Bellevue Light Rail Best Practices Public Involvement Report

June 17, 2008

Introduction

The Light Rail Best Practices (LRBP) public involvement effort had the following objectives[1]:

1. Foster involvement by a broad spectrum of the community;
2. Convey information that is objective and understandable to encourage an informed public dialogue about the best practices for light rail implementation in Bellevue;
3. Engage stakeholders in direct dialogue about their concerns regarding potential impacts, possible opportunities and benefits resulting from light rail service, and ideas for achieving the best system for Bellevue;
4. Provide information and opportunities that offer meaningful experiences for participants;
5. Ensure a transparent process that demonstrates how the public is being involved and how their input is being applied; and
6. Establish a framework for response to the Draft EIS that does not pre-analyze or pre-determine alignment alternatives.

This report describes the steps taken to achieve these objectives, including the LRBP project web site; Committee meetings; open house public meetings; newsletters and advertising; local media coverage; and consideration of public comment (oral and written). The Light Rail Best Practices public involvement effort was developed and executed by city staff and the project consultants, David Evans and Associates and Norton-Arnold & Company.

Light Rail Best Practices

As Sound Transit considers the options for extending light rail to the Eastside through Bellevue, the Mayor and City Council wanted Bellevue to learn from the "best practices" of other communities with light rail systems. They also wanted the City to be in a position to influence decisions that will be made by the Sound Transit Board regarding the location, design, and operation of light rail in Bellevue. The goal for the Best Practices Project was "finding the right fit for Bellevue."

Essential to the Best Practices Project was providing a range of opportunities for public involvement. The project was initiated by Council largely in response to community comment and concern about light rail. The project included regular opportunity for public input, review, and feedback to the Committee. The project also sought to increase community understanding of light rail. This report describes the techniques used to engage and inform Bellevue residents and other stakeholders throughout the Light Rail Best Practices Project.

Light Rail Best Practices Committee Charge

The Council-appointed Light Rail Best Practices Committee is composed of two members each from the Environmental Services Commission, Parks and Community Services Board, Planning Commission and Transportation Commission in addition to a liaison and alternate from City Council. The Committee worked with city staff and a consultant team on the following charge:

1. Provide direction to and review of the staff and consultant work on the Best Practices technical study;

[1] From Light Rail Best Practices Public Outreach Plan 10/10/2007

2. Engage the public in a dialogue that provides information about how other jurisdictions have implemented light rail and how to apply those lessons to Bellevue;
3. Create a "catalog" of best practices and outcomes from other jurisdictions that the Committee identifies as desirable for light rail implementation in Bellevue; and
4. Based on "lessons learned," develop guiding principles and policy recommendations, including draft Comprehensive Plan amendments, for consideration by the City Council.

The draft policies generated by the Light Rail Best Practices project are expected to address a range of issues about light rail design, construction, operation and mitigation, in order to maximize local opportunities and minimize local impacts. The Committee will not draw any conclusions about specific light rail routing or station locations, but its recommendations will ultimately assist the community and City Council in evaluating and determining Bellevue's light rail routing preferences.

Early Phase Comments and Topic Area Development

The Light Rail Best Practices project was initiated by Council largely in response to community comment and concern about light rail during Sound Transit's initial 2006 – 2007 environmental scoping process. Comments to Sound Transit, oral and written comments to Bellevue City Council, and the best practices project initial open house became the framework for the project's research. These comments were analyzed and organized into the eight topics used throughout the process: Community and Neighborhoods; Connecting People to Light Rail; Land Use; Street Design and Operations; Elevated, At-Grade, and Tunnel; Property Values; Station Security; and Construction Impacts and Mitigation.

A final topic, Community Involvement, was later added by the Committee for the Final Report. The Community Involvement topic reviews the public involvement practices of other transit agencies, and emphasizes the importance of engaging the public in the various stages of a light rail project.

Web Site

The city utilized a project web site (www.cityofbellevue.org/light_rail_best_practices_info.htm) that included a project overview; a schedule of committee meetings; meeting agenda packets and minutes; staff contact information; updated project documents and reports; frequently asked questions; and a link to the Sound Transit East Link website. Interested persons were included on the project mailing list and received e-mail alerts when new project information was posted. The project web site was also accessible from the City of Bellevue home page.

Committee Meetings

The Light Rail Best Practices Committee convened a total of 14 meetings between July 2007 and June 2008.[2] A schedule of the Light Rail Best Practices meetings was available on the project web page. Meetings were also announced in city publications, and noticed by e-mail to the project mailing list. Meeting agenda packets and presentation materials were available to the public on the project web page, and print copies were available at Bellevue City Hall. Hand-outs available for the public at each meeting included meeting materials, a "Frequently-Asked-Questions" handout, and a project brochure. An opportunity for the public to address the Best Practices Committee was provided at each meeting. An ad hoc committee of residents from the Surrey Downs neighborhood attended Best Practices meetings, and regularly provided the Committee with feedback on the project. This included oral comment, letters and a binder of information on other light rail systems that the Surrey Downs residents compiled and submitted.

[2] For all of the Committee tours, including the Central Link project, the potential East Link alignments, and the case study city tours to San Diego, San Jose and Portland, itineraries and notes of the tours were made available to the public.

Open House/Workshop Public Events

Four public events were held at key points in the project. The city publicized the events in a number of ways including: sending flyers via mail to the Best Practices, Downtown Projects and Bel-Red Corridor interested parties lists; distributing flyers to 12 City of Bellevue facilities (e.g. neighborhood, community and senior centers); sending approximately 800 e-mails to the interested parties lists from the above mentioned projects as well as the Bellevue neighborhood leaders and Bellevue residents who signed in at the Sound Transit workshops on East Link; printing an advertisement in the Bellevue Reporter which is distributed to approximately 43,000 households and businesses in Bellevue; posting information about the open house on the city website; and publishing an article in the Neighborhood News newsletter distributed electronically to community and neighborhood associations throughout the city. Hand-outs available at each event included meeting information and materials specific to that stage of the project; "Frequently-Asked-Questions;" a pre-addressed, postage-paid comment form; and a project brochure.

September 13, 2007 - Scoping of the topic areas. This open house was attended by approximately 100 people and generated over 140 comments. Some additional comments were received via e-mail and USPS using the postage-paid comment forms. A summary of the event and comments received was made available to the Committee and the public.

November 14, 2007 – Public open house/round table discussions focused on draft research findings on the first four topics: Community and Neighborhoods; Connecting People to Light Rail; Property Values; and Station Security. Attendees were invited to drop by the open house displays and also participate in small group discussions facilitated on each of the four topics. This event was attended by more than 30 people. A summary of the event and a transcript of the roundtable discussions were made available to the Committee and the public.

January 9, 2008 - Public open house/round table discussions focused on draft research findings on the remaining four topics: Land Use; Street Design and Operations; Elevated, At-grade and Tunnel; and Construction Impacts and Mitigation. The event included both open house displays and round table discussions. This event was attended by more than 30 people. A summary of the event and a summary of the roundtable discussions were made available to the Committee and the public.

May 15, 2008 - Public event focused on draft report release. The "Spring Forward Expo" showcased a number of city projects and was attended by approximately 200 people, with about 25 of those stopping by the Light Rail Best Practices display and providing comment. A summary of comments was made available to the Committee and the public.

Newsletters, Advertising and Local Media

Project newsletters for upcoming events were sent to the project mailing list and distributed at City of Bellevue facilities (e.g. neighborhood, community and senior centers). The Project also initiated articles or advertisements in the quarterly publication *It's Your City*, the publication *Bellevue Reporter* and the electronic newsletter *Neighborhood News* to inform the larger community on public events and opportunities for public comment. The 1/9/2008 Light Rail Best Practices Open House & Round Table Discussion was covered on the Channel 13 evening news.

Council, Community Groups, Boards and Commissions

Staff provided five Council updates on the progress of Light Rail Best Practices. Staff also provided briefings to the following groups: each of the four boards and commissions represented on the Committee; Bellevue Arts Commission; Bellevue Network on Aging; Bellevue Downtown Association (BDA); and BDA/Chamber Joint Transportation Committee.

How Public Involvement is Incorporated in the Report

Public comment was the basis for the development of the topics around which the research was structured. Every topic has some aspect of community involvement contained within one or more best

practice or action. The Community Involvement topic was added by the Committee as a recognition of the importance of public involvement throughout a light rail project. This topic explores how meaningful community involvement efforts have been used in other cities to provide better information and understanding, engage the public in the planning and design, and create a better system in the process.

As the Committee discussed which national best practices were applicable to Bellevue, they also considered public comment provided about the national research. Additionally, as the Committee developed recommendations about Bellevue best practices and future actions, they also considered public comment on the community's priorities and top concerns. The Committee reviewed suggested edits to the draft report before finalizing the content.

How Project Public Involvement Objectives were Addressed

1. **Foster involvement by a broad spectrum of the community:** Many public involvement opportunities reached beyond the Committee and the project's interested parties list, including well publicized events and the city's "Spring Forward Expo", and staff presentations to community groups and city boards and commissions.
2. **Convey information that is objective and understandable to encourage an informed public dialogue about the best practices for light rail implementation in Bellevue:** Public participation was encouraged throughout the process, which included two workshops to review and discuss the draft research findings and background information for each of the eight topics. The draft and final reports also served this objective.
3. **Engage stakeholders in direct dialogue about their concerns regarding potential impacts, possible opportunities and benefits resulting from light rail service, and ideas for achieving the best system for Bellevue:** Efforts to engage stakeholders included outreach to neighborhood groups, to each of the four Boards and Commissions represented on the Committee, the Bellevue Arts Commission, the Bellevue Network on Aging, the Bellevue Downtown Association (BDA), and the BDA/Chamber Joint Transportation Committee.
4. **Provide information and opportunities that offer meaningful experiences for participants:** Workshops, open houses, and outreach to community meetings were some actions to engage the public outside of meetings. Also, notes and reports of the Committee's case study tours and information provided to the Committee for the tour were made available to the public.
5. **Ensure a transparent process that demonstrates how the public is being involved and how their input is being applied:** The Project began with the development of a Public Outreach Plan, which formed the basis for much of the work program. Meeting agendas, materials, minutes and presentations were all made available to the public. Public comment, written and oral, was presented to the Committee at every regular meeting.
6. **Establish a framework for response to the Draft EIS that does not pre-analyze or pre-determine alignment alternatives:** The Committee's final report presents research and findings on impacts, trade-offs, mitigation and best practices of other systems that can be applied to any light rail system in Bellevue, regardless of the specific alignment.

Synthesis of Comments

Throughout the project, the Committee received comments in many forms. The Committee received over 60 e-mails and over 30 oral comments from meetings, plus comments received at the four public events. Prior to the formation of the Best Practices Committee, Bellevue City Council received over 100 written plus 30 Council meeting oral comments. The focus of public comment evolved somewhat over the course of the project. Prior to the inception of the Best Practices Committee, the comments were almost exclusively about the specific alignments being proposed by Sound Transit. Comments ran the gamut from supporting or opposing individual alignments and station locations to advocating for other technologies. Many of the comments also raised questions, concerns and fears such as displacement of

homes and businesses, noise, dust, vibration, crime, property values, traffic, safety and construction. As discussed previously in this report, these early comments helped to frame the research.

There continued to be advocates for and against particular alignments and technologies throughout the project. However, as the project progressed, the Committee's discussion of the research and case study tours helped to shift the focus of the public comment to how these issues were addressed in other cities and light rail systems. Comments tended to be about what techniques were used to ensure safety and security around stations, what techniques were used to minimize construction impacts, and what role the public played in the design and construction of other systems. This is not intended to imply that the initial concerns have disappeared as a result of this project. Rather, that there appeared to be a recognition and willingness by some participants to engage in a meaningful dialogue of the project purpose, i.e. to be better prepared if and when a light rail system is developed in Bellevue.

Comments toward the end of the project, during development and deliberation of specific actions, tended to focus on preservation of residential neighborhoods and avoiding or minimizing impacts. In one sense, the public discussion had come full circle to include policies and best practices related to alignments. By this point, however, the discussion was in keeping with the Committee charge and it discussed policies and other actions related to any alignment that might be developed in Bellevue.

Comment Summaries Available

Open House Public Meetings: Summary reports, including comment summary and/or transcript of roundtable discussions are available for the September 13, 2007, November 14, 2007, and January 9, 2008 Open House Public Meetings.

Oral Comment from LRBP Committee meetings (July 2007 – May 2008)

Written/e-mail comment to LRBP Committee (July 2007 – May 2008)

Summary of light rail related e-mails to Council (December 2006 – May 2007)

Summary of May 15 Open House comments

BELLEVUE LIGHT RAIL BEST PRACTICES
Project Resources & Research Bibliography (June 2008)

Please contact city staff to request copies of resources:

- Mike Kattermann, Planning & Community Development; mkattermann@bellevuewa.gov, 425-452-2042
- Maria Koengeter, Transportation; mkoengeter@bellevuewa.gov, 425-452-4345

1. Project Resources

Santa Clara Valley Transportation Authority; *Community Design and Transportation, A Manual of Best Practices for Integrating Transportation and Land Use*. Editor: Chirs Augenstein, AICP; 2003.

Surrey Downs East Link Committee Light Rail Best Practices Research binder.

Project Public Comment Summaries (available on City of Bellevue website at: http://www.bellevuewa.gov/light_rail_best_practices_info.htm

1. Open House Public Meetings: Summary reports, including comment summary and/or transcript of roundtable discussions are available for the September 13, 2007, November 14, 2007, and January 9, 2008 Open House Public Meetings.
2. Oral Comment from LRBP Committee meetings (July 2007 – May 2008)
3. Written/e-mail comment to LRBP Committee (July 2007 – May 2008)
4. Summary of light rail related e-mails to Council (December 2006 – May 2007)

2. Research Findings Memo Resources

Communities and Neighborhoods

Dittmar, Hank; Ohland, Gloria. *The New Transit Town*. Island Press, 2004.

Downtown San Diego Partnership website: http://www.dtsd.org/index.cfm/fuseaction/clean.home.

Herman, Amy. *Study Findings Regarding Condominium Parking Ratios*. Sedway Group. San Francisco 2001.

How Transportation and Community Partnerships Are Shaping America, Part 1: Transit Stops and Stations. Project for Public Spaces, pps.org.

Lesson 33: UTA Light Rail Construction in the Salt Lake City Central Business District. Federal Transit Authority. March 2, 1998.
http://www.fta.dot.gov/publications/reports/other_reports/publications_1374.html.

Loukaitou-Sederis, Anastasia; Houston, Douglas; Bromberg, Ava; *Gold Line Corridor Study Final Report*. Ralph and Goldy Lewis Center for Regional Policy Studies, University of California, Los Angeles. March 2007.

www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf

Schlossberg. Marc. *"How Far, by Which Route, and Why? A Spatial analysis of Pedestrian Preferences."* Mineta Transportation Institute, a San Jose State University Transportation Center, 2006.

South Corridor Light Rail, Transit, Land Use Study, Metro.

Transit Oriented Development Best Practices Handbook, The City of Calgary (2004)

Transportation Cooperative Research Program, Report 102: *Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects* (2004).

Connecting People to Light Rail

ADA Accessibility Guidelines for Buildings and Facilities, Appendix A to Part 1191. www.access-board.gov/adaag/ADAAG.pdf

Ewing, Reid. *Pedestrian and Transit-Friendly Design: A Primer for Smart Growth.* 1999.

Litman, Todd, *Valuing Transit Service Quality Improvements: Considering Comfort and Convenience in Transport Project Evaluation.* Victoria Transport Policy Institute, May 10, 2007.

Nelson Nygaard 2003, *BART Station Access Guidelines*

Puget Sound Regional Council, *Creating Transit Station Communities in the Puget Sound Region: A Transit Oriented Development Workbook.*

Rabi Mishalani, Mark McCord and John Wirtz. *Passenger Waiting Time Perceptions at Bus Stops,* Transportation Research Board 84th Annual Meeting, Washington, D.C., 2005.

Schlossberg, Marc. *"How Far, by Which Route, and Why? A Spatial analysis of Pedestrian Preferences." 2006.* Funded by the Mineta Transportation Institute, San Jose State University Transportation Center.

Station Security

"Capitol Expressway Corridor: Final EIR - Safety and Security." Santa Clara Valley Transportation Authority. April 2005.
http://www.vta.org/projects/dtev/docs/environmental_analysis/volume_1/4_15_safetysecurity.pdf.

Currie G. & Smith P. *An Innovative Design for Safe and Accessible Light Rail/Tram Stops Suitable for Mixed Traffic with Median Track Operations.* 28th Australasian Transportation Research Forum, Sydney NSW Sept 2005.

Liggett, Robin. 2002. *Journeys to Crime: Assessing the Effect of a Light Rail Line on Crime in the Neighborhoods*. University of California, Los Angeles

Liggett, Robin; Loukaitou-Sederis, Anastasia; Iseki, Hiroyuki. *Protecting Against Transit Crime: The Importance of the Built Environment*. University of California, Los Angeles, 2004.

Light Rail Stirs Safety Worries On MLK. The Seattle Times. April 2004.

Myths vs. Reality: Light Rail and Property Values in Orange County. Light Rail Progress. May 2003. http://www.lightrailnow.org/myths/m_oct003.htm.

Portland to Milwaukie LRT. *Frequently Asked Questions*. Metro. 2007. http://www.metro-region.org/library_docs/trans/design_operations_faq.pdf

Rochester Rail Transit Committee: Questions and Answers. 2001. http://www.ggw.org/rrtc/learn/qa.htm

Staying on Track: Review of Public Safety and Security on Light Rail Systems. City of Seattle Strategic Planning Office. February 1999.

State Safety Oversight. United Stated Department of Transportation Federal Transit Authority. 2003.

The Environment – Transit Crime Connection. University of California, Los Angeles. Loukaitou-Sideris, Anastasia, and Robin Liggett. 2002.

Valley Metro Light Rail. http://www.valleymetro.org/METRO_light_rail/Light_Rail_Safety/Safety_Design/index.htm

Property Values

Al-Mosaind, M. et. al. *Light Rail Transit Stations and Property Values: A Hedonic Price Approach*. Portland, OR: Center for Urban Studies. Preprint, Transportation Research Board, 72nd Annual Meeting, 1993. In PB 2001.

American Public Transportation Association (APTA) and Public Transportation Partnership for Tomorrow, *The Benefits of Public Transportation: Building Investment Value in Our Economy and Marketplace*. 2003.

Cervero, Robert; Duncan, Michael. *Land Value Impacts of Rail Transit Services in Los Angeles County*, National Association of Realtors, Urban Land Institute, 2002.

Chen, Hong et. al., *Measuring the Impact of Light Rail Systems on Single Family Home Values: A Hedonic Approach with GIS Application*. 1997.

Diaz, Roderick B. et. al., *Impacts of Rail Transit on Property Values*. May, 1999.

Landis, John D., et. al. *Capitalization of Transit Investments into Single-Family Home Prices*, Working Paper, University of California Transportation Center, 38pp, 1994.

Landis, John D. et. al. 1995. *Rail Transit Investments, Real Estate Values, and Land Use Change: A Comparative Analysis of Five California Transit Systems*, Institute of Urban and Regional Development, University of California at Berkely. In *The Effect of Rail Transit on Property Values*, Parsons Brinckerhoff, 2001.

Lewis-Workman, Steven, and Daniel Brod. 1997. *Measuring the Neighborhood Benefits of Rail Transit Accessibility*. Transportation Research Record 1576, pp. 147-153. In PB 2001.

Light Rail Progress 2000, Austin Light Rail Plan: Support Grows (http://www.lightrailnow.org)

Light Rail Systems and Property Values, 2004 (http://www.slp2.org/documents/propertyvalfs04.pdf).

Portland LRT 10 Station Area Best Practices Assessments and Recommendations, David Evans and Associate, Inc, SERA Urbsworks, Nelson Nygaard 2007.

Summit-University Planning Council, *Summit University Planning Council's Position Paper on Light Rail Transit on University Avenue*.

The Effect of Rail Transit on Property Values, Parsons Brinckerhoff, 2001.

Weinstein, B., Clower, T., 2003. *DART Light Rail's Effect on Taxable Property Valuations and Transit Oriented Development*, Center for Economic Development and Research, University of North Texas.

Land Use

Best Practices in Transit-Oriented Development. City of Reno, Nevada, June 2004.

http://www.bouldercolorado.gov/index

http://www.cherokeedenver.com/

Community Building Sourcebook: Land Use and Transportation Initiatives in Portland, Oregon. TriMet, August 2005.

http://www.dart.org/

"Developing TOD in Sacramento." Fred Arnold, James Robinson, and Michael Bernick, *Sustainability Concepts: Enhancing Communities Through TOD,* June 2007.

"Developers Consider Future With – or Without – Light Rail." Aubrey Cohen, Seattle Post Intelligencer. October 27, 2007.

Federal Transit Administration. Guidelines and Standards for Assessing Transit-Supportive Land Use, May 2004.

Federal Transit Administration. Transit Oriented Development Lessons Learned: Results of FTA's Listening Sessions with Developers, Bankers, and Transit Agencies on Transit Oriented Development, December 2005.

Maricopa Association of Governments. Growing Smarter Implementation Project Best Practices Paper #6 – Transit Oriented Development, August 2003.

http://www.mockingbirdstation.com/

"New Tools for Building Wealth: Linking Affordable Housing to Transit." Presentation by Shelley Poticha, Center for Transit-Oriented Development, March 2006.
www.lisc.org/docs/experts/2006/eo_03_02_2006.pdf)

On the Right Track: Meeting Greater Boston's Transit and Land Use Challenges. Urban Land Institute Boston District Council, May 2006.

http://www.orencostation.net/

Reconnecting America's Center for Transit-Oriented Development. Realizing the Potential: Expanding Housing Opportunities Near Transit, April 2007.

www.sdcommute.com

Strategic Plan for Transit Oriented Development. Regional Transportation District (RTD) FasTracks, June 2006.

Statewide Transit-Oriented Development Study: Factors for Success in California – Final Report. California Department of Transportation Business, Transportation and Housing Agency (Caltrans), September 2002.

Transit Cooperative Research Program Research Results Digest: An Evaluation of the Relationships Between Transit and Urban Form. Transportation Research Board, June 1995 – Number 7.

Transit Cooperative Research Program Report 16 Volume I – Transit and Urban Form. Transportation Research Board, 1996.

Transit Cooperative Research Program Report 17 – Integration of Light Rail Transit into City Streets. Transportation Research Board, 1996.

Transit Oriented Development Best Practices Handbook. The City of Calgary Department of Land Use Planning and Policy, January 2004.

T-REX Transit Oriented Development Lessons Learned Report. Regional Transportation District, September 2007.

Ten Principles for Successful Development Around Transit. Urban Land Institute, 2003.

http://www.vta.org/projects/tod.html

Wasatch Front TOD Guidelines. Envision Utah, 2002.

Street Design

Agran, P.F., Castillo D.N, Winn, D.G. "Limitations of Data Compiled from Police Reports on Pediatric Pedestrian and Bicycle Motor Vehicle Events." Accident Analysis and Prevention, Vol. 22, No. 4, 1990, pp. 361-370.

Chandler C, Hoel L "Effects of Light Rail Transit on Traffic Congestion." Mid-Atlantic Universities Transportation Center, May 2004, pp. iii.

"Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Urban Intersections" by R. Van Houten et al., in IIHS Status Report, Vol. 32, No. 7, Aug. 30, 1997.

Hubbell, John and Dave Colquhoun, "Light Rail Transit in Calgary: The First 25 Years," Calgary Transit, 2006, 26th International Joint Light Rail Conference, St. Louis, Missouri.

Independent research by Michael King of Nelson\Nygaard.

Intersections" by R. Van Houten et al., in IIHS Status Report, Vol. 32, No. 7, Aug.

Irwin, Don, "Safety Criteria for Light Rail Pedestrian Crossings," Transportation Research Board, 2003.

James, H. "Under-reporting of Road Traffic Accidents." Traffic Engineering and Control, Dec. 1991, pp. 574-583.

Korve, H., et. al. "Integration of Light Rail Transit into City Streets." Transit Cooperative Research Program Report 17, Transportation Research Board, National Research Council 1996.

Online TDM Encyclopedia, Victoria Transport Policy Institute, Todd Litman, accessed on 11/16/07 at http://www.vtpi.org/tdm/tdm69.htm.

"Pedestrian Head Start Signal Timing" by J. Fleck, in Compendium of Papers. Institute of Transportation Engineers, District 6 Annual Meeting, San Diego, California, 2000. http://www.walkinginfo.org/pedsafe/casestudy

Phone interview with Bob Hastings, the Agency Architect at Tri-Met, 12/10/07.

"Safe Routes to Transit: Bus Rapid Transit Planning Guide: Pedestrian Guide," Nelson\Nygaard for the Institute for Transportation and Development Policy, July 2005.
TCRP Report 23 "Wheel/Rail Noise Control Manual", Transportation Review Board, 1997, pg. 147.

Elevated, At-Grade, Tunnel Integration

Project & Construction - Management Guidelines (2003 Update), Federal Transit Administration http://www.fta.dot.gov/publications/reports/other_reports/publications_3875.html

Construction Impacts and Mititagation

City of Aspen, Colorado. Aspen Parking, Construction Staging and Emergency Access Plan. 2004.

Construction Impact Mitigation Plan, Downtown Salt Lake City. Salt Lake City Chamber of Commerce. March 31, 2006.

Federal Transit Administration Project Management Oversight Program, Contract No. DC-27-5004 Task Order No. 6, CLIN 0004-Lessons Learned Program PG No. 14: Grantee: Regional Transportation District (RTD). Lessons Learned The T-REX Mega-Project Experience, Delivered: June 2007. STV Incorporated, 225 Park Avenue South, New York, NY 10003.

Impact of Light rail Construction on Existing Businesses; a survey of six cities with recent light rail construction projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. May 1, 2006.
Interviews with Richmond Business Owners., an informal survey of concerns about the possible LRT line in Richmond. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 18, 2006.

Lesson 45: Tri-Met's Successful Disadvantaged Business Enterprise Program on the Interstate MAX Light Rail Project. Federal Transit Administration. Reports & Publications. Project & Construction - Management Guidelines. PMO Lessons Learned References in Guidelines. Lesson 45: Tri-Met's Successful Disadvantaged Business Enterprise Program on the Interstate MAX Light Rail Project (2003 Update).

Light rail Construction: Mitigation of Business Interruption; a survey of methods used in six cities during recent projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 21, 2006.

LRT Now! Austin. CapMetro's Pledge to Business. Capital Metro. 2001.

METRO Business Assistance Plan. METRO Light rail. METRO Light rail.org. Phoenix, Arizona. May 2007.

Tasman East Light Rail Project Environmental Assessment, Capitol Corridor Light Rail Project Environmental Assessment, Santa Clara Valley Transportation Authority (website). Last Updated: December 09, 2007.

The Associated General Contractors of America, Arizona Chapter. Valley Metro Rail Update. Views and News. January 2005.

U.S. Department of Transportation. Federal Highway Administration. Construction. State Workshop Reports: Oregon, Paving The Way. Chapter 1: Workshop Details (website). Last Updated: July 27, 2007.

Research Findings
Community and Neighborhoods

The "Community and Neighborhoods" section explores best practices for integrating light rail into communities and neighborhoods in a way that accentuates its positive effects and minimizes undesirable effects. This memorandum presents an overall discussion of best practices, recognizing that there are a variety of types of communities and neighborhoods, both among established neighborhoods and in transit-oriented development.

Issue #1: What benefits to existing neighborhoods does light rail bring other than improved access via transit and what policies and strategies can Bellevue pursue to ensure that neighborhoods near stations benefit from rail investments?

A new light rail line and station have the potential to complement established neighborhoods by:

- *Celebrating local history or culture with sculpture, murals, community narratives*
- *Providing the opportunity to use station design and art to reflect the unique character of the community and foster civic pride*
- *Catalyzing community projects by providing funding or momentum to initiate projects, such as utility undergrounding or putting in new street lights*
- *Reducing car-dependence by introducing new transportation options*
- *Building a network of recreational facilities by connecting to nearby multi-use paths*

It is important to focus on accentuating a genuine sense of place and not just build a transit project. Bearing this in mind, planners may consider several best practices when designing a light rail line as a community asset:

- *Establish a clear vision and common goals for what purpose the station will serve and refer back to the vision throughout the planning and implementation phases*
- *Understand the context of the area before making the alignment choice*
- *Be responsive to the context*
- *Choose an alignment that will bring the most benefit*
- *Balance light rail service with the reality of potential impacts*
- *Centrally locate station within community*
- *Integrate the station into its surroundings using good urban design, including building to appropriate heights and using complementary building materials*
- *Ensure that the design of the station reflects the character of the surrounding community through mechanisms such as resident design review boards and design guidelines*

Active uses on ground floor with less active uses above

Street benches and trash receptacle in Palo Alto, California.

Cesar Chavez entrance to Olvera Street, a latino cultural marketplace near Union Station in Los Angeles, CA (Source: Gold Line Corridor Study Final Report, Appendix B).

Photo example of green space and parks strengthening the connection to Pasadena City Center at (Memorial Park Station and Holly Street Village Apartments) on Los Angeles' Metro Gold Line

- *Create engaging public places, at an appropriate scale for the neighborhood, that allow for concerts, markets, exhibits and gatherings*
- *Include attractive street furniture, pedestrian-scale lighting and public art.*

To ensure that neighborhoods near stations benefit from rail investments, keep the following best practices in mind.

Design in a pedestrian-oriented way

As described in "Connecting People to Light Rail," pedestrians that can access the land uses within a neighborhood are more likely to use those sites, including retail, parks and transit. Placing daily goods and services, as well as recreational destinations, within walking distance of residents reduces incentives for car ownership and use, supporting transit use for commuting and other regional travel. The following recommendations outline the key design factors that focus development for pedestrians:

- *Locate active uses that generate a higher number of daily trips on the first two floors. These should include retail and open space located in the first 15 to 20 feet of building height. Land uses that generate fewer trips should occupy higher floors.*
- *Bring sidewalks up to the building line and prohibit parking from being located between the sidewalk and the building.*
- *Design sidewalk-driveway interfaces to be identical to sidewalks (e.g. the sidewalk material and level should continue across the driveway). This alerts both pedestrians and drivers that they are traveling on a portion of the sidewalk.*
- *Install bollards, trees and other street furniture to protect pedestrians and buildings from errant drivers.*
- *Sidewalks should be at least five feet wide at all points.*
- *Install curb extensions (wider sidewalks) at all corners with on-street parking.*
- *Install pedestrian signals at all traffic signals.*
- *Program pedestrian-phase signal at all times with traffic phase, instead of forcing the pedestrian to push a button.*
- *Include Leading Pedestrian Intervals at all signals, thus allowing pedestrians to start across the street before the cars accelerate.*

USE MITIGATION PROJECTS TO CREATE BENEFITS AND AMENITIES FOR AFFECTED AREAS

Utility undergrounding

Unsightly overhead utility wires can be placed below ground, creating a cleaner streetscape environment. Undergrounding the utilities during light rail construction can reduce costs and minimize the impact of construction on the neighborhood by performing all of the trenching and repaving at once and avoiding the need to disrupt the street a second time. For example, concurrent construction of Salt Lake City's UTA Light Rail, utility repairs and sidewalk reconstruction reduced the length of street closures in the central business district.[1]

Sidewalk construction and maintenance

Along the light rail corridor, new sidewalks could be constructed, narrow ones widened and old ones repaired during the right-of-way excavation. New sidewalk pavers could be installed along primary pedestrian pathways and at the light rail station areas. And in some cases the light rail construction will require bringing existing intersections into ADA compliance by widening sidewalks, creating new sidewalk ramps and installing detectable warning strips.

Parks or Greenbelts

New neighborhood pocket parks, linear parks and planted medians could be created while the right of way is being reconfigured for the light rail. Center light rail platforms might incorporate green medians or tree plantings, and likewise light rail station designs could include permeable surfaces, shade trees and grass. Street trees and sidewalk planter boxes could be planted along the light rail corridor sidewalks during the later phases of light rail construction.

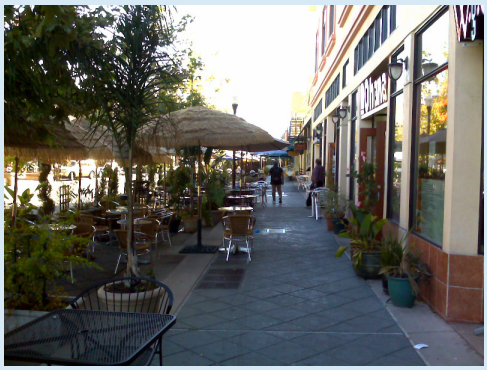
Existing traffic noise mitigation

For neighborhoods that already experience elevated noise levels due to traffic and bus operations, light rail provides the opportunity to reduce this noise with the same mitigation measures used for the new light rail construction. When the street is repaved after the light rail construction is complete, a noise-mitigating materials can be used, as well as sound barriers.[2][3]

New street furniture

Street furniture, such as benches, pedestrian lighting and wayfinding signs enhance the streetscape, providing an inviting place to walk. A new light rail corridor will induce additional foot traffic, as pedestrians walk to and wait for the train. Therefore, updating or installing new street furniture could provide the finishing touches on a newly constructed light rail corridor. Furniture along the corridor could be coordinated with the light rail station design to create a cohesive environment.

Historic Saint Charles trolley tracks in New Orleans' Garden District (Source: www.friends4expo.org/neighbors.htm).



Newly renovated sidewalk in downtown Mountain View, California.

1 FTA Lesson 33: UTA Light Rail Construction in the Salt Lake City Central Business District, March 2, 1998, http://www.fta.dot.gov/publications/reports/other_reports/publications_1374.html.
2 http://www.epd.gov.hk/epd/noise_education/web/ENG_EPD_HTML/m4/mitigation_2.html
3 http://www.legco.gov.hk/yr05-06/english/sec/library/0506rp04e.pdf

Conceptual Drawing of Blossom Plaza, with station in background (Source: www.crala.org/internet-site/Projects/Chinatown).

Programming for Public Places

Programming can bring people into public places, by creating visual interest or providing active uses such as performing arts demonstrations, public art installations, food kiosks and flower or produce vendors. Public places could be programmed in conjunction with light rail construction, especially if the public place is adjacent to a station or along the light rail corridor. Coordinating similar kiosks, digital billboards or art installations in public spaces and light rail stations could reduce installation costs and help relate the two spaces to each other, thus creating a unified identify for the neighborhood.

Clean and Safe Teams

After a light rail corridor is constructed, the area may benefit from having a staff of people keeping the area tidy and safe. Clean and safe teams provide landscaping, maintenance and hospitality services in business improvement districts and are often distinguishable by a brightly colored t-shirt or uniform. For example, in downtown San Diego Maintenance Ambassadors provide trash pick-up, landscaping, sweeping and graffiti removal services, and Safety Ambassadors patrol on foot and bicycle.[4]

4 Downtown San Diego Partnership website: http://www.dtsd.org/index.cfm/fuseaction/clean.home.

EXPLORE ALL POSSIBLE FUNDING MECHANISMS FOR NEIGHBORHOOD BETTERMENTS

Community Benefit District

A property tax is assessed in a defined area to pay for specific services and capital investments, including both operations (such as a transit shuttle or safety ambassadors) and capital investments (such as improved bicycle facilities).

Parking Benefit District

Revenues from paid parking (meters, garages, permits, etc.) are re-invested in public improvements for the area in which they are collected, including new capital investments and ongoing maintenance.

Transportation Impact Fee

Impact fees are charges assessed by local governments against new development projects that attempt to recover the cost incurred by government in providing the public facilities required to serve the new development. Impact fees are only used to fund facilities, such as roads, schools and parks, that are directly associated with the new development. They may be used to pay the proportionate share of the cost of public facilities that benefit the new development; however, impact fees cannot be used to correct existing deficiencies in public facilities.

Safe Routes to Schools

Safe Routes to Schools is a federally and state-sponsored program providing funding to local communities to encourage more students and their families to walk and bicycle to school.

Grant programs

A variety of federal, state, regional and local grant programs exist to fund specific projects. For example, some federal SAFETEA-LU and Congestion Mitigation and Air Quality Improvement Program funds are available for capital improvement projects in local communities to improve the walking and bicycling environment to encourage people to travel via these modes more often, instead of driving.

In order to prevent visitors and employees from parking on residential streets, a residential permit district (also known as preferential parking district) may be established to issue parking permits to residents. These permits allow the residents and their visitors to park within the district while all others are prohibited from parking there for more than a few minutes.

Issue #2: What negative impacts might occur and how can they be mitigated?

It is important to identify and mitigate potential undesirable impacts to ensure that the addition of light rail to the community is an asset rather than a generator of community complaints. Incorporating changes to the design before construction not only saves money in the long run, it avoids lengthy project delays and ensures community support.

Only by acknowledging the nature of the light rail impacts can they be addressed adequately. The following list contains potential negative impacts that a community might encounter:

- *Noise*
- *Light*
- *Vibration*
- *Foot and vehicle traffic*
- *Parking crunch*

Study projected impacts along light rail alignments

The National Environmental Protection Act (NEPA) requires transit agencies to undertake an environmental review process to study potential negative impacts of a light rail project. Impacts such as noise, light, vibration, traffic, and property impacts will be discussed in an Environmental Impact Statement (EIS). Sound Transit is currently conducting this study and will release a draft EIS in fall 2008.

Engage the community in review and consideration of project impacts to select an alignment

Consider real versus perceived impacts when assessing alignment choices.

- *When trying to preserve the "quiet of people's homes," it could be a matter of alignment choice. The community can assess whether the quiet street is real or perceived. What is the baseline noise level? How would light rail compare? Identify where the alignment would change existing conditions.*
- *Maximize light rail benefits by balancing travel time and speed—another way to respond to context. To bring the noise level down in some areas, trains can be slowed down through corridors, but this may have impacts on street operations and travel time.*

Incorporate mitigation measures early in design and engineering stage

If there are impacts, identify mitigation measures to incorporate into design in order to meet Federal Transit Authority (FTA) standards. For example, there are several measures that the FTA has found to be effective in reducing noise impacts (Transit Noise and Vibration Impact Assessment, 2006). These techniques include berms, landscape screening, low track-side barriers or knee-walls, vehicle skirts, under-car absorption materials, enhanced ballast and rail lubrication on curves or cross-overs.[5]

5 www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf

Work with the transit agency and community to secure mitigation and betterments (as discussed in the previous question) and include elements early in the design process. For example, the site planning for the Mission Meridian station along the Metro Gold Line (Los Angeles, CA) garnered substantial community opposition from the city of South Pasadena. To address the residents' concerns regarding an increase in noise generated by the new line, the city proposed the following suggestions:

- *With the help of the Public Utilities Commission, the city was able to reduce train warning bells from 90 seconds to 30 seconds.*
- *A Safety and Noise Element was added to the city's General Plan.*[6]
- *Engineering design took advantage of advances in asphalt composition and transparent sound walls to mitigate noise impacts.*

Design safe public spaces

Transit planners for the Portland/Milwaukee light rail corridor are applying principles from the nationally recognized, multidisciplinary approach to designing safe public spaces called Crime Prevention Through Environmental Design (CPTED) to their station design. CPTED strategies include promoting natural surveillance (placing windows overlooking sidewalks and using transparent materials when possible), regular maintenance (alluding to the Broken Window Theory that dirty streets attract more litter), and programmed activity and foot traffic attractors. CPTED principles also encourage street trees and landscaping as these elements have been found to contribute to an increased sense of safety. These strategies along with community education programs will be developed in conjunction with local neighborhoods and schools in the Milwaukee area.

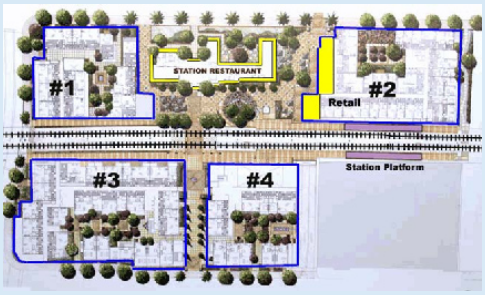
Consider launching a residential parking permit program

For neighbors concerned with increased automobile traffic and spillover parking occupying curbspace in residential areas outside stations and retail areas, a residential parking permit (RPP) program is a good answer. RPPs are initiated when parking availability is consistently low and a significant proportion of vehicles are from outside the local area. Cities can issue a certain number of permits to residents, either for free or a nominal fee, which allow residents to park within the scheme's boundary for free. Those vehicles without a permit are limited to parking for only a few hours or are prohibited altogether.

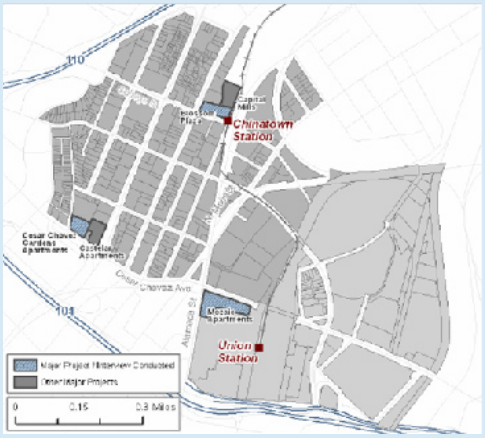
The City of Seattle has implemented a resolution which states that a RPP scheme can be established if 75% of on-street spaces are in use for at least eight hours, with at least 25% of those spaces used by non-local vehicles. The City of Pasadena established RPP schemes at each of the Gold Line Metro stations where they anticipated spillover parking to be a problem for local residents. These schemes were established before the stations opened so drivers accepted the program from the beginning of operations. A related residential parking concept charges outsiders for permits and allows residents to decide how to use the revenue for improvements in their neighborhood.

6 Gold Line Corridor Study Final Report, Appendix B

Del Mar Station on the Gold Line in Pasadena's city center (Source: Gold Line Corridor Study Final Report, Appendix B).



Del Mar Station area plan showing four apartment buildings adjacent to Metro Gold Line tracks in Pasadena, CA (Source: Gold Line Corridor Study Final Report, Appendix B).



CASE STUDY: DEL MAR STATION, UNION STATION AND CHINATOWN STATION, GOLD LINE, PASADENA TO LOS ANGELES, CA

Del Mar Station in old Pasadena is a 4.2 acre development that includes 346 rental units (of which 21 are affordable), 20,000 square feet of retail and a subterranean 1,200-space parking garage. It was completed in 2006. An attractive apartment complex called Archstone Del Mar surrounds the Metro platform; trains run through the middle of the project and pedestrians cross the tracks through a narrow gateway at the center of the complex.

Key noise and vibration mitigation practices include replacing single-paned windows with double-paned windows in homes where the lines pass near backyards, adding 6-foot-high concrete walls to block sound, finding softer crossing bells and hand-lubricating parts of the track to reduce screeching.

CASE STUDY: HIAWATHA LIGHT RAIL LINE, MINNEAPOLIS, MN

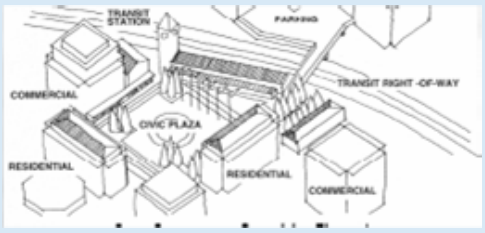
The Hiawatha Light Rail line is made up of three segments: Downtown Minneapolis, south Minneapolis neighborhoods, and the Fort Snelling/ airport/Bloomington segment. On the south Minneapolis neighborhood segment the line runs immediately adjacent to established residential areas west of the tracks, while State Highway 55, Hiawatha Avenue, is immediately east of the tracks. The noise mitigation measures included sounds walls and earthen berms, and coincided with the reconstruction of Hiawatha Avenue that happened just before construction of the light rail.

When testing on the line began, Metro Transit received complaints from neighbors about the noise level from the electronic bell emitted from the light rail vehicles. In response, the transit agency reduced the noise level of the bell and clarified its policy on when it should be sounded. The sound of the bell, as well as the audible warning emitted by the crossing gate system, is now a part of the everyday background noise in the neighborhoods west of the line, even with the mitigation efforts. To date, no studies have been done to quantify the magnitude of this effect or the degree to which mitigation efforts have been effective. It should be noted that, unlike the Hiawatha Line, light rail in Bellevue will not have gates and ringing bells at every intersection—only where the alignment is siding running or crossing a non-signalized intersection

Bike racks aboard the Hiawatha light rail line in Minneapolis (Flickr source: Payton Chung).

Passengers disembark the Hiawatha light rail line in Minneapolis at night (Flickr source: philcozz).

Milwaukee light rail station assessment showing a five-minute walk (Source: DEA/ SERA 2007).



Sample layout for land uses near a transit station (Source: ULI Ten Principles of Successful Development around Transit).

Multi-space parking meter in Washington, D.C.

Issue #3: What is the "radius of influence" for light rail tracks and stations in terms of encouraging redevelopment and benefiting from improved access to transit?

A radius of influence refers to the area around the light-rail tracks and stations that experiences a shift. By focusing attention on the radius of influence around stations, the city will stimulate the kind of development that would generate social, economic and quality-of-life benefits for residents.

Research shows that people are willing to walk about a half-mile, or 10 minutes to light-rail stations, rather than the prevailing notion of a quarter to a third of a mile.[7] Improvements should be focused in a one-mile radius around the station, given the understanding that development one mile from the station is not likely to attract the same level of transit usage and create some of the trip generation benefits as development inside a 1/2-mile radius. The radius should reflect distance along the actual street network to station entrances, not a distance as the crow flies.

Inside this radius, the community can expect to see more pedestrian and vehicle activity, more retail and local services, and ideally, more development. For example, a new transit station in Plano, TX, catalyzed downtown redevelopment.

Focus improvements and mitigation efforts inside the radius of influence around stations

Locating a station at the center of the neighborhood rather than on its periphery allows neighborhoods to take advantage of the station's beneficial effects. As described in the Urban Land Institute's Ten Principles for Successful Development around Transit, the new station will connect a regional transit system to the surrounding community, and its location should reflect the centrality of its role. It can also help to create an activity center that surrounds the station on all sides.

Locating transit-supportive uses as close to the station as possible, within the radius of influence, enables people to do errands on their way to and from the station and to make transit the most convenient and attractive travel mode for the site.

Establish smart parking policies

Getting parking right is critical to the success of light rail integration. Parking can fundamentally shape the look and feel of neighborhoods. It forms the start and end of most visitors' experiences of the area. Because parking is costly to build and maintain, it can be a barrier to new development.

Parking is an economic asset, not an end in itself. The high prices people pay to park in downtown environments is a testament to the value of parking near mixed-use, compact and pedestrian-oriented development. But not all spaces have the same value. In all mixed-use districts, some parking spaces are more desirable than others. Left to market forces, the more desirable spaces would command higher prices.

7 Marc Schlossberg. "How Far, by Which Route, and Why? A Spatial Analysis of Pedestrian Preference." 2006. Funded by the Mineta Transportation Institute, a San Jose State University Transportation Center.

When parking is underpriced, the city incurs all the burden of operating and maintaining it while enjoying none of the financial benefits of controlling it. More importantly, underpriced parking reduces customer convenience, with the best spaces quickly filled by the lucky few. While underpriced parking results in direct loss of revenue to the city, the indirect costs are even higher if shoppers and developers are deterred by a lack of convenient parking.

The following ten general principles can be used to inform parking management policies:

1. **Consumer choice.** *People should have viable parking and travel options.*
2. **User information.** *Drivers should have information on their parking and travel options.*
3. **Sharing.** *Parking facilities should serve multiple users and destinations. Shared parking is essential to creating a park-once district.*
4. **Efficient utilization.** *Parking facilities should be sized and managed so spaces are frequently occupied.*
5. **Flexibility.** *Parking plans should accommodate uncertainty and change.*
6. **Prioritization.** *The most desirable spaces should be managed to favor higher-priority uses.*
7. **Pricing.** *As much as possible, users should pay directly for the parking facilities they use.*
8. **Peak management.** *Special efforts should be made to deal with peak-demand.*
9. **Quality vs.** *quantity. Parking facility quality should be considered as important as quantity, including aesthetics, security, accessibility and user information.*
10. **Comprehensive analysis.** *All significant costs and benefits should be considered in parking planning.*

The Los Angles County Metropolitan Transportation Authority's (MTA's) "transit parkway" plan calls for a park and bikeway along the light rail tracks on the 50- to 100-foot-wide right-of-way. This concept sketch shows the north side of National Boulevard in Culver City (Source: www.friends4expo.org/neighbors.htm.).

Art should be used to humanize a route, provided that it does not create lurking opportunities. Site-relevant artwork installed at the Mission Station on LA's Metro Gold Line instills a sense of place and identity. Landscaping and seating allow transit users and community members to enjoy the plaza (Source: www.tndwest.com/missionmeridian.html).

Issue #4: How can art and parks/green spaces be used to strengthen the connection between light rail stations and the surrounding community?

Well-managed open space is a valuable resource for commercial as well as residential areas. It can provide a central organizing point around which important activities and services can be oriented. Well-managed parks and green spaces can bring people and vitality to an area with pedestrian networks and seating areas, the organization of events, art installations, water features or children's play areas. In addition, open spaces can create pleasant and direct pedestrian and bicycle routes to destinations adjacent to the park. These attributes are all particularly important in enhancing the profile of a transit station in a community. A centrally located transit station and plaza or park can be an organizing point for the establishment of adjacent uses such as the residential units, commercial and government services. The following best practices can ensure that any park associated with the light rail addresses the needs and desires of those who spend time in it.

Engage the community

Getting input from local residents, retailers, businesses, institutions and other stakeholders is essential in the planning and design phase, as well as after the park opens to the public.[8]

Create a good place

The Project for Public Places defines a "good place" as one that provides a range of things to do; is easy to get to and connected to the surrounding community; is safe, clean and attractive; and is a place to meet other people.[9]

Build partnerships

Private funding, either from individual donors, nonprofit entities or local businesses, can be essential for supporting maintenance plans and programming outreach for parks.

Provide seating

Seating in parks and plaza settings should be accessible, comfortable, well-maintained and located in the right places.

Create a management plan

A park's long-term success depends on the ongoing efforts in marketing, safety and security, maintenance and operations, and economic activities and concessions.

8 http://www.pps.org/parks_plazas_squares/info/parks_plazas_squares_approach/

9 http://www.pps.org/parks_plazas_squares/info/design/goodplaces

Issue #5 What have cities done to ensure neighborhood stability in the short-and long-term when a major change like light rail is introduced, i.e. avoiding neighborhood decline and protecting neighborhood health?

A community's investment in public transit will provide significant public benefits including greater accessibility to services and recreation for people who are not able to drive, cannot afford to drive or do not wish to drive. Transit services become a vital link for children, elderly and the disabled in the community.

Key to promoting a station as a positive feature in the community is ensuring that the site is centrally located within a ten-minute walk to the majority of local services and activities. A focus on quality pedestrian focused urban design tenets will help the site be less of a building and more of a place.

In the long term, light rail has been a catalyst for improving neighborhood health. Station areas can benefit from placemaking strategies that recognize that stations function as community places as well as transportation facilities. New Jersey Transit and the New Jersey Department of Transportation developed a Model Stations and Shelters Initiative to improve accessibility, maintenance and aesthetics at their bus and rail passenger facilities. Through observations of passenger use of the stations, interviews with transit users, consultation with transit riders, local residents, merchants and city representatives a clear picture develops of how each station is used and is perceived.

INVOLVE ALL COMMUNITY STAKEHOLDERS IN THE STATION DESIGN

The New Jersey Transit Woodward Station is an excellent example of how community involvement created an enduring process for maintaining the well being of the station area.

- *Transit users and the community identified needed enhancements (clear directional signage, new entrance canopies, dedicated kiss-and-ride), which were rectified.*
- *Station design elements were created to better integrate the station with the community (a "Welcome to Woodbridge" sign was painted in colors and typeface matching those that are used by the Downtown Woodbridge Merchant's Association, an artist-created station map was installed showing transit, business, and cultural information, and two retail kiosks were established at the main entrance.)*
- *The merchant's association created a special improvement district where parking fees are collected for the maintenance of the station area to ensure it stays clean and attractive.*

RESOURCES

South Corridor Light Rail, Transit, Land Use Study
TOD Best Practices Handbook, The City of Calgary (2004) – DEA has this?
Gold Line Corridor Study Final Report, Appendix B

Project for Public Spaces: How Transportation and Community Partnerships Are Shaping America, Part 1: Transit Stops and Stations

Site plan of Del Mar station on LA's Metro Gold Line in Pasadena, CA.

Connecting People to Light Rail

People connect to light rail using a number of travel modes—on foot, on bicycle, in buses or shuttles, and in carpools and single occupancy cars. In order to give the largest number of people access to light rail, keep people safe and protect neighboring communities from the potentially negative impacts of living near a light-rail line, this is the order of priority these modes should take in station and street design.

Issue #1: What are the best practices for getting pedestrians to light rail from residences and businesses?

Public transit riders always begin and end their journey as pedestrians or bicyclists. Pedestrians need a network of route options to and from a station. These routes should be appealing, safe and directly link to adjacent services, attractions and the local street grid. Potential ridership could suffer if access to the station is difficult or inconvenient. Research shows that people are willing to walk about a half-mile, or 10 minutes to light-rail stations, rather than the prevailing notion of a quarter to a third of a mile.[1] The improvements should reflect distance along the actual street network to station entrances, not an as-the-crow-flies distance. Bearing this in mind station planners should consider four best practices during station design:[2]

Create routes that are short and direct

Passengers want direct walking routes with minimum delays when crossing streets. Pedestrian connections should aim to be the shortest direct link between destinations. People will always seek the shortest route even if they are not supposed to go that way. Effective designs work with natural desire lines instead of trying to change people's behavior.

When exiting the station, people should be able to walk directly onto the street sidewalk. Unless they are going to a car or bus, they should not have to pass through a parking area or bus transit center. Where this is not possible, pedestrian routes and crossing points should be clearly marked and as direct as possible.

In a similar vein, light-rail stations should allow for continuous pedestrian routes. Where there are routes on either side, they should continue through the station property, allowing non-riders to take the most direct route, even if it runs through the station.

Create a sense of safety and security

Passengers want their routes to be safe from traffic and crime. Perceived danger is as big a threat as real insecurity and can discourage people from using certain routes.

Build on-street pedestrian routes, and avoid crossings over and under highways or rights of way, particularly if they are indirect routes with no natural surveillance. Where essential, security cameras should be provided. Lighting should be installed at a human scale, between 10 to 12 feet in height, incorporate interesting detailing if possible and provide .75 to 1.5 foot-candles of illumination.[3]

Portland's Max Interstate Line's pedestrian crossings incorporate tactile surfaces, pedestrian-activated traffic signals, lighting from adjacent street lamps and large signage alerting pedestrians to potential traffic danger.

Balboa Park BART Station in San Francisco: Off-street pedestrian routes, with little or no natural surveillance from windows facing the path, tend to attract few pedestrians, particularly at night.

1 Marc Schlossberg. "How Far, by Which Route, and Why? A Spatial Analysis of Pedestrian Preference." 2006. Funded by the Mineta Transportation Institute, a San Jose State University Transportation Center.
2 Nelson Nygaard 2003, *BART Station Access Guidelines*
3 Puget Sound Regional Council, *Creating Transit Station Communities: A*

On-street parking may be used as a buffer between pedestrians and motor vehicles, except where the space is required for bus, taxi or drop-off/pick-up operations. Other traffic calming tools include reduced lane widths, tighter curb radii and plantings to achieve a design speed of 25 mph on local streets surrounding the station.

Crosswalks should be supplied about every 200 feet, including at mid-block locations. The location and type of crosswalk is determined by the size of the street and speed of nearby traffic. Most injuries and fatalities occur as pedestrians attempt to cross the street, and a high proportion of these occur at night, so crosswalks should be marked and lighted. Provide boldly marked crosswalks on pedestrian desire lines and median refuges where crosswalks are not appropriate, but where people will continue to cross anyway. Signalized crosswalks, including countdown-style indicators and audible signals, should be considered on major streets. Sidewalk bulbouts can minimize crossing distances and slow traffic speeds by narrowing turning radii.

Create a comfortable walking and waiting environment

Lighting, building setbacks and orientations, and sidewalk widths are important determinants of whether a pedestrian feels like a welcomed guest. Streets should be designed at a "human scale." For example, station area and sidewalk lighting should be at heights that are oriented to the size and speed of pedestrians, not cars. Pedestrian safety should not be compromised to accommodate greater auto volumes. Double right turn lanes and free right turn lanes should be avoided throughout the station area, particularly along primary pedestrian routes.

Sidewalks should be wide enough for expected pedestrian volumes, particularly around train stations. But they should not be so wide that they feel empty and dead. In fact, some sidewalk crowding can create a feeling of liveliness. All pedestrian routes that arrive at the station should continue past the station property edge to the platform entrance.

Stations should be designed to provide a pleasant environment for riders to wait. Seating, shelter, art and other street furniture should be installed, where appropriate, to humanize a route. Use street trees and other green infrastructure for shade, shelter, streetscape appeal and to provide some separation from auto traffic. A tree canopy and other landscape design creates a more appealing environment for pedestrians while also mitigating some external factors such as sun, wind, rain and traffic. Waiting time at transit stops is weighted more heavily by riders than travel time, so providing information on wait-time reduces resentment.[45]

Provide sufficient information

Schedule technology that alerts passengers to the next few train arrivals take the guesswork out of waiting for the train. Occasional travelers, in particular, need wayfinding information to reach local destinations.

Transit-Oriented Development Workbook.

4 Rabi Mishalani, Mark McCord and John Wirtz, *Passenger waiting time perceptions at bus stops*, Transportation Research Board 84th Annual Meeting, Washington, D.C., 2005.

5 Todd Litman, Victoria Transport Policy Institute, Valuing Transit Service Quality Improvements: Considering Comfort and Convenience In Transport Project Evaluation, May 10, 2007.

Issue #2: What are best practices for providing safe access for special needs communities such as children, elderly, non-English speaking, physically or mentally impaired people?

DESIGN STATION PLATFORMS TO BE IN COMPLIANCE WITH ADA GUIDELINES[6] AND "WASHINGTON STATE RULES AND REGULATIONS FOR BARRIER-FREE DESIGN"

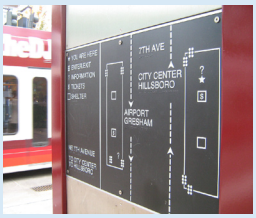
- *Sites should be chosen so that lifts and ramps have sufficient clearance for wheelchairs.*
- *Stations should be connected by an accessible route to the boarding area with a minimum width of 60 inches.*
- *Signs should be installed at an appropriate height from the floor, with appropriate character sizes and use of color.*
- *Sidewalks should be clear of permanent obstacles.*
- *Platform edges should have a detectable warning if they border a drop-off that is not protected by platform screens or guard rails.*

CREATE STREETS THAT ARE EASY FOR CHILDREN, THE ELDERLY AND PEOPLE WITH DISABILITIES TO CROSS

Street crossing improvements could include extending the crossing signal time and reducing crossing distances at intersections through traffic calming measures such as refuge islands or bulb-outs.

PROVIDE DIRECT LINE-OF-SIGHT CONNECTIONS ALONG PEDESTRIAN DESIRE LINES AND PROVIDE WAYFINDING SIGNAGE

The use of transparent material can enable passengers to see the places they wish to walk to and promote feelings of personal security. For non-English speaking people, wayfinding signs should use universal signs to communicate key destinations or be printed in multiple languages.



NE 7th Avenue Station: Portland's Max stations incorporate both Braille into station wayfinding diagrams and Spanish translation into station ticket machines.

Accessible pedestrian signals incorporate large push-buttons that can be actuated by people with limited dexterity. Some models may include vibrotactile arrows and pedestrian instructions (Source: walkinginfo.org and www.mtc.ca.gov).

Countdown indicators can improve pedestrian safety and improve accessibility for slow walkers.

6 ADA Accessibility Guidelines for Buildings and Facilities, Appendix A to Part 1191. www.access-board.gov/adaag/ADAAG.pdf

Sharrows painted in lieu of a bicycle lane along JFK Boulevard through San Francisco's Golden Gate Park (Source: San Francisco Department of Parking and Traffic report entitled, "San Francisco's Shared Lane Pavement Markings").

Issue #3: How should bicycles access stations and how can bicycle parking best be accommodated?

BICYCLE ACCESS

Design adequately-wide bicycle lanes or curb lanes with sharrows

Routes to and from light-rail stations should have adequately wide bicycle lanes, if possible, or wide curb lanes with sharrows at a minimum. Sharrows are roadway paint stencils that remind cars to share the road with bicycles.

Invest in bicycle infrastructure

Bicycles should trigger all actuated traffic signals near the station and the location of bicycle-sensitive loop detectors should be identified with bicycle loop detector pavement markings. This investment in bicycle infrastructure can increase the number of new riders in the area and also greatly expand the geographic area from which transit riders travel without driving.

Create a safe and pleasant experience for cyclists

Make routes to stations attractive to the inexperienced cyclist who might be uncomfortable cycling on arterials with high traffic volumes, even where bicycle lanes are provided. The latest AASHTO "Guidelines for the Development of Bicycle Facilities" are good standards to use. Sidewalks should be used as bicycle routes only when no alternative options are available, and only when they have been designed to safely combine the expected volumes of bicycle and pedestrian traffic.

Design station entrances to minimize conflicts between bicyclists, pedestrians, automobiles and buses

Providing alternative routes means that cycling on the sidewalk should not be necessary. Bicycle and pedestrian entrances into stations should be located at each intersection adjacent to the property and at mid-block entrances. Stair channels to allow riders to wheel bicycles up and down stairs without impeding the flow of pedestrians.

Use signage to explain how bicycle and transit networks relate

Signage is an important element for residents to better understand the bicycle network and how it is integrated with the transit system. There should be signs to the light rail station from adjoining streets and bikeways. All bicycle-related signs should be integrated with signs for other modes and should not interfere with ADA requirements or pedestrian and vehicle circulation. Lastly, there should be maps in the station helping bicyclists orient themselves to surrounding streets, popular destinations and existing bikeways.

Allow bicycles on trains while protecting pedestrian safety or comfort

Bicycles should be allowed on trains in designated areas. If necessary, bicycle access can be managed with regulations, such as implementing rush-hour restrictions on bicycles when trains are crowded.

BICYCLE STORAGE

Provide bicycle parking in convenient, well-lit and secure locations

Bicycle parking should be located in secure, well-lit locations along bicyclists' desire lines between major bikeways to the station entrance. It should be located in areas with high pedestrian flows or where other informal surveillance is possible. However, the first priority is to ensure adequate space for pedestrian circulation, and racks or lockers should not impede pedestrian flows.

Provide sufficient bicycle parking to meet seasonal demand

There should be enough Class I parking (bicycle lockers and attended parking) and Class II parking ("U" and wave racks) to meet demand, including seasonal fluctuations. Bicycle parking should also be protected from weather, such as under a roof or awning. Consider the potential for providing covered parking in other locations, such as bike stations or office buildings.

Design bicycle parking so cyclists can ride up to it

Cyclists should not have to dismount and walk to bicycle parking, but should be able to ride up to it. This means that bike routes should continue as close as possible to the platform entrance. Signs requiring cyclists to dismount generally have limited effectiveness.

Bike parking at stations should be protected from poor weather and in plain view to prevent theft (note glass enclosure above).

The style of the bike parking structure can be tailored to the neighborhood character.

Minimizing the Impact of Parking

DESIGN COMFORTABLE AND SAFE PEDESTRIAN ENVIRONMENTS

Provide direct pedestrian routes through parking. Parking aisles and internal roadways should be designed as comfortable and safe walking environments, with lighting and landscaping. Pedestrian pathways through the parking lots should be indicated with sidewalks, trees, and/or surface markings. Direct pedestrian bridges from garages to the station are not necessary—instead provide safe, well-marked surface-level routes.

DESIGN GARAGES WITH SEPARATE ENTRANCES AND EXITS.

Where parking is provided, care should be taken to minimize its visual impact on the station area and the neighborhood. Garages should be designed with separate entrances and exits so pedestrians and bicyclists crossing these border areas must only pay attention to traffic traveling in one direction, not two.

DESIGN GARAGE AND LOT ENTRANCES TO SLOW VEHICLE SPEEDS

Entrances to garages and lots should be designed for slow entry speeds, using raised crosswalks, speed bumps or raised domes. Parking structures should have street-facing windows or active uses such as retail on the ground floor, particularly on the sides facing major pedestrian corridors. Parking entrances and exits should not be located on major pedestrian corridors, if access can be provided from an alternative street.

Path through Memorial Union's parking lot at the University of Wisconsin at Madison (Flickr source: Kelly Hafermann).

Issue #4: How should station areas be designed to accommodate vehicle movements and parking? What are the best practices for preventing overflow and unwanted parking in neighborhoods?

PARK-AND-RIDE

MINIMIZE PARK-AND-RIDE LOTS AT TRANSIT STATIONS

An oversupply of park-and-ride lots at transit stations will undermine compact land use strategies. However parking availability at stations that draw passengers from a large suburban area may be a requirement for ridership success. As an example, the Puget Sound Regional Council recommends park-and-ride lots only for stations around which immediate development is not expected. A local or regional agency should manage the park-and-ride lots.

GIVE PRIORITY SPACES TO MOTORCYCLES AND CARPOOLS

Park-and-ride facilities should give priority to motorcycles and carpools over single-occupancy vehicles, by allowing them to park closer to the platform entrance than the majority of the at-large parking spots. In garages, carpool and motorcycle parking should be placed on the first or second floors.

RESERVE CAR-SHARING SPACES IN HIGH-PROFILE LOCATIONS

Reserved spaces for car-sharing services should be in an area that is closer to the platform entrance than the majority of the at-large parking spots. Where clearly visible locations are available, car-sharing spaces can be provided on-street.

USE DESIGN FEATURES THAT SLOW DOWN CARS

The design speed for vehicles should be 5 mph, using tight turning radii at corners, narrow lanes and other design features to slow cars.

EMPLOY ITE TRADITIONAL-NEIGHBORHOOD-DEVELOPMENT STREET DESIGN STANDARDS

Not all roadways on station property must accommodate emergency vehicles or service vehicles such as cash handling trucks, although designated service routes should be provided. Emergency access can often be provided through pedestrian areas, using knock-down bollards.

KISS-AND-RIDE AND TAXI FACILITIES

Where drop-off and pick-up areas (kiss-and-ride) and taxi facilities are provided at high-capacity stations, the following parameters should apply.

Provide clearly marked kiss-and-ride and taxi facilities

These should be clearly marked and should be located to maximize safety and minimize congestion impacts. Drivers should be able to stop without impeding traffic flow or delaying transit vehicles.

Give priority to transit and pedestrians at drop-off areas

The drop-off area and taxi stand should be located as close as practical to the platform entrance. However, bus, shuttle and paratransit services are a higher priority for this curbspace. Pedestrian crossings of the drop-off lane should include a stop sign and a marked crosswalk, to allow pedestrians to cross easily and safely. Signage should direct both vehicles and passengers exiting stations to drop-off and pick-up areas.

Design sufficiently large pedestrian areas

The pedestrian area should be designed with enough space to accommodate passengers waiting to be picked up. The waiting area should have pedestrian-scale lighting, seating and weather protection. It might be possible to combine transit and drop-off waiting areas if automobiles do not delay transit vehicles.

Locate taxi stands so they are visible from station entrances

The capacity of taxi stands should reflect the importance of taxi trips for a particular station. The telephone numbers for taxi providers in the area should be displayed and public telephones should be provided.

Kiss-and-ride facilities should be clearly marked and accompanied by sufficiently large pedestrian waiting areas (Flickr sources: Mike_fj40 above and gillicious below).

In order to prevent visitors and employees from parking on residential streets, a residential permit district (also known as preferential parking district) may be established to issue parking permits to residents. These permits allow the residents and their visitors to park within the district while all others are prohibited from parking there for more than a few minutes.

OVERFLOW PARKING

Preventing overflow parking in adjacent neighborhoods

Overflow parking is often a concern with neighbors. The following best practices are simple proven parking demand management tools:

Reduce city parking requirements within a ½-mile station radius of the station.

Price parking to distribute the demand throughout the day. A higher fee should be charged to morning peak hour commuters and no early bird discounts should be given.

Provide passenger parking ¼ mile from platform entrance. Parking does not need to be provided directly adjacent to the station.

Provide signage to other parking options at the same station or in the same travelshed, where parking facilities regularly fill to capacity. Where there are several parking facilities at one station, provide real-time information signage directing drivers to parking lots with available space.

Design shared parking. For example residential or entertainment users might use station parking during evenings and on weekends.

Establish a residential parking zone program. Residential permit districts allow communities to manage residential parking demand while generating extra revenue to fund neighborhood improvements. Parking permits are provided to residents of the district for free or for a small fee, and if extra parking capacity is available, additional permits can be sold to non-residents at a market rate. New revenue generated from the sale of non-residential permits can be spent on local public service or infrastructure improvements, such as better parking enforcement, sidewalk improvements or street tree plantings.

Issue #5: What are the best practices for providing transit service to deliver passengers to and from stations?

Successful multi-modal station design should consider the design of pedestrian routes between modes, the provision of information and the impact of vehicle movement (buses, trains) on the pedestrian experience.

Design stations to ease intramodal transfers

Stations should cater to multi-modal passengers who will demand that transfers feel effortless. Buses or shuttles should meet every train, if possible. Schedules should provide overlapping arrival and departure times and real-time vehicle arrival and departure information should be provided. Ideally transit operators should provide a single-payment fare structure so that passengers are not required to purchase a second ticket at the transfer station.

Locate bus stops to minimize walking distances and avoid street crossings

Well-located bus stops will minimize walking distances to platform entrance and avoid the need to cross roadways, particularly busy arterials. Where a highway needs to be crossed, the bus stop should be located adjacent to a marked crosswalk. Passengers should not have to cross more than one major roadway. Minimizing distances between bus stops also facilitates bus-bus transfers and simplifies bus-light rail transfers. Transit stops should be immediately visible upon exiting the platform. Bus stops should not be located where they will block crosswalks, obstruct traffic signals or be obscured from motorists, bicyclists and pedestrians.

Design sufficient bus bays or curb space

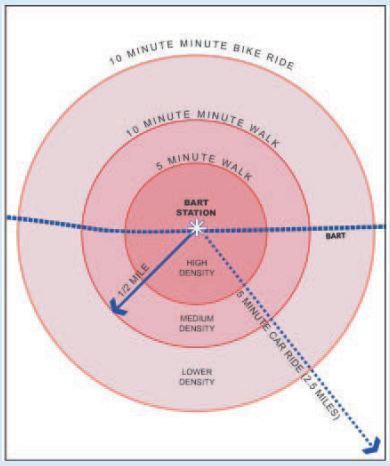
Bus transit providers should design sufficient bus bays or curb space to meet peak demand and expected future growth. Where infrequent services mean pulse scheduling is required, with all buses present to load and unload simultaneously, this should be accommodated. However, bays can be shared between different routes and operators, including paratransit vehicles, in order to minimize the amount of space needed.

Provide on-street bus stops

Bus stops should be located on-street, unless off-street facilities are necessary to accommodate layovers or transfers, or avoid passengers having to walk through a parking lot. In addition, layovers at light rail stations should be discourage. Where these are essential for operational reasons, however, sufficient layover space should be provided to meet peak demand. Layovers should not occur along key curbspace at the station entrance.

Bus stops, such as this one outside Albina Station on Portland's Max Line, should be easily visible from light rail stations in order to facilitate transfers.

Clear and abundant signs direct passengers to allow for quick transfer to their next mode.



Land within a half-mile radius from the station, equivalent to a 10-minute walk, offers the best opportunities for development to boost walking trips to light rail (Source: Nelson\Nygaard report, Bart Station Access Guidelines, October 2003).

Private shuttles can help solve the last-mile problem of getting passengers to their destinations.

Issue #6: What are the best practices for providing access to stations for people that live beyond the typical walking distance?

Promoting bicycling is one of the most efficient ways to increase the catchment area of a station. While passengers are usually willing to walk a half mile to a station, or about 10 minutes, they can travel more than two miles by bicycle in the same amount of time.

Provide feeder transit service

Feeder transit service is an alternative to driving to a station for riders living more than half a mile from the station. It can expand the catchment area of a station considerably—particularly for riders who are unable or unwilling to drive. Feeder transit is also important for the elderly and persons with disabilities, who may have difficulty walking even a few blocks to the station.

Complement public transit service with private shuttles

Private shuttles,operated by private entities, can provide a useful complement to regular public transit service, particularly to sites such as hospitals, large employers, shopping districts, office parks and schools. Some offer timed transfers to a limited number of peak-period services, but many simply circulate. Most provide free service to eligible riders.

Shuttles are also useful in serving employment destinations that are not served by regular feeder buses. In general, it is preferable to serve employment destinations via regular feeder bus services, as these have the greatest potential to serve other riders. Care should be taken not to duplicate existing bus transit services when designing shuttle routes. However, in many cases—particularly where regular transit is infeasible due to cul-de-sacs, a discontinuous street grid or lack of sidewalks—shuttles may be the most effective and efficient option.

Other Resources

Ewing 1999 Pedestrian and Transit-Friendly Design

Research Findings
Construction Impacts and Mitigation

Construction of light rail lines can cause impacts such as property access limitations, traffic disruption, noise and dust. The extent of potential disruptions is influenced by adherence to local, state and federal regulations, clear and concise construction agreements, and coordination with residents and the business community. Experience has led transit agencies and their contractors to utilize a variety of practices to help mitigate those impacts.

This memo examines methods used in current or completed light rail transit and other major capital construction projects to address neighborhood issues, communicate project messages, promote and support businesses, and reduce the environmental impacts to sensitive areas during construction. The literature review for this memo drew from the experience of cities with light rail construction in residential and downtown areas, including at-grade, elevated and tunnel sections. Specifically, light rail transit construction projects were examined in the following cities: Dallas, Denver, Los Angeles, Minneapolis, Salt Lake City, and San Diego. Findings support the summation that mitigation is a collaborative process between an agency, the local city, surrounding neighborhoods, and the business community. Mitigation measures often involve a trade-off of gaining improvements (e.g. context-sensitive noise walls) at the expense of project time and cost. The strategies used to mitigate a construction impact are dependent on the situation and what is most practical for a given area.

Research Findings
Construction Impacts and Mitigation

SEPA: State Environmental Policy Act

NEPA: National Environmental Policy Act

Issue # 1: What are the most effective techniques used by other systems to mitigate impacts related to construction? Who is responsible for maintaining mitigation?

Impacts of light rail construction are similar to those of any significant capital project and typically include aesthetics/visual, noise, vibration, dust, traffic, safety and security. Temporary effects of construction can result in the creation of barriers, loss of vegetation, disruptions from lighting and noise, dust accumulation, and general annoyance due to the presence of construction materials and equipment. A variety of techniques have been used to mitigate the impacts that result from construction of a light rail line and are described by the type of impact.

Soil Erosion and Air Quality

Excavation and grading for light rail construction should be managed in a way to control erosion and sediment flow, as well as airborne dust emissions. The development of measures to mitigate potential soil erosion and air quality impacts often occurs through the preparation of a mitigation plan in advance of construction. City issued permits may also contain appropriate restrictions and mitigation requirements. Mitigation plans should also follow all state and federal (SEPA/NEPA) regulations.

Depending on the type of impacted environment, mitigation measures could include:

- *Watering areas of exposed soil to control fugitive dust.*
- *Covering open body trucks which transport materials to and from construction sites.*
- *Using wheel baths or rock aprons to prevent dirt or mud from being carried from construction sites onto public streets.*
- *Promptly removing accumulated soil and other materials from paved streets.*
- *Temporarily paving, repaving and/or revegetating exposed areas during specific phases and after completion of construction.*

Visual and Aesthetic Conditions

Construction impacts can include the movement of construction equipment, construction of temporary roads and access ways, the presence of construction materials and equipment in staging areas, and the actual construction activity. Various mitigation techniques have been used to minimize the visual and aesthetic impact of light rail construction. In neighborhoods, the construction of temporary fences and screens can be used to shield staging and construction areas from the community. For example, Sound Transit constructed temporary walls with insulation around the Beacon Hill station staging area to mitigate the visual and noise impacts of construction. Some projects have also used solid fencing at the request of neighborhoods and have used them as opportunities for public art.

Noise

Noise and noise mitigation are often two of the most important aspects of a construction project for residents and businesses. Noise impacts are typically different for residential areas and businesses.

For example, residential areas may have a greater need for noise mitigation at night, whereas businesses need noise mitigation throughout their hours of operation. Examples of standard noise mitigation techniques include:

- *Completing a detailed construction noise assessment during final design to identify sensitive noise receptors, such as residences, offices, hotels, and entertainment districts.*
- *Conducting construction activities according to state and local requirements.*
- *Providing an appropriate waiver process for unique construction circumstances.*
- *Employing design considerations to reduce impacts to receptors such as temporary noise barriers, routing trucks away from residential streets, and locating noise-generating equipment as far as possible away from noise sensitive areas.*
- *Using an operations sequence that avoids nighttime construction in residential areas or altering construction practices to reduce noise at night.*
- *Utilizing alternative methods, such as drilled piles instead of impact pile driving; requiring noise suppressed equipment in construction specifications, and using alternative demolition or pavement breaking techniques.*

The T-REX Southeast Corridor light rail project in Denver, Colorado was a five-year, 17 mile highway and light rail construction project along the southeast corridor of Interstates 25 and 225. Before construction began in fall 2001, T-REX staff organized regular meetings with affected residents. T-REX used the following methods to keep residents informed and to mitigate noise impacts:

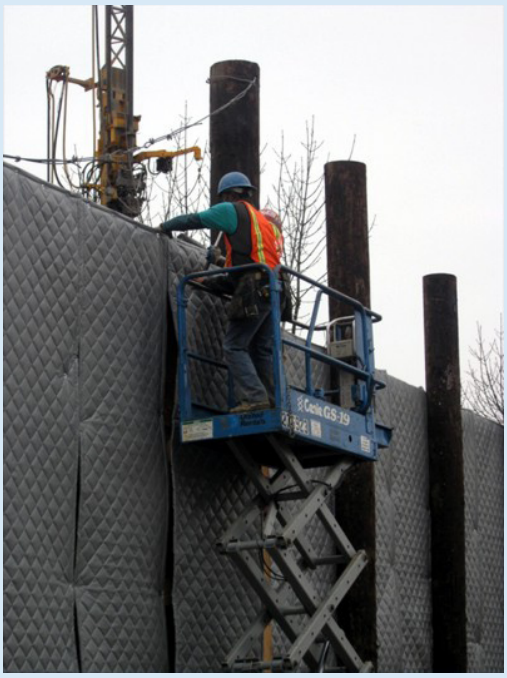
- *A 24-hour hotline to call-in noise complaints.*
- *Temporary noise walls in the form of semi-trailer box cars that could be moved to different sites.*
- *The limited use of hotel vouchers for affected residents within close proximity to nighttime bridge demolition work.* [1]

Vibration

Construction vibration impacts are usually intermittent and temporary. A detailed vibration analysis can be conducted during final design to identify properties that may be affected by construction of a light rail line. This analysis can build on data collected during preparation of the Environmental Impact Statement (EIS). Within built environments, mitigation techniques could include:

- *Establishing vibration limits during the construction period for nearby buildings. Historic structures may require special attention.*
- *Requiring contractors to monitor and report vibration levels at nearby buildings throughout the excavation and construction phases.*
- *Monitoring foundation conditions at nearby buildings.*

1 Federal Transit Administration Project Management Oversight Program, Contract No. DC-27-5004 Task Order No. 6, CLIN 0004-Lessons Learned Program PG No. 14: Grantee: Regional Transportation District (RTD). Lessons Learned The T-REX Mega-Project Experience. June 2007.



Installation of noise blankets at Beacon Hill Light Rail Station, Seattle. (photo courtesy Sound Transit)

To reduce traffic and noise impacts to businesses, a significant amount of demolition and major reconstruction work for the T-REX project occurred at night. (photo courtesy T-TREX).

- *Phasing demolition, earth-moving, and other ground impacting operations so they do not occur in the same time period.*

SAFETY AND SECURITY

Safety and security is often a primary concern of both the transit agency/project sponsor and public. The contractor should ensure appropriate storage and security efforts both along the light rail line and staging area. Contractors want to restrict access to reduce area theft, vandalism and safety risk. Mitigation techniques that have been used to facilitate a safe and secure project site include:

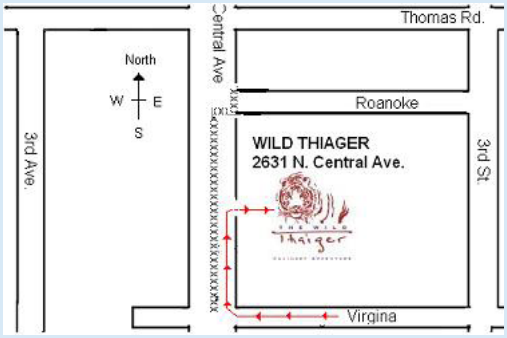
- *Using temporary construction fencing and barricades around all construction sites.*
- *Controlling access into construction sites and require all contractor personnel to display appropriate identification badges.*
- *Requiring the contractor to provide adequate flagging and traffic control during operations in the public right-of-way.*

Literature suggests that the following best practices can be used to keep affected residents and businesses apprised of project changes and reconcile conflicting wishes and concerns:

Best Practices:

- *Develop a written policy governing how impacts will be handled, monitored, and establishing deadlines for mitigation requests and a process for evaluating and considering requests.*
- *Hold regular meetings with affected residents and businesses before construction begins and regularly during construction.*
- *Provide advance notification of proposed changes to a mitigation approach/plan and communicate to all affected parties prior to the actual change.*

Business access signage for Mall Extension light rail construction, Portland, OR (Damian Conrad Photography)



Access Plan for local business access during light rail construction when the typical access was temporarily closed, Phoenix, AZ (photo courtesy METRO Transit, Phoenix, AZ)

Issue #2: What are successful examples of providing local access to businesses, visitors, and residents during construction?

Approaches to providing local access during construction are the same as those during any major construction project. Approaches include keeping roads partially open and timing activities requiring a significant portion of the road closure to coincide with off-business hours. Where construction affects sidewalks in business and residential areas, temporary sidewalks or bridges over excavations can be used to maintain access. Access and parking can be managed through temporary access permits and local agency review and approval of parking management plans submitted by the contractor.

For example, in Salt Lake City, two lanes in each direction on University Drive were kept open during construction and access was provided to businesses at all times, with a significant portion of work taking place at night. The city developed roadway project construction criteria for signage, public information, and citizen advisory committees in an attempt to clearly communicate construction impacts, schedule, road detours and access points. [2]

Best Practice:

- *Work closely with the transit agency, contractors, and community to develop construction management plans when adequate details are available*

Access for pedestrians and businesses during light rail construction on the Transit Mall in Portland, OR (Damian Conrad Photography)

Construction of light rail line along Central Avenue, Phoenix, AZ. Through lanes kept open with access crossovers approximately every ¼ mile (photo courtesy METRO Transit)

2 Light rail Construction: Mitigation of Business Interruption; a survey of methods used in six cities during recent projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 21, 2006.

Issue #3: What are the best practices for phasing and staging construction to minimize disruption to street functions and local community life? What are the best practices for traffic management around light rail construction, both along the route and at staging areas? What techniques have been used to reduce the size needed for staging areas?

Contractors typically include staging and phasing plans as part of a Maintenance and Protection of Traffic Plan. Items to be considered when planning for construction staging and phasing include:

- *Space needs for material and equipment storage.*
- *A design to ensure contractor and motorist safety.*
- *Methods and opportunities to minimize cost and shorten the project timeframe.*
- *Opportunities to partner as a means of reducing cost and duration.*
- *Opportunities to minimize conflicts with utilities or other right-of-way (ROW) uses.*
- *Detour routes and low-cost improvements to facilitate traffic movement.*
- *Maintenance of adequate road capacity to critical locations, such as to hospitals*
- *Contractor needs for moving materials and equipment to and from work areas.* [3]

Case Study:

The City of Portland instituted a series of construction guidelines that contractors were required to follow to mitigate the effect on local businesses. The guidelines included construction in a maximum length of four blocks at a time and breaking the construction into phases, including separate phases for utility relocation and civil construction. Each phase of construction was completed in one reach before starting the next reach. About eight weeks were allowed per reach to rebuild outside lanes and sidewalks. The streets and sidewalks were restored if gaps existed between utility relocation and civil construction phases. The guidelines required that access be maintained via vehicle routes into parking and pedestrian routes into business entrances. Driveway/ doorway reconstruction was scheduled to accommodate business hours and at least one sidewalk was to remain open on each route at all times.

Transportation, Traffic and Parking

The impact of light rail construction on traffic flow and parking can be significant but there are ways to reduce the effects. For example, the following mitigation measures have been used in other project settings to maintain traffic flow:

- *Conduct off-peak hour construction to minimize disruption to access, driveways and business entrances.*

Message alerts, Dallas Area Rapid Transit (graphic courtesy Dallas Area Rapid Transit)

3 Interviews with Richmond Business Owners.; an informal survey of concerns about the possible LRT line in Richmond. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 18, 2006.

- *Relocate utilities simultaneously with construction of the light rail trackway where prudent to avoid additional disruption due to construction. Alternatively, advance utility relocation may be desirable to speed trackway construction and limit excavated areas.*
- *Place mitigation measures in construction contract specifications and plans to require responsible construction practices by contractors.*
- *Provide full and controlled pedestrian access to businesses.*
- *Limit open excavation and trackway construction and coordinate construction phasing to minimize impediments to traffic and pedestrian movements.*
- *Identify festivals or other special events during which construction will be limited or prohibited in the construction specifications.*

In an effort to inform the public of upcoming work, road closures and to provide information about detours, the T-REX project in Denver and the Dallas Area Rapid Transit (DART) have used fixed Dynamic Message Signs (DMS).

Staging Areas

Staging areas need to consider their location relative to the construction area, land availability, and access route. A larger staging allows for more storage of construction materials and equipment and may allow for a shorter construction period if all materials and equipment are on site. However, larger staging areas require more land. A smaller staging area may minimize the land requirements, but require more complex construction plans to coordinate the timing of materials and equipment use and storage due to space limitations.

Construction staging areas should be designed to minimize inconvenience to adjacent land uses. Contractors could be required to provide a staging area parking and access plan prior to work. Various local agencies require submission of a job site plan that describes the staging area, location and number of construction-related vehicles, and ensuring emergency vehicle access. [4] Considerations to minimize inconvenience could include preserving on-street parking for neighborhoods/businesses or requiring the contractor to provide parking for their employees. This regulatory requirement could be implemented on a large scale for light rail construction projects.

Staging areas can also include parking for construction vehicles, workers and project contractors. The staging areas should account for space required to accommodate these vehicles or develop alternative parking management strategies. Contract specifications can be used to require contractors to transport workers from remote parking lots to the work site to minimize worker parking in congested areas. Travel routes could be established to direct vehicle travel in an effort to reduce neighborhood impacts. Parking access times could also be established to regulate travel periods to the staging area.

Staging Area, Interstate 205 MAX Extension, Portland. (Damian Conrad Photography)

Case Study:

4 City of Aspen, Colorado. Aspen Parking, Construction Staging and Emergency Access Plan. 2004.

During the preparation of the Final Environmental Impact Report (FEIR) for the Capitol Corridor Light Rail Project in San Jose, California, the Valley Transportation Authority (VTA) Board of Directors adopted Findings of Fact for each significant effect. A Mitigation Monitoring and Reporting Program (MRP) that outlined when and how the project mitigation measures are to be implemented was adopted and the project approved. For staging areas, the MRP required the following actions:

- *Pave, apply water three times daily, or apply (nontoxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.*
- *Sweep daily (preferably with water sweepers) all paved access roads, parking areas and staging areas at construction sites.*
- *Sweep streets daily (preferably with water sweepers) if visible soil material is carried onto adjacent public streets.*
- *Staging of construction equipment and unnecessary idling of equipment within (200 feet) of noise-sensitive land uses will be avoided whenever feasible.* [5]

Best Practices:

- *Advance design of staging areas to be able to thoroughly evaluate trade-offs before selecting staging areas*
- *Develop a construction management plan that includes a decision-making process, framework for dispute resolution, and clear roles and responsibilities of the city, transit agency, contractors, and other community organizations*

5 Tasman East Light Rail Project Environmental Assessment, Capitol Corridor Light Rail Project Environmental Assessment, Santa Clara Valley Transportation Authority (website). Last Updated: December 09, 2007

Issue #4: What are models for providing community and business support (i.e. promoting patronage to impacted businesses) during construction?

Mitigation programs take many forms, and can include financial, marketing, management, information, and communication support. Business and neighborhood concerns can be incorporated into agreements with a transit agency/project sponsor. Programmatic efforts can be integrated into construction practices as part of city issued permits. Cities and transit agencies can also modify their management procedures to be more collaborative and responsive, and promote accountability for business impacts in their organizations. It should be noted that each community is different and there isn't a blanket approach to mitigation. Programs are individually developed for each community based on the needs and the type of impact as a result of the nature of construction.

Public and Business Involvement

Advisory Committees

Proactive public involvement practices during construction can take many forms. For example, during the construction of the Hiawatha light rail line in Minneapolis, a 40-member Community Advisory Committee (CAC) was empowered by statute and charged by a Corridor Management Committee to advise policymakers on a full range of issues with a direct community impact, take the lead on citizen participation, and recommend the structure of communications. The CAC was responsible for keeping community residents, transit riders, the general public and other interested parties continuously informed and involved in the project, and for facilitating two-way communication between the project and neighborhood groups. The CAC was successful in advising the project's management committee on station area land use, station design, feeder bus routes, and impacts on residential and business communities. The management committee was better equipped to communicate with the public and interested parties.

Project Messaging

The contractor hired to complete the T-REX Project, Southeast Corridor Constructors, made it their number one goal to reduce inconvenience to the public. As a result, $3 million of the budget was set aside for Transportation Demand Management (TDM) activities during construction. Activities included transit and vanpool subsidies, community outreach and education as well as maintaining a project website. In addition, other organizations in the area partnered to provide outreach and incentives to encourage motorists to use alternative modes of transportation.

Extensive public meetings were held during the planning phase of the T-REX Project to let the public participate in decisions that affected their communities. In addition to construction issues, public input was sought for transit station design, sound wall aesthetics, and similar aesthetic-related project elements. The project team worked with the public to include their suggestions within the established budget. This helped to give the neighborhoods and stations identities and tailor the design to fit the context and "feel" of the area.

A website was also developed to provide T-REX information and updates and contact names. The team used the website along with a 24-hour telephone hotline to provide notice of road closures, detours, and construction phasing areas and periods. A project newsletter was mailed to impacted areas and provided on the website to provide up-to-date information about the progress of construction. Keeping the public informed about the progress of T-REX and upcoming construction activities and delays was critical to the project's successful ability to obtain a high-level of "buy in" to the project by the commuting public, local residents and businesses, and stakeholders. [6]

Another strategy of the T-REX public involvement process was to provide "Vision, Progress, and Coping" messages in print media and on electronic signs above the affected highways. Much of this information consisted of progress updates, upcoming projects, and alternate route planning. These messages were often used by local media and broadcast over radio and television outlets. The timely release of the messages was critical to the success of this communication method. [7]

Business Support

Many transit agencies have realized the importance of providing measures of business support during construction periods that match area needs. During construction of an extension to their existing light rail system, Portland's TriMet included four dedicated community relations staff available for one-on-one contact with businesses to provide regular information updates and respond to complaints. TriMet also established a construction hotline, with community relations staff and construction staff accessible on a 24-hour basis. Business association support was provided through office space and financial assistance to print and mail a monthly newsletter. [8]

Additional examples of business support include:

- *In Los Angeles, the transit authority worked closely with businesses to find effective and easy-to-implement solutions to parking impacts during construction of the Eastside extension of the Gold Line. The transit authority added angled parking and additional parking spots to streets where possible to reduce business concerns regarding parking and access to their sites.* [9]
- *In Salt Lake City, an independent contractor served as a construction mitigator on the University line and was paid by the City and the transit authority to have regular contact with the businesses.* [10]

The T-REX Project Team created an instantly recognizable brand and logo to ensure disseminated information was associated with T-REX (courtesy T-REX)

6 FTA PMO Program, Contract No. DC-27-5004 Task Order No. 6, CLIN 0004-Lessons Learned Program PG No. 14: Grantee: Regional Transportation District (RTD). Lessons Learned The T-REX Mega-Project Experience. June 2007.
7 IBID
8 Light rail Construction: Mitigation of Business Interruption; a survey of methods used in six cities during recent projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 21, 2006.
9 Impact of LRT Construction on Existing Businesses; Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. May 1, 2006.
10 Light rail Construction: Mitigation of Business Interruption; a survey of methods used in six cities during recent light rail projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 18, 2006.

- *The City of Portland maintains records on the affected small businesses as part of light rail construction mitigation efforts and has found many success stories. Past experience shows that those business owners who participate in city programs such as distributing and maintaining up-to-date information, and anticipating and planning ahead for the changes and potential financial loss, are much more likely to "weather the storm."* [11]

Management and Financial Assistance

In several cities, transit authorities have helped coordinate a local service to offer low interest loans to mitigate the temporary negative effects of light rail construction on small businesses. The use of management and financial assistance efforts includes the following examples:

Case Study 1:

Salt Lake City established a revolving low interest loan program and set aside funding for construction mitigation up to $20,000 at 3% interest for businesses located within one block of the line work to apply toward options ranging from rent payments to business advertising. [12] The Salt Lake Chamber of Commerce organized a triage approach to construction mitigation for their light rail project, in cooperation with the Downtown Alliance, Salt Lake City Corporation, and major project sponsors. Major work tasks included forming a Community Advisory Committee (CAC); working with developers and the CAC to develop Memoranda of Understanding (MOUs) to formalize protocols to follow during the construction period; establishing a construction impact mitigation incentive fund; having project staff available to resolve issues related to business access, traffic, parking, utility disruption, and temporary alternative transit plans; assisting with content for a one-stop website; implementing a hotline for public emergencies and concerns; and initiating regular communication with stakeholders via email newsletters, one-on-one visits, regular meetings and open houses. Members of the CAC attended project inspections when there were concerns on the part of developers, the city or adjacent property owners and businesses. A business marketing campaign was implemented and impacted businesses were referred to city services for small business loan assistance. [13]

Case Study 2:

During construction of METRO Transit's light rail line in Phoenix, the city has contracted with private-sector consultants to provide management technical assistance to assist with accounting projects and financial systems development, financial reviews and loan packaging, workforce recruitment, retention, training and development, and office technology development. The City also offers different types of loans to corridor business owners, including:

- *Expansion Assistance and Development: A collateral reserve deposit that offers enhancements up to $150,000 are available at no cost to METRO Light Rail line corridor businesses or to their lenders.*

11 Light rail Construction: Mitigation of Business Interruption; a survey of methods used in six cities during recent projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 21, 2006.
12 IBID - July 18, 2006.
13 Construction Impact Mitigation Plan, Downtown Salt Lake City. Salt Lake City Chamber of Commerce. March 31, 2006.

- *New Markets Loan: Provides below-market rates on loans to stimulate economic growth in low-income areas. Project minimums are $1 million and loan repayment terms range from one to seven years.*
- *Community-based micro loans: A fund that helps small businesses access capital in amounts ranging from $200 to $35,000.* [14]

Case Study 3:

During construction of Portland's Interstate line, TriMet was able to assure that management and financial assistance were provided to businesses as a result of collaboration between the City, Portland Development Commission (PDC), Albina Bank, and Cascadia Financial Group to establish a revolving fund. The PDC offered business assistance in the form of pre-development (pre-construction) assistance, business loans, and storefront façade improvement funds. An outside consultant was used to assess the condition of businesses before the construction and then again immediately after construction. A small loan program (up to $100,000) was made available to businesses if their cash flow was impacted and they could not meet their obligation. In an effort to maintain the vitality of an area and reduce further financial impacts, businesses that were already failing were offered up to a $25,000 short-term business loan to help maintain their operations during the construction period. Cascadia Financial provided business and technical assistance to applicants and borrowers with financial tools and business advising. For larger borrowers, Cascadia offered business coaching (signs, space configuration, curb appeal, accounting, and advertising). If a client's needs were beyond their parameters, Cascadia helped find professional assistance. [15]

Business Marketing

During construction of some recent light rail projects, project sponsors have recognized a need to provide business assistance in the form of advertising and promotion.

In Salt Lake City, funds were allocated for business advertising and customer signage to assure customers that businesses were still open during construction. Examples included "Still in Business" advertisements; special sales promotions; coupons for local shops; and mini-celebrations as segments of construction were completed. [16]

Valley Metro Rail in Phoenix, Arizona implemented a construction signage program at the start of their light rail construction project to provide businesses with a complimentary sign or banner advertising their business during light rail construction. [17]

14 METRO Business Assistance Plan. METRO Light rail. METRO Light rail. org. Phoenix, Arizona. May 2007.
15 Light rail Construction: Mitigation of Business Interruption; a survey of methods used in six cities during recent projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 21, 2006.
16 IBID
17 METRO Business Assistance Plan. METRO Light rail. METRO Light rail. org. Phoenix, Arizona. May 2007.

Portland's TriMet marketing efforts for all of their projects include "Open for Business" signs and banners, monthly transit passes to winners of monthly drawings, ads on buses, a business directory on the TriMet website, and scheduled special events to draw people to the area. [18]

Business Impact Mitigation

Light rail line construction has differing impacts on businesses depending on the location of the business in relation to the actual construction, the type of construction, and the timing of construction. Different approaches may be required for business coordination and outreach depending on these differing impacts and nature of the construction. The following are examples of approaches that project sponsors have used to communicate and mitigate potential business impacts:

- *In Dallas, the North Central Task Force (NCTF) created a Mobility Task Force to look at better ways to build the light rail segment, and a communications component, where NCTF notified businesses a year in advance of what to expect and when, and kept them informed during construction. A Right-of-Way Task Force was created to determine which properties were needed and each owner was contacted well in advance. Personal contact with the property owners was key to their approach.* [19]
- *The City of Portland assigned a full-time engineer to serve as the City's Project Manager on recent light rail construction and the individual was integrated into TriMet's project management team. The City also implemented a holiday moratorium on construction so that businesses could capitalize on seasonal revenue without disruption. The three mile long project was divided into three sections, and the City assigned a staff person to each section to work with the businesses.* [20]

Best Practice:

Engage the Business Community Early and Consistently to Develop and Implement Meaningful Mitigation Programs

Research suggests that while few business owners desire a high level of involvement in actual construction monitoring activities, they would like to be kept informed as additional information becomes available. The public forms opinions based upon information they gather from a variety of sources, including meetings led by community activists, conversations with other business owners, communications from the project sponsor (City or transit agency), public statements and news coverage, and through their own experiences, observations and data gathering.

Many transit agencies have been successful at engaging local business owners and managers, and making them aware of construction plans to allow them to operate their businesses successfully through the construction. A major factor appears to be concerted proactive efforts by the transit agencies or oversight groups to minimize the negative effects on businesses along a line.

18 Light rail Construction: Mitigation of Business Interruption; a survey of methods used in six cities during recent light rail projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. July 18, 2006.
19 IBID - July 21, 2006.
20 IBID

Issue #5: What are the best practices for construction and design techniques in environmentally sensitive areas?

Impacts to environmentally sensitive resources are typically identified during the environmental review process. Procedures to mitigate impacts are developed as part of final design and are incorporated as conditions in the environmental Record of Decision issued by the Federal Transit Administration. Environmental topics of concern can range from ecological impacts (floodplains, groundwater, surface waters and wetlands, and threatened and endangered species), to historic and archaeological resources, and include contaminant sites. The environmental review also addresses noise and vibration impacts, visual impacts and traffic, among other topics.

Ecological Resources

Water related resources affected by light rail line construction can include floodplains (impact to channel geometry), groundwater (depth of groundwater table), surface waters (stormwater management and contaminants containment), and wetlands (temporary removal of vegetation, increased stormwater runoff, increased sedimentation in wetland areas).

Many techniques can be used to mitigate impacts to environmentally sensitive areas, including:

- *Floodplains and floodways: Design bridge and culvert crossings to minimize backwater conditions, and rail/road profiles designed to minimize overtopping.*
- *Groundwater: Monitor groundwater table depth, contain/manage contaminants.*
- *Surface Water: Restrict in-stream construction activities to periods of low-flow or based on needs of local fish populations; require contractors to install hay bales and/or fabric filters at the construction area periphery to filter out sediments from stormwater runoff prior to discharge into storm sewer inlets and surface waters.*
- *Wetlands: Install fabric filters along the periphery of the wetland (or construction zone); revegetate within temporary construction areas with native plantings in a timely fashion. Require wetland replacement at ratios established by local regulators based on the type of wetland affected.*

Historic and Archaeological Resources

Construction activities and the resulting noise, vibration and dust could have impacts on historic and archaeological resources. Techniques used to mitigate these impacts could include:

- *Conduct pre-construction surveys to identify the presence of archeological or historic resources.*
- *Coordinate measures to address impacts to identified resources with the State Historic Preservation Office and local resource agencies.*
- *Include construction specifications that require the contractor to halt work if previously unidentified resources are encountered during construction.*

Construction of bridge crossing using hay bales and/or fabric filters runoff control strategies to minimize impact on surrounding land.

- *Minimize fugitive emissions by watering areas of exposed soil, covering open body trucks, and removing soil and other materials from paved streets.*
- *Restrict hours of construction and use sound dampened equipment.*
- *Monitor vibration levels and establish vibration limits, monitor foundation conditions at nearby buildings.*
- *Phase demolition, earth-moving, and other ground impacting operations.*
- *Restore any site to at least its pre-construction condition.*

Hazardous Materials and Contamination

Contaminated or potentially contaminated sites and underground storage tanks along the corridor should be identified prior to construction. Specific approaches that could be used to deal with hazardous materials and to avoid the spread of contaminants include:

- *Require the construction contractor to have a hazardous material spill prevention plan and emergency response procedures in place prior to construction.*
- *Require the use of specialty sub-contractors to remove contaminated soil or other hazardous materials, and require proper documentation of disposal in designated hazardous waste disposal sites.*
- *Conduct field monitoring during excavation and dewatering to identify changes in conditions and require the contractor to stop work upon discovering contaminated or potentially contaminated materials.*
- *Have technically qualified personnel available to respond to the discovery of contaminated or potentially hazardous materials and to determine the proper course of action.*
- *Stockpile excavated soils on heavy, waterproof plastic and segregate and cover any contaminated materials.*

Best Practices:

- *Use innovative resource management techniques to meet community standards and objectives*
- *Create an environmental management plan with clear responsibilities for monitoring, maintaining, and managing environmental mitigation efforts*

Issue 6: What Incentive Strategies Have Been Used To Minimize Construction Impacts?

Incentives, mostly in the form of financial bonuses, have been applied in various projects to establish and maintain a high level response by contractors to business and resident concerns. Incentive programs that have been implemented in other cities include:

- *In Salt Lake City, business owners were provided control over contractor bonuses for the most recent light rail project. The Downtown Business Association negotiated with the City and established a contractor incentive program. There was a community hotline to the contractor at all times for any complaints or concerns and the contractor was required to respond immediately. While businesses experienced problems, the Utah Transit Authority (UTA) allowed the affected businesses to control bonuses given to contractors during construction of the first rail line and during construction of the University Line. This proved to be very effective and resulted in a more proactive effort by the contractor to become engaged with the affected businesses. In addition, the contractor took much more ownership of business outreach and coordination efforts.* [21]
- *During construction of the Valley Metro Rail Line in Phoenix, Community Advisory Boards (CABs) review the contractor's interaction with the public during construction. The CABs will have authority to provide an additional $2.5 million in incentives for contractors that "go above and beyond the call of duty" when addressing the needs of the community.* [22]
- *The use of incentives also extends to the use of Disadvantaged Business Enterprises (DBE) for construction work. The Tri-County Metropolitan Transportation District of Oregon (TriMet) is working with the community to maximize opportunities for Disadvantaged Business Enterprises (DBE) in building the Interstate MAX light rail line. TriMet's goal is to direct 16 percent of capital spending to certified DBEs.*[23]

21 Impact of Light rail Construction on Existing Businesses; a survey of six cities with recent light rail construction projects. Houston Tomorrow: Independent research for Houston's future. Gulf Coast Institute. May 1, 2006.
22 The Associated General Contractors of America, Arizona Chapter. Valley Metro Rail Update. Views and News. January 2005.
23 Lesson 45: TriMet's Successful Disadvantaged Business Enterprise Program on the Interstate MAX Light Rail Project. Federal Transit Administration. Reports & Publications. Project & Construction - Management Guidelines. PMO Lessons Learned References in Guidelines. Lesson 45: TriMet's Successful Disadvantaged Business Enterprise Program on the Interstate MAX Light Rail Project (2003 Update).

Research Findings
Elevated, At-Grade, and Tunnel Integration

What are the best practices for integrating elevated, at-grade, and tunnel alignments in existing residential areas and developed downtowns?

This memorandum is based on direct experience in the planning, design and/or construction of light rail transit systems in Portland, Phoenix, San Diego, Calgary and other cities in North America. It is also drawn from professional expertise and visits to other light rail systems and discussions with the planners and engineers for various North American light and heavy rail transit systems. Finally, it also draws upon research into best practices published by the Federal Transit Administration. [1]

The compatibility and acceptability of a new light rail line within an existing community is influenced significantly by the choice of vertical and horizontal alignments. Each alignment type—elevated, at-grade and tunnel—has different impacts on the public streetscape, pedestrian and vehicle circulation, development opportunities, transit operations and financial feasibility.

Technical factors are a major consideration in planning for light rail transit. Some of the more common design considerations include:

- *Maximum grade for light rail, typically 6%;*
- *Minimum length of vertical curves;*
- *Maximum bridge span lengths;*
- *Station passenger platform lengths near grade crossing;*
- *ADA requirements for station platform slope and access;*
- *Distance of station platform from grade crossing;*
- *Incorporation of tangent (straight) track alignment approaching and leaving stations;*
- *Avoiding, where, possible right-angle and short radius turns (100 foot minimum) sometimes used in downtown environments to make right-angle turns*
- *Roadway types, signals and traffic volumes at roadway crossing;*
- *Signal systems for grade crossing detection, warning and protection;*
- *Vertical clearance for vehicles and overhead contact system (electrification); and,*
- *Drainage requirements.*

1 Project & Construction - Management Guidelines (2003 Update), Federal Transit Administration http://www.fta.dot.gov/publications/reports/other_reports/publications_3875.html

RESEARCH FINDINGS
Elevated, At-Grade, and Tunnel Integration

Issue # 1: What are the relative advantages and disadvantages of different profiles? What are the functional and productivity trade-offs for different profiles? Are there capacity differences between the profiles?

Each of the three profiles or alignment types, i.e. at-grade, elevated and tunnel, physically support the light rail tracks and associated signal, communication and electrification equipment. Each alignment type has certain characteristics which make it suitable for use in particular circumstances. Understanding the characteristics, advantages and disadvantages of each type of alignment is important so that the City of Bellevue can appropriately participate in the planning for light rail service in the community.

Advantages and Disadvantages

The advantages and disadvantages of each type of alignment are summarized on the following table:

ADVANTAGES	DISADVANTAGES
At-grade Alignment	
Can be constructed in exclusive, semi-exclusive and shared rights-of-way; Easiest to construct; Lowest cost to construct; Easiest for passengers to identify and access stations; Visibility of station and trains communicates that an alternative form of travel is available; Scale of at-grade system communicates “friendlier” and easier to use; Easiest to provide intermodal transfers at stations; Fits well in many environments; Can be an opportunity for implementation of urban design techniques in the corridor; Can help encourage development or re-development of communities if properly planned; Can activate streets and create a more interesting pedestrian environment.	Construction at-grade requires disruption and detours; Greater potential for vehicular and pedestrian conflicts; Operating trains impact vehicular traffic; May encounter greater drainage issues; Generates greatest potential noise and vibration impacts; Slowest operating speed in semi-exclusive and shared rights-of-way; Overhead power system increases visual presence; May require land acquisition for construction of trackway and stations or loss of traffic capacity if constructed on public streets.

RESEARCH FINDINGS
Elevated, At-Grade, and Tunnel Integration

ADVANTAGES	DISADVANTAGES
Elevated Alignment	
Fully grade separated trackway; Exclusive right-of-way; Minimal conflicts with pedestrians or vehicles; LRT can operate at maximum speed depending on grades and curves; Visibility of station and trains communicates that an alternative form of travel is available; Less costly to construct than tunnel.	Construction of elevated alignment and stations may be disruptive depending on construction methods and staging sites available; More costly to construct than at-grade; Requires more maintenance than at-grade; Elevated stations appear more massive than adjacent elevated trackway; Elevated trackway and stations are visually intrusive; More difficult to access stations than at-grade; Elevated stations require elevators, escalators or lengthy ramps for ADA access; Less likely to stimulate new development than an at-grade alignment; Does not create movement at street level which can add interest and activity; Somewhat more difficult to evacuate passengers in emergencies than an at-grade.
Tunnel Alignment	
Fully grade separated trackway; Exclusive right-of-way; Minimal conflicts with pedestrians or vehicles; LRT can operate at maximum speed depending on grades and curves; Construction can be less disruptive than alternatives in certain locations, such as areas with high traffic volumes and constrained right-of-way; Provides higher capacity than at-grade because of separated right-of-way.	Construction of tunnel and underground stations may be very disruptive depending on construction methods chosen, i.e. cut and cover; Highest cost per mile to construct; Requires more maintenance than at-grade; May require extensive utility relocation; Stations are expensive and difficult to construct relative to at-grade; Construction period generally longer than either at-grade or elevated; “Hidden” (underground) stations may mean “out-of-sight, out of mind” to potential users; Stations require both elevators and stairs or escalators for normal and emergency access; Requires complex and expensive ventilation system; Increased fire-life safety issues, such as more complex evacuations in emergencies than at-grade; Requires an extensive construction staging area, though construction staging areas can be consolidated; Does not create movement at street level which can add interest and activity.

Functional and Productivity Trade-offs

Light rail trains can most easily achieve maximum speeds in exclusive right-of-way. From a project feasibility perspective, higher speeds are desirable because they translate into travel time savings, a central criteria in the federal funding process. Exclusive right-of-way can be provided at grade but elevated or tunnel segments are sometimes required to avoid traffic conflicts, to negotiate steep grades or to avoid major impacts to utilities and to the built or natural environment.

There are many distinguishing characteristics between at-grade and tunnel or elevated alignments, however, primary is cost. On a cost-per-mile basis tunnel and elevated alignments are much more expensive to construct and to maintain. In a cost constrained project, higher costs may mean reductions in other project elements such as alignment length, number of stations and station finishes.

A secondary distinguishing characteristic is the nature of access to the stations. Both tunnel and elevated options offer the opportunity for controlled access to the stations platforms, something that is more difficult to achieve with at-grade platforms. Tunnel and elevated stations require elevators, stairs and possibly escalators making them more expensive to access and potentially less friendly to pedestrians that at-grade designs.

Capacity Differences

The higher speed achievable with an exclusive right of way translates into shorter travel times and higher capacity, i.e. the opportunity to provide more train service within the same track. At grade operations that are not in an exclusive right-of-way are generally the slowest of all operating environments. This includes both semi-exclusive right-of-way, where the light rail runs in the street side-by-side with vehicle traffic, and shared right-of-way, where non-rail vehicles are allowed to drive in the same lanes that the trackway is located. (Shared right-of-way is not common for modern light rail systems with the exception of streetcars.)

Maximum train speeds in shared or semi-exclusive rights-of-way are normally limited to the posted speed on the adjacent street because the trains are moving with traffic and using the same signal systems. Speeds are further restricted if the trains must make tight turns to follow a prescribed route. Because vehicles and pedestrians are also present in these environments, the potential for conflicts is increased. In general, slow travel times may translate into lower ridership and lower capacity. However, a section of light rail in an urban environment that is part of a broader system can combine slow speeds with high ridership, such as light rail through a downtown core serving commuters from residential neighborhoods.

Issue #2: What are the urban design and land use opportunities and challenges associated with elevated, at-grade, and tunnel profiles?

Light rail affords communities an opportunity to influence development in the designated high-capacity transit corridor. In order to maximize the development benefits associated with the introduction of light rail, the community must consider a number of issues. These are the practices that other communities have used to maximize the benefits of different alignments.

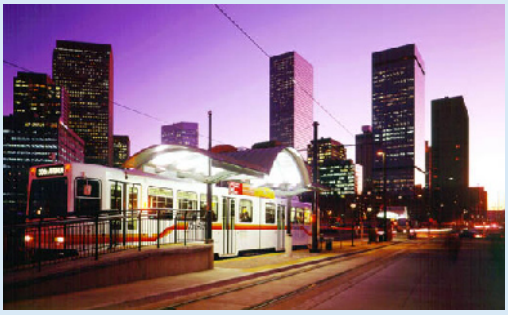
Use Urban Design Features to Enhance Safety and Community Integration

Quality design and materials can enhance the way a community feels about light rail, improve safety, and deter vandalism. Public art, as part of the station, portal or structure design helps identify the system as an asset owned by the community. However, the trade-off between functionality and a high level of design generally revolves around the initial cost of the trackway and stations and the continuing costs of maintenance and repair. Naturally, the transit agency is concerned about both aspects. Elaborate designs often give way to more functional requirements. Agencies typically prefer to have uniform design so parts can be more easily stockpiled and thus are readily available for quick repairs which minimizes system or station down time.

At-grade

There are a variety of ways to integrate at-grade trackways into urban, suburban and industrial environments. Distinctive trackway treatments or landscaping can be used as a design element along the trackway. Landscaping can also be used as a form of barrier to prevent pedestrians from crossing the tracks in other than designated locations. Alternatives to a landscaped barrier include a low bollard and chain barrier, ornamental fencing or other art projects. In suburban areas where pedestrian crossings of the trackway may be provided at locations other than an intersection, a “Z” crossing may used to force the pedestrian to look briefly in the direction of a potentially on-coming train before crossing. Care must also be taken to ensure that the headlights of a light rail vehicle operating at night do not blind oncoming motorists or create a nuisance to adjacent residences or businesses. Design elements that enhance safety near light rail stations and crossings are covered in more detail in Street Design and Operations.

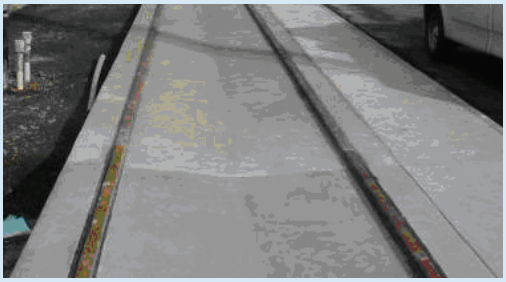
At-grade LRT stop in downtown Portland.



At-grade station in downtown Denver.

Belgium block trackway on original MAX line in downtown Portland

Mountable trackway of colored and stamped concrete, Hillsboro, Oregon



Paved concrete track installation on Portland Interstate MAX.

Pedestrian Z-crossing Seattle Washington

Choose Trackway Finishes that Complement Community Objectives and Fit Budget

Once the type of paved trackway has been determined, the finish of the trackway surface remains to be determined. The trackway can be simple gray concrete, colored concrete, colored and textured concrete or constructed of ornamental pavers or Belgium blocks. There are often community impact considerations in choosing trackway finishes. The light rail alignment through Portland's Old Town utilizes Belgium blocks to integrate better with the surrounding historic structures. Sometimes special trackway finishes are important for delineating light rail right-of-way to prevent drivers from entering the trackway. The type of trackway finish has a significant impact on cost and constructability. The more complex the trackway finish, the more costly and typically the longer it will take to construct the trackway.

Elevated

Because an elevated trackway generally avoids conflicts with pedestrian and vehicle traffic, the urban design issues tend to focus on the design and placement of the trackway support structures and station access. The support structures are typically constructed of reinforced concrete and form liners. Techniques can be used to provide a visually attractive finish to the supports. Integrated public art can also find a place in the decoration of an elevated trackway. Placement of the trackway supports, especially in areas where the trackway parallels roadways, must consider motorist sight lines and avoid the creation of visual barriers. The trackway and supports create shadows and block sightlines, and may be barriers to pedestrian movements in some locations. Care must also be taken to ensure that the headlights of light rail trains operating at night do not create a nuisance to adjacent residences or businesses.

Tunnel

Few urban design issues are present with a tunnel alignment following its construction. The issues tend to focus on the integration of the portals, station access areas and ancillary facilities, such ventilation structures, into the fabric of the community. These are discussed under Issue #3.

Stations

The design of stations and adjacent areas should reflect the character of the neighboring community and the transit agency's need to maintain consistency in the overall design and configuration of the stations. Street-level stations are similar in scale to other elements of the urban fabric and they tend to be easier to integrate than elevated stations. Because elevated stations tend to be substantial structures, it is difficult to integrate them visually into a suburban environment. This is somewhat easier in a downtown setting with many large multi-story office buildings; however, the impact of the elevated structures on sight lines from buildings is an important consideration, as is its shadowing effect on street and pedestrian areas. The urban design treatment of station access areas for both elevated and tunnel stations should provide a measure of visual integration consistent with good identification and way-finding for transit patrons unfamiliar with station access points. This is particularly important for tunnel stations where the trackway itself is not present to provide visual cues to the station locations.

Land Use Opportunities and Challenges with Elevated, At Grade and Tunnel Systems

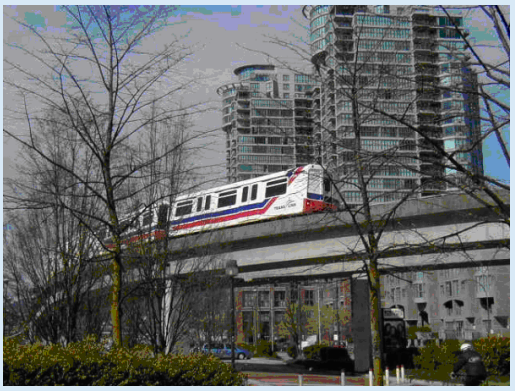
In general, at grade systems are seen to be more favorable to street-level development and transit oriented development (TOD). The system is visible from the land uses, and the land uses are visible from the system. An at-grade system helps to generate a greater amount of street level activity, creating an interesting pedestrian environment by adding people and movement. However, in urban settings, elevated and tunnel systems can be integrated into buildings or malls, taking advantage of the activity centers and increasing the economic development benefits of the light rail investment.

Street level businesses are sometimes considered at-risk when an elevated system is proposed, citing that the pedestrian environment may be shadowed and generally less attractive. Quality urban design and maintenance can address many of these concerns by ensuring a light, bright, safe sidewalk area, and minimizing the ground-level view of the overhead system.

Tunnel system and station areas require adequate underground real estate, which may be hindered by utilities, sidewalk vaults and parking garages, especially in urban settings. Maximizing visual connections to the station at entrances to connect the system with the surrounding land use is especially important with tunnel stations which do not have the trackway to provide visual cues to the station presence.

The effect of light rail on land use, and the reciprocal effect of land use on light rail, are covered in the Land Use memo.

Side-running elevated alignment Seattle, Washington



Elevated trackway Vancouver, BC

Elevated trackway and station San Diego, California

Elevated station construction Seattle (Tukwila)

Tunnel portals adjacent to US 26 west of Portland, Oregon

Cut and cover tunnel portal in Dallas, Texas

Urban tunnel portal in Los Angeles, California

Tunnel portal located in a topographic valley in Hoboken, New Jersey

Issue #3: How do tunnel portals and station access impact the pedestrian environment and traffic circulation? After construction, how can tunnel portals be integrated into the urban fabric?

Tunnel portals are significant structures. The selection of the locations for the portals is one of the critical steps in the planning of a light rail line. Likewise, stations play a vital role in the operation of the transit system. Successful stations depend on the selection of the correct site and thoughtful design of the station, station access and its surrounding environment.

A tunnel is typically an expensive element of a light rail transit line. Likewise, construction of a tunnel of significant length will often be the most time-consuming activity in the construction schedule. Tunnel construction is considered risky, both from the standpoint of worker safety and because of the unknown conditions encountered in tunnel construction. For these reasons, tunnels are usually only incorporated into a light rail transit line when absolutely necessary – such as in a dense urban environment with limited available right of way, to negotiate a steep grade, or to avoid impacts. A shorter tunnel can help minimize the expense and risk of construction for a transit agency depending on construction methods. Curves both complicate tunnel construction and potentially limit the running speed of the light rail vehicles.

Underground stations and long running-tunnels require special ventilation equipment to deal with potential fires and smoke underground. The ventilation equipment for the station may be incorporated into the station headhouse along with service elevators and emergency access stairs. Ventilation of the running-tunnels may be provided by installing fans at the portals. If the tunnels are sufficiently long, it may be necessary to construct auxiliary ventilation structures at the surface along the alignment to house additional ventilation fans. These structures are fairly large and require construction of shafts to reach the tunnels. Operation of the ventilation fans can be noisy.

Designing Underground Stations

Underground stations must be sized to accommodate trains of the ultimate length expected to be used on the system. Station platforms must be placed on tangent (straight) sections of track for low floor trains.

The location and appearance of station entrances are an essential component of a tunnel design. Station entrances need to provide a recognizable visual signal that transit service is “available here”. This may be accomplished through the entrance itself or, more commonly, through a logo sign that marks the entrance. The station may be placed within the pedestrian right-of-way or inside private development. Either way, it needs to provide full access to all transit patrons. If in a pedestrian area, the station entrance should provide easy access for all patrons and avoid impeding pedestrian movements. This can be challenging because entrances need to provide for both stairs and elevators and possibly escalators. These features require surface space that may be difficult to allocate within a limited amount of sidewalk space. This makes entrances provided within buildings an attractive alternative.

Choosing Portal Locations

Where the tunnel is designed to overcome a topographic obstacle, like a significant hill, the selection of a portal is guided by the limited number of suitable locations available. Where a tunnel is selected for other reasons, such as avoiding on-street traffic conflicts or minimizing right–of-way acquisition in a city, portal selection can be more challenging. In these cases, the location of the portal will be influenced by the alignment approaching each end of the tunnel and the availability of suitable sites in adjacent areas.

If the tunnel portal must be constructed in or adjacent to public right-of-way like a street, several factors must be considered. Beyond the portal, in the direction of the tunnel, sufficient length must be provided for the tunnel roof to be sufficiently below the surface of any cross streets or other buried obstructions such as utility pipes that may be encountered. The grade of the tracks in the tunnel will determine how much distance will be required to maintain sufficient clearance. If the portal is located in a street, positive protection must be provided to prevent vehicles from entering the tunnel. Pedestrian access into the tunnel must also be restricted. The impact on traffic circulation, such as cross street interruptions, can be minimized if block lengths are adequate to allow the tunnel to drop under obstructions. Careful planning and placement of the portal may reveal other opportunities to minimize impacts.

Underground station serving two-car light rail trains in Portland, Oregon


Urban tunnel portal in San Jose, California


Underground station at San Diego State University


Colored trackway along MLK Boulevard, Seattle, Washington

Land Use

This memorandum provides a review of information related to the different ways in which transit is connected to land use. Transit can have a powerful impact on land uses but only when both the market and regulatory environment facilitate change. The original streetcar systems in American cities were a tool used by developers to attract buyers. Modern streetcar systems initiated by local governments have had similar success. Light rail transit has also led to beneficial land use changes. However, there are many examples of transit systems that did not lead to significant land use changes. Transit investments provide communities the opportunity to create and/or reinforce a land use vision. If desired, cities can use the implementation of transit to promote beneficial land use changes in order to enhance their community.

An extensive literature review was conducted to support this memorandum. It draws from professional experience in cities with light rail systems in order to provide examples of how land use is impacted by transit. Examples of light rail construction in other settings demonstrate significant opportunities to capitalize on a public infrastructure investment by promoting the enhancement and development of vibrant neighborhoods, thriving employment centers and new public spaces.

Transit Supportive and Non-Supportive Land Uses [2]

Transit Supportive Land Uses

- *Multi-family residential*
- *Affordable housing*
- *Small lot single family homes*
- *Offices and hotels*
- *High-schools and institutes of higher education*
- *Day-care centers*
- *Cultural institutions*
- *Athletic, recreational, and health club facilities*
- *Retail shops*
- *Restaurants, coffee shops and bars*
- *Grocery stores*
- *Financial institutions and neighborhood businesses*
- *Dry cleaners*

Non-transit Supportive Land Uses

- *Automobile sales, services, and repairs*
- *Car washes*
- *Large-scale warehouse retail*
- *Large-scale grocery emporiums*
- *Drive-in/Drive-through services*
- *Warehouse distribution*
- *Outdoor storage*
- *Regional parks*
- *Funeral homes*
- *Parking lots*
- *Low-density single family homes*
- *Low intensity industrial uses*

2 Transit Oriented Development Best Practices Handbook. The City of Calgary Department of Land Use Planning and Policy, January 2004.

Issue #1: What are the most common land use issues generated by light rail, before and after construction, and how have those been addressed?

There is a clear and inextricable relationship between transportation and land use. This has been made evident through extensive research and analysis undertaken over the last thirty years. The implementation of transit investments, including light rail, tends to have long-term effects on land use, particularly in those locations proximate to station areas. Since stations are the primary interface between the transit system and the user, transit has the most opportunity to affect land use primarily at the station location and has little to no effect on land uses located along the alignment but not near a station.

Historic Perspective

Transit has been a notable force in shaping the structure and character of American cities. The invention and implementation of the electric streetcar in the late nineteenth century freed people to live separately from their place of employment, creating a decentralization of population centers and employment centers. Population growth followed streetcar lines and stations. The effects of the streetcar on land use can be seen to this day in the way land has developed in most large American cities. Real estate interests often became deeply intertwined with the implementation of electric streetcars as a method of promoting land development projects. By the mid-twentieth century, however, the streetcar largely disappeared and was replaced by the automobile. Just as streetcars had a particular effect on land use, so has the personal vehicle, which has resulted in distinct land development patterns that have led to a general decrease in densities and the decentralization of communities in the form of urban sprawl. Such development patterns de-emphasize the needs of pedestrians, put primary importance on the presence of parking, and encourage low-density uses. In the last three decades, transit has again become an influence on land use in American cities[1].

Impact Of Land Use On Transit

Results from travel demand simulations and other computer-based models clearly demonstrate a relationship between different land uses and densities and how they impact transit ridership. Land uses support transit to varying degrees. There is a clear relationship between density and ridership: as both population and employment densities increase, ridership increases. An appropriate mixture of land uses (in different combinations of residential, retail, and office) encourages higher ridership, especially during off-peak hours. Consequently, most transit agencies see value in locating stations in densely developed areas and, where supported by local policy, seek ways to increase the density of station areas in order to increase productivity of the transit investment.

1 Transit Cooperative Research Program Research Results Digest: An Evaluation of the Relationships Between Transit and Urban Form. Transportation Research Board, June 1995 –Number 7.

Impact of Transit on Land Use

There are many factors that affect the influence of a transit investment on land use. Studies have shown that transit investments are not able to overpower the effects of a weak regional economy. The accessibility provided by transit is only one factor among many that influences the decision to invest in real estate. For example, changes to land use and urban form are unlikely to occur without shifts in public policy and without the support of local governments through changes to zoning standards, infrastructure improvements, pro-growth initiatives and other measures. In general, fixed-guideway transit is apt to influence land uses to a greater degree than bus transit, since bus transit routes do not have the same permanence as fixed-guideways. Research has indicated that at-grade light rail might have greater redevelopment impacts because of the higher level of visibility that is provided by traveling within communities (as opposed to above or below them).

Research conducted by the Transit Cooperative Research Program (TCRP) indicates that transit investments influence land use in four ways. Transit improvements can influence:

- *the value of land*
- *the amount and intensity of development that occurs*
- *the urban structure of an area*
- *the timing of development.*

These four factors are discussed in detail below.

Value of the Land

Transit improvements generally increase the value of residential and non-residential properties near stations. Residential properties that benefit the most are usually located in places where transit systems are well developed and well integrated into the pattern of development. These effects are seen in downtown regions, sub-regional employment centers, urban residential areas, and suburban residential areas. These effects, as well as measures to protect and enhance property values are discussed in Fact Sheet #4 “Property Values.”

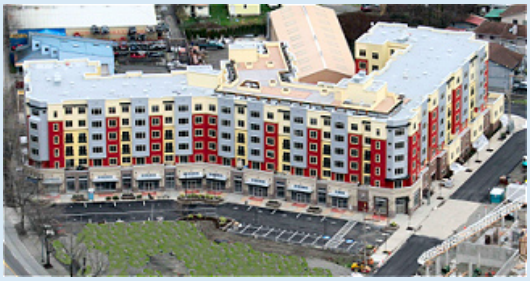
Intensity of Development

The TCRP report indicates that areas with access to rail transit grow more quickly (to varying degrees) than areas that lack this accessibility. This is the case in San Francisco, where Bay Area Rapid Transit (BART) is one of the factors that helped downtown San Francisco to retain its role as the region’s office and financial center. BART also influenced the development of other office employment areas along transit service lines. The areas served by BART were developed to a greater degree and at a faster rate compared to other non-transit corridors. A similar phenomenon is occurring in Atlanta, where transit continues to stimulate office and commercial growth. Cambridge, MA presents a case where transit has brought little to no change in land uses. In the 1970s, the extension of the subway to Cambridge was not accompanied with any changes to zoning standards or public policy. Consequently, the subway serves existing residences and businesses, but has brought little change to land use.[3]

3 Transit Cooperative Research Program Report 16 Volume I – Transit and Urban Form. Transportation Research Board, 1996.

Atlanta’s Lindbergh Station - One of Atlanta’s largest companies, BellSouth, made the decision to move to Atlanta’s Lindbergh station in the community of South Buckhead (located in Atlanta city limits). By doing so, BellSouth consolidated several scattered suburban offices to a central transit node in response to increasing employee frustrations about traffic congestion and declining quality of life. Prior to the development of Lindbergh Station, South Buckhead had been primarily composed of commercial and retail establishments with very affluent homes in adjacent neighborhoods. The area saw a decline in the 1980s accompanied by an increase in crime, at which time the city began to enact measures to control the community’s nightlife and enhance the residential character of the area. Recent development has increased the number of residences and enlivened the area with a variety of uses. The Lindbergh Transit-Oriented Development (TOD) is slowly becoming a “mini-city,” in large part due to BellSouth’s decision to act as anchor to the development, which will also house numerous residential units, a pedestrian-friendly Main Street, retail space, a hotel, and office space. [4]

4 Transit Cooperative Research Program Report 102 – Transit-oriented development in the United States: Experiences, challenges, and prospects. Transportation Research Board, 2004.



Courtland Place Rainier Court in Seattle - Development like the Courtland Place has sprung up along a light rail line in Seattle that won't operate until 2009.

Impact to Urban Structure

American cities have been gradually decentralizing so that cities tend not to have just one large employment center, but several second-tier employment and/or commercial centers throughout the metropolitan area. Transit systems must recognize this polycentric quality of today's urban environment in order to respond to demand. In most cities, the largest land use changes occur in downtown areas and in sub-regional employment centers. Several such "edge cities" have formed around transit stations in a number of cities including Atlanta (Midtown and Sandy Springs), San Francisco (Mountain View and Sunnyvale), Washington, D.C. (Rosslyn-Ballston in Virginia and Silver Spring in Maryland), and Vancouver, B.C. (Burnaby). In the Seattle region, some of the major employment centers outside of downtown Seattle include downtown Bellevue, the University District, Overlake, and downtown Everett.

Timing of Development

Transit investments can often accelerate development patterns near station areas. Many cities see an increase in real estate activity well before construction, during the planning phase of projects. This is the case in Seattle, where developers have been rapidly developing the Rainier Valley that will be served by Sound Transit beginning in 2009[5]. In the case of Rainier Valley, development was also accelerated by Seattle Housing Authority's "NewHolly" community, a project that entailed redeveloping an old public housing facility into a mixed-use, mixed income community through public funds, private contributions, and federal grants.

5 "Developers Consider Future With – or Without – Light Rail." Aubrey Cohen, Seattle Post Intelligencer. October 27, 2007.

A Note About Transit Oriented Development

In many cases, the implementation of transit service results in a land use pattern referred to as Transit Oriented Development (TOD). TOD is generally characterized by high-density, mixed-use, and pedestrian-oriented development. It typically occurs in regions that have a clear planning vision that favors such development and where the political culture is supportive of transit. TOD usually occurs only when the transit service precedes or coincides with regional growth and depends somewhat on the presence of public policy tools used to limit or focus growth. TOD is discussed in terms of its definition, effects, and best practices under Issue #2.

Negative Effects on Land Use

There also are several examples of unsuccessful development occurring near transit facilities. In Atlanta, where there is a high demand for office development, high density commercial development has sprung up near Metropolitan Atlanta Rapid Transit Authority (MARTA) stations, however the suburban-style office towers have poor pedestrian connectivity to nearby stations and provide conventional auto-dominated development patterns. Such properties exist partly in response to density entitlements provided by the zoning codes which have increased property values in station areas. Since property values are so high, only high-end office and retail developments are able to afford these locations. In other cases, TOD has improved the area directly adjacent to the station, but the previous development pattern of low-density strip mall areas still persists outside of the TOD. This leads to a situation where the TOD project is not well-integrated in the community and becomes isolated.

DART station and TOD in downtown Plano - TOD in Addison, Texas near the Addison DART Station

Issue #2: What have other cities done to pro-actively foster transit-oriented development and redevelopment, where desired, around stations?

Committee comments: Has transit oriented development been successful in other cities and what has been the effect on surrounding properties and neighborhoods?

Transit Oriented Development (TOD) projects have had great success in other cities. Experience has proven that it is most likely to be successful in communities that pro-actively foster TOD and redevelopment. This section describes the basic tenets of TOD, how it can be beneficial to communities, and how other cities have planned and implemented successful projects.

WHAT IS TOD?

Transit Oriented Development (TOD) has, in the last decade, become a prevalent strategy for development near transit facilities. Although TOD is sometimes portrayed as a particular style of urban design, it is not a style, but a specific philosophy of developing the built environment that maximizes the functional relationship between the development and transit. This functional relationship works to enhance the value of both the transit facility and development. TOD is often undertaken as redevelopment, but can also be conducted as "greenfield" development. It can take many physical forms which generally include the following elements[6]:

- *Located near transit nodes – TOD, by definition, is located near a transit station or major stop.*
- *Density – TOD is more compact and intensely developed than existing development patterns in the same area.*
- *Mixed Uses – TOD incorporates mixed uses that usually include residential, retail, office employment. Such mixed use development can be either horizontally or vertically organized.*
- *Pedestrian-oriented streetscapes – TOD focuses on measures to enhance the pedestrian environment. This is in contrast to auto-dominated orientation of sprawl-pattern development.*

One common misconception of TOD is that it is inherently anti-car. In actuality, TOD projects have proven that an attractive and functional pedestrian environment can be achieved without excluding good automobile access or a park and ride facility. TOD is thought to be attractive to demographics that prefer an urban lifestyle and those who value walkability and a sense of community. It is not to be confused with Transit Adjacent Design (TAD), which is a term used to describe land uses that are near transit stations, but do little to provide a functional relationship to the transit node.

6 Strategic Plan for Transit Oriented Development. Regional Transportation District (RTD) FasTracks, June 2006.

POTENTIAL BENEFITS OF TOD

TOD has the potential to benefit the community, transit agency, local government, and private developers.

Potential benefits for the community are social, environmental, and fiscal in nature. Vehicle trip reduction and congestion relief is one benefit of TOD. Therefore, it is more valued in settings that already experience or have potential for high levels of congestion. Land conservation, improved pedestrian and bicycle conditions, and an increase in availability of affordable housing are also possible with TOD projects. TOD is often characterized as improving the quality of life for residents by reducing automobile dependence, enhancing walkability, and increasing sense of community. This is difficult to quantify, although the outcomes of many TOD projects across the United States suggests this could be true. Fiscally, communities can benefit from TOD (if affordability is maintained) by improving the transportation-housing balance. Under auto-dominant land development patterns, households that spend less on housing consistently spend more on transportation. This is because individuals typically are forced to move farther from employment centers in order to find affordable housing. A transit system allows residents to reduce those transportation costs without losing access to jobs, services, and amenities, particularly if those individuals reside near transit stations[7]. Financial lenders sometimes recognize the value of living near transit through "Location Efficient Mortgages" that allow homebuyers to increase the amount of money they borrow because of reduced household transportation costs.

The most proven benefit that directly results from TOD is an increase in transit ridership. The increase in density that occurs with TOD generally leads to higher use of the transit facility. This higher ridership increases revenue for the transit agency and produces a more efficient and cost-effective service. The inclusion of mixed uses can have the effect of increasing ridership during off-peak times, further improving the efficiency of the transit service. The benefit of TOD to transit agencies has encouraged several agencies to become directly involved in the development process. This is the case with Dallas Area Rapid Transit (DART) and the Santa Clara Valley Transportation Authority (VTA), both of whom are highly involved in joint development projects. For example, the intent of the VTA's joint development program is to "create a long-term continuing source of revenue to support the operations of VTA and increase utilization of this community's public transit system"[8].

Local governments can benefit from TOD as well. TOD can be successful at promoting economic development and job growth, although research clearly indicates that TOD, as with development of all types, is not likely to thrive during periods of economic stagnation. Since TOD focuses growth at transit stations, it capitalizes on expensive public investments and maximizes the local and regional benefits of these investments. An example of TOD's ability to benefit government is in the Rosslyn-Ballston transit corridor in Arlington, VA where development generates roughly one-third of the country's real estate tax revenue from less than 8% of its land area.

7 On the Right Track: Meeting Greater Boston's Transit and Land Use Challenges. Urban Land Institute Boston District Council, May 2006.
8 http://www.vta.org/projects/tod.html

Rosslyn-Ballston corridor - Arlington County, Virginia demonstrates how a long-term vision can culminate in effective development. The county held firm to their vision of providing a transit system that would revitalize Wilson Boulevard, a failing commercial corridor. Their commitment to this vision convinced Metrorail to site the system along Wilson Boulevard instead of along Interstate 66, as was originally planned.

Under the right conditions, private developers can have a high level of success with TOD; however experience indicates that those successes take time to achieve. Good developers understand that TOD is a long-term process, and that it can take time to see gains in property values and overall market performance through high rents and sales prices.

TOD has been successful in many cities. These successes are the direct consequence of several factors, which are outlined below as best practices. Each best practice is accompanied by a case study which describes a city that has pro-actively fostered TOD and describes how that city has been successful.

Engage in Long-term Visioning and Early Planning Efforts

TOD has the most success in places that are politically supportive of transit service and in which TOD is closely aligned with the development policies of the community. Many communities who experienced successful integration of transit and land use through TOD began planning for success long before transit facilities arrived. The importance of maintaining community vision is exemplified by Arlington County, VA (see sidebar). The City of Calgary also began early planning of potential TOD opportunities and has had great success as a result. Denver's Regional Transportation District (RTD) recently hosted a "lessons learned" workshop to discuss the outcomes of the recently completed T-REX project. Participants of the workshop consistently indicated that they wished the TOD process had started earlier and had been more comprehensive[9]. In addition to long-term visioning, it is important that the Environmental Impact Statement (EIS) process be used to maximize TOD opportunities. The RTD lessons learned session recommended that environmental clearance be conducted as part of the EIS for the largest possible physical area around stations. The clearance of a large station footprint allows for future flexibility in the development of TOD near stations. The RTD team also recommended that there be more emphasis on TOD in the scope of the EIS and more TOD expertise on the EIS team. Local governments should actively pursue the creation and adoption of land use plans for station areas so that they can then be acknowledged and referenced in the EIS and inform project design. Efforts to form partnerships with private entities should also be encouraged early in the process. Governments can also assist in laying the groundwork for TOD by encouraging appropriate zoning standards, assisting in land assembly, and ensuring that the correct level of infrastructure is in place. Early planning is critical to successfully fostering TOD and redevelopment where desired.

9 T-REX Transit Oriented Development Lessons Learned Report. Regional Transportation District, September 2007.

Establish Interim Planning Measures for Incremental Development

Although a strong long-term vision is indispensable for successful development, it is also very important to establish guidelines for the interim so that incremental development will maintain the long term vision for the station area. By providing public infrastructure, establishing pedestrian connectivity and guiding future development patterns, local governments can set the stage for development. An incremental approach to the development of TOD can also be helpful in slowly gaining the acceptance of adjacent communities. It can be particularly useful to identify those corridors or properties that are considered high priority where immediate efforts can be focused, and lower priority corridors or properties where efforts can be made to ensure that current development activity does not preclude TOD in the future [10]. In cases where a vertical mix of uses is not possible at first, mixed uses should be encouraged to exist horizontally so that the right mix is present when development does occur. Many governments and transit agencies use surface parking as a land bank for potential TOD opportunities. The idea is that parking lots can be converted to redevelopment sites when local land use policies and market conditions are supportive of such a change. However, this approach can present challenges or backfire due to the difficulty of removing parking from park and ride users, who can be very protective of their "right" to park[11]. Surface parking can also be converted to structured parking to maintain park and ride access while preserving space and integrating new development. Park and ride lots may not be appropriate at all stations due to siting issues, such as adjacent land use, access and capacity.

Ensure that Key Components of a Successful TOD are in Place

Multiple TOD projects have been constructed in recent years. Several principles of successful TOD have emerged from these projects and are outlined at right.

Create Places that Attract People

A TOD project holds a dual purpose. For the transit agency, the TOD serves as a node for transportation activities (train arrivals/ departures, connections to bus services, bicycle parking, etc.) In another sense, the TOD is meant to be a place for people. These two goals can be successfully integrated into one facility. Transit planners are responsible for creating a station that functions well as a node. The developer is charged with creating a sense of place through establishing an identity and drawing on key identifying features of the area. To support this, mixed uses should be encouraged as much as possible. Mixed uses can be organized vertically (retail on the ground level, office employment on mid-levels, and residential on top floors) or horizontally, meaning that different uses exist in the same area, but not within the same structure.

10 Best Practices in Transit-Oriented Development. City of Reno, Nevada, June 2004.
11 Statewide Transit-Oriented Development Study: Factors for Success in California – Final Report. California Department of Transportation Business, Transportation and Housing Agency (Caltrans), September 2002.
12 Ten Principles for Successful Development Around Transit. Urban Land Institute, 2003.

Seattle's Interim Overlay zoning district - The Seattle City Council passed legislation in 2001 to preserve opportunities for TOD and other pedestrian-oriented development around Link light rail stations. This overlay district encourages mixed uses, higher density development, and increased pedestrian and bicycle enhancements. The idea is that these elements will be in place by the time transit service begins.

Urban Land Institute's (ULI) Ten Principles for Successful Development around Transit[12]

1. *Make it Better with a Vision*
2. *Apply the Power of Partnerships*
3. *Think Development When Thinking about Transit*
4. *Get the Parking Right*
5. *Build a Place, Not a Project*
6. *Make Retail Development Market Driven, Not Transit Driven*
7. *Mix Uses, but Not Necessarily in the Same Place*
8. *Make Buses a Great Idea*
9. *Encourage Every Price Point to Live around Transit*
10. *Engage Corporate Attention*

DART's Mockingbird Station - One DART example of TOD is the Mockingbird Station. DART aims to locate stations right in the middle of the development, and locates transit facilities (such as parking) on the edge of activity centers. The Mockingbird station has over 200 upscale lofts, 140,000 square feet of office space, and 180,000 square feet of destination and convenience retail, theaters, and restaurants. Mockingbird is built around an historic industrial structure and integrates new loft structures into the architectural mix [13].

13 http://www.mockingbirdstation.com/

Developers are generally more comfortable with developing a mix of uses near each other, but on separate lots. A benefit of this approach is that it can encourage pedestrian-oriented design between uses. Since mixed use projects are difficult to finance and can be complex to build, it might be more advantageous to spread uses along the same transit corridor, so that a number of activity nodes exist along the same transit line. The transit systems can accommodate travel in both directions between activity nodes. The retail component is an element that can support a sense of place. Retail can thrive in TOD due to the high visibility that a station can provide. However, several TOD projects have suffered from the stigma of failure that comes from overbuilt and unoccupied retail space. Therefore, the Urban Land Institute (ULI) and others recommend that retail should not be used as a justification for development and should not be required as part of TOD unless there is abundant evidence that retail can be supported. Public facilities can also be very successfully included in TOD. For example, the Dallas Police Headquarters was successfully sited at The Cedars station in downtown Dallas.

In preparing for TOD, governments can create a special TOD zone or change existing classifications. More common than either rezoning or new designations, however, is the creation of an overlay zone. As its name implies, an overlay zone is placed on the zoning map over a base zone. The overlay modifies, eliminates, or adds regulations to the base zone. Overlays provide for effective land-use control without increasing the complexity of the regulations. In addition to identifying transit unsupportive land uses, TOD zones often specify activities that are permitted as-of-right.

Promote Density

TOD generally requires a minimum of seven dwelling units per acre in residential areas and 50 jobs per acre in commercial centers to create adequate ridership in support of light rail technology. By increasing population and employment densities, more potential riders are located within walking distance of transit stations and are more likely to use the transit service. Not only do densities result in increased ridership, and therefore support more efficient use of the transit facility, densities also help to support active street life and commercial activities. Local governments are responsible for encouraging density, and can do so through a number of regulatory measures. Transit agencies typically use land planning decisions made by the local government to locate transit stations where high ridership is likely to exist. The Center for Transit-Oriented Development has developed a list of typologies that assign different levels of density for different types of TODs.

Typologies for TOD: Density and Service Level [14]

TOD Type: Urban Downtown
Recommended Land Use Mix: Office center, urban entertainment, multi-family housing, retail
Recommended Minimum Housing Density: Greater than 60 units per acre
Connectivity Requirements: High level of regional connectivity; Hub of transit system
Transit Service Frequency: Less than 10 min.

TOD Type: Urban Neighborhood
Recommended Land Use Mix: Residential, retail, commercial
Recommended Minimum Housing Density: Greater than 20 units per acre
Connectivity Requirements: Medium level of regional connectivity; Access to downtown circulation
Transit Service Frequency: 10 min. peak; 20 min. off-peak

TOD Type: Suburban Center
Recommended Land Use Mix: Office center, urban entertainment, multi-family housing, retail
Recommended Minimum Housing Density: Greater than 50 units per acre
Connectivity Requirements: High level of regional connectivity; Access to downtown hub
Transit Service Frequency: 10 min. peak; 10-15 min. off-peak

TOD Type: Suburban Neighborhood
Recommended Land Use Mix: Residential, retail, local office
Recommended Minimum Housing Density: Greater than 12 units per acre
Connectivity Requirements: Medium level of regional connectivity; Access to suburban centers and access to downtown hub
Transit Service Frequency: 20 min. peak; 30 min. off-peak

TOD Type: Neighborhood Transit Zone
Recommended Land Use Mix: Residential, neighborhood retail
Recommended Minimum Housing Density: Greater than 7 units per acre
Connectivity Requirements: Low level of regional connectivity; Access to suburban center
Transit Service Frequency: 25-30 min.

Emphasize Pedestrian Connections

Pedestrian-oriented design should be considered to the same degree as transit-oriented design. Pedestrian connections should be convenient and direct. Streets with sidewalks should be organized in a clear hierarchy to define which routes are primarily pedestrian in nature and which are primarily vehicular. Off-street multi-use trails have also been successfully integrated within TODs. Pedestrian connectivity is described in detail in the "Connecting People to Light Rail" Memo.

Orenco Station, Hillsboro, Oregon - The Orenco Station development includes 450 single-family detached and townhouse units and 1,384 apartments at a density of 9.2 units per acre[15].

Pedestrian Bridge in Denver, Colorado - This development, located near Denver Union Station, the transit hub for RTD's light rail system provides excellent pedestrian amenities and connections, including this bridge over a freight rail line.

14 "New Tools for Building Wealth: Linking Affordable Housing to Transit." Presentation by Shelley Poticha, Center for Transit-Oriented Development, March 2006. www.lisc.org/docs/experts/2006/eo_03_02_2006.pdf)
15 Community Building Sourcebook: Land Use and Transportation Initiatives in Portland, Oregon. TriMet, August 2005.

Market Common at Clarendon, Arlington County - The Market Common at Clarendon development successfully integrates pedestrian-friendly designs, transit oriented design, and automotive access to attract a wide range of clientele. The development houses over 350 residential units, as well as retail space and office space, all within walking distance of two Metrorail stations. Clarendon is also home to a well-established historic community. Although the Market Common development is very dense, the intensity of development gradually transitions to neighborhood scale.

Public parking wrapped in commercial uses in Boulder, Colorado - Parking structures in the City of Boulder are often wrapped in commercial uses, as shown here. Efforts in Boulder are also made to ensure that parking structures materials and design fit with the general architectural style of the area.

Create transitional zoning to protect neighboring community

Existing neighborhoods and communities often express concern about land use changes associated with TOD. Sensitivity to existing residential communities should be expressed when implementing TOD with high-density housing, commercial, and retail elements. Transitions between the more intense heights and densities encouraged as a part of TOD should be provided. Transitions can come in the form of "stepping down the height of structures, reducing lot coverage, adding buffers or increasing open space uses, increasing architectural detailing, reducing permitted maximum densities, and changes in use" Enabling the intensity of development to "taper off" from the station area can help TOD interface better with the surrounding community and allay the concerns of existing residents. The Urban Land Institute recommends that measures be taken to "demarcate neighborhood boundaries more clearly and to defend existing residential areas from intrusion by incompatible commercial uses" as part of any TOD project.

Manage Parking

The economic success of TOD projects may also require sufficient parking, particularly if many trips to TOD land uses will not involve transit. But just as too little parking will create economic problems, so will too many spaces. Real estate studies in San Francisco's transit oriented neighborhoods found that for every parking space provided with a residential unit, the number of units achievable on a typical parcel decrease by 20 percent, and the market cost of each unit increased by 20 percent. To maximize the number of units around stations and maximize those units' affordability, it is important to ensure parking does not consume too much of the buildable square footage in TOD projects. By "unbundling" parking from residential units, meaning that structure parking is not included with a residential unit, developers can make housing more affordable and create a more pedestrian-friendly environment.

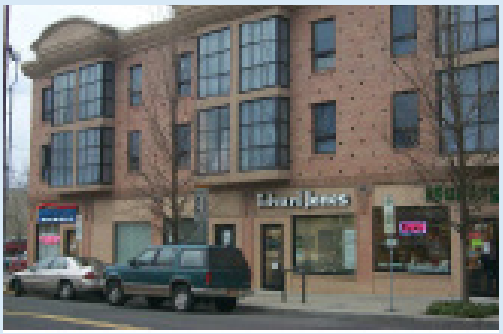
Since large park and ride facilities tend to conflict with the function of TOD, it is important to properly locate, design, and manage parking in such a way that conflicts are minimized. Good parking design is summarized in ULI's four principles: "move it, share it, deck it, wrap it". Parking should be located away from the platform, so that park and ride users walk amongst the TOD in order to get to their car. Sharing parking with non-concurrent uses (churches, events centers, etc.) can minimize the space necessary for parking. Parking should be "decked" in structures, to reduce the amount of space dedicated to parking. Wrapping parking with commercial and retail uses, landscaping, or local architectural features creates a more engaging street level.

Provide Supporting Infrastructure

Local governments can pro-actively plan for TOD by ensuring that the full range of public facilities are in place, including street connectivity and pedestrian and bicycle facilities. Well-designed public amenities and infrastructure will attract development. Since developers prefer to acquire a few larger parcels for development (instead of small, scattered parcels), governments can also assist in assembling land parcels for future development. This will make the land near stations more attractive for quality development.

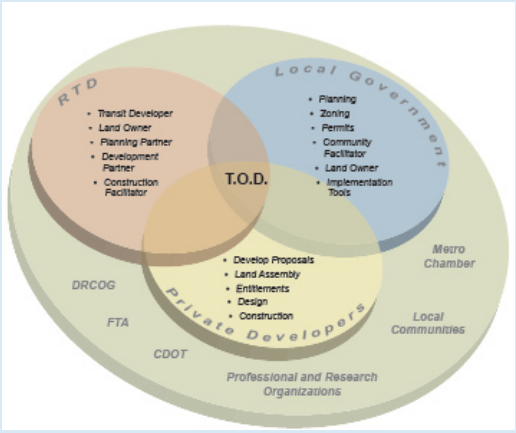
Incorporate Housing

The inclusion of housing has been a key element in the success of many TOD projects. Housing can create activity centers that increase non-peak hour activity. The demand for housing near transit is expected to increase substantially. The Center for Transit Oriented Development has projected that the demand (nationally) for housing within walking distance of transit will more than double by the year 2025[16]. It is also important that affordable housing be included in TOD. Residential development around transit can be so successful that it attracts wealthier households, resulting in escalating real estate values and rising rents. It is important to preserve housing that is affordable, since lower-income people tend to represent a large contingent of transit users. In some cities, agencies have linked transit funding with the provision of affordable housing.



Richmond Place in Portland, OR - The Richmond Place development in Portland, Oregon provides 21 transitional housing units designed in a style that integrates well into the neighborhood.

16 "Developing TOD in Sacramento." Fred Arnold, James Robinson, and Michael Bernick, Sustainability Concepts: Enhancing Communities Through TOD, June 2007.



Denver, CO: Roles in the TOD Process - The transit agency, local government, and private developer have overlapping roles in the TOD process that should be further defined early in the project.

Define Roles in TOD Process and Clarify Decision-making Process

It is important for the decision-makers in TOD projects, namely the transit agency, local government, developers, and community stakeholders, to clearly define their roles in the TOD process with buy-in from one another. The roles of transit agencies and local governments can exist with varying degrees of involvement from each party.

In some cases, the transit agency is the driving force in TOD efforts. This is the case with the Santa Clara Valley Transportation Authority (VTA) and at Dallas Area Rapid Transit (DART). The VTA seeks private and public sector development of VTA-owned property at and adjacent to transit stations and corridors. The VTA also involves local governments to establish development patterns that enhance transit use. The VTA's goal is to generate long-term sources of revenue, intensify land uses near the transit system (and thereby increasing ridership), and ensure the highest quality urban development at transit stations is implemented.

In other cases, the transit agency acts as more of a facilitator. In Denver, the RTD works to foster relationships with local jurisdictions, private developers, and local stakeholders and offers the assistance of RTD staff to local governments. The RTD does not act as the direct developer. This is also the case in Portland, where city and regional governments have been the driving force in aggressive TOD efforts. TriMet's involvement is limited to advocacy, education, and funding.

In order for TOD to be successful, local governments must be supportive of such land use changes and work to encourage TOD development through land use planning, zoning regulations, development guidelines, development review, and permitting.

INCREASE COMMUNITY KNOWLEDGE AND ACCEPTANCE OF TOD

Infill developments have been halted by community opposition to TOD. Communities may fear that a mixture of land uses will have a negative impact due to increased traffic congestion, additional stress on public infrastructure, and other issues. Some residents may also fear that affordable housing will change the character of their communities or decrease property values. In Mountain View, CA community opposition forced the Whisman light rail station to cut residential densities in half and to cancel plans to build rental properties. Although it still is considered a successful project, many view it as a casualty of "Not In My Backyard" syndrome that could have been avoided with better community outreach. Communities who have undertaken aggressive public involvement campaigns have successfully addressed these concerns through increased knowledge and awareness of what TOD is and how it can benefit communities, as well as through an increased sense of engagement. The Urban Land Use Institute (ULI) outlines several ways to engage individuals from disparate groups, so that they can learn that they have more in common than is directly evident. The ULI suggests the use of tools such as visual preference surveys, design charrettes, and focus groups to encourage collaboration. It is also advantageous to identify advocates, preferably civic or business leaders, who can speak persuasively on behalf of the effort and use influence to advance the project.

Envision Utah Outreach Program - The non-profit group Envision Utah, an organization focused on promoting quality growth in the Wasatch front range, launched an outreach program to show illustrative plans for four proposed station developments. The plans were presented to the public from a streetscape perspective so that stakeholders could clearly see how transit might change their communities. [17]

MINIMIZE RISKS AND "ROADBLOCKS" TO GOOD DEVELOPERS

Although TOD is becoming a proven form of successful development, some risks still exist for developers. Local governments can help reduce these perceived risks. The City of Calgary, which is considered the first North American city to successfully undertake TOD projects, helped to reduce these risks by "ensuring planning policies, zoning, and approval processes were in place to eliminate roadblocks and reduce timelines." In addition, the City of Calgary recognized the importance of both public and private participation in TOD. Calgary acknowledged that "large public land holdings around transit stations can reduce developer risk, speed development timing, and ensure public benefits are achieved through TOD". Furthermore, it is important that local governments align their zoning standards with TOD goals. A mixed-use project should be no more difficult to develop than a conventional project. If zoning standards are not easily conducive to mixed-use development, developers are likely to revert to conventional methods of developing. This has been the case in Montgomery County, Maryland where development has lagged due to what developers view as a more complicated development review process. Design standards and guidelines should not be so specific as to deter good developers. Another method of reducing developers concerns about financing is through public-private partnerships. Such a partnership proves that the government is committed to mixed use development. TOD in Portland's West Corridor MAX line was the product of public-private partnerships that ensured the future success of TOD in Portland. The implementation of a tax increment financing (TIF) district can be a powerful tool in financing TOD.

Fish Creek/Lacombe Station in Calgary - The City of Calgary has encouraged TOD in part through an effort to minimize roadblocks to good developers.

17 Wasatch Front TOD Guidelines. Envision Utah, 2002.

Santa Clara Valley Transportation Authority (VTA) - The VTA has engaged in several joint development projects, such as Whisman Station (above), which combines park and ride capacity within the residential development, and continues to seek out opportunities for joint development.

San Diego Trolley station - Well-designed transit amenities, like this station in downtown San Diego, are likely to attract good development. [18]

Consider Joint Development Opportunities

Joint-development around light rail stations is the most direct way to capture the potential of increased transit use and compact land use patterns. It is private development on, above or adjacent to a transit agency's property. The basic strength of this public-private coordination is that public investment and support makes TOD more attractive to profit-reliant developers, while direct involvement allows public agencies to shape projects around civic goals. Just as importantly, joint-development offers tremendous potential to capture some of the value that transit services add to adjacent and surrounding real estate. Competition for public money is intense. TOD value capture can provide the means to help fund transit improvements, by sharing in the real estate benefits of transit access.

The most common form of joint-development is the leasing of ground space or air rights on or above agency property. After changes to FTA rules in 1997, sales of such rights and space have gained favor as well. Many developers and investors, however, strongly preferred outright ownership to lease agreements. The FTA's new joint development policies allow an agency to sell land and keep the proceeds, so long as they are used to support the agency's mission of providing transit service. Since this change, many agencies have shifted to fee-simple sales (meaning that the owner is entitled to the entire property outright), attracting stronger developer interest as a result. This has increased the pool of developers responding to RFPs and has made recent joint development deals generally more remunerative. In addition to service improvements and maintenance, the new FTA policies allow transit agencies to place property/air rights sales revenue into a revolving fund to support additional TOD activity.

Other forms of joint-development include sharing:

- *Operating costs such as ventilation systems, utilities and parking facilities between a transit station and adjacent development*
- *Construction costs (foundations, parking facilities and construction staging areas) between station and adjacent development*

A large number of players are often involved in any TOD project. At a minimum, joint development involves one transit agency, one local government and one developer. Overlapping jurisdictions and service areas can add additional parties, as can the need for multiple lenders and investors beyond those directly involved. Comprehensive public involvement, a crucial component of TOD planning that should be initiated as early as possible, adds local advocacy groups, business organizations, neighborhood associations and other stakeholders to the mix.

18 www.sdcommute.com

Issue #3: What techniques have been the most effective at integrating light rail with community assets, i.e. parks and trails, iconic businesses, environmentally sensitive areas?

As discussed in the "Community and Neighborhoods" memo, light rail has the potential to enhance communities in a variety of ways. Any benefits to communities are greatly increased if a focus is put on encouraging a sense of place. Transit investments have the ability to increase a neighborhood's access to open space and parks, increase the visibility of local businesses, and engage and empower the public to make decisions for their community. It is vital that any light rail project closely adhere to the National Environmental Policy Act (NEPA), as well as any local environmental regulation, so that the transit service is sure to minimize harm to any natural areas and resources. In addition, it is important that safe and attractive pedestrian, bicycle, and vehicular crossings be provided in order to integrate the transit service with existing activities. The following best practices can encourage the successful integration of a light rail system and community assets.

Incorporate Public Spaces and Greenways

Public space is an asset that can be encouraged with transit investment. Public spaces, plazas, parks, and greenways can be utilized as part of station design so that the station becomes a focal point of the neighborhood. Public spaces can also serve to offset the negative effect of higher density development by providing open areas which the community can enjoy. The creation of gathering spaces with seating and a pleasant environment can help transit stations to not just integrate with the community, but to enhance it. This has been the case at the White Rock station in Dallas and the Orenco station in Hillsboro, Oregon. The DART White Rock station is heavily landscaped with a waterfall of greenery and an arbored walkway from the parking lot [19]. The Orenco station takes its name from the Oregon Nursery Company and retains landscaping elements in honor of that history. Orenco Station is home to two large parks and many smaller pocket parks. Best practices for incorporating greenways are also discussed in Fact Sheet #2, "Community and Neighborhoods."

Orenco Station in Hillsboro, Oregon - The Orenco TOD in Hillsboro, Oregon incorporates two large parks and many pocket parks in its design. [20]

Dallas White Rock Station - The DART White Rock Station incorporates landscaping elements to integrate natural qualities of the surrounding community.

19 http://www.dart.org/
20 http://www.orencostation.net/

Santa Clara Valley Transportation Authority - A VTA light rail line runs adjacent to this public park.

Preserving Environmentally-Sensitive Areas - The NEPA process ensures that environmentally-sensitive areas are preserved to the greatest extent possible.

Adhere to the National Environmental Policy Act (NEPA) Process

The National Environmental Policy Act (NEPA) requires that any federal action go through a detailed decision making process that evaluates a wide range of social and environmental impacts that may occur with a project. The NEPA process will identify any environmentally-sensitive areas that might be impacted. NEPA requires evaluation of measures to avoid and minimize these impacts, and requires that all impacts be mitigated.

Involve Business Interests in the Planning Process

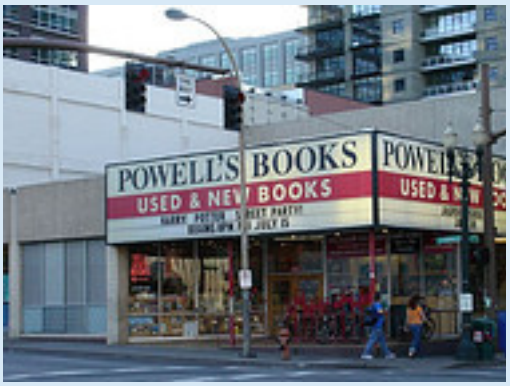
Business interests can reap large benefits from a successful transit system and can be powerful advocates of transit investment. Businesses are also uniquely positioned to provide information on the needs of their clientele and are able to shed light on how best to integrate light rail with the community. Powell's Books, a prominent book emporium in Portland, is a good example of how transit has integrated well with an iconic business. Powell's Books has grown tremendously, in part because of its access to light rail. Powell's was involved in the planning of the transit service and has become a vocal proponent of its expansion.

Involve the Community in the Planning Process

As discussed in Issue #2, an engaged community is much more likely to support transit investment. The community can also offer planners important insight into what they want their community to look like, and the extent in which they'd like to see transit integrated into it. Transit investment can offer the community a chance to create vision for their community and to identify enhancements they'd like to see incorporated.

Create a Safe and Attractive Pedestrian and Bicycle Environment

Pedestrian and bicycle connectivity is an important part of transit investment. In particular, it is very important that any crossing of the light rail system be as safe as possible. This is especially true for pedestrian and bicycle facilities that are not located along streets. One approach for locations where many pedestrians are crossing is the installation of fencing or other barriers are used to direct pedestrians to controlled crossings. A pedestrian z-crossing is another approach. Z-crossings are configured so that pedestrians must turn facing in the direct view of on-coming trains before turning again to cross the track. Gates and signals are sometimes employed alone, or in conjunction with z-crossings. Full grade-separations can also be provided for pedestrian and bicycles. At-grade vehicular crossings also need to be enhanced for pedestrian and bicycle use with applications such as crosswalk demarcations, pedestrian refuges in medians, pedestrian signal phases, and signal timing displays. The "Connecting People to Light Rail" memo further discusses pedestrian and bicycle connections.



Powell's Books benefits from the exposure that Portland's TriMet service provides, and has in turn become a vocal proponent of transit systems.

Market Common at Clarendon, Arlington County, Virginia - Clearly marked pedestrian crossings clarify crossings for both pedestrians and drivers, enhancing safety.

Z-crossing in Portland, Oregon - The Z-crossing is one method of creating safe pedestrian and bicycle crossings.

Design Element at VTA station - Urban Design Elements, such as this fencing used at a VTA station, can be employed to create a sense of area identity around transit facilities.

Elevated BART Rail - Landscaping, like the mature trees shown here, can help to minimize the visual impact of the elevated track.

San Diego Trolley Station - This station uses architectural detailing that is consistent with the surrounding community, which enhances a sense of area identity.

Elevated VTA track - The open design of this VTA track maximizes visibility while employing urban design elements such as pedestrian-scale infrastructure. Transit users are more likely to feel safe in this environment.

Issue #4: What techniques have been applied to overcome or minimize the real or perceived barrier created by the light rail system to maintain connectivity and area identity? (barriers i.e. tracks, retained cuts)

The implementation of any transit service, whether it is at-grade, underground, or elevated in nature, can present challenges to connectivity and area identity and can create both real and perceived barriers in communities. There are several practices that can minimize these effects.

Employ High-quality Urban Design Elements

For communities that have light rail running through them, barriers can be alleviated through the use of high-quality urban design elements. One way to achieve this is through the creation and reinforcement of neighborhood identity. Strategic use of public art elements, landscaping, architectural detailing, and lighting elements can be employed. These elements should be consistent throughout the community, particularly in areas where the tracks intersect the community. The use of high-quality materials is also important in making transit lines visually pleasing and in helping them to withstand the wear and tear of time. Visually unattractive materials such as razor wire and chain link fence should be avoided, since those materials can connote a hazard and lack of safety. For transit lines that are elevated, it is important that urban elements are as open as possible to prevent the area from feeling dark and closed in. Maintenance should be dutifully performed so as not to let areas fall into disrepair. A poorly-maintained facility is much more likely to blight neighborhoods than one that is well-cared for. For at-grade facilities, substations and utilities should be placed underground where possible. This will reduce the visual barrier created by overhead wires and catenaries[21].

Implement Measures to Bolster User Safety

Underground and elevated stations and transit lines can feel unsafe and present safety issues, since they generally have less visibility than at-grade facilities. Good natural surveillance should be provided so that pedestrians feel safe. Visibility should be maximized to the greatest extent possible through architectural design. Safety measures are discussed further in the “Station Security” Memo.

Provide Pedestrian, Bicycle, and Vehicular Connectivity

Connectivity is key in minimizing the real and perceived barriers of light rail. Vehicular connectivity must be maintained on the nearby transportation network so that light rail imposes no restrictions to access or mobility. Pedestrian and bicycle connections are equally important, and are a particular concern for at-grade systems. Special consideration should be given to pedestrian and bicycle crossings of an at-grade system. Examples of safe pedestrian and bicycle crossings are provided under Issue #3. Methods to increase connectivity are discussed in detail in the “Connecting People to Light Rail” Memo.

21 Transit Cooperative Research Program Report 17 – Integration of Light Rail Transit into City Streets. Transportation Research Board, 1996.

Issue #5: What are the long term benefits of light rail experienced by other systems in each of the urban forms relevant to Bellevue?

Particular urban forms are likely to respond differently and reap different benefits from light rail. Although particular land uses can be distinctly more supportive of transit systems, most urban forms do experience long term benefits from light rail. Some forms such as commercial strip retail and industrial uses, are particularly conducive to redevelopment, so that land productivity can be maximized. The urban forms that are relevant to Bellevue, including suburban residential areas, office parks, minor commercial hubs, downtown urban core, and industrial/large-scale commercial, are discussed below.

Suburban Residential Areas

Suburban residential land uses can experience a multitude of benefits from light rail. Transit service can improve resident's local and regional mobility and can allow people more options for travel to work and leisure activities. Stations, if well-designed, are likely to bring enhancement to the pedestrian and bicycle environment. Station development can bring the addition of neighborhood retail and services, if desired. Stations can also incorporate public spaces, plazas and parks, providing gathering space for communities. Such spaces, when integrated well, have the effect of increasing the sense of community and sense of place. In addition, residential properties generally increase in value with transit investments. This is discussed in the "Property Values" memo.

Office Parks

Commercial office land uses, even low-density offices, can benefit from transit investments. Employees will benefit from improved mobility, especially if circulator or feeder bus service is provided to connect employees from transit stops to workplaces that are not located within walking distance of the station. Areas currently populated with low-density office areas have potential to support increased density with a transit investment. This can lead to job growth and the development of sub-regional employment centers. As cities evolve toward multiple centers, systems that link central business districts and outlying employment centers will be especially important.

Minor Commercial Hubs

Minor commercial hubs, including strip mall developments, can be prime areas for TOD and redevelopment. Stations located in these areas can enliven commercial centers and increase land productivity. Some communities have chosen to recoup some of the cost of capital improvements through the implementation of a local improvement district (LID). The Central Area General Improvement District (CAGID) in the city of Boulder, Colorado uses funds collected at public parking lots and meters as well as funds collected from the 160 shops and 80 restaurants to maintain its 35 block area and invest in capital improvements[22] .

VTA San Antonio Station - The San Antonio Station is a small neighborhood station that serves nearby suburban residences.

Franklin Business Park in Calgary, Alberta - The Franklin Business Park is a 40 acre development north of Calgary Transit's Franklin Station. It includes offices, manufacturing, businesses, and the DeVry Institute of Technology, shown above. Ridership increased at this station by 30% between 1991 and 2004.

Fruitvale Station in Oakland, CA - The Fruitvale Station is the product of a redevelopment of a declining commercial strip near BART's station. It includes retail, offices, and housing elements.

22 http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=1232&Itemid=429

Pearl Street Mall in Boulder, CO - The Pearl Street Mall is part of Boulder's Central Area General Improvement District (CAGID). Money collected through sources including parking lots and meters funds the maintenance and improvement of downtown Boulder.

Mixed-Use development in Albuquerque, New Mexico - More compact commercial and retail development can complement transit service and enhance opportunities for business to thrive.

Gates Redevelopment in Denver, Colorado - This project is a redevelopment of the former Gates Rubber Factory, a Denver landmark located adjacent to RTD's I-25 and Broadway station. The Gates redevelopment project encompasses 50 acres that will be redeveloped over the next 10 years as a vibrant mixed-use community.

Urban Core

Transit investments typically have the greatest influence on downtown urban areas. Downtown areas are likely to see an increase in office commercial and retail activity. Urban core areas can also see an increase in residential units along with transit investment. Stations located in urban areas have the opportunity to become great urban spaces, as evidenced historically in places like Grand Central Station, and more recently in cities like Portland and the Central Platte Valley in Downtown Denver.

Industrial and Large-scale Commercial

Large-lot industrial and warehouse retail sites are particularly well-suited for redevelopment and transit oriented development. Orenco Station in Hillsboro, OR is a former industrial site that is now a 199-acre pedestrian-oriented community. The benefits of TOD are discussed under Issue #2. Employees at industrial sites can benefit from the increased accessibility that transit service brings, especially if that service is accompanied by circulator or feeder bus service that connects transit stations to employment centers.

RESOURCES

In addition to the references cited in the text as footnotes, the following resources were consulted:

Federal Transit Administration. Guidelines and Standards for Assessing Transit-Supportive Land Use, May 2004.

Federal Transit Administration. Transit Oriented Development Lessons Learned: Results of FTA's Listening Sessions with Developers, Bankers, and Transit Agencies on Transit Oriented Development, December 2005.

Maricopa Association of Governments. Growing Smarter Implementation Project Best Practices Paper #6 – Transit Oriented Development, August 2003.

Reconnecting America's Center for Transit-Oriented Development. Realizing the Potential: Expanding Housing Opportunities Near Transit, April 2007.

PROTECTING AND ENHANCING PROPERTY VALUES

The introduction of light rail into a community often creates expectations about the effect of light rail on property values, ranging from hopes for dramatic increases, to fears about significant decline. Over the past 20 years, analysts have studied the impact of light rail on property values in both residential and commercial land uses. This memo summarizes an array of typical research findings for the City of Bellevue's consideration. Specific attention was given to how proximity to two different types of land use, residential and commercial, influenced property values and whether there are appropriate government actions to mitigate negative impacts.

Issue #1: What has been the experience of other cities with regards to property values when light rail systems have been planned and built?

The majority of research documents that property values increase with light rail because of increased access to transit for residents, employees, and visitors. Residential buyers put a premium on having alternatives to driving and the pedestrian amenities that accompany light rail stations. Businesses benefit by greater customer access, infrastructure enhancements related to the light rail investment, and, when available, incentives like tax abatements around rail stations.

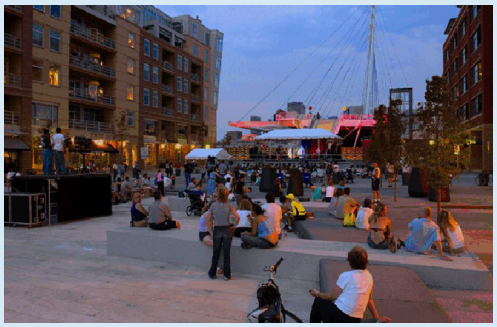
The research for this project is based on studies that have been done over the past 20 years with the objective of understanding the effects of light rail on property values. It is virtually impossible to isolate the effect of light rail transit from other factors that affect property values. Issues such as neighborhood quality, housing stock quality, age and desirability (new homes sell better in some areas, older homes are prized in others), proximity to other transportation facilities (such as freeways), economic factors, and station design, all play a role in the desirability and price of properties.

Most studies attempt to separate out the very high and low value properties, and attempt to account for other factors to the extent possible. Significant research efforts have been performed using "hedonic modeling", a price estimating methodology that assigns values to all of the components that might affect the price of something. In the case of housing, age, proximity of transportation facilities, and quality of neighborhood are examples of the types of elements that might be found in a hedonic modeling analysis. Hedonic modeling was used in most of the studies cited in this memorandum.

RESEARCH FINDINGS

Several national studies indicate that commercial and residential property values generally rise the closer they are to light rail stations. However, the overall economic climate for the area is often the principal driver when assessing how light rail transit investment will affect properties.

Water fountain is featured at this transit oriented development BART station in downtown Oakland, CA.



High quality, mixed-use, transit oriented development near Denver's Union Station.

Fruit Vale Village mixed-use development and BART Station signage.

Research Findings
Property Values

A home in Hillsboro, Oregon is quiet and visually protected with a sound wall as MAX slips by (top). The bottom photo shows a house directly across the tracks that has no visual or sound protection from the train.

Light rail integrated into single family neighborhoods. (Cleveland - top, Pittsburgh - bottom)

Key factors in increasing property values include:

- Increased accessibility provided by light rail
- Station design
- Quality of transit service
- Land market
- Policy and institutional factors, e.g. public investments, design standards

In general, a high quality transit system provides increased access to work and other activities for households and to customers and employees for businesses, which are subsequently reflected in the value of a home or a commercial property.

Residential

In general, properties within walking distance of stations experience increases in value. Walking distance is typically measured at ¼ to ½ mile, or a 5 to 10 minute walk. General findings suggest properties adjacent, within 200 to 900 feet of the station, are most likely to experience no change in value or experience a decrease in value. Note that, in the examples that follow, the effects of light rail systems on home prices are often reported as a value associated with a distance. This is because researchers have tried to understand the radius of influence of light rail systems on property values:

- *Dallas, TX. Property values were first studied beginning two years before DART began service (from 1994 to 1998; DART service began in 1996). This study found that the value of residential properties in neighborhoods served by a DART station increased 25% more than similar properties in neighborhoods not served by DART. An update to the study, performed from 1997 to 2001, found that values of properties rose 39% more than the control group not served by rail. Median values of residential properties increased 32.1% near DART compared to 19.5% in the control group areas.* [1]
- *Sacramento, CA. In a city-wide study in 1995, no statistically significant effects, positive or negative were found regarding the effect of the proximity of light rail transit on single-family home values.* [2]
- *Sacramento, San Diego, San Jose Light Rail Systems: A 1994 study compared the positive effects of accessibility with the potentially negative affects of noise and vibration associated with light rail on home prices. The study found that even homes "extremely close" to an above ground light rail transit line (300 meters) did not result in lower home prices.*[3]

1. Weinstein, B., Clower, T.; 2003. DART Light Rail's Effect on Taxable Property Valuations and Transit Oriented Development, Center for Economic Development and Research, University of North Texas.
2. Landis, John D. et. al. 1995. Rail Transit Investments, Real Estate Values, and Land Use Change: A Comparative Analysis of Five California Transit Systems, Institute of Urban and Regional Development, University of California at Berkely. In The Effect of Rail Transit on Property Values, Parsons Brinckerhoff, 2001.
3. Landis, John D., et. al. Capitalization of Transit Investments into Single-Family Home Prices, Working Paper, University of California Transportation Center, 38pp, 1994.

- *San Diego, CA. A 2002 study found that multi-family homes near the East Line and South Line stations experienced 17% and 10% premiums, respectively. [4] A 1995 study reported that the 1990 sale price of single family homes increased $2.72 for every meter closer it was to a light rail station. [5]*
- *Santa Clara/San Jose, CA. The price of single family homes increased 0.1% for every 1,000 feet closer to a station, but decreased 10.8% if closer than 900 feet. In San Jose, homes in a commercial/industrial area serving lower income residents experienced a $1.97 decrease in property values per meter closer to light rail. [6]*
- *Portland, OR. A 1993 study of seven stations on the Eastside MAX line found that for houses within ¼ mile radius of stations, the typical house sold for $663 more for every 100 meters it was closer to a light rail station. [7] A 1997 study found that, on average, residential property values along Eastside MAX increased by $75 for every 100 feet closer to the station (within the 2,500 ft. – 5,280 ft. radius). [8]*

COMMERCIAL

Throughout the U.S. real estate investments in residential, commercial, and business properties that are served by high quality public transportation "command higher rents and maintain higher value than similar properties not as well served by transit". [9] The magnitude of the impact on commercial property values will vary according to how much accessibility is improved, the relative attractiveness of the locations near the station area, and the real estate market in the region.[10]

The following are examples of the change in property values with the introduction of light rail in several cities:

- *Dallas, TX. A study performed from 1997 to 2001 (after revenue service started, but before the completion of all stations) found that the median value of office buildings near DART increased by 24.7% versus 11.5% for non-DART properties. Office buildings very near DART stations increased by 53%. [11]*
- *San Diego, CA. A 2002 study reported a 72% premium resulted for parcels near stations in the Mission Valley corridor. The study concluded that offices, retail shops, restaurants and other commercial uses reap significant benefits when located near a station in major business-retail settings.[12]*

Homes located along VTA light rail in a suburb of San Jose, CA.

DARTs Mockingbird Station, and adjacent commercial district.

4. Cervero and Duncan, 2002.
5. Landis, 1995 in PB 2001.
6. Landis, 1994.
7. Al-Mosaind, M. et. al. 1993. Light Rail Transit Stations and Property Values: A Hedonic Price Approach. Portland, OR: Center for Urban Studies. Preprint, Transportation Research Board, 72nd Annual Meeting. In PB 2001.
8. Lewis-Workman, Steven, and Daniel Brod. 1997. Measuring the Neighborhood Benefits of Rail Transit Accessibility. Transportation Research Record 1576, pp. 147-153. In PB 2001.
9 American Public Transportation Association (APTA) and Public Transportation Partnership for Tomorrow, The Benefits of Public Transportation: Building Investment Value in Our Economy and Marketplace. 2003. www.apta.com/research/info/online/land_use.cfm
10. The Effect of Rail Transit on Property Values, Parsons Brinckerhoff, 2001.
11. Weinstein and Clower, 2003.
12. Cervero and Duncan, 2002.

Historic train station in San Diego is now a multi-modal transit center. Saving beloved architecture for modern uses generates pride and ownership in a community.

Cafes, an open design, quality materials and human scale architecture makes this a great destination station to meet a friend in San Diego.

Rendering of Valley Metro's "prototype" station. Design was responsive to CPTED principles and extreme heat conditions in the region.

- *Santa Clara/San Jose, CA. Properties less than a ¼-mile from a station experienced a 23% sales premium. Rent for units within ¾-mile of a station increased 4 to 12%.* [13]

Analysis: The studies reviewed indicate that while there can be site specific decreases in property values, light rail generally enhances the value of residential and commercial properties. The studies are consistent with demographic shifts and market trends. Americans are increasingly choosing to live in locations within easy walking distance of public transportation. Younger and older households want walkability and alternatives to the automobile. As much as 30 percent of the demand for housing is for "denser, walkable, mixed-use communities, and that less than two percent of new housing starts are in this category". This gap in supply versus demand makes existing residential properties more valuable.[14]

Issue #2: Is there a distance where any effects to property values of the light rail line or station are notably increased or reduced (e.g. ¼ mile, ½ mile)?

Research Findings

Studies are inconclusive on this point. As discussed above, both increases and decreases in property values were observed for both residential and commercial land uses at ¼ and ½ mile distances from stations. In general, most studies showed increases everywhere within walking distance from the station with some site specific decreases.

Local circumstances, such as the economy and land market, appear to be the most influential determinant of the relationship between distance from stations and property value changes. Another important factor in determining whether there are negative property value impacts is the quality of the design of the stations, safety and security, and noise. These design and operation issues may have positive or negative impacts on properties within one or two blocks of the station.

13. Cervero and Duncan, 2002.
14. APTA 2003.

Issue #3: What are the best practices to maximize and/or protect property values during the phases of light rail development (e.g. agency communications, construction management)?

Research Findings

There are strategies that have been successfully applied around the country that help to protect and maximize property values. The real success of each strategy is the appropriateness of the application in each setting. Not all strategies are applicable in every city or for every type of property. The community needs to be clear on the objectives and vision for each property area and develop strategies that support and promote that vision.

Analysis: This issue can be addressed in two different ways. Maximizing property values suggests one set of strategies to foster growth and economic development; protecting property values from a decrease suggests a different set of strategies to maintain and enhance values without changing the urban environment. Maximizing property values tends to imply increasing commercial value, so these strategies listed include redevelopment and densification options. Protecting property values implies retaining the character of an area, so these strategies focus primarily on residential neighborhoods.

APPROPRIATELY APPLY PLANNING, DESIGN, AND IMPLEMENTATION STRATEGIES TO ADVANCE COMMUNITY VISION

Strategies that can both Protect and Maximize Property Values (All land use types)

Coordinate Infrastructure Improvements: The scale of light rail construction often offers an opportunity to enhance existing areas. At-grade light rail construction offers the opportunity to underground utilities, provide noise abatement, rebuild streets with complete sidewalks, and enhance urban design.

Maintain System: Keeping station areas, trackways, and adjacent public areas free from debris, clutter, and graffiti is critical to maintaining an image worthy of the surrounding community. Bellevue neighborhoods and downtown Bellevue are well-maintained, and the light rail line should reflect a similar upkeep.

Protecting Property Values (Residential)

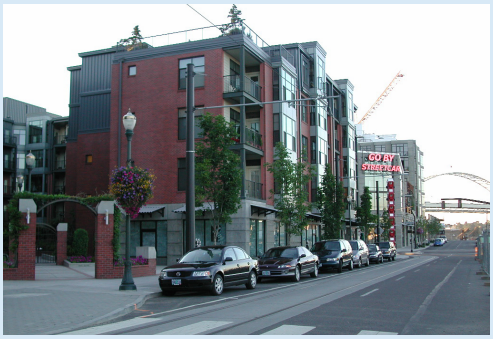
Research indicates that the presence of light rail typically adds value to homes and businesses. However, communities are sometimes concerned about the effect of light rail on single family neighborhoods. Protecting property values can be achieved through strategies such as design guidelines, traffic calming and diversion methods.

Provide Station Access to Properties along the Light Rail Line: Station access has been shown to increase property values, therefore, it's important to provide access for the communities served by light rail.

Encourage Nearby Walkable Services and Community Gathering Places When Existing Land Use Permits: In locations where land use permits, encourage the development of walkable amenities such

AIA Award winning transit station at King Street Station in Seattle.

Public art enhances LRT station at the Portland EXPO - "Tori Gates" each metal tag represents a Japanese American interred there during WWII.



New condo project in Portland is accessible by transit.

Attractive and easy to understand station graphics on VTA's Mountainview - Champion Line.

Materials, landscaping and architecture at Orenco Station reflect the values of the surrounding community. Orenco takes its name from the "Oregon Nursery Company", the original landowner, so plants and plant art play a significant role at this station.

as coffee shops, laundry services, and neighborhood cafes. These uses can strengthen community character and provide gathering spaces.

Adopt Design Guidelines That Reflect Neighborhood Character: The light rail line and station should be designed to reflect the character and style of the community. The materials, color and art should fit in and complement the community. Safe pedestrian amenities, landscaping, sound walls (where appropriate), and crossing design are all components.

Traffic Calming and Diversion: In Bellevue, the light rail line and stations may be located on arterials that currently experience significant traffic volumes. In order to prevent diversion through neighborhoods by autos accessing the station, traffic calming, neighborhood identity, and traffic diversion measures should be considered. Utilize Neighborhood Traffic Calming programs to address driver behavior and provide opportunities for physical measures such as speed bumps and traffic circles, in the context of community advocacy and involvement.

Parking Management: Residential Parking Management Programs allow communities to manage "hide and ride" activity, where commuters park their car and ride the train. This can take two approaches: 1) General parking restrictions restrict parking during certain hours of the day for all vehicles – resident or not. This is appropriate for streets where residents do not need street parking during the day. 2) Residential Parking Zones allow only permitted residential vehicles to park during certain hours of the day, and is appropriate in communities where residents rely on street parking.

Noise and Visual Mitigation: Light rail is relatively quiet, similar to other transportation modes such as light trucks. However, in some areas where ambient noise is not present, light rail can stand out. Noise is typically more of an issue with elevated sections rather than at-grade sections. Noise abatement measures may be appropriate in some locations, and are described in the Communities and Neighborhoods Fact Sheet. Properties adjacent to light rail may prefer visual screening from the light rail line, such as fencing and landscape buffers. Consistent design guidelines for these measures can help create a unified feel to the community.

Maximizing Property Values (Commercial)

Maximizing property values, as discussed here, involves increasing density and income potential. This can be achieved through a number of strategies:

Conversion of Land Uses (Washington D.C. Area & Atlanta, GA). In Farifax, Prince William, and Stafford counties, planners and developers are turning previously open and out-of-the-way land near the Virginia Railway Express stations into mixed retail, commercial and residential communities. [15]

The proximity of light rail lines to industrial uses often has a negative effect on property value, as shown with the MARTA east line in Atlanta. Light rail may interfere with access and delivery by large motor vehicles associated with industrial properties, making them less desirable for these purposes.[16]

15 APTA 2003
16. Weinstein and Clower, 2003.

Planning for a conversion of uses to more transit-compatible uses requires local municipalities and jurisdictions to work with their transit agency for appropriate buffer uses between the remaining industrial land and the transit station area. Long term plans may include conversion of these areas to housing or commercial space.[17]

Support Joint Development: Many cities have implemented comprehensive joint development programs and policies that combine public and private funding and resources. Actions that support joint development can include providing information on available sites for development by establishing a process to receive, evaluate and approve development proposals, and by providing assistance in the public outreach during the development review process.

Create Supportive Public Policies (San Diego, CA): In San Diego's Mission Valley Corridor, increases in land values have been recorded for commercial properties where public policies have been implemented to leverage or initiate development. Public policies favoring development near transit and affecting land values around transit station areas include zoning bonuses designed to leverage transit oriented development, overlay zoning encouraging a mix of uses, and targeted infrastructure investments.

Eliminate Parking Minimums: This reduces public and private costs to accommodate private vehicles.

Location-efficient Mortgages: Provide the opportunity for purchasing homes near transit services for middle and lower-income households. These mortgages increase a buyers ability to purchase property near a transit line by taking into account the transportation savings they'll enjoy by being able to walk or take transit to the store and work. Effectively, the transportation savings is translated into approximately 10 percent more disposable income for the buyer.

Co-location: Co-location of public and private facilities and services that are convenient and geared toward residents and transit riders, such as retail, commercial, convenience shopping, personal services, community centers, and child care are a few examples.

Commercial development in San Jose adjacent to VTA light rail. Yahoo and Adobe corporate headquarters depicted.

Hillsboro's Central Station has a public library service center for book return.

17. Diaz, Roderick B. et. al., Impacts of Rail Transit on Property Values. May, 1999.

Specific Approaches for Project Phases

What can cities do to address concerns by residential and business owners during the different phases of light rail project development? Common concerns that arise during the planning phase include concerns about property impacts, redevelopment opportunities, noise, vibration, visual, and construction impacts. The federal environmental review process is designed to provide factual information about impacts in a publicized timeframe. Unfortunately, there is not a significant body of research discussing specific approaches to addressing concerns during the different project phases. Literature regarding planning and design of light rail projects as a whole provides the following best practices:

Best Practices:

- *Have a transparent public outreach process that listens, and shares as much information as is available throughout the planning phase.*
- *Share information about national trends and the effects of light rail in communities.*
- *Use the time to develop policies to strengthen the community vision*
- *Develop a community forum for sharing information about the project*
- *Engage community in project development at appropriate times in the environmental process*

Construction: This topic will be covered in detail in the Construction Mitigation technical memoranda.

View of Beaverton's Round from a sunny outdoor cafe.

Other Resources:

Agency Overview, Dallas Area Rapid Transit (DART), April 2007.

Chen, Hong et. al. 1997, Measuring the Impact of Light Rail Systems

on Single Family Home Values: A Hedonic Approach with GIS Application

David Evans and Associate, Inc, SERA Urbsworks, Nelson Nygaard 2007, Portland LRT 10 Station Area Best Practices Assessments and Recommendations

National Resource Defense Council, Guide to Location Efficient Mortgages. www.nrdc.org

NRDC.org: Guide to Location Efficient Mortgages.

Research Findings
Station Security

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Light rail has been implemented safely in over 25 cities around the country. Two related issues must be addressed in the design of light rail stations—security and safety. This memorandum addresses station security—the prevention of intended harm to people or property from criminal activity. It addresses best practices for preventing criminal activity. By contrast, "safety" at stations includes unintentional harm to people or property at and around stations. It includes the issue of crashes between trains, motor vehicles and pedestrians, and the safety of pedestrians at stations. A separate memo, Street Design, will thoroughly cover safety and accident prevention of light rail systems including at station areas.

Issue #1: Has the introduction of light rail had any effects on crime rates? Are there differences between elevated, at grade, or underground systems?

Light rail does not bring crime

A common concern about the introduction of light rail into suburban communities is that it will bring crime from urban areas to the neighborhoods, or generate crime that wasn't there before. A significant amount of research has been done to assess the validity of these concerns based on the experience of communities across the country.

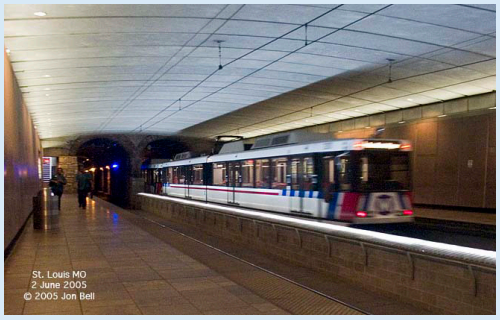
A primary finding is that crime rates near transit stations are closely related to the community around it. Communities with a history of crime continued to experience crime once light rail was introduced. Communities that enjoyed safety continued to experience security and safety after light rail was introduced. This finding was supported by two major studies of transit systems across America.[1]

A comprehensive study of the Green Line in Los Angeles County set out to answer this very question – "Does light rail transport crime from areas with high crime to areas with low crime?" The study evaluated crime rates in urban and suburban communities along the corridor prior to the opening of the light rail system. No increase in criminal activity was found in any of the relatively crime-free communities, and in some cases, crime rates decreased after light rail was introduced.[2]

Types of crimes associated with rail

When crime occurs, it tends to happen at stations rather than along the lines. The type of crime that occurs at stations tends to be public nuisance or quality of life crimes, which include vandalism, petty theft, vagrancy, and other similar incidents. Although of a less serious nature, public nuisance crimes can be very intimidating for transit riders and can deter ridership. However, there are best practices to reduce the occurrence and impact of these crimes (see Issue #2).

A 1996 evaluation of crime occurring on rail fixed guideway systems in America (including light rail and heavy rail) recorded that 93 percent of crimes on rail systems are public nuisance or "quality of life"crimes,



Underground and elevated stations, like these in St. Louis and San Diego, can be designed to feel safe and welcoming by using high quality materials, lighting, bright stairways, and open architecture.

1 Staying on Track: Review of Public Safety and Security on Light Rail Systems. City of Seattle Strategic Planning Office. February 1999.
2 Liggett, R., Loukaitou-Sideris, A., Iseki, H. "Journeys to Crime: Assessing the Effect of a Light Rail Line on Crime in the Neighborhoods." UCLA Department of Urban Planning, 2002.

Open design, visibility, access, art that reflects the community, and meticulous maintenance make this Sacramento transit center shine.

This San Diego multi-modal station is bright and open despite portions of it being underneath the rail line.

and property crimes. Fare evasion accounts for more than 80 percent of property crimes, while theft and burglary accounted for less than 20 percent. Violent crimes accounted for 6.6 percent of all crimes, and the most serious crimes (homicide and rape) comprised less than one percent of all violent crimes.[3]

Lower visibility = greater crime potential

In general, environments with low visibility, such as underground stations and underneath overpasses, tend to experience more crime than at-grade stations. This is because the reduced visibility provides an opportunity for vandalism and other offenses. Underground and elevated systems can be designed with enhanced visibility, and other social practices, e.g. community block watch, can support a crime-free environment. These ideas are discussed in the next section.

ISSUE # 2: What are the best practices to reduce or eliminate crime rates at stations and in adjacent communities?

Security improvements and crime reduction can be greatly affected by design and maintenance, technology, community outreach, and enforcement. While enforcement is a critical component, it is part of a larger approach that also applies design techniques to deter crime and promote safety.

Employ design techniques and maintenance practices that deter crime

Station security starts with good design and upkeep. Generally, physical attributes that correlate with lower crime rates include well kept neighborhoods, office and industrial parks, and good building stock. Attributes associated with higher crime levels include deteriorating buildings, large vacant park and ride lots and vacant parcels, litter and graffiti, and underpass station design.[4]

"Crime Prevention Through Environmental Design (CPTED)" provides guidelines to deter criminal activity through four design principles[5]:

Natural Surveillance: Concepts that keep activity areas and people visible including at stations, in parking areas, and while connecting to stations. Strategies include transparent barriers, street-level windows that reveal underground stations, adequate lighting, and pedestrian friendly designs.

Territorial Reinforcement: Concepts that promote a sense of ownership among users and translates into a deterrent to intruders. Examples include features that define property lines and distinguish public from private spaces through the use of plantings, landscaping design, pavement materials and fencing. Note that cyclone and razor wire fencing communicate a lack of presence and enforcement, and are not recommended.

3 Seattle, 1999.
4 Liggett, R., Loukaitou-Sideris, A., Iseki, H. "Protecting Against Transit Crime: The Importance of the Build Environment," UCLA, 2004.
5 Liggett, R., Loukaitou-Sideris, A., Iseki, H. "Protecting Against Transit Crime: The Importance of the Build Environment," UCLA, 2004.

Natural Access Control: Concepts that deny access to targets and create a sense of risk in potential offenders. This is achieved by clearly delineating public routes through landscaping and design, and preventing access to private property through physical barriers.

Target Hardening: Features that prevent entry, such as locks, bolts and interior hinges.

Considering these principles, stations should be visible from adjacent streets, and easily accessible to law enforcement personnel. The design of the station and surroundings should provide good sight-lines and avoid creating conditions that will obscure the presence of individuals, such as full landscaping. Station design should avoid creating conditions where a patron could be trapped by physical barriers. Light, bright environments deter vandalism and increase people's sense of security. The lights from stations should be shielded from adjacent neighborhoods. However, the safety of pedestrians walking to those neighborhoods must be considered in design. Bright designated walkways with appropriate landscaping, free of entrapment areas (i.e. dead ends or blocked exits), deter crime. Stations should be kept clean, and signs of vandalism removed immediately to send the message that the community is in control.

The security of park and ride lots and the access to them from stations is critical to ensuring a safe environment. Smaller, well lit lots that are integrated into the surrounding community tend to be safer than large vacant lots. Increased patrols, possibly paid for from parking charges, or the presence of vendors (coffee stands, sundries) could enhance the security of the lot. [6]

Locating stations in low crime areas, or in proximity to activity centers, integrating the station with the neighborhood and surrounding environment, and providing connections to safe areas reduce the occurrence of crime. Stations that are elevated or located in tunnels pose a greater challenge because they are not visible to routine patrols. However, there are ways to address this challenge. Patrols can be assigned to visit the station platforms during operating hours. Light, bright stations with constant activity are less likely to experience crime. Sound Transit has designed their elevated and tunnel stations to be closed when trains are not running, so security during off-hours should be less of a concern. At grade stations will be open even when trains are not running, so the design must consider visibility and security even during unpopulated hours.

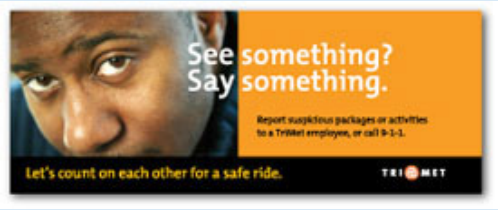
Employ technology to deter crime

Cameras recording station activities are an effective deterrent to vandalism and crime. Real-time train arrival schedules let patrons know when the next train is coming, so they don't have to wait at the station longer than they are comfortable. Security phones placed throughout the station area increase a patron's sense of security and provide real help in case of an emergency.

Underpass stations that are dark or have hidden areas are more likely to have higher crime rates.

Keep it clean. Good maintenance not only prevents injury, but sends the message that the community owns this station, and discourages criminal activity.

6 Liggett, R. 2004



Portland MAX campaign to increase security on trains and at stations.

The safety of this underground station in San Diego is enhanced by natural light, high quality stonework, transparent materials, pedestrian scale architecture and exquisite maintenance. The transparent upper level of this structure is at the street level – so pedestrians on the street can observe activities in the underground station. This offers additional security for those inside.

Light rail well integrated with neighborhood in Ontario, Canada

ENGAGE THE COMMUNITY IN STATION DESIGN AND SAFETY CAMPAIGNS

An active community can do a lot to enhance safety at stations and throughout the community. Campaigns that promote safety awareness and warn against criminal activity are effective. Implementing neighborhood watch in adjacent neighborhoods, and ensuring the neighborhoods are well maintained and active are useful deterrents. Stations should be viewed as being a part of the neighborhood just like a park, school, or local business.

A safety and security advisory committee which includes representatives of the community and local law enforcement can be beneficial in developing good designs. If an advisory committee is engaged early in the planning and design process, they can provide input to the selection of station locations based on local knowledge and policing practices. In order to provide effective input, the committee must be advisory only, and understand the many other issues relevant to selecting station location, such as engineering issues, ridershed, distances to other stops, land use issues, etc.

PROGRAM REGULAR LAW ENFORCEMENT PRESENCE

Frequent and unpredictable presence of law enforcement increases people's feelings of security, and reduces the occurrence of crime. Unexpected sweeps on trains and at stations, and boarding pass checks can complement routine security. Local law enforcement, as opposed to a transit police force, may be better positioned to rapidly respond to an emergency in certain locations. Intergovernmental agreements between the transit agency and the local government(s) have been used successfully to implement such an arrangement. While not applicable at all stations, the inclusion of a neighborhood law enforcement office at the Bellevue Transit Center provides regular presence.

ISSUE # 3: Is the effect of light rail on crime rates different in different types of land uses, e.g. residential versus downtown?

The biggest factor in whether crime occurs around light rail systems is the existence of crime prior to the introduction of light rail. Urban downtown settings tend to have more crime than residential neighborhoods, and as a result station crimes are more likely to occur at urban stations versus neighborhood stations.

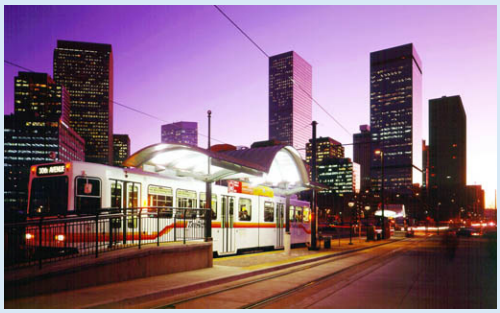
The study of the Green Line in LA County, mentioned earlier, supports this assertion. Analysts compared crime rates before and after the introduction of light rail in the communities along the line. Community types ranged from urban downtown settings with a history of crime to upscale residential and commercial suburbs with low crime rates. The study found that, with the introduction of light rail, crime rates dropped throughout the system, with the exception of the urban downtown.[7]

7 Liggett, R. 2002

ISSUE #4: Is transit schedule a factor in crime around stations?

The frequency and reliability of train service is a deterrent to crime in station areas. Frequent train service means that the station area is more frequently under observation by the train operators as well as passengers on-board. Reliable service accompanied by displays in the station which present real-time arrival information allow passengers to time their arrival and avoid long waits in the station area.

Some light rail systems do not run twenty four hours a day, seven days a week, and stations may not be able to be closed during off-hours. At times when the trains are not running, the station must still be bright and law enforcement must still provide a presence to reduce potential vandalism. Sound Transit elevated and tunnel stations are designed to be closed at night, so crime at these stations would not be an issue during closure hours.



A light, bright station with clear sight lines, like this one in Denver, provides a more secure environment for patrons, even at night.

This suburban San Jose station is integrated into the surrounding neighborhood through the use of colored paving, plantings, and benches. The structure offers protection from weather, while capturing natural light and using open architecture with clear sight lines.

Crime rates at stations are directly related to the crime in the adjoining community. Communities that enjoy low crime rates prior to the introduction of light rail can expect the same once light rail is present.

Small community station adjacent to single family neighborhood in San Diego.

RESOURCES

"Capitol Expressway Corridor: Final EIR - Safety and Security." Santa Clara Valley Transportation Authority. April 2005.

"The Four Strategies of CPTED" Crime Prevention Through Environmental Design. www.cpted-watch.com, 2006.

Liggett, R., Loukaitou-Sideris, A., Iseki, H. "Journeys to Crime: Assessing the Effect of a Light Rail Line on Crime in the Neighborhoods." UCLA Department of Urban Planning, 2002.

Liggett, R., Loukaitou-Sideris, A., Iseki, H. "Protecting Against Transit Crime: The Importance of the Build Environment," UCLA, 2004.

"Staying on Track: Review of Public Safety and Security on Light Rail Systems." City of Seattle Strategic Planning Office. February 1999.

Research Findings
Street Design and Operations

Thoughtful planning of street design and light rail operations can anticipate and influence people's behaviors in and around stations. This section will focus on design elements that address the safety of light rail within the street network and the experience of pedestrians, bicyclists and drivers.

Issue #1: How can light rail be integrated into streets with automobiles, buses, freight, bicycles and pedestrians?

Light rail can be integrated into streets with all modes of travel if careful consideration is given to the physical design and operations of the tracks and stations. The following sections provide best practices to make light rail facilities accessible from all modes.

Physical Design

Light rail that operates in a street right-of-way presents a complex set of issues. Design treatments include the following best practices:

Provide Clear, Unambiguous Directions to Drivers and Pedestrians

The use of traffic control lights and signs as well as lane alignments should make it clear to drivers and pedestrians how they are supposed to interact with the light rail system. Intersections, left turn lanes and pedestrian crossings should be understandable and simple.

Provide Light Rail Signals that are Clearly Distinguishable from Traffic Signals

Where light rail shares the road with pedestrians and cars, signals for light rail vehicles should be unique and easily distinguished from vehicle and pedestrian signals in order to reduce confusion on the part of motorists and reduce accidents. For example, many cities use a vertical, solid white bar to signal transit vehicles to go because it is difficult to confuse with the standard three-color traffic light or arrow signs that direct cars.

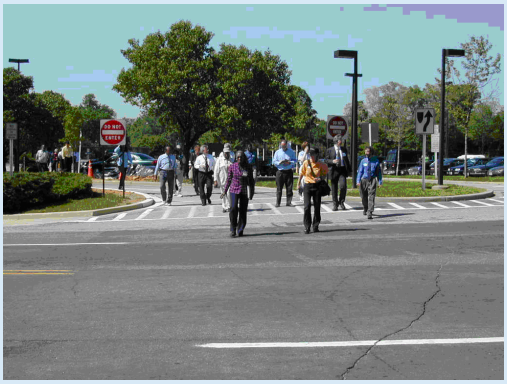
Manage Vehicle Turning to Minimize Conflicts with Light Rail

Accidents between cars and light rail vehicles can occur if an automobile turns illegally in front of a moving train. Adding protected left and right turn lanes to the roadway, and making them long enough to safely channel cars in traffic, can reduce conflicts. Train movements and car movements that are totally separated by traffic light controls can also help. It is also important to coordinate traffic signal phasing and timing to prevent cross-street traffic from stopping on and blocking the tracks.

Reduce Pedestrian Delay to Less Than 30 Seconds

Pedestrians do not want to be delayed by ill-timed traffic signals or inconvenient crossings, especially when the train is coming. Instead they will find a different (and possibly unsafe) route, cross illegally against the signal or not use the facility at all.

Research shows that the likelihood of compliance is significantly reduced if total delay is greater than 30 seconds. In other words, when faced with an above-grade crossing that has a travel time of 30 seconds or more than the at-grade route, people will not use it.



Pedestrians cross a street outside a BART station with no crossing protection because it's the quickest way to get to their destination.

Pedestrian Walk Patterns per Delay

PEDESTRIAN DELAY (SECONDS)	LIKELIHOOD OF NONCOMPLIANCE
<10	Low
11-20	
21-30	Moderate
31-40	High
41-60	
>60	Very High

Source: Highway Capacity Manual 2000 (Transportation Research Board)

The 30-second rule applies primarily to traffic signals and delays caused by above-grade crossings, but also to cases where there are no traffic signals – where pedestrians generally must wait for a "gap" in traffic to cross the street. If the flow of traffic is so great that sufficient gaps are not available, the person may attempt to cross the street before it is safe to do so. For this reason, pedestrian facilities near light rail stations should allow pedestrians to create a gap in the traffic with pedestrian-activated signals. Furthermore, street-level crosswalks should be placed as close to the station entrance as possible. Otherwise, customers might simply cross at an uncontrolled point closer to their intended destination.

Use Physical Barriers to Separate Trains and Vehicles

Separate light rail operations from motor vehicles by a design element more substantial than paint or striping, such as low-profile pavement bars, rumble strips, contrasting pavement texture, or mountable curbs.

Separate Freight Routes

Loading zones should be located on different streets than light rail operations in order to prevent traffic congestion. When freight routes and light rail systems intersect, retain freight access to alleys.

Locate Bus Stops to Direct Pedestrians to Safe, Direct Street Crossings

Locate bus stops near safe, designated pedestrian crossings that provide direct access to the light rail platform. As discussed above and in the "Connecting People to Light Rail" memo, pedestrians prefer direct walking routes with minimum delay and will cross illegally if designated routes are not direct.

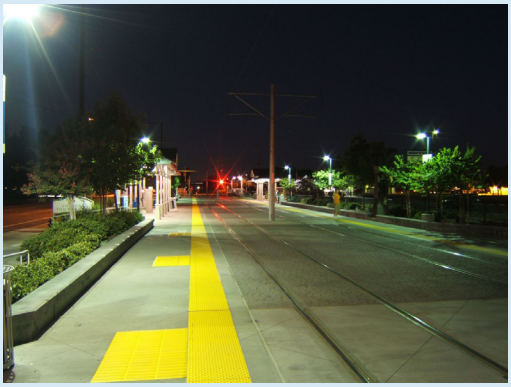
San Francisco Municipal Railway Breda light rail vehicle on the 19th Avenue exclusive right-of-way (Flickr source: Skew-T).

Provide Universal Access to The Light Rail Station

Universal access is generally defined as a design that accommodates "the widest range of potential users, including people with mobility and visual impairments and other special needs," such as people with bicycles, baby strollers, and handcarts[1]. A Paved Accessible Route (PAR) is way of accessing facilities that conforms to ADA standards. A PAR is not just a sidewalk or individual walkway, but is an entire system of accessibility to all destinations. The technical dimensions of a PAR are based on the physical needs of wheelchair users in order to have consistent and reliable access. The following example guidelines have been developed with access to many types of facilities in mind, but could be applicable here for access to and circulation within a light rail station[2].

- *Pathways should be at least 5 feet wide (though greater width is recommended to provide enough clearance for two wheelchairs to pass each other)*
- *The surface should be stable and firm and made of slip-resistant material*
- *Where ramps and flat ground meet, the connection should be seamless*
- *The lip where two floor surfaces meet at different heights should not exceed one-quarter inch*
- *Floor materials should be smooth to minimize vibration*
- *On existing surfaces with grades steeper than 11%, level areas should be provided*
- *Cross slopes should be consistent (i.e. planar) and not exceed 2%*
- *Obstacles, including grates, access covers, poles, parking meters and bike racks, should be kept out of the PAR*

Universal design standards reduce the barriers that disabled people face when attempting to use public facilities, such as Sara D. Roosevelt Park in New York City (Flickr source: Carlos Martinez).



At-grade crossing in Sacramento shows two textured materials that indicate both where the track area begins, and where to line up for opening doors. (Flickr source: EX-pert).

1 Online TDM Encyclopedia, Victoria Transport Policy Institute, Todd Litman, accessed on 11/16/07 at http://www.vtpi.org/tdm/tdm69.htm.
2 "Safe Routes to Transit: Bus Rapid Transit Planning Guide: Pedestrian Guide," Nelson\Nygaard for the Institute for Transportation and Development Policy, July 2005.

Understand Alignment Design and Construction Issues

It is very important to understand the technical design considerations involved in the selection of the appropriate type of alignment to be used for different areas of the community. Likewise, it is important to understand how the location of a station can affect its ability to meet travel demand and be a positive development in the eyes of the community.

Where the tracks are located in the street (referred to as “embedded” or “paved track”), the options tend to focus on the method of construction and the type of materials used for the trackway. Another consideration is whether the trackway needs to be mountable, i.e. designed to be driven on by other vehicles. The trackway may be designed for normal use by non-rail vehicles; to be used only in emergencies and otherwise restricted from use by general traffic; or it may be designed to preclude use by other vehicles. If the trackway will occasionally be used by other vehicles, but is not intended for their regular use, then a best practice is the use of some form of physical feature such as a low (1’’-2”) curb, small traffic delineators, or a change in surface texture to identify the edge of the trackway for motorists.

In urban and suburban areas, consideration must be given to the type of grade crossing protection to be provided. In downtown areas, light rail trains are usually controlled by special two-aspect signal lights mounted at intersections and integrated into the overall traffic signal system. Some type of signal priority or signal preemption is normally provided to minimize delays to the LRT. These LRT signals advise the operator when it is safe to pass through an intersection. However, in suburban areas where train speeds may be somewhat higher, traffic signals further apart and motorists may not be accustomed to rail operations, traditional grade crossing protection in the form of flashing lights and gates may be selected as a more physical form of protection. Generally state or transit agency safety rules will mandate the use of the train’s horn as it approaches the crossing. Recently, some communities have opted for four-quadrant gates or median barriers at gated crossings to eliminate a motorists’ ability to run around a typical two-gate installation. The use of four quadrant gates will generally eliminate the requirement for the train’s horn to be sounded as it approaches the crossing, but the waiver must still be approved by the state agency that regulates rail crossings.

Exclusive and shared use trackway delineation
Jersey City, NJ

Consider Opportunities to Minimize Utility Conflicts

A very important consideration in selecting an alignment for paved track is the presence of overhead and underground utilities. Physical conflicts between the trackway and pipe or wire utilities should be avoided wherever possible. Relocating utilities is a disruptive, time consuming and expensive undertaking and adds considerably to the risks inherent in light rail construction. However, utility relocation is often a priority for both service providers who fear loss of access for maintenance and replacement and transit agencies that want to avoid service disruption.

Consider Station Access When Choosing a Profile

Station access in urban areas is normally designed to accommodate pedestrian movements from the ends of the platforms to avoid the need to cross active tracks at mid-platform. A platform long enough to accommodate a four-car train will be approximately 400 feet in length. This length will also accommodate some variation in stopping position while still aligning the doors for proper boarding and alighting. If urban block lengths are greater than four hundred feet, it will be possible to locate a station between adjacent intersections with little disruption to either normal pedestrian or vehicle movements, such as is typically the case in downtown Bellevue. Note that if the trackway is located in the street, additional width will be required in station blocks. This can be accomplished by dropping or narrowing lanes or widening the right-of-way, or some combination of these techniques. A typical urban platform will be approximately 15-18 feet wide or wider depending on demand and configuration. Adequate pedestrian capacity approaching the station and on the platform should be provided.

Access to elevated and tunnel stations requires stairs, elevators and possibly escalators. Block length does not need to be a consideration which provides the flexibility to use longer trains and lengthier platforms.

Operational Elements

Preserve Existing Traffic Patterns

Minimizing changes in roadways, walkways and traffic controls to which motorists and pedestrians have become accustomed can help to reduce vehicle-pedestrian conflicts and confusion over new rules and layouts. For example, new traffic signal sequences that resemble the previous ones and familiar design of turn lanes, crosswalks and other traffic control devices reduce the impact of other necessary changes.

Give Priority to Pedestrians when the Light Changes

At an intersection with Leading Pedestrian Interval signal timing (LPI), the pedestrian walk phase begins a few seconds before the vehicular movement phase. Typically, this permits a pedestrian to get halfway across the street and establish presence in the crosswalk before vehicles start turning, thus increasing the chance that drivers will yield as required. Pedestrian signals can also end before the green cycle to allow for vehicle right turns.

Research shows that this head-start for pedestrians can reduce the number and severity of accidents. Analysis of 10 years of crash data from New York City shows that intersections with LPIs have 26% fewer pedestrian injuries and those injuries are 36% less severe[3]. Data from San Francisco show that 89 to 98 percent more drivers yielded to pedestrians after LPIs were installed[4]. Data from St. Petersburg, Florida show that 95 percent more drivers yielded to pedestrians after LPIs were installed[5]. Signal timing priority can be given to bicyclists too, as is done in the Netherlands.

3 Independent research by Michael King of Nelson\Nygaard.
4 "Pedestrian Head Start Signal Timing" by J. Fleck, in Compendium of Papers. Institute of Transportation Engineers, District 6 Annual Meeting, San Diego, California, 2000.
5 "Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Urban Intersections" by R. Van Houten et al., in IIHS Status Report, Vol. 32, No. 7, Aug. 30, 1997.

Issue #2: What can effective street design and technology do to increase safety, improve performance and mitigate noise and light impacts?

Among accidents that take place in light rail systems, 92% of collisions between trains and cars occur in shared-rights-of-way at speeds less than 35 miles per hour even though these shared areas account for the smallest percentage of total light rail mileage[6]. Because shared rights-of-way have the greatest potential for conflicts, a special emphasis should be placed on maximizing safety in this part of the system.

The TCRP report entitled, "Integrating Light Rail Transit into City Streets" identifies common safety-related problems, ranked below in order of decreasing severity: [7]

1. Pedestrians trespassing on side-aligned light rail rights-of-way where there are no sidewalks
2. Pedestrians jaywalking across light rail/transit mall rights-of-way after receiving unclear messages about crossing legality
3. Inadequate pedestrian queuing areas and safety zones
4. Two-way or contra-flow side-aligned light rail operations
5. Motorists making illegal left turns across the light rail right-of-way immediately after termination of their protected left-turn phase
6. Motorists violating red left-turn arrow indications when the leading left-turn signal phase is preempted by an approaching light rail vehicle
7. Motorists violating traffic signals with long red time extensions resulting from light rail vehicle preemptions
8. Motorists failing to stop on a cross street after the green traffic signal indication has been preempted by a light rail vehicle
9. Motorists violating active and passive NO LEFT/RIGHT TURN signs where turns were previously allowed prior to light rail construction
10. Motorists confusing light rail signals, especially left-turn signals, with traffic signals
11. Motorists confusing light rail switch signals (colored ball aspects) with traffic signals
12. Motorists driving on light rail rights-of-way that are delineated by striping
13. Motorists violating traffic signals at cross streets, especially where light rail vehicles operate at low speeds
14. Complex intersection geometry resulting in motorist and pedestrian judgment errors

6 Korve, H., et. al. "Integration of Light Rail Transit into City Streets." Transit Cooperative Research Program Report 17, Transportation Research Board, National Research Council 1996.
7 Ibid, pg. 3-4.

TCRP Table - Possible Solutions to Observed Problems

The report goes on to describe possible solutions to observed problems in the table.

	PROBLEM	POSSIBLE SOLUTION
1	PEDESTRIAN SAFETY	
	• Trespass on tracks	Install fence Install sidewalk if none exists
	• Jaywalk	Install fence/barrier between tracks, or to separate LRT r-o-w Provide curbside landscaping, bollards, barriers
	• Station and/or cross-street access	Define pedestrian pathways Provide adequate storage/queuing space Design station to preclude random crossings of tracks Install safety islands. Install pedestrian automatic gates, swing gates, bedstead barriers, and Z-crossings
2	SIDE-RUNNING ALIGNMENT	Operate LRVs with headlights on and use audible devices Close driveways especially through land use changes Prohibit conflicting left or right turns by parallel traffic Provide separate turning lanes and phases for conflicting traffic Provide LRV-only signal phase. Provide a comfort zone between dynamic envelope and curb Replace side-running with median operations
3	VEHICLES OPERATING PARALLEL TO LRT R-O-W TURNING LEFT ACROSS TRACKS	
	• Illegal left turns	Provide left turn phase after through/LRV phase Limit multiple LRV preemptions within same cycle Install active TRAIN APPROACHING signs
	• Protected left turn lanes with signal phases	Install active TRAIN APPROACHING signs Improve enforcement (e g , photo enforcement)
4	TRAFFIC CONTROL OBSERVANCE	
	• Passive turn restriction sign violations	Install active signs.
	• Active turn restriction sign violations	Improve enforcement
	• Confusing traffic signal displays	Provide distinctive LRT signals that are placed at separate locations Louver or optically program out conflicting signal indications
	• Poor delineation of dynamic envelope	Delineate dynamic envelope by contrasting pavement color and/or texture or paint
5.	MOTOR VEHICLES ON TRACKS	Install NO VEHICLES ON TRACKS signs Pave tracks with different texture/paint Pave tracks at slightly different elevation (e g , 4" above tracks)
6	CROSSING SAFETY (RIGHT-ANGLE ACCIDENTS)	Increase all-red clearance intervals for cross-street traffic Modify or limit LRV preemption to maintain cross-street progression Provide photo enforcement
7	POOR INTERSECTION GEOMETRY	Simplify roadway lane geometries Use traffic signals or other active controls to restrict motor vehicle movements while LRVs cross

To the extent that pedestrian traffic increases around stations, there is increased potential for pedestrian and automobile conflicts, particularly where those stations are located within or adjacent to the street right-of-way. The four factors of pedestrian safety on roadways discussed here can be applied to the increased pedestrian volumes around light rail stations.

1. Vehicle speed
2. Pedestrian exposure risk
3. Driver predictability
4. Vehicle volume

Use Traffic Calming Techniques to Reduce Vehicle Speeds

Vehicle speed is a significant determinant of crash severity and often affects the pedestrian-oriented nature of a street. As the speed of vehicles on the road increases, so does risk to drivers and pedestrians; accommodating higher vehicle speeds safely therefore involves installing physical protection from crashes. If vehicle speed is lower, the range of design options expands.

There are many techniques to reduce traffic speeds, including speed limits, police enforcement and street design. Traffic-calming design tools include:

- *Using speed bumps and raised crosswalks to slow drivers*
- *Designing intersections with curb extensions to force slower turning speeds*
- *Rerouting roads to meander around trees, planters and medians*
- *Change from smooth to rough road surfaces, or use rumble strips to alert drivers to a bicycle or pedestrian crossing*

Recent research[8] suggests that Zebra crosswalks should only be used by themselves on low-volume, narrow or low-speed roads. At higher volumes, speeds or number of lanes, Zebra crosswalks alone do not make crossings safer, and more substantial treatments such as listed above are required.

Reduce Pedestrians' Exposure to Risk While Crossing

Risk exposure occurs when a pedestrian is crossing a traffic lane. The longer the crossing distance and the higher vehicle speeds and volumes, the higher the exposure risk. Reducing risk exposure increases safety.

There are a few fundamental ways to reduce exposure risk to pedestrians crossing the street. The roadway can be narrowed, either as a whole or at specific points, by creating curb extensions. Traffic or pedestrian refuge islands, where people can wait in the middle of a two-way street, can be added. Traffic signal timing can be extended to provide additional time for pedestrians to cross the street. Traffic signal phases can be altered to give walkers priority over vehicles, such as prohibiting right turns on red signals or using an exclusive walk phase. Finally, lower speeds (attained through design or through enforcement of speed limits) and speed humps can create longer gaps between passing cars and give pedestrians more time to cross the street. Lower vehicle speed also gives drivers more time to react to a potential conflict.

8 http://www.walkinginfo.org/pedsafe/casestudy.cfm?CS_NUM=37

A zebra crossing in Helsinki, Finland (Flickr source: La Febbra).

This zebra crossing at 3rd Street and Yesler in Seattle has a wide turning radius that permits vehicles to turn the corner at unsafe speeds, endangering pedestrians (Flickr source: Joe Goldberg).

Increase Driver Predictability

Drivers make decisions the entire time they are behind the wheel, and if other street users—cyclists, pedestrians or other drivers—can better predict those decisions, then the street will be safer. Reducing the number of options that drivers can make at key junctures is the simplest way to improve driver predictability.

Techniques to increase driver predictability in an urban context include:

- *dedicated turn lanes*
- *traffic islands (which double as pedestrian refuge islands and may take the form of a light rail station)*
- *curb extensions (which prevent drivers from passing on the right)*
- *narrow lanes (which prevent double parking)*
- *medians (which prevent sudden turns)*
- *good sight distance (so that everyone can see what everyone else is doing)*

Pedestrians can be protected from errant drivers through physical obstructions, such as bollards, trees and parked cars. Placing bollards to protect curbs at intersections prevents trucks and motorists from jumping curbs and hitting pedestrians. Bollards also are used to prevent motorists from parking on sidewalks.

Increase Pedestrian Predictability

Conflicts between pedestrians and vehicles have been described above, but the degree to which pedestrian behavior affects traffic patterns and safety around train stations deserves a special note. Pedestrians running to catch the train or bus are a problem unique to transit facilities. Frequent train service can mitigate this tendency because people won't fear missing a train, knowing another one will arrive soon. Even at the highest frequency, however, crossing safety can be compromised when people are in a hurry. Second, vehicles might be less prepared to stop for inadequately marked mid-block pedestrian crossings placed to serve a transit station. Inattentive drivers might not realize a crossing exists and may fail to properly yield to pedestrians or to obey mid-block traffic lights.

There are many solutions to providing safer and more effective pedestrian crossings at or near transit stations.

- *The design of the crossing must be clear to drivers that there is a mid-block crossing; cues from multiple height levels, for example, can draw driver vision to the fact that somebody might be crossing*
- *The areas beside the roadway should allow for clear visibility, so that the sight lines of both pedestrians and drivers are unimpeded by signage or vegetation*
- *The crossing's painted surface should be highly visible and well maintained (luminescent paints or reflectors can provide additional visibility for evening hours)*
- *High-illumination street lights should be placed over the crosswalk*
- *Signs and advertisements can create visual clutter that distracts drivers from seeing traffic signals and pedestrians properly, and should be avoided when possible*

Use Passive Safety Devices to Indicate Safe Crossing and Waiting Areas

Passive devices such as signs, pavement markings and fencing should be used to direct people to safe waiting and crossing areas, while discouraging pedestrians and bicyclists from crossing the light rail tracks unsafely.

Pavement markings and tactile warning strips (raised bumps) can indicate safe waiting areas. “Stop Here” pavement markings should be used in less urban areas where light rail design speeds exceed 15 miles per hour and where a safe pedestrian stopping location is not obvious. Tactile warning strips should be used with “Stop Here” markings to accommodate visually-impaired pedestrians, and in other locations that require a detectable warning. The tactile warning strips can be used to indicate the edge of a station platform and the beginning of an at-grade crossing.

“Look Both Ways” signs remind pedestrians and bicyclists to look for oncoming trains in both directions as they approach the tracks. These signs may not be needed in urban environments since the train speeds are typically lower than 15 miles per hour, but they can be especially useful at mid-block pedestrian crossings.

Creative campaigns to get people’s attention can successfully get people to assess their actions and change potentially dangerous behavior. For example, Portland MAX targets teenagers who run across tracks with this sign, “Get Real—MAX weighs 55 tons.” Restricting activities such as bicycling, skating and skateboarding on station platforms is important, as is enforcement of the rules.

Minimize Line-of-sight Obstructions

Use only low plantings and landscaping along light rail tracks to avoid obstructing pedestrians and drivers’ ability to see oncoming trains. Sound barriers, gates, fencing and signage should also be positioned out of the line of sight.

Reduce People’s Ability to Rush Across the Tracks

Railings, fencing or gates are used to prevent or discourage pedestrians and bicyclists from crossing tracks in unsafe spots[9]. These physical barriers limit the opportunity for people to take hasty short cuts across the tracks. These barriers should not obstruct sight lines to oncoming trains. Moreover, train operators must have a clear view of the tracks and pedestrian walkways so that they can be sure the tracks are clear before departing from stations.

Similarly, slowing pedestrian movement across the tracks will increase safety. Using swing gates or pedestrian barriers that impede pedestrian movements will reduce people’s ability to cross the light rail tracks in a hurry. Swing gates should open towards the tracks and automatically spring closed, and should be easily operated by people with disabilities. Pedestrian barriers include small fences that require pedestrians to move along a zig-zag course instead of darting straight across the tracks. These devices are most effective in situations where sight lines to oncoming trains are obstructed, and where other channeling devices ensure pedestrians cannot cross the tracks at other locations.

9 Hubbell, John and Dave Colquhoun, “Light Rail Transit in Calgary: The First 25 Years,” Calgary Transit, 2006, 26th International Joint Light Rail Conference, St. Louis, Missouri.

Pedestrian safety gates installed after a fatality at Beaverton Transit Center, a busy transit center serving buses and Portland MAX. These gates provide access for autos and pedestrians to the adjacent commercial and residential communities.

Fences can deter people from running across the tracks, shown here in Charlotte, North Carolina (Flickr source: Doug Letterman).

Make Safety Devices Accessible to the Visually Impaired

Visual impairments require different types of safety features. These devices guide pedestrians by giving information to senses other than sight. The critical locations for these devices are at intersections and borders between pedestrian areas and vehicle areas. The intention at signalized intersections is to provide information to the pedestrian necessary to initiate the Walk phase, and to sense when the Walk phase is active. Options include:

- *Accessible Pedestrian Signals (APS)*
- *Push-button locator tones to alert the pedestrian to the audible walk indication*
- *Vibro-tactile walk indication*
- *Tactile arrow*
- *Tactile map or push-button information message*
- *Automatic sound adjustment*

Detectable warning strips are raised bumps at key locations that alert the pedestrian to a changing condition—stop signs for the blind. These warnings denote station edges and curbs.

Provide Audible and Visible Warnings [10]

Well-maintained light rail systems run quietly. While this is often seen as a benefit, it can also be a safety issue if people don't hear a train approaching. For this reason, it is important to alert people in the area to the oncoming train. Oncoming trains can trigger automated safety devices that provide audible and/or visible signals to pedestrians and motorists. For example, there can be a voice or a "ding" sound that riders become accustomed to hearing as an indicator of an approaching train. Audible signals don't need to be loud and repetitive, such as at railroad crossings—a simple but unique chime to indicate that the train is approaching or starting motion is effective.

Flashing illuminated signals can be very effective. They are appropriate where cars are permitted to make left turns across the light rail tracks, where cross streets have high traffic counts or a high volume of truck traffic and where a driver's view of oncoming trains is obstructed. A flashing pedestrian signal should be installed when the light rail system operates in a center median or at mid-block pedestrian crossings.

Apply Traffic Control Devices Uniformly and Consistently

A standard set of signs and signals should be used throughout the light rail corridor, and applied consistently to different right of way conditions. This will improve motorist, pedestrian and bicyclist recognition of signs and signals, thereby reducing confusion, congestion and collisions.

Two examples of tactile warning strips for visually impaired people (Flickr sources: Darrin Frazer above and Clearly Ambiguous below).

Signs remind pedestrians and bicyclists to look for oncoming trains (Flickr source: Rainer Ebert).

10 Irwin, Don, "Safety Criteria for Light Rail Pedestrian Crossings", Transportation Research Board, 2003.

Mitigate Noise and Light

Although sounds and lighting can enhance safety around transit vehicles, tracks and stations because they attract attention to their presence, reducing noise and light is important to surrounding neighborhoods.

Perform Regular Maintenance on Light Rail Vehicle Wheels and Tracks

The most effective way to minimize noise from a light rail system is to grind excess metal off the tracks and align the train wheels regularly. Track grinding can reduce noise levels by as much as 6dB,[11] while aligning wheels can reduce noise by 5-10db. [12]

Install Sound Barriers

Sound barriers installed parallel to the light rail right-of-way can be an effective noise control measure, and can also visually screen the light rail from residential neighbors. Potential types of sound barriers include extra-thick glass, concrete blocks or painted steel panels. [13] While vegetation will not provide further sound-proofing, it will soften the barrier's visual appearance and reduce glare.

Install Lighting that does not Create Light Pollution

Adequate lighting makes people feel safe as they wait for trains at night, but too much light causes light pollution, or artificial light that is allowed to illuminate or pollute areas not intended to be lit. To prevent light pollution, it is important to ensure that the lights are accurately aimed to illuminate only the surface intended and do not throw light onto a neighboring property. It is also helpful to shield the sky above from any glare to force all light downward in the station area.

Tasteful lighting in Sacramento that provides security and yet does not create a lot of light pollution (Flickr source: Darrin Frazer).

11 TCRP Report 23 "Wheel/Rail Noise Control Manual", Transportation Review Board, 1997, pg. 147.
12 IBID p105.
13 IBID p175.

Issue #3: What have been the experiences of other systems with auto, pedestrian, and bicycle safety and light rail?

The City of Calgary compared light rail transit with bus transit safety and found that in terms of both collisions and station boarding/alighting incidents, light rail was much safer. Passenger incidents were recorded as "slips, trips and falls" related to station activity (Hubbell and Colquhoun, 2006).

Calgary Transit LRT and Bus Collisions and Passenger Accidents

	1995	2005
Collisions per million km		
Bus Collisions	23.0	17.8
LRT Collisions	11.3	10.3
Passenger accidents per million boardings		
Bus Passenger Accidents	5.6	1.6
LRT Passenger Accidents	0.40	0.06

Source: Hubbell and Colquhoun, 2006

After completion of its Westside MAX extension in 1998, Portland's TriMet experienced an increase in incidents involving pedestrians and light rail vehicles, primarily caused by pedestrians violating posted No Crossing signs or other behavior, despite TriMet's adherence to current track crossing design and safety standards. [14]

TriMet's experience in Portland, Oregon offers several important lessons. [15]

Automobiles

TriMet Agency Architect Bob Hastings says that they have encountered safety problems on the fringes of downtown. In these locations there are no crossing gates because the speed of the vehicle does not warrant them. "Drivers think they can make the yellow light, but they don't get across the tracks before it goes red, and boom. We've seen trains that struck cars just outside of downtown," says Mr. Hastings. "We've also had drivers downtown end up in the light rail median, and eight times out of 10 that person's visiting from somewhere else." He says that cars end up on light-rail tracks because drivers want to beat a train and they either don't see it coming or they think they can outrun it.

Auto-light rail incidents happen during the day, but they're worse at night. Mr. Hastings says that concrete does not contrast well at night. Instead the paving material must provide a high nighttime contrast with a bright white stripe. They strive for the greatest level of pedestrian illumination at intersections. "You can't just go with standards for street illumination, you must get site-specific lighting strategies—landscaping, site lines, site-specific illuminations.

14 Irwin, Don, "Safety Criteria for Light Rail Pedestrian Crossings," Transportation Research Board, 2003.
15 Phone interview with Bob Hastings, the Agency Architect at Tri-Met, 12/10/07

Bicycles

TriMet uses a textural separator between bikes and light rail, when the two modes run together along the same street in a downtown environment. Outside of the paved light rail track, bicycles have bike lanes next to the vehicle lanes. The biggest safety problem arises when bicycles cross the light rail track—"Cyclists are more independent in their thinking and will not necessarily obey traffic lights," says Mr. Hastings. For this reason, illumination and visibility of site lines are crucial for the operator. "Can they see the cyclist? If so, they can lay on the horn or, as last resort, try to stop train, which is so hard to do."

Other safety mechanisms include a prohibition of riding on the platform, because they can be slippery and riders can accidentally fall on the tracks. TriMet also installed bedstead barriers, which forces the cyclist to dismount and walk the bike through the barrier to slow them down. This gives them a chance to see the train coming. Bedstead barriers were a last-defense mechanism added where Tri-Met officials observed risky behavior.

Pedestrians

TriMet's hardest learned lesson, says Mr. Hastings, is about lighting and visibility. It is imperative to minimize furnishings, landscaping and artwork at 7 feet high and below. Pedestrians must intuitively understand the environment around them and TriMet learned that it cannot rely on signing or arrows for wayfinding. "It's got to be innately clear what's going on. So that requires a different mindset as a designer," he says. "You have to be a psychologist to anticipate how people will interpret materials."

For example, when designing Interstate Max (Portland's most recently added alignment built in 2004, along which operates the yellow line), stakeholders had decided against a ballasted trackway because they didn't want it to look like a railroad. So TriMet designed a beautiful alignment with material that looked like a sidewalk—and people walked in it. It took an environmental product designer, not an urban designer, to identify how people would respond to the system because they know how people visually code materials and elements so they understand their environment without having to think too hard about it. Unfortunately, when the station or the crossing isn't designed intuitively, the first response is to put up more signs to get people to behave the way designers envisioned.

Now TriMet places important information (such as "This Way to Hillsboro") at seven feet and higher, and marks it clearly. To make it visible at night, the sign must be lit from behind or transparently lit; the agency does not rely on ambient light. Good sign lighting also adds to the perception that it's a bright, safe environment. The most effective illumination will light the surface along the horizontal plane (for boarding), the vertical plane (to reduce shadows) and will not create a masking effect (where people coming towards you are in shadow while you are in light, which increases anxiety at night). TriMet is currently exploring the possibility of using energy-efficient LEDs, but first and foremost they must provide effective illumination.

Tactile warnings and distinctive paving patterns and colors indicate to pedestrians that the zone is shared with a transit line, seen here in Sacramento, California, at St. Rose of Lima Park Station (Flickr source: Paul Kimo)..

Issue #4: How are speed, capacity and movement of traffic affected within a shared right-of-way?

Shared right-of-way is a design configuration where vehicles can travel within the same lane as the light rail trains. Light rail and auto speeds will be lower in shared right-of-way than with dedicated right-of-way because of conflicts with vehicle movements. Elements affecting vehicle capacity include the number of at-grade crossings, intersections, and roadway capacity. Average vehicle delays are determined by traffic volumes at crossings and the frequency of light rail crossings.[16] Sound Transit's Environmental Impact Statement will provide data on the impact of light rail on traffic and intersection capacity along alignments.

Adjust Signal Phasing to Optimize Both Transit and Vehicle Movements

Signal timing is an important tool for successfully balancing the needs of efficient transit operations and reduction of vehicle delays.[17] In addition, there should be automobile left-turn pockets that don't conflict with transit or left turns restricted to every few blocks to simplify movements. The more light rail crossings there are, the more travel delay will be experienced by traffic flowing in the conflicting direction.

Incorporate Transit Signal Preemption

Light rail trains can be equipped with technology that gives transit vehicles priority at intersections, by pre-empting regular traffic light phases to allow the train to go through without waiting for a natural phase. Trains that preempt signals near light rail crossings increase the total delay experienced by cars making movements in conflict with the train, but improves travel time for non-conflicting movements since it lengthens green light time in the train's direction.

Light rail that operates in the right-of-way might slow cars down, but can increase mobility for people who take the train (Flickr source: Jeffrey Beall).

16 Chandler C, Hoel L "Effects of Light Rail Transit on Traffic Congestion." Mid-Atlantic Universities Transportation Center, May 2004, pp. iii.
17 IBID, pp. 14.

Issue #5: What types of injuries could occur around stations? Are there countermeasures?

Station activity can be fast-paced and complex especially during peak periods when traffic and passenger volumes are high. Vehicles queue at kiss-and-ride locations, pedestrians rush from trains to buses while others rush to the train, passengers go from trains to parked cars, or walk to their next destination. Some riders need to purchase tickets. Cyclists disembark with bicycles, gear up and set off, maneuvering around pedestrians and autos. And the train, after the required waiting time, moves on. Foul weather and darkness can further complicate these activities. In this environment, there is a greater chance for injuries, collisions and other conflicts to occur. Incidents at stations can involve one person (e.g. slipping), multiple people (e.g. perhaps bumping into each other) and cyclists, automobiles and trains.

Vehicle-to-vehicle incidents and incidents involving fatalities are typically reported with reasonable accuracy. However, research indicates that only 35 to 85 percent of vehicle-bicycle and vehicle-pedestrian incidents involving injury are included in typical crash statistics. A study of California children estimated that police reports only cover 80% of hospital admissions.[18] A British study found that only 67 percent of slight injuries to pedestrians were reported, while 85 percent of serious injuries were.[19] In Germany the figures are 50% for major injuries and 35% for minor ones. Based on this research, it is appropriate to adjust vehicle-bicycle and vehicle-pedestrian injury statistics upwards by at least 50 percent. [20]

Researchers at Lund University in Sweden have developed a conflict-analysis technique where a location is observed and conflicts between various roadway users are observed and recorded. These conflicts could be near misses, evasive maneuvers or simply a reduction in speed. This type of information paints a more complete picture of the safety at a particular location than do accident statistics. The technique is especially useful in contexts where a large portion of traffic incidents might go unreported.

A 1996 Transit Cooperative Research Program (TCRP) study of 10 light rail systems across the country concluded that light rail systems are safe because there were a relatively low number of incidents: 80% of the 30 highest-accident locations in the 10 surveyed systems averaged fewer than four light rail vehicle accidents per year. The primary cause of accidents was found to be related to driver and pedestrian inattention, disobedience to traffic laws and confusion about the meaning of traffic control devices (which resulted in risky behavior that contributed to accidents.)

Safe design for pedestrians, cars and light rail in Sacramento, California.

18 Agran PF, Castillo DN, Winn DG. “Limitations of Data Compiled from Police Reports on Pediatric Pedestrian and Bicycle Motor Vehicle Events.” Accident Analysis and Prevention, Vol. 22, No. 4, 1990, pp. 361-370.
19 James, H. “Under-reporting of Road Traffic Accidents.” Traffic Engineering and Control, Dec. 1991, pp. 574-583.
20 Hautzinger H, Dürholt H, Hörnstein E, Tassaux-Becker B. Dunkelziffer bei Unfällen mit Personenschaden (Unreported Proportion of Personal-Injury Accidents). Report M13. Bundesanstalt für Strassenwesen (Federal Highway Research Institute), Bergisch Gladbach, Germany, 1993.

Provide Separate Station Entrances

To reduce conflicts between pedestrians and automobiles, pedestrians must have safe, separate facilities for accessing the station, such as sidewalks or walkways. Walkways that are out of public view should be avoided when possible because these may lead pedestrians to feel unsafe and susceptible to crime. The Bellevue Transit Center features some excellent examples of safe pedestrian walkways and transit access. Special paving materials improve the visibility of pedestrian walkways and act as a visual signal to drivers that pedestrians are present. Sidewalks or routes through parking areas are also critical. Posted speeds should be low, and reinforced by design elements that slow automobiles such as tight turn radii and speed bumps if appropriate.

Pedestrian station access in San Jose

Raised platforms at light rail transit stations provide an easier and safer entry onto the light rail line (VTA, Campbell, CA).

LIGHT RAIL
Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Case Study Cities Memo

April 1, 2008

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Case Study Cities Memo

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Case Study Cities

The City of Bellevue is exploring the experiences of other cities to take inspiration and lessons learned for integrating light rail into a vibrant downtown, redeveloping districts, and established residential neighborhoods. In order to illustrate and understand the nuances of light rail best practices implementation, the Committee and staff have toured four cities with similar attributes to Bellevue and the planned East Link light rail system: Dallas, San Diego, San Jose, and Portland. This memo provides a summary of the transit systems toured and the findings of the Committee and staff.

Purpose of Case Studies

Case study cities have modern light rail systems that travel through similar urban forms, have similar roles in the regional transportation system, have examples of at-grade, elevated, and tunnel profiles in multiple land use forms, and demonstrate success and lessons learned that have applicability for Bellevue.

Case study tours provided the opportunity for the Committee members to experience light rail, both to ride the system and explore the surrounding areas. Tours included meeting with transit agency and city staff to discuss challenges, lessons learned, and applications of best practices. There were also informal conversations with transit riders and a meeting with a neighborhood representative in Portland. A Sound Transit staff member accompanied the tours so they could also explore the best practices being considered by Bellevue.

Touring case study systems was a critical component of the project as it provided the opportunity for committee members to critically assess the national best practices and begin to formulate key lessons and priorities for Bellevue.

How were Case Study Cities Chosen?

There are approximately 22 cities in North America with light rail systems. Some are more like trolley systems, and others more like heavy rail systems. The candidate cities with potential to closely resemble a light rail system like East Link are listed in the box on the right. As a point of reference, city populations are included.

Using a comparison matrix, staff screened the cities against the following general criteria:

- Urban Form: Light rail integration into established single-family residential areas, an intensely developing urban downtown, and light industrial areas redeveloping to mixed use and transit-oriented development (TOD).
- Alignment: Examples of elevated, surface and tunnel sections in urban and residential communities, within areas of limited right-of-way, and within multi-modal corridors.
- Relationship to Region: Major city on line or extension, serving communities with similar geographic and political relationship to other regional cities, and city worked with regional transit agency to implement system.
- System Demographics: System built within the last twenty years and projects of similar length, stations, and ridership.

North American Light Rail Cities and Population (thousands)

Baltimore	651
Bellevue	117
Buffalo	293
Calgary	850
Cleveland	478
Dallas	1,189
Denver	555
Houston	1,954
Jersey City	240
Los Angeles	3,695
Memphis	650
Minneapolis	383
Newark	274
Pittsburgh	335
Portland	529
Sacramento	407
St. Louis	348
Salt Lake City	182
San Diego	1,223
San Francisco	777
San Jose	945
Seattle	563

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

- Outstanding Success Story: System demonstrates success in ridership, fit into urban fabric, quality of system, and community acceptance.

Based on these criteria, Dallas, San Jose, San Diego, and Portland were chosen as the most relevant cities for the Bellevue Light Rail Best Practices project to study.

How were the Case Study Cities studied?
The study took place in three phases: research, staff tours, and Committee tours.

- Research on city demographics and land uses, policy framework, regional governance, and transit system characteristics was compiled and provided for case study system selection and as background prior to the tours.
- Staff tours to cities in December 2007 provided Bellevue staff an opportunity to tour the systems, meet with transit agency staff and officials, and prepare for the upcoming Committee visits. Dallas was deleted from the Committee tour after the staff visit due to a lack of similarity to the critical issues facing Bellevue, including developing a new system within developed urban areas and in areas of constrained right-of-way.
- Committee tours in January and February 2008 provided the opportunity for Committee members and staff to ride multiple light rail systems, visit stations, tour adjacent areas including established neighborhoods and new transit-oriented development, and meet with city and agency staff and local citizens. A Sound Transit staff member accompanied the group on both the Committee and staff tours. Summaries of the tours are provided as an appendix to this document.

CASE STUDY CITY #1: Dallas, TX

The City

Dallas is the second largest city in Texas and the ninth largest in the U.S. with a population of 1.2 million and covering 385 square miles. Dallas is the cultural and economic center of the Dallas-Fort Worth-Arlington metropolitan region (at 6 million residents, the fourth largest metropolitan region in the Unites States). Dallas has a rich and varied economic history, including farming, manufacturing, communications, and the financial industries. Dallas has historically been predominately white, but the population has diversified as the city grew, with 25% of Dallas' population being foreign-born. Like many cities developing in the late 20th century, Dallas is a low-density city where the primary mode of local transportation is the private auto, although the city and region are making efforts to increase the availability of alternative modes. Dallas is at the confluence of a large number of interstate highways, connecting the city and numerous suburbs.

System Governance

Dallas Area Rapid Transit (DART) is the regional transit agency for the greater Dallas area created by voters and funded with a one-cent local sales tax on August 13, 1983. DART is responsible for regional transportation planning and operations. DART is governed by a 15-member board appointed by member-city councils based on population. The member cities are Addison, Carrolton, Cockrell Hill, Dallas, Farmers Branch, Garland, Glenn Heights, Highland Park, Irving, Plano, Richardson, Rowlett and University Park.

Light Rail System

DART is one of largest American light rail systems, carrying 17.5 million passengers in 2005. DART's first 11 mile light rail line opened in 1996, followed in 1997 by a 6 mile extension of the Red/Blue line and a 3 mile extension of the Blue Line. 2006 marked the 10th anniversary of light rail operations with a system that has since grown to 45 miles and 35 stations. Two new lines are under construction and scheduled to open between 2009-2018, doubling the network's length. Additionally, the board recently adopted a 2030 plan, including numerous extensions to existing lines, a new station with TOD development at Lake Highlands Town Center, and the "Cotton Belt" commuter line from Plano to the DFW Airport.

Light rail connects downtown Dallas with multiple growing suburbs, including Plano, Garland, and Richardson. Dallas is recognized for an aggressive and successful TOD program. Most notable is Mockingbird Station, Dallas' first modern transit village with retail destinations and the highest density population within three miles of any Dallas light rail station. In Richardson, light rail has been used strategically to stimulate redevelopment around an existing business district (Galatyn Park Station) and in a former park and ride (Arapaho Station). Dallas also has a tunnel station at Cityplace, serving the West Village and Uptown areas of Oak Lawn, immediately north of downtown and connecting to the M-Line streetcar serving major shopping and retail destinations. DART has a noteworthy public art program, with each station uniquely decorated to reflect each neighborhood's personality and history.

Landscaped pedestrian walkway provides connection between bus depot and light rail station. The walkway is considered part of the station area, and proof of payment in required.

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Residential development adjacent to Plano Station.

Barriers, signs, and special paving at Plano Station delineate pedestrian areas.

When the system opened in 1996, it was embraced by Dallas citizens and quickly exceeded ridership projections (by 2000, DART had 40,000 riders instead of 25,000). Public support has been further demonstrated by five highly publicized pull-out votes, all of which DART defeated by significant margins. While the system enjoys strong community support, specific projects have not been without controversy. The Cotton Belt line was the most controversial component of the 2030 Plan. The affluent Far North Dallas neighborhoods were opposed to the noise and pollution from the diesel trains and desired the line to be put in a trench. Concessions were made in the plans to convert from diesel to electric light rail trains to address neighborhoods concerns, but the DART board balked at the additional $250 million cost to trench the line. The final plan contains $50 million "to help address neighborhood concerns."

System Snapshot: Light Rail Transit

- Service began: 1996
- Average weekday ridership: 63, 400 (2007)
- Total annual ridership: 18,000,000 (2007)
- Light rail miles: 45 miles of light rail transit (DART Rail);
- Number of stations: 35 stations
- Extensions planned: 48 more miles by 2013

Lessons for Bellevue

Dallas was selected as a case study because of multiple common interests with Bellevue including tunnel and at-grade profiles, traveling through downtown and neighborhood environments, existing and planned TOD developments, a comparable decision-making structure, and lines currently under construction. Despite the removal of Dallas from the Committee itinerary, staff identified the following best practices and lessons for Bellevue based on their tour.

Land use is a critical factor to the success of a light rail system. DART built the regional light rail system on existing railroad right-of-way (ROW) with the hope that land use will follow. In some cases, cities are taking steps to provide transit supportive land uses around stations. In the meantime, the system relies heavily on an extensive network of park and rides to bring riders to the stations and boost ridership. The system was designed within exclusive right-of-way, except within downtown, including a number of overpasses and structures to avoid conflicts with traffic. The combination of exclusive right-of-way and longer distances between stations allows the system to gain high speeds, resulting in attractive travel time and high ridership, despite the lack of supporting land use.

Ensure development around stations is transit-supportive and generates pedestrian activities. The light rail station in Plano was located a few blocks from the center of a historic downtown. A transit oriented development adjacent to the station physically transitioned the station area to the existing downtown. While the development was designed to be contextually appropriate, using materials and design principles to fit in with the historic surroundings, the development was multi-family residential and did not generate any mid-day activity around the station. Consequently, the station felt isolated from the town because activities were separated.

Conduct regular, frequent (optional) community outreach to supplement (required) public involvement as part of the environmental process. DART had a number of examples of conducting regular engagement with the communities beyond the public involvement required by the federal environmental process. Activities included community visioning processes, designing station areas and allocating betterments funds, implementing a school education program focusing on using the light rail system, and developing station art. DART staff felt this was valuable because it allowed DART to develop multiple constituencies for the project, incorporate and coordinate complementary programs, such as the school program, and it kept the project in people's minds during an otherwise dormant time between the completion of the EIS and the funding and subsequent construction of the project, therefore reducing the number of issues revisited during implementation of the project.

Use a betterments policy to constructively engage community in discussion of impacts and mitigation. DART adopted a betterments policy which provided a percentage of project resources for betterments within communities to complement the light rail project. This resource provided a framework for DART to constructively discuss impacts and mitigation with the community by giving the community a mechanism to allocate betterments funding to areas of importance to the community. At the same time, it set expectations for the amount to be spent on betterments in each area and allowed DART to budget accurately.

Most effective deterrents to crime are a police presence and fare inspectors. DART staff felt that a police presence and regular fare inspection were the most effective deterrents to crime. DART installed cameras at some stations and was expanding the system, which will allow DART to monitor the stations and dispatch police. Cameras are an important tool, but a uniformed police or security presence was the most effective in preventing crime.

DART ticket kiosk outside of station area. DART requires proof of payment to be within station area.

Mixed-use development incorporating residential and retail uses adjacent to Mockingbird Station.

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

In San Diego, the station platforms are fare zones, allowing MTS to control loitering and activity on the station platforms.

Small scale park and ride in San Diego. The parking spaces are visible from the station, lending a sense of security to the space.

CASE STUDY CITY #2: San Diego, CA

The City

San Diego is the eighth largest city in the United States, with 1.2 million residents. It is the county seat and economic center the San Diego-Carlsbad-San Marcos region. The area is south of Orange County and north of Tijuana, and supports an economy including sixteen military facilities, biotech research, and agriculture. The City of San Diego has seen explosive growth and redevelopment in the latter part of the 20th century and early 21st century (2007 population: 1,316,837), starting with the downtown. In the 1970's, only a few hundred people lived downtown. Now, there are approximately 30,000 people living downtown with steady growth anticipated for the future. The city of San Diego formed the Centre City Development Corporation, a non-profit corporation, in 1975 to implement downtown redevelopment. Horton Plaza, one of the Corporation's significant projects, was completed in 1985 and is credited with starting to draw people back to the downtown center. Subsequent redevelopment projects created more housing and an increasingly desirable live-work environment. The light rail system (referred to locally as "the Trolley") has helped with central city revitalization by providing access into downtown from throughout the region.

System Governance

The Metropolitan Transportation System (MTS) is the regional transit operator and has responsibility for service provision, ownership of regional transit assets, and system maintenance. The San Diego Association of Governments (SANDAG) is responsible for regional transportation planning. In 2002, the State merged planning, financial programming, project development, and construction functions of MTS into SANDAG.

Light Rail System

The San Diego Trolley opened in 1981 and was the first new light rail line built in the U.S in 20 years. In June 2007, the system carried 108,000 daily riders. Most of the Orange Line and the Blue Line south of downtown were built on existing railroad ROW. Freight service continued to operate in the corridor and now runs mostly at night. The Green Line, which opened in 2005, was built through already developed residential and commercial areas.

The Blue line connects downtown San Diego with the Mexican border, running mostly parallel to I-5 south of downtown. The Santa Fe Depot, served by both the Blue and Orange Lines, provides a multi-modal connection to Amtrak and Coaster commuter rail service to Oceanside, where it connects with LA's Metrolink commuter train. The Green Line, i.e. the Mission Valley extension, begins at Old Town, where it heads east into the Mission Valley. This extension required the purchase of new ROW. It includes at-grade, elevated, and tunnel configurations and

was developed through established residential neighborhoods. The Orange Line includes a loop within downtown, paralleling the Blue Line through part of downtown and separating at the Santa Fe Depot to travel through the Seaport Village, Convention Center, and Gaslamp Quarter. From downtown, the Orange Line travels through residential, industrial and lightly forested areas to connect with the Green Line at Grossmont Transit Center and serve smaller towns outside of San Diego. Downtown block lengths limit trains to three cars, and sometimes east of downtown, cars are added to Orange Line trains.

San Diego has three station area planning models: transit-based housing, commercial joint development, and master-planned transit villages. America Plaza, a joint development downtown, incorporates a station into the structure of the building. Rio Vista West, a master-planned transit village, illustrates the challenges and opportunities of planning for a master planned community. During a recession in early 90's, a big box retail center was developed within the community in order to allow the project to survive financially.

System Snapshot: Light Rail Transit

- Service began: 1981
- Average weekday ridership: 118,400 (2007)
- Total annual ridership: 36,800,000 (2007)
- Light rail miles: 51.1 miles
- Number of stations: 53 Stations
- Extensions planned:11 miles

Lessons for Bellevue

Incorporate signage into station and surrounding areas. Real-time arrival and wayfinding signage were limited on trains, station platforms, and station approaches. Committee members felt that station signage should provide real-time travel information, be double-sided so that riders can read from all platform locations, provide sufficient information for riders to understand how to use the system from that location, and be universally understandable, with an emphasis on graphic symbols and multiple languages. Additionally, local wayfinding signage should provide direction to the stations and real-time travel info should be available at major locations outside of the station, such as shopping and events centers.

Connect the right dots. San Diego's Green Line connected Old Town, shopping centers, residential areas and San Diego State University (SDSU) at greater expense and trouble than other potential alignments in order to serve the activity centers, get ridership, and support the local land use vision. The SDSU tunnel in particular served the community at greater cost and delivered a better outcome for the university in terms of service and for the transit system in terms of ridership. Committee members felt that the city and Sound Transit should be careful not to make the convenient choice, but the right choice to serve activity areas and riders. A contrasting example of this was also available in San Diego, where existing right-of-way was used on the first line, which didn't serve employment and required an extensive park and ride network to allow access to the system.

At-grade train San Diego. Pedestrian scale lighting, colored paving and paint, bright station shelters, and benches contribute to creating a comfortable environment.

American Plaza, a vertically integrated transit-oriented development in San Diego, where the train passes through portions of the building and retail uses abut the station platforms.

At Rio Vista, the station area is integrated into the sidewalk of the adjacent transit-oriented development.


Non-motorized trail adjacent to light rail tracks in San Diego.


The San Diego State University tunnel employs design features including natural light and air, high quality finishes, and art to create a comfortable waiting environment.

Consider land use goals and transit system needs when siting park and rides. San Diego has an extensive park and ride network along its system to provide auto access initially and transit oriented development opportunities as the land use around the system matures. This allows the system to build ridership early and create revenue generating opportunities later. Committee members observed that land banking was an important tool for MTS to generate revenue and ridership. At the same time, Committee members noted that park and rides may only be appropriate in Bellevue at the edges of the system and not in downtown or high density areas, as bringing riders in only to park all day is not supportive of the downtown land use vision.

San Diego State University represented "best practices" in station siting and design. The Committee cited a number of features of the SDSU station as examples of "best practices," including:

- The selection of the tunnel alignment and station location, although more expensive and difficult to construct than other alternatives, provided the best service to the university and surrounding neighborhoods;
- The incorporation of natural light and air resulted in an open and comfortable feeling despite being in a tunnel;
- The use of urban design features, the extension of tunnel finishes on the campus, and the inclusion of a architecturally unique pedestrian bridge integrated the station into the campus and surrounding neighborhood, heightening the aesthetic quality of the area surrounding the station; and
- The use of high quality finishes added to the attractiveness of the station.

However, some Committee members observed that the art features were too subtle and looked like mistakes in station design, and while vending machines were appreciated, the stations can appear cluttered with newspaper and other debris.

Employ a uniformed presence on the stations and trains and establish a fare zone within the station area to maintain safety and security. San Diego employs both sworn officers and a uniformed security force to provide system and station security. Additionally, station platforms are fare enforcement areas, requiring riders to possess or be in the process of purchasing a ticket, allowing security to control loitering and activity on the station platforms. Based on conversations with agency staff and a former police officer, Committee members felt that providing a strong uniformed presence on the system and the ability to control the station areas are important tools to increasing both the feeling of security and actual security at the stations.

CASE STUDY CITY #3: San Jose, CA

The City

San Jose is the oldest city in the state of California and currently the third largest with 945,000 residents. Once an agricultural center, San Jose and the surrounding cities are known for the concentration of technology companies. The area is suburban, located in the south end of the San Francisco Bay Area, and most development has occurred in the past 40 years. As such, the development pattern/ urban form is almost entirely auto-oriented with major freeways, wide arterials, and cul-de-sac residential areas. In the late 1980's, the city of San Jose began to take steps to refocus investment in downtown rather than in surrounding areas and to create a more dense urban environment. The San Jose Redevelopment Agency was formed to spearhead joint public/private projects such as the Adobe Headquarters in downtown. San Jose also selected an at-grade light rail alignment for the downtown to stimulate investment and support the urban vision for downtown. Additionally, surrounding cities, such as Mountain View, Santa Clara, and Sunnyvale, served by the light rail system have taken steps to foster transit oriented development around light rail stations.

System Governance

The Santa Clara Valley Transportation Authority (VTA) is an independent special district responsible for bus, light rail, and paratransit operations; congestion management; specific highway improvement projects; and countywide transportation planning. VTA operates under the direction of a 12-member Board of Directors consisting of elected officials appointed by Santa Clara County and the cities within the VTA boundaries.

Light Rail System

San Jose's Valley Transit Authority (VTA) operates a light rail system consisting of three lines, 42.2 miles of track, 62 stations, and 21 park and rides with 7,000 stalls. In 2007, the system served 33,000 daily riders. Construction of the light rail system began in 1980s when the area was largely developed in a suburban model with a low density downtown. The system has experienced volatile ridership levels due to dramatic changes in the economy, but ridership has partially rebounded.

Alignments are primarily at-grade in dedicated right-of-way along arterials and highways. There are some short elevated sections near a major mall. In downtown, the line operates within a pedestrian-oriented transit mall. Speeds are slow (9-10 mph) and emphasize access with frequent stops. Similarly, stations are also primarily at-grade with at least one elevated station at the "Great Mall." Tracks and stations pass through single family residential areas, strip commercial, the high-tech research corridor, and San Jose's downtown. Over the past ten years, the VTA has aggressively pursued TOD near stations in partnership with local jurisdictions.

San Jose's light rail system provides multimodal connections to local and regional transit services. In

An open, well maintained elevated station in San Jose.

The design and colors of this at-grade station in San Jose integrate the station with the neighborhood.

Station art at a San Jose station.

Residential transit-oriented development in San Jose.

At-grade train in San Jose. Paving textures, rows of trees, street furniture and signs all help to define the train right-of-way, while creating a comfortable pedestrian environment.

Minimalist station design in San Jose.

downtown San Jose and Mountain View, the system connects to Cal-Train heavy commuter rail. There is an extensive network of transit feeder service providing connections to numerous entertainment venues (Great America Amusement Park), office parks, the downtown trolley, a downtown fixed route circulator, a hospital, and residential areas.

System Snapshot: Light Rail Transit

- Service began: 1987
- Average weekday ridership: 32,567 (2007)
- Total annual ridership: 10,278,460 (2007)
- Light rail miles: 42.2 miles
- Number of stations: 62 stations
- Extensions planned: 8.2 miles in planning/ environmental phase

Lessons for Bellevue

Design sound walls to be consistent along corridor, use attractive materials, and use vegetation to soften the visual impact. Committee members observed that sound walls adjacent to single family homes along the Alum Rock line in San Jose used inconsistent materials and provided no vegetation, resulting in a fragmented, unattractive appearance. Committee members felt that sound walls should be consistent along a corridor to create a cohesive feel, use attractive materials, and use vegetation (which should be regularly maintained) to soften the visual impact.

At-grade system in downtown San Jose had both merits and disadvantages. Merits of the San Jose downtown segment identified by the Committee included:

- The design of the at-grade transit mall employed attractive pavers and station furniture and created a pleasant pedestrian environment; and
- The at-grade alignment assisted the city of San Jose in advancing local land use objectives.

Disadvantages perceived by the Committee of the at-grade alignment included:

- The speed limitation of 9-10 mph in the downtown transit mall constrains system capacity by limiting the number of trains that can travel through the downtown segment;
- The increased travel time due to the at-grade alignment in downtown San Jose is a deterrent

for the south San Jose residents to use the system for trips north to employment areas; and

- During the Committee visit, a building fire on the transit mall forced light rail service to stop within that segment, and a "bus bridge" provided a service connection for the system, resulting in the observation that incidents in streets impacted service, whereas a tunnel would be less affected.

Additional general observations by the Committee about at-grade alignments included:

- VTA staff suggested that, from a system performance perspective, VTA would select an underground alignment if they had that choice again;
- The buses on the transit mall were louder than the light rail trains, and that the trains used a low-volume chime as they pulled into and out of the stations to alert pedestrians to their arrival; and
- While LRT contributed to the advancement of San Jose's land use vision for the downtown, it was not enough alone to overcome the reduced development cycle caused by the larger economic downtown during the early 2000's.

Include trees and vegetation along route. San Jose has significant vegetation along the light rail route, including immediately adjacent to the rail and catenary system in landscaped medians. In the most recent lines, VTA has installed more mature trees along the lines, rather than waiting for smaller trees to mature. Committee members observed that the landscaping improved the appearance and feel of the light rail system especially around stations by softening the visual impacts, providing weather protection, and blending light rail into the local environment. Committee members suggested planting mature trees as part of the landscaping mix in Bellevue.

Include dedicated, separate construction contracts for performance of timely reparations to adjacent property owners. VTA separated the major construction and the remediation portions of the construction work into separate contracts. Creating a separate contract for remediation, including the replacement of property owners landscaping, provided a structure in which individual property owner concerns could be addressed promptly and comprehensively while allowing the expensive heavy construction to advance. This allowed for both positive relations with adjacent property owners and increased ability to keep the larger project on schedule. The Committee observed that this appeared to be an effective contracting model for all parties.

Street configuration and tactile curbs in San Jose.

Elevated trackway in San Jose.

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Alum Rock station adjacent to single-family neighborhoods. Landscaping along the line and at stations improves the appearance and feel of the system.

Directional transit signage and emergency phone at a downtown San Jose station.

Additional Committee observations about the San Jose system are dicussed below.

Elevated stations: The Committee toured an elevated station outside of downtown San Jose and observed that it was a functional way to avoid street conflicts and that breaking up the station into multiple levels minimized the bulk of the station. However, the Committee had reservations about elevated stations fitting into Bellevue because of the scale.

Station design: Some Committee members expressed a preference for minimalist station designs, such as the Campbell station on the San Jose line. Some stations had wind screens with opaque glass that blocked sightlines, which Committee members felt limited the feeling of safety and security at stations, and were not necessarily effective at blocking the wind. VTA was in the process of retrofitting stations to add closed circuit cameras for security, illustrating the importance of designing stations adequately in the beginning because retrofitting was expensive and resulted in less-than-integrated designs.

Neighborhood character: The Committee observed that the single-family neighborhoods along the Alum Rock Line looked healthy and did not look blighted. “No parking” was sprayed on driveways immediately adjacent to the station, indicating the need for a residential parking zone or other parking enforcement approach. In Campbell, VTA worked with adjacent residences to adjust bells and maintain trackway to minimize noise impacts of train operation.

CASE STUDY CITY #4: Portland, OR

The City

The Portland metropolitan region is home to over two million residents, and Portland itself has over 500,000 residents. The region is known for its strong land use planning and investment in public transportation. The Portland Development Commission (PDC) coordinates resources to revitalize areas throughout the city with joint public/private projects. Agencies such as the PDC, Metro (the regional metropolitan planning organization (MPO)) and the City of Portland regulate policies and practices that incorporate community and environmental goals into urban redevelopment and are the backbone of Portland's planning environment.

System Governance

The Portland regional government, Metro, is the only directly elected MPO in the United States and, among other responsibilities, leads regional land use planning and transportation planning for the regional transit system. TriMet is a municipal corporation which operates a comprehensive transit network servicing three counties in the Portland metropolitan area. Metro's regional transportation and livability goals guide TriMet's Transportation Investment Plan (TIP) which sets direction for transportation investments for the next 20 years. The TIP sets the framework for TriMet to partner with local, regional, and state agencies to invest in roadways, pedestrian infrastructure, signal priority for transit vehicles, and building codes that enhance transit-supportive urban environments.

Light Rail System

Portland's Metropolitan Area Express (MAX) light rail system consists of 44 miles of light rail, made up of three lines (Blue, Red, Yellow) with 64 stations. Downtown Portland serves as the hub of the system. A fourth extension, the Green Line is under construction and an Orange Line is planned. Serving 99,000 weekday riders, the MAX system has the fourth highest ridership of light rail systems in the U.S. Additionally, commuter rail service is scheduled to open in 2008. Westside Express Service (WES) will link the cities of Beaverton, Tigard, Tualatin and Wilsonville, and passengers will connect to the MAX system at the Beaverton Transit Center.

The MAX Blue Line, which opened in 1986, is the major west-east light rail line, traveling from Hillsboro to Gresham. The MAX Red Line travels between Beaverton and the Airport. The MAX Yellow Line travels from downtown Portland north to the Expo Center.

In Portland and Hillsboro, MAX trains run in dedicated lanes on surface streets, and in other areas, the trains run in fully separated right-of-way. The system utilizes two-car trains due to the small block lengths (200 ft) in downtown Portland. The system has one tunnel, three miles long, with an underground station at Washington Park. At 260 feet below ground, it is the deepest transit station in North America.

The central station is Pioneer Courthouse Square in downtown, in the center of "Fareless Square," an area where light rail, buses, and the streetcar are

TriMet broke up the transit mall construction in Downtown Portland into short segments to reduce the duration of time construction took place in front of any one group of businesses.

At-grade light rail system through downtown at Pioneer Square Station. TriMet uses Belgium block in downtown rail application because it is durable and easy to replace.

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Washington Park Station, MAX's tunnel station, serving the Portland Zoo, Children's Museum, Forestry Center, and Washington Park.

Beaverton Transit Center providing bus and light rail connections.

fare free. Outside of Fareless Square, Metro uses a proof of payment system. TriMet coordinates bus service to provide connections to MAX throughout the system. TriMet has made improvements to the system over time to increase accommodation pursuant to the Americans with Disabilities Act (ADA) and provide real-time travel information at stops. Additionally, TriMet and the city of Portland have worked collaboratively to develop innovative construction management techniques to minimize street and business disruption during construction. TriMet actively supported TOD along MAX corridors, and developed Airport MAX through a public/private partnership involving a 120 acre TOD (Cascade Station) which recently opened.

System snapshot: Light Rail Transit

- Service began: 1986
- Average weekday ridership: 104,200 (2007)
- Total annual Ridership: 34,700,000 (2007)
- Light rail miles: 44 miles
- Number of stations: 64
- Extensions planned: 8.3 mile extension is under construction and future extensions are in the environmental analysis phase

Lessons for Bellevue

Design construction approaches to meet objectives and appropriately mitigate for impacts, i.e. residents vs. businesses. TriMet has divided construction of the transit mall into multiple phases (separating utility relocation from "heavy civil") and into small "reaches" of three blocks in order to minimize the duration of construction in a particular place and the scope of impact to the downtown street network. This approach was developed in response to input from the businesses along the mall and based on past construction experience, where unexpected delays in utility relocation negatively impacted the schedule for "heavy civil," the most expensive part of construction. From this practice, the Committee observed that breaking construction into smaller pieces, although not necessarily into multiple phases and only three block stretches, may make sense to reduce the duration of impacts in any one place, and developing construction approaches that incorporate the needs of adjacent property owners is important for community acceptance. TriMet also utilized a "conduct of construction" to set expectations for construction in advance, which the Committee also agreed was a useful tool to have clear expectations for how issues will be addressed and by whom during construction.

General Committee observation about the Portland system are dicussed below.

At-grade alignments: Portland's at-grade light rail system in downtown included established at-grade light rail, a more recent streetcar addition, and light rail on the transit mall currently under construction. Committee members made a number of observations about the at-grade alignments in downtown Portland, including:

- Downtown Portland was the primary destination of the TriMet system, so slower speeds

through downtown were not such an issue as for systems, such as San Jose, where many people are riding through downtown onto other destinations. Downtown Bellevue will be a major destination on East Link, but may not be the primary destination on the system, as people will be traveling through to Seattle and Redmond. Consideration of tradeoffs of travel time for riders with downtown Bellevue as the destination versus riders traveling through downtown Bellevue is an important consideration;

- The at-grade alignment served a number of major destinations downtown, as opposed to one central location. Portland made the decision to serve these locations at-grade aware of the trade-off between delivering people closer to their final destination and the longer travel time.
- The transit investment and activity along surface alignments is attractive to developers and increases the intensity of development;
- The construction underway in the transit mall appeared to be handled well in that street closures were minimized, the business community was involved in designing the construction management plan, design and materials choices reflected lessons learned from past designs, and construction was on schedule; and
- The materials chosen for the transit mall were attractive and, although they cost slightly more initially, were less expensive to maintain over time than other choices.

Tunnel: Portland has one three mile tunnel segment including one underground station, Washington Park. Committee members made a number of observations about the tunnel alignment, including:

- Traveling through the tunnel was louder than expected;
- The station felt dark without any natural light;
- The tunnel was more difficult to construct than anticipated due to unexpected rock conditions;
- The tunnel offered high performance, both in terms of travel speed and the ability to accommodate crowds during events at Washington Park, such as summer concerts at the zoo.

Community involvement: Involving the Goose Hollow community early in the planning and design process allowed TriMet to respond to concerns and include community suggestions in the design of system and stations. This resulted in community buy-in to the project, and allowed the community to successfully lobby for desired benefits, including an additional station in the Goose Hollow neighborhood. Agencies should provide adequate staff to respond to community concerns in a timely manner, so that issues can be addressed promptly and effectively. This reinforced lessons learned from all the systems: early and on-going active engagement of the community, not just communications to the community, are critical for project success.

Pedestrian signage at track crossing and security presence at Beaverton Transit Center.

Goose Hollow Station, integrated into an established single-family neighborhood.

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Public art integrated into PGE Park Station, just west of downtown Portland.

Beaverton Round is challenged by adjacent undeveloped vacant lots, and limited foot traffic.

Pathway connects Orenco Gardens, a multi- and single-family development with Orenco Station.

Transit-Oriented Development: The Orenco station demonstrated a nice mix of land uses (residential, park and ride, mixed use) and urban forms, while meeting both the demands of retail (by putting it away from the station and on a major arterial) and ridership needs (by putting the retail and residential adjacent to or within walking distance and providing a park and ride facility). The Beaverton Round didn't look healthy, had minimal retail activity and the parking structure dominated the space. Along the Red Line, some TOD was present, but other planned TODs had yet to develop, reinforcing the notion that while light rail can help stimulate TOD, it is not enough to overcome other development market forces.

Placement/Alignment: TriMet shared the city of Gresham's decision to have light rail terminate outside of their downtown. If they had the decision to repeat, Gresham would have allowed light rail to serve the center of town. Committee members acknowledged that this lesson, the desire to serve the center of town, may have relevance for Bellevue when the decisions are made about alignment and station selection.

Station design: Some Committee members felt that the Orenco station had a great overall design, with a comfortable, attractive scale, mix of alcoves and open area, open sightlines, and feeling of security. Other Committee members noted the general attractiveness of minimal station designs throughout the Portland system.

System functionality: Committee members made the following observations about the functionality of the Portland system:

- Real time signage very helpful for users;
- Airport connection valuable for residents and visitors;
- System served destinations outside of downtown well because of the high speeds achieved between stations.

Conclusions

While no single system was similar to Bellevue in all aspects, each case study system visited provided useful information and applicable lessons. The Committee gained a better understanding and appreciation for system design considerations as they relate to neighborhood integration, station security, ridership, and successful TOD, among others. The Committee concluded that the case study visits, including meetings with city and agency staff, riders and local citizens, were a worthwhile experience that helped them identify valuable lessons for Bellevue

and best practices.

APPENDIX

San Jose & San Diego Case Study Tour Notes

Approved by Commitee 2/5/2008

LIGHT RAIL Best Practices
FINDING THE RIGHT FIT FOR BELLEVUE

Following is an annotated summary of the Light Rail Best Practices Committee (Committee) tour of two case study systems, San Jose and San Diego, from January 16 to January 18, 2008. The purpose of the case study tour was for the Committee to be able to experience the light rail systems first-hand and talk to the local people that operate and use the systems. There were no decisions or actions taken by the Committee during the tour.

Wednesday, January 16, 2008

The group departed SeaTac Airport for San Jose, CA on the same flight at approximately 10 a.m. and included nine Committee members (Jennifer Robertson, Joel Glass, Don Davidson, Faith Roland, David Karle, Francois Larrivee, John Rogers, Lise Northey and Doug Mathews), five city staff (Goran Sparrman, Dan Stroh, Bernard van de Kamp, Maria Koengeter and Mike Kattermann), and one Sound Transit staff (Don Billen).

The flight arrived in San Jose at approximately noon. The group traveled in four separate cabs (light rail does not serve the airport) to downtown San Jose and checked into the Sainte Claire Hotel. The entire group met for a working lunch at approximately 1 p.m. in the hotel restaurant. David Knowles, with David Evans and Associates, joined the group at the hotel and accompanied them during the remainder of the tour.

City staff and the consultant provided an overview of the itinerary and materials in the folders provided to the Committee prior to the tour (e.g. background information on the systems, a summary of the binder from the Surrey Downs East Link Committee, and a memo of the case study tour purpose), as well as some additional information handed out at the meeting (i.e. a memo summarizing Committee discussion and questions to date on the topic papers, a matrix for taking notes on the different topics during the tour). The Committee was reminded that this was not a formal meeting, there would be no decisions or actions by the Committee on the tour and there would be no minutes taken; however, these notes would be prepared to summarize the tour.

At approximately 1:30, the group was joined by two staff from the Santa Clara Valley Transportation Authority (VTA); Gail Collins, Marketing and Public Affairs; and Ken Ronsse, Project Manager, Engineer. Gail and Ken responded to numerous questions from the Committee about the VTA system – including but not limited to lessons learned, funding, public outreach and construction impacts and issues. At approximately 2:15 p.m. the group walked a few blocks to the downtown transit center and met with Ray Salvano, Senior Civil Engineer, City of San Jose Transportation Department. Ray gave a brief oral presentation on light rail through the downtown and responded to questions from the group including but not limited to cooperation between with city and the VTA, costs, design issues, lessons learned.

The group (including the two VTA staff) then boarded a light rail train at the downtown transit center and disembarked at San Jose Diridon Station. This stop was chosen because of the transit oriented development (TOD) around the station, station design, pedestrian safety measures, a tunnel portal, and a pedestrian tunnel connecting the light rail station with the commuter rail and Amtrak station. After walking around the area and talking with VTA staff, the group boarded the light rail train and disembarked at Campbell, a station designed to reflect the historic character of downtown Campbell, a city immediately south of San Jose. The group looked around the station and the downtown and boarded the train for downtown San Jose, returning to the hotel at approximately 5:30 p.m.

Thursday, January 17, 2008

The group convened at 7:30 in the hotel restaurant for a breakfast meeting with Gail Collins and Chris Augenstein, VTA Transportation Planning Manager, for an oral presentation on TOD. The Committee asked questions of Gail and Chris about issues including, but not limited to, mistakes made, what worked well, ridership, land use and design.

At about 8:30 a.m., the group, joined by Gail Collins, boarded a bus for the Alum Rock station. Alum Rock is the southern terminus of the blue line. This line was selected for the tour because it travels at-grade in the median of an arterial that runs along existing single family residential and existing

commercial areas as well as having elevated guideway and stations near newer residential and commercial developments. The group walked around the bus transit and light rail stations at Alum Rock before boarding the train and disembarked at the Great Mall/Main elevated station where they were joined by Ken Ronsse. The group toured the elevated platform and the area at-grade around the station, including the adjacent bus transit center and pedestrian areas along the arterial leading to the elevated structure. The group again boarded the blue line train for downtown and continued to ask questions of Gail and Ken until disembarking at the Convention Center station in downtown San Jose. Gail and Ken returned to their offices and the group returned to the hotel at about 11:30. The group met for lunch at about noon in the hotel restaurant. At approximately 1 p.m., the group took 4 cabs to the airport for a flight to San Diego. Dan Stroh took a separate flight returning to Seattle. David Knowles joined the group on the same flight from San Jose to San Diego.

The flight to San Diego departed at approximately 3 p.m. and arrived at about 4:15. The group divided up again into cabs (light rail does not serve the San Diego airport) for the ride to the Manchester Grand Hyatt Hotel in downtown San Diego.

Friday, January 18, 2008

At 8:30 a.m. the group traveled by light rail train to the offices of the San Diego Metropolitan Transit System (MTS) for a briefing from Wayne Terry, MTS Vice President of Operations, and John Haggerty, Chief Engineer with San Diego Area Governments (SANDAG). Wayne and John generally described what the group would be seeing along the routes and answered questions before everyone boarded an orange line train to Grossmont Station. After a brief view of the Grossmont Station (located under a roadway overpass), the group transferred to a green line train and disembarked at the 70th Street Station. This stop was an opportunity to see a small park and ride lot at a light rail station combined with a bus transit center. The station was also near a tunnel portal and at-grade vehicular crossing. The next stop was San Diego State University (SDSU), to see a tunnel section, underground station, pedestrian and bus transit connections. John Haggerty described the design and construction issues of the tunnel and station and why the tunnel was selected over an elevated alignment along the freeway.

The group boarded the train to the Rio Vista station, also located on the Mission Valley (green) line. Rio Vista is a mixed use TOD project that abuts the light rail platform on one side with residential and a pedestrian connection to a public plaza, commercial and additional residential and vehicular access on the interior of the project. On the other side of the platform was a pedestrian trail and an environmentally sensitive area including the San Diego River and associated wetlands.

There was an intermediate stop in Old Town to transfer from the green line to the blue line that travels through the downtown blocks of San Diego. Several members of the group disembarked at the America Plaza station and walked several blocks along the downtown light rail line to a lunch meeting at Dakota Grill. Two of the light rail lines stop at America Plaza, which is a high-rise office building with a light rail station and retail integrated into the ground floor. The walking tour was to look at downtown stops, block lengths, land use and street treatment in the light rail corridor. There was no agenda or program for the lunch meeting; it was an opportunity for Committee members to share their observations and ask questions.

After lunch, the group met again at MTS offices and received a brief presentation from MTS staff: Peter Tereschuck, General Manager; Brandon Farley, Senior Transportation Planner; and Sharon Cooney, Government Affairs Director. The Committee had many questions for MTS staff about issues including but not limited to financing, ridership, TOD, land use, SDSU tunneling, and crime. The meeting ended about 4 p.m. so the group could get to the airport for the return flight to Seattle, which departed at approximately 6:45 p.m.

APPENDIX

Portland Case Study Tour Notes

Approved by Commitee 3/18/2008

Following is an annotated summary of the Light Rail Best Practices Committee tour of the Portland, OR, light rail system on February 29, 2008. The purpose of the case study tour was for the Committee to be able to experience the light rail system first-hand and talk to the local people that operate and use the systems. There were no decisions or actions taken by the Committee during the tour.

Friday, February 29, 2008

The group departed SeaTac Airport for Portland, OR, on the same flight at approximately 8 a.m. and included all ten Committee members (Jennifer Robertson, Joel Glass, Faith Roland, David Karle, Francois Larrivee, John Rogers, Lise Northey, Doug Mathews, Claudia Balducci and Don Davidson), seven city staff (Goran Sparrman, Bernard van de Kamp, Maria Koengeter, Rick Logwood, Paul Inghram, Janet Lewine and Mike Kattermann), and one Sound Transit staff (Don Billen).

The flight arrived in Portland at approximately 9 a.m. The group was met at the airport by David Knowles of David Evans and Associates (DEA) and then traveled via light rail (Red Line) to Pioneer Square in downtown Portland and walked to the Tri-Met downtown project office for a brief presentation. At the Tri-Met office the group was joined by Claudia Steinberg and Bob Hastings of Tri-Met staff and Susie Serres of DEA. The focus of the presentation and questions by the group was on the current downtown transit mall project in terms of construction management, mitigation, community outreach and business support, with particular attention to the phased construction approach used on the project. The group then took a guided walking tour of several blocks of the downtown project with David Evans and Tri-Met staff. There was considerable construction activity and the group was able to view the different phases of the project in the multiple segments that were on the tour.

At approximately 11 a.m. the group met for a lunch at the Porto Terra Restaurant in downtown Portland, where it received a briefing from Ann Becklund, Community Affairs Director for Tri-Met. The briefing covered community outreach on current and previous projects, lessons learned, tunnel v. at-grade in downtown, experiences with businesses and neighborhoods and transit-oriented development (TOD).

After lunch the group boarded the light rail train to PGE Park station and met with Jerry Powell from the Goose Hollow Neighborhood Association. Mr. Powell guided the group on a tour of two stations in the neighborhood on the west edge of downtown. He discussed their experiences in working with Tri-Met on issues related to station location and design (the neighborhood fought for and won an additional station Tri-Met did not support), parking replacement, land uses, construction impacts and the tunnel.

Mr. Powell departed as the group boarded a light rail train for the underground station located in Washington Park. At that station, the group was joined by Dan Blocher, Director of Capital Construction Management for Tri-Met. Mr. Blocher began his presentation in the station and concluded it on the surface. He discussed issues and construction challenges they faced in building the tunnel and station. The group asked several questions related to costs, construction duration, parking, impacts and lessons learned that were answered by Tri-Met and DEA staff. Tri-Met staff departed and the tour group, including DEA staff, boarded the west bound train to Beaverton and then transferred to another west bound train to Orenco Station in Hillsboro to tour the TOD project.

The group was met at the station by Wink Brooks, former planning director for the city of Hillsboro. Mr. Brooks discussed the history and development of the Orenco Station area and described additional development planned for the area. He provided a guided walking tour for the group through the adjacent residential development and discussed pedestrian connectivity to the light rail line, parking, access and design features of the TOD project. After a question and answer session about the project, the group then boarded an east bound train for downtown Portland.

At approximately 4 p.m., the group met with John Carroll, with Carroll Investments, LLC, a developer of transit-oriented, downtown residential and mixed use projects. Mr. Carroll discussed his approach to TOD and the importance of the light rail and street car lines to the projects. He answered questions about specific projects, funding of the street car (including a local assessment), and working with local city and transit agency staff.

The meeting ended about 5:45 p.m. so the group could catch the light rail train to the airport for the return flight to Seattle, which departed at approximately 7:45 p.m.

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RESOURCES

DALLAS

http://www.uli.org/AM/PrinterTemplate.cfm?Section=Home&CONTENTID=117342&TEMPLATE=/CM/ContentDisplay.cfm

http://www.dart.org/about/economicimpact.asp

http://www.uli.org/AM/PrinterTemplate.cfm?Section=Home&CONTENTID=61096&TEMPLATE=/CM/ContentDisplay.cfm

http://www.dallasparks.org/downloads/DowntownParks_MasterPlan.pdf

http://www.dart.org/about/expansion/2030plan.asp

http://www.dallas-edd.org/downtown.html

http://www.dallas-edd.org/images/community_redevelopment/downtown/downtown_highlights/downtown_highlights.pdf

SAN DIEGO

http://www.sandiego.gov/planning/community/pdf/cow/planninghistory.pdf

http://www.uli.org/AM/Template.cfm?Section=Search&template=/CM/HTMLDisplay.cfm&ContentID=27362

http://www.austinchamber.com/TheChamber/AboutTheChamber/SanDiego07_Intercity/icv07MetroTransSys.pdf

http://www.dot.gov/affairs/fta0800.htm

http://www.signonsandiego.com/uniontrib/20060723/news_1m23trolley.html

http://www.sdmts.com/MTS/documents/MTS2007.pdf

http://www.sandag.org/resources/demographics_and_other_data/demographics/fastfacts/sand.htm

http://www.sandiegohistory.org/journal/2002-1/holle.htm

http://www.sandiego.gov/planning/boardcomm/index.shtml

http://www.sandiego.gov/planning/genplan/pdf/sfe.pdf

http://www.sandiego.org/article/Media/272

http://www.sandiego.org/downloads/1201474042.41885700_bd104b1b9c/2007General%20Facts.pdf

http://www.ccdc.com/index.cfm/fuseaction/aboutCCDC.home fs

http://www.sandag.org/index.asp?fuseaction=about.home

http://onlinepubs.trb.org/onlinepubs/circulars/ec058/03_01_Thompson.pdf

SAN JOSE

http://www.sanjoseca.gov/planning/nsj/docs/NSJ%20Final%20GP%20Text.pdf

http://www.sanjoseca.gov/planning/design_guidelines/Chap%205A_TOD.pdf

http://www.sanjoseca.gov/planning/design_guidelines/TOD%20guidelines%20FINAL.pdf

http://www.sanjoseca.gov/planning/design_guidelines/mid-%20and%20high-rise%20res%20guides%20FINAL.pdf

http://www.hcd.ca.gov/hpd/tod.pdf

http://www.lightrailnow.org/facts/fa_sj001.htm

http://www.lightrailnow.org/features/f_sj002.htm

http://www.seattle.gov/transportation/SAP/TOD_Case_Studies/SanJose_LRT.pdf

http://www.sanjoseca.gov/about.html

http://www.lightrailnow.org/facts/fa_sj001.htm

http://www.hitachigst.com/portal/site/sanjosesite/menuitem.57a41673ce5f560dacd3d307aac4f0a0/

http://findarticles.com/p/articles/mi_m1215/is_n8_v192/ai_11135698

http://www.transcoalition.org/reports/it_takes_transit_village.pdf

http://www.transcoalition.org/reports/it_takes_transit_village.pdf

http://usj.sagepub.com/cgi/reprint/44/5-6/1041.pdf

http://sanjose.org/pressroom/presskit/history.php

http://sanjose.org/pressroom/presskit/glance.php

http://www.metroactive.com/papers/metro/03.09.05/sub-urban-0510.html

http://www.heritagetrolley.org/TNERJSanJose.htm

PORTLAND

http://www.portlandstreetcar.org/pdf/annual_ridership_graph.pdf

www.trimet.org

http://www.portlandonline.com/