Transit Authority, July 2011

U.S. Department of Transportation

Federal Transit Administration

U.S. Department of Transportation
Federal Transit Administration
East Building
1200 New Jersey Avenue, SE
Washington, DC 20590
http://www.fta.dot.gov/research