LIGHT RAIL Best Practices

FINDING THE RIGHT FIT FOR BELLEVUE

RESEARCH FINDINGS SUMMARY
Topic Areas 5-8

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Purpose of Project

- Prepare City leaders for decision on LRT
- Recommend Best Practices
- Research implementation of LRT in other cities

Where we are

July 2007	Nov 2007	Jan 2008	March 2008	April 2008	June 2008
Project Start	Topic Areas Group 1	Topic Areas Group 2	Case Studies	Policy Development	Adoption

Today's Topics

- Land Use
- Street Design and Operations
- Elevated, At-Grade, and Tunnel Integration
- Construction Impacts and Mitigation

Topics Selected by Committee

1. Community and Neighborhoods
2. Connecting People to Light Rail
3. Property Values
4. Station Security
5. Land Use
6. Street Design and Operations
7. Elevated, At-Grade, and Tunnel Integration
8. Construction Impacts and Mitigation

Land Use - Issues

- What are the most common land use issues generated by light rail, before and after construction, and how have those been addressed?
- What have other cities done to proactively foster transit-oriented development and redevelopment, where desired, around stations?
- What techniques have been the most effective at integrating light rail with community assets such as parks and trails, iconic businesses and environmentally sensitive areas?
- What techniques have been applied to overcome or minimize the real or perceived physical barrier created by the light rail system?
- What are the long term benefits of light rail experienced by other systems in each of the urban forms relevant to Bellevue?

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.

Land Use - Findings

- Historically, transit facilitated separation of residence and employment and helped stimulate real estate development
- The land use-transit connection: Modern Context
- Transit Influences land use in four principal areas
  - Value of land
  - Amount and intensity of development
  - Urban form
  - Timing and phasing of development
- Potential to be ineffective
- What is Transit Oriented Development?
  - Located near station
  - More compact and dense then overall development pattern
  - Mix of uses
  - Pedestrian oriented streetscape

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.

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).

Land Use – Findings *Continued*

- Benefits of TOD
  - Reduced auto dependence; balanced mode split
  - Increase in transit ridership
  - Economic development
  - Place making and complete neighborhoods

- Making TOD work: typical elements
  - Establish a long term vision
  - Protect opportunities through interim planning measures
  - Create places not projects
  - Promote density
  - Emphasize pedestrians
  - Provide for transitions to neighboring community
  - Include housing
  - Provide leadership
  - Facilitate good development

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.

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 acre15.

Land Use – Findings *Continued*

- Benefits for Bellevue urban form
  - Suburban residential
  - Industrial/commercial redevelopment
  - Urban core
  - Minor commercial hubs

- Effective techniques for integrating light rail
  - Focus on creating a sense of place
  - Make it attractive for pedestrians and bikes
  - Include public spaces and art
  - Connect to pedestrian trails
  - Incorporate greenways, parks, landscaping
  - Involve citizens and businesses in planning

- Techniques to mitigate "barrier" perception
  - High quality materials
  - Safety and security measures
  - Pedestrian, bicycle and vehicle connectivity

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

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

Street Design and Operations - Issues

- How can light rail be integrated into streets with automobiles, buses, freight, bicycles and pedestrians?
- What can effective street design and technology do to increase safety, improve performance and mitigate noise and light impacts?
- What have been the experiences of other systems with auto, pedestrian and bicycle safety and light rail?
- How are speed, capacity, and movement of traffic affected within a shared right-of-way?
- What types of injuries could occur around stations: Are there countermeasures?

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).

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

Street Design and Operations - Findings

- Integrating light rail with vehicles, pedestrians and bicycles
  - Use signs and lights that provide clear unambiguous directions to drivers and pedestrians
  - Provide LRT light signals that are clearly distinguishable from traffic signals
  - Manage vehicle turning to minimize conflicts with LRT
  - Use physical barriers to separate trains and vehicles
  - Separate freight routes and loading zones from LRT alignment
  - Locate bus stops to direct pedestrians to safe, direct street crossings
  - Link LRT vehicle design and station considerations
  - Design alignment and track bed to facilitate vehicle and bicycle circulation
  - Preserve existing traffic patterns as much as possible
  - Provide pedestrian traffic signals
  - LRT signal pre-emption and phasing

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

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

Street Design and Operations – Findings *Continued*

- Street design techniques for improving safety
  - Slow vehicle speeds through traffic calming
  - Reduce pedestrian risk through street and signal design
  - Increase driver predictability
  - Increase pedestrian predictability
  - Reduce peoples ability to rush across the tracks
  - Use safety devices to indicate safe crossing and waiting areas

- Experiences of other systems
  - Calgary
  - Portland

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

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.

Street Design and Operations – Examples

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

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

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).

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).

Pedestrian station access in San Jose

Exclusive and shared use trackway delineation Jersey City, NJ

Elevated, At-Grade, and Tunnel Integration - Issues

- 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 different profiles?

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

- 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?

At-grade LRT stop in downtown Portland

Elevated trackway Vancouver, BC

Elevated, At-Grade, and Tunnel Integration - Findings

Advantages	Disadvantages
At Grade	
Least cost	Greater potential for vehicle and pedestrian conflicts
Easiest to construct	Possible loss of traffic capacity
Easiest inter-modal transfers	Potential noise and vibration impacts
Can help activate urban streetscapes	Slowest speeds in semi-exclusive and shared rights of way
Elevated	
Fully grade separated trackway	More costly than at-grade
Higher operating speeds	Structure can have negative visual impacts
Fewer vehicle conflicts	Pedestrian access more difficult than at-grade
Less costly than tunnel	Not as likely to stimulate new development
Tunnel	
Fully grade separated trackway	Most expensive alignment
Higher operating speeds	Stations are out of sight and trains do not activate the street
Few or no vehicle conflicts	Higher maintenance than at-grade
	Construction can be very disruptive

At-grade station in downtown Denver

Side-running elevated alignment Seattle

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

Elevated, At-Grade, and Tunnel Integration – Findings *Continued*

- With any alignment use design features to integrate LRT into adjacent development and community
  - At-grade trackway treatments
  - At-grade station design and treatments
  - Location and design of elevated trackway support
  - Station access points for tunnel alignments

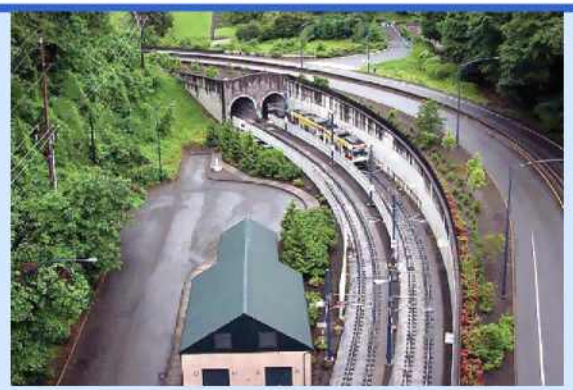
- Station Characteristics
  - At grade stations can be an amenity in an urban core and higher density areas. Help to activate the street and stimulate development. Easy for pedestrians to access
  - Elevated stations are visible but separation from street makes pedestrian access more difficult. Structure can be an visual eyesore.
  - Tunnel stations are not visible. Entrances can be visible or not. Design can help provide visual cues about station location

Belgium block trackway on original MAX line in downtown Portland

Elevated trackway and station San Diego

Elevated, At-Grade, and Tunnel Integration – Findings *Continued*

- Tunnel portals
  - Topography and alignment are primary determinants
  - In public right-of-way, utilities and adjacent development are issues
  - Grade of descent will affect length of portal
  - Block length will affect disruption of street grid



Tunnel portals adjacent to US 26 west of Portland

Cut and cover tunnel portal in Dallas

Urban tunnel portal in Los Angeles

Construction Impacts and Mitigation - Issues

- What are the most effective techniques used by other systems to mitigate impacts related to construction. Who is responsible for maintaining mitigation?
- What are successful examples of providing local access to businesses, visitors and residents during construction?
- 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?
- What are models for providing community and business support during construction?
- What are the best practices for construction and design techniques in environmentally sensitive areas?
- What incentive strategies have been used to minimize construction impacts

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

Construction Impacts and Mitigation - Findings

- Use EIS process to identify potential impacts
- Develop policies on mitigation of construction impacts in cooperation with local government, neighbors and businesses.
- Communicate, communicate, communicate
- Soil, erosion and dust mitigation
  - Remove soil from paved streets
  - At-grade station design and treatments
  - Temporary paving and landscaping of exposed areas.
- Noise
  - Identify sensitive noise areas in advance and plan for them
  - Sequence operations for maximum noise during day
  - Truck routing and construction staging

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

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

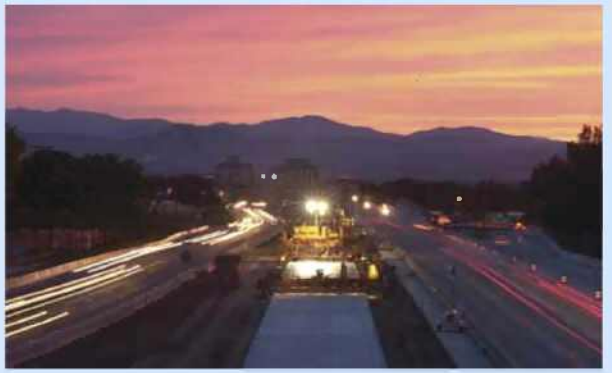
Construction Impacts and Mitigation – Findings *Continued*

- Vibration
  - Establish vibration limits
  - Monitor building impacts
  - Phasing of heavy vibration activities

- Safety and Security
  - Temporary fencing
  - Access controls
  - Traffic flagging and controls

- Construction phasing
  - Focus on completion of short segments to reduce business impacts
  - Coordinate utility relocation and upgrading with local utility providers
  - Off peak construction to reduce traffic impacts
  - Incorporate mitigation obligations in construction contracts

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



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).

Construction Impacts and Mitigation – Findings *Continued*

- Construction staging
  - Evaluate staging areas for impacts in advance
- Supporting business during construction
  - Advisory Committees
  - Project communications
  - Maintain access
  - Provide marketing support and street signage
  - Financial assistance
- Construction in environmentally sensitive areas
  - Design techniques for in-water and wetland work
  - Monitor water and air impacts
  - Construction phasing for in-stream work
  - Fabric filters and erosion control

Staging Area, Interstate 205 MAX Extension, Portland. (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)