Runningway Guidelines User Guide:

A Supplement to the Regional Transitway Guidelines

Metropolitan Council
8/31/2011

This document supplements the Runningway discussion in the Regional Transitway Guidelines by providing additional information for topics discussed in the Guidelines.

1 Introduction

This document supplements the Runningways discussion in the Regional Transitway Guidelines by providing additional information for topics discussed in the Guidelines. The User Guide is organized into five sections:

1. Introduction
2. Light Rail Transit (LRT)
3. Commuter Rail
4. Highway Bus Rapid Transit (BRT)
5. Arterial BRT

Some topics are discussed in more than one section in this document; review the entire User Guide when looking for information on a topic and remember this information only supplements the Regional Transitway Guidelines. For example crossing accommodations, including those for bicycles and pedestrians, are discussed in the Transitway Guidelines and also in sections 2.6, 3.6, 4.5, and 5.5 of this User Guide.

The remainder of this Introduction defines runningways and discusses important aspects of corridor right-of-way.

1.1 Definitions

The following section defines terms applicable to the Runningways Guidelines.

Runningway - The linear component of the transit system that forms the right-of-way reserved for the horizontal and vertical clearance requirements of transitway vehicles and ancillary structures or equipment required to operate LRT or Commuter Rail trains or BRT buses (sometimes called guideway). While the runningway incorporates the space needed to operate transit, it should be differentiated from right-of-way, which incorporates the potentially larger area needed to implement the project. For example, right-of-way would include stations as well as additional property that may need to be acquired to relocate facilities that are adjacent to the runningway and need to be moved, such as sidewalks, driveways, light poles, landscaping, etc.

In general, the runningways for each mode can be characterized as follows, but the specific guidelines for each mode are provided in the Regional Transitway Guidelines:

- LRT: Dedicated right-of-way containing rail trackage designed for LRT vehicles. Twin Cities LRT runningways typically hold two tracks, and typically are not shared with other transportation modes except at at-grade crossings. LRT runningways can be either paved or unpaved (constructed with ballasted track). LRT runningways include ancillary facilities within the runningway right-of-way such as traction power substations.

- Commuter Rail: Dedicated right-of-way containing railroad trackage designed for freight and passenger railroad rolling stock. Commuter Rail runningways can hold one or more tracks, and are frequently jointly used by both Federal Railroad Administration (FRA)-compliant passenger transit and freight rail vehicles. Commuter Rail runningways are constructed with ballasted track except at at-grade crossings.

- Highway BRT: Highway, freeway, or paved bus-shoulder lanes within a limited access or other multi-lane highway designed for posted speeds of 45 miles per hour or higher. Highway BRT runningways can be dedicated to bus transit, shared with other high occupancy vehicles, shared with general traffic turning movements and incident management/emergency use, or incorporated into priced facilities. Highway BRT runningways can be barrier separated or indicated by surface striping, markings, color, and/or signage. Highway BRT runningways can be positioned as median, curb, or “dynamic” shoulder lanes.

- Arterial BRT: Roadway lanes, typically within a minor arterial or collector roadway designed for posted speeds of less than 45 miles per hour, where transit travel-time advantages are provided under congested roadway conditions. Arterial BRT lanes can use time-of-day lane controls to provide dedicated right-of-way for buses. Arterial BRT runningways can be positioned as median or curb lanes, and are typically not barrier separated from general traffic lanes. Arterial BRT can operate in dedicated lanes, shared-use lanes, managed lanes, or in general purpose mixed traffic lanes with operational advantages.

1.2 Assembly and Ownership of Corridor Right-of-Way

1.2.1 Property Acquisition and Remnant Parcel Resale or Reuse

Where it is determined that property should be acquired for a transit runningway, and that such acquisition is feasible and cost-effective, such acquisition should follow all applicable local, state, and federal regulations, including National Environmental Policy Act (NEPA) requirements for environmental clearance before property acquisition.

Where remnant parcels are documented as unneeded, resale procedures should follow local, state and federal regulations and procedures.

1.2.2 Right-of-Way Ownership

Under all four modes, stations are owned by the transit operator. Stations are addressed in the Stations and Support Facilities Guidelines and User Guide.

Light-rail transit: LRT runningways may be constructed within public streets or within private right-of-way. Whether within public or private right-of-way, the Metropolitan Council/Metro Transit is the owner of runningway facilities such as tracks, intersection protection equipment, catenary, etc. The Metropolitan Council, as owner-operator, may bid equipment such as safety equipment out to another operator.

Within public right-of-way, ownership of the right-of-way within which the LRT tracks lie, such as University Avenue or the Southwest LRT Corridor, should be retained by the owning entity.

Within private right-of-way such as a railroad, ownership must be controlled by the Metropolitan Council through a permanent easement or other legal agreement with the right-of-way owner. Where right-of-way must remain under the ownership of a private entity, negotiated operating rights identify the Council’s rights and obligations.

Commuter Rail: Commuter Rail runningways may be constructed within public or private right-of-way. As with all Commuter Rail implementation within a railroad-owned right-of-way, the issue of ownership and maintenance responsibility of infrastructure improvements should be negotiated with the railroad. Generally, improvements within the right-of-way which only benefit the Commuter Rail provider (station platforms, etc.) will be owned by the Commuter Rail provider and maintenance will be the responsibility of the Commuter Rail provider. Improvements within the right-of-way which benefit both parties will be owned and maintained by the railroad. The physical maintenance of infrastructure within the right-of-way (with exception of passenger platforms) will typically be performed by the railroad regardless of who is responsible for the cost of maintaining said infrastructure. As example, the switch the passenger trains use to enter the station tracks at Target Field is owned by the Council but is maintained by the railroad at the Council's expense but other switches installed on the corridor as a result of Northstar that are used by both parties are owned and maintained by the railroad.

Where Commuter Rail operates on railroad-owned trackage and operates via permanent easement or negotiated agreement with the track owner, the railroad remains the owning entity. A permanent easement or negotiated operating rights identify the Council's rights and obligations. Where Commuter Rail operates on separate, non-railroad-owned trackage, the Metropolitan Council is the owner of that trackage. As an example, the Metropolitan Council is the owner of runningway facilities such as the tracks and switches at the Big Lake maintenance facility on the Northstar Line.

Highway BRT: Ownership of the right-of-way within which Highway BRT operates, excluding any BRT facilities such as stations and vehicles, should be retained by the roadway-owning entity, which may be the Minnesota Department of Transportation (Mn/DOT), county, or city. The Metropolitan Council/Metro Transit is the owner of runningway facilities such as intersection protection equipment. The Metropolitan Council, as owner-operator, may bid such equipment out to another operator.

Arterial BRT: Ownership of the right-of-way within which Arterial BRT operates, excluding any BRT facilities such as stations and vehicles should be retained by the roadway-owning entity.

1.2.3 Utility Considerations

Procedures and criteria governing design for the provision, consolidation, relocation, adjustment, protection, or other work related to existing public and private utilities necessary to accommodate transit runningways are given in the *Central Corridor LRT Report for Design Criteria (CCLRT Design Criteria), Northstar Corridor Rail Project Design Criteria (Northstar Design Criteria)* (both available from Metropolitan Council on request), and/or state and local roadway design documents.

In addition, consideration should be given to utilities that share the runningway space. Runningway designers should work with utility owners to locate and design underlying utilities to withstand the impacts of the transit runningway and minimize the need for disruption due to routine or emergency maintenance.

Agreements that will be needed to cover the cost of utility relocation/protection should be identified during the NEPA/preliminary engineering process.

In addition to following available guidance, the transit operating agency should pursue partnerships with local utilities to pursue the following:

- Assess opportunities to reduce the total carbon footprint of the system
- Demonstrate environmental stewardship
- Partner on projects that result in utility investment in alternative technologies that reduce overall system consumption
- Seek opportunities to consume and store energy during off-peak periods
- Optimize public investment in shared infrastructure

2 LIGHT-RAIL TRANSIT

2.1 Fundamental Laws and Underpinning Planning Requirements

A number of national, state, and local regulations, standards and practices presently shape LRT runningway design. These include, but are not limited to, those listed below.

2.1.1 Laws and Regulations

United States Department of Transportation (US DOT) Final Rule, Transportation for Individuals with Disabilities

- Americans with Disabilities Act (ADA)
- Federal Railroad Administration (FRA)/Federal Transit Administration (FTA) Joint Policy on Shared Corridors
- Title VI of the Civil Rights Act of 1964
- National Environmental Policy Act (NEPA)
- Minnesota Environmental Policy Act (MEPA)

2.1.2 National/State Design Standards

- Relevant American Railway Engineering and Maintenance of Way Association (AREMA) standards and recommended practices
- Relevant American Public Transportation Association (APTA) standards and recommended practices
- Relevant American Association of State Highway and Transportation Officials (AASHTO) standards and recommended practices
- Relevant National Fire Protection Association (NFPA) standards and recommended practices
- *Minnesota Manual on Uniform Traffic Control Devices for Streets and Highways* (MnMUTCD)
- *Minnesota Department of Transportation (Mn/DOT) Road Design Manual*
- Minnesota Department of Transportation (Mn/DOT) State Aid guidance

2.1.3 Local Design Guidance

2.1.3.1 CCLRT Design Criteria, July 2008

For most issues, LRT design guidance is provided in the *CCLRT Design Criteria*, July 2008 and as updated (available from Metro Transit on request). That document built on lessons learned from the Hiawatha LRT project. It documents basic design criteria to be used in the design of the Central Corridor LRT system, and forms the basis for subsequent LRT corridor design in the Twin Cities. Where LRT operates in a public street or shares right-of-way with buses, the design requirements and concepts of Mn/DOT, AASHTO, county and local municipalities should also be utilized.

The *CCLRT Design Criteria* directs optimizing LRT design including considerations for elements such as:

- Cost for design, construction, capital facilities
- Operating expense
- Energy consumption
- Minimizing disruption to local facilities and communities
- Meeting aesthetics, community, and local agency standards.

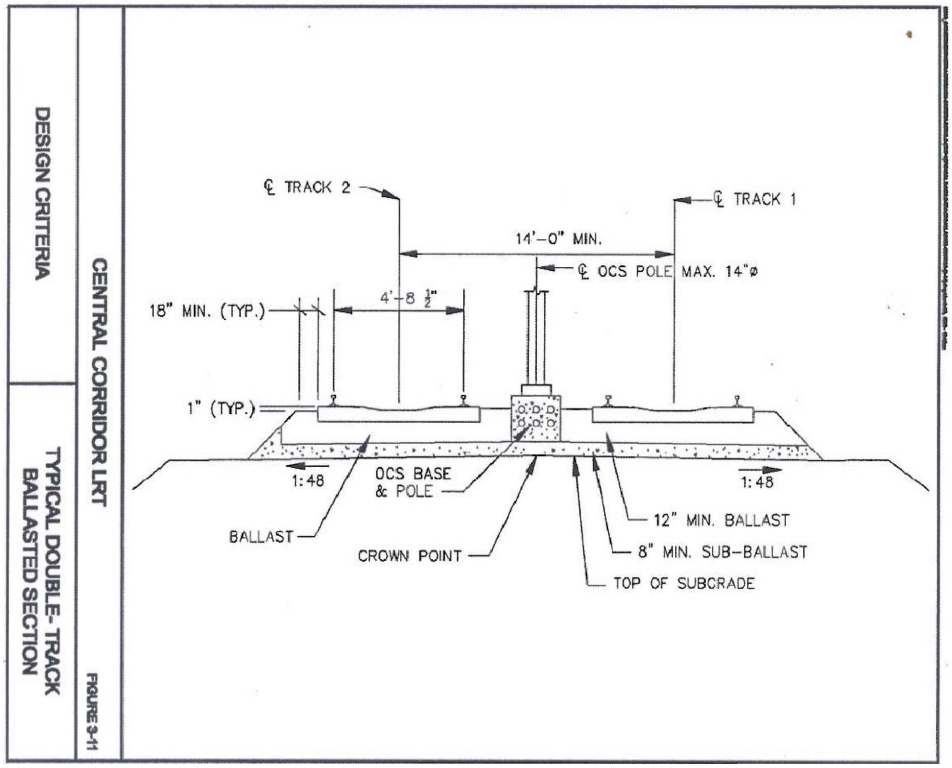
The CCLRT report also directs that design be consistent with passenger safety, system reliability, service comfort, mode of operation, type of light-rail vehicle to be used, and maintenance considerations.

Vehicle clearance envelopes that dictate horizontal and vertical requirements for LRT runningways are provided in the appendices of the Report. Figure 2-1 illustrates a typical Twin Cities LRT cross section (source: *CCLRT Design Criteria:* Fig 3-11 - Typical Double-Track Ballasted Section*)*. Clearance requirements are dependent on several factors, including vehicle requirements, curvature, grade, and other factors.

Modifications may be made due to local conditions subject to FTA and local jurisdiction approval. Twin Cities alternates to the APTA or AREMA standards should be based on a safe operating history, described and documented in the system’s safety program plan (or another document that is referenced in the system safety program plan). Documentation of alternate practices should:

- Identify the specific rail transit safety standard requirements that cannot be met
- State why each of these requirements cannot be met
- Describe the alternate methods used
- Describe and substantiate how the alternate methods do not compromise safety and provide a level of safety equivalent to the practices in the APTA safety standard

Figure 2-1 - Typical Cross Section for LRT Runningway



2.1.3.2 Guidance from Local Jurisdictions

Local jurisdictions may also have design guidance and/or local policies relevant to integrating municipal facilities when transit runningways traverse or cross city streets, sidewalks and bikeways. Current municipal guidance includes:

- *St. Paul Central Corridor Bicycle and Pedestrian Plan* (http://stpaul.gov/index.asp)
- *Access Minneapolis*, Street and Sidewalk Design Guidelines (http://www.ci.minneapolis.mn.us/publicworks/trans-plan/DesignGuidelines.asp)
- *Minneapolis Downtown Action Plan*
- *Minneapolis Pedestrian Master Plan*
- *Minneapolis Bicycle Master Plan* and *Bicycle Design Guidelines*

The section on transit facilities in the *Access Minneapolis*, Design Guidelines for Streets and Sidewalks, Pedestrian Facility Design, October 26, 2009 provides s a good example of local guidance.

2.2 Physical Characteristics of LRT Runningways

2.2.1 Number/Direction of Tracks

LRT runningways should be designed to provide a double-track, system that provides for trains running in both directions through the length of the corridor. The two tracks may be adjacent to each other, or may be separated by other traffic lanes within the same roadway. For traffic operations and rail maintenance, it is preferred to have tracks directly adjacent to and not separated by roadway lanes.

Where short-term train storage is desirable and space is available at stations, pocket track segments should be constructed. These tracks should be connected to the running tracks via crossovers. Multiple tracks at operating and maintenance facilities should also be provided to facilitate expeditious access to, through and from maintenance facilities, yards and shops.

2.2.2 Runningway Width

LRT runningway widths should be sufficient to accommodate required horizontal clearance for trackage and ancillary facilities. Horizontal clearance requirements are described in the *CCLRT Design Criteria*.

2.2.3 Pavement Type

The *CCLRT Design Criteria* addresses the three distinct types of track construction: ballasted, embedded, and direct fixation, and conditions indicating where each type is appropriate. Ballasted track, while requiring an additional average of two feet of right-of-way width, is significantly less costly than the other options, and therefore the preferred pavement type, with the following exceptions.

Where LRT is constructed within an existing roadway, such as Central Corridor LRT in University Avenue or downtown streets, embedded track is preferred. Factors to consider include community context (e.g., land uses, density, and proximity to runningway), left-turn driveway access, available right-of-way, and potential hazards of loose rock in the roadway.

- Where LRT intersects or adjoins paved streets, sidewalks and bikeways, such as Hiawatha LRT intersections with 46th and other streets in south Minneapolis, embedded track is required.
- For tunnels and bridges such as the Hiawatha Lake Street and Crosstown Highway LRT bridges, direct fixation track is preferred.

Grass or other vegetation is not an acceptable runningway paving treatment.

Where a bikeway or recreational trail is parallel to the transit runningway, ballasted track should be maintained to provide clear delineation between the runningway and the trail.

Where a paved bikeway, pedestrian sidewalk, or recreational trail is parallel to a transit runningway with paved track, that facility should be clearly separated and so marked from the runningway.

2.2.4 Pavement Depth

Where LRT runningways contain paved track, pavement depth for embedded or direct fixation track is described in the *CCLRT Design Criteria*.

2.2.5 At Grade/Grade Separated

LRT runningways should be at grade to minimize cost. Grade separation will be considered where dictated by transitway and adjacent systems operating conditions, topographic conditions, or crossing major facilities such as freeways or bodies of water.

Where grade separations are required, clearance requirements and all design considerations are as described in the *CCLRT Design Criteria*. Where LRT runningways are proposed on pre-existing structures not owned by the Metropolitan Council or Metro Transit, such structures should be evaluated or modified to accept intended loads. Any evaluation or modification is subject to review and approval by the owning entity.

2.2.6 Runningway Placement/Direction relative to Other Transportation Rights-of-Way

Design criteria for rail clearances are complex and based on numerous assumptions and interfaces. LRT runningway designers should consult the *CCLRT Design Criteria* for specific standards relative to the placement of LRT runningways, which are generalized below.

Roads - LRT runningways may be adjacent to, within medians of, or separated from roadway lanes. Median lane implementation is preferred because of traffic operational challenges associated with side running LRT – a significant lesson learned from early Hiawatha LRT operation.

Runningways should be positioned to minimize conflict with traffic flow and property access. LRT in runningways adjacent to traffic lanes may run in the same direction as traffic (concurrent flow), or in the opposite direction (contra-flow). As an example, LRT on 5th Street in downtown Minneapolis operates in both directions on a one-way street. Fifth Street is one-way northbound, and Hiawatha LRT trains run both with traffic flow when northbound, and contra-flow when southbound.

Where roadways and/or property access driveways operate adjacent to LRT runningways, LRT runningways should be separated from those facilities as specified in the *CCLRT Design Criteria* addressing clearances, and the type, size, and location of fencing or barriers following AASHTO, Mn/DOT, and/or local agency guidelines.

Rail – LRT runningways may be within or adjacent to railroad right-of-way. When within a freight railroad runningway, the private railroad will stipulate required clearance and barrier type. Typically 25- to 50-foot minimum from center line of both freight and LRT trackage is required *(*source: BNSF Railway – Union Pacific Railroad Guidelines for Railroad Grade Separation Projects, and Resor, Catalog of “Common Use” Rail Corridors, sponsored by US DOT, FRA*).* A crash barrier or fence may also be required.

Adjacent to freight railroad right-of-way, recommended minimum LRT clearance is 15-feet from center line of closest LRT track to the edge of the railroad right-of-way. The 15’ allows for a safety walkway between the track and the fence. If a full ballast section with a drainage ditch is used, 25’ is needed. *(*source: CH2M Hill rail engineering staff*).* A fence would be located on the right-of-way line.

Pedestrian/Bicycle Path – For pedestrian and bicycle paths adjacent to LRT runningway, 15-feet from center line of outside track to edge of pedestrian/bike right-of-way is recommended. Fencing is preferred.

2.2.7 Interlock/Crossover/Special Requirements/Reverse Direction Running

Railway signaling application within runningways should be as specified in the *CCLRT Design Criteria*, to enhance safety in the movement of trains and to improve the overall efficiency of train operations.

2.2.8 Time-of-Day Runningway Controls

Twin Cities LRT runningways should be developed for the dedicated use of LRT. Time-of-day runningway controls, also called temporal separation, to permit other vehicles within the runningway should be permitted only in exceptional circumstances. Where LRT is proposed to operate with temporal separation on track shared with railroads under the jurisdiction of FRA, FRA has jurisdiction and must approve along with FTA, affected jurisdictions, and the transit operator.

2.2.9 Traffic Signal Type and Interaction

Traffic signal interaction should be coordinated during the design phase with the jurisdictional authority, to give transit every feasible travel advantage while maintaining reasonable traffic operations. Examples of traffic strategies to be considered include signal priority, which provides the most flexibility to manage all modes of transportation.

Roadway traffic signals at locations that interface with LRT runningways should have backup power in coordination with the entity having jurisdiction over the specific traffic control system.

2.2.10 Backup Power for Corridor Runningway Systems

Runningway designers should address the spacing of substations, as backup runningway traction power is to be provided by adjacent substations. Redundancy should be limited to the backup power each substation provides to the substation on both sides.

Backup power separate from substations should be extended to train control, safety, and security systems.

Backup power for tunnel lighting should be from a separate source so that loss of power from one source does not remove power from tunnel lighting.

Backup power for station elements is addressed separately in the Station and Facility guidelines.

In coordination with the jurisdiction with authority over an adjacent or intersecting roadway's traffic control system, a backup power supply for traffic control should be provided, with the capacity to operate the warning system for a reasonable length of time during a period of primary power interruption.

2.2.11 Lighting

Runningway lighting should be provided to ensure safe operation and personal security and should be consistent with ADA and AASHTO requirements. Selection and design of fixtures and levels should be reflective of context, and comply with the goals, objectives, and provisions of the *CCLRT Design Criteria.* While the Central Corridor LRT traverses a fully urbanized area, the goals and objectives established in that document are appropriate to runningway corridor lighting throughout the Twin Cities region. Coordination with the local jurisdiction and adjacent property owners where LRT runningways intersect with residential and commercial land uses should be pursued to develop appropriate levels, heights, and shielding techniques.

2.2.12 Barrier Types

Current LRT design standards stipulate discouraging or prohibiting guideway crossings other than at marked, controlled crossings. Lane striping, pavement color, pavement texture, and/or barriers may be appropriate to guide, discourage, or prevent access to runningways in areas not designated as a legal crossing. Techniques include "z- crossings", mountable curbs separating LRT from street traffic lanes, bollards and other concrete barriers, and fencing.

Access to LRT runningways should be as appropriate to provide security and/or enhance safety, as specified in the *CCLRT Design Criteria*. Type, size, and location of fencing or barriers should be determined by site-specific conditions and requirements, following AASHTO, Mn/DOT, AREMA and/or local agency guidelines.

2.2.13 Landscaping

Runningway landscaping should be coordinated with the local jurisdiction to comply with its requirements as well as with the goals, objectives, and provisions of the *CCLRT Design Criteria*. While the Central Corridor traverses a fully urbanized area, the goals and objectives established in that document are appropriate to runningway corridor landscaping throughout the Twin Cities region.

Any landscaping, including noise walls, should be designed and provided to maintain sight lines for all transportation modes at at-grade crossings.

2.2.14 Signage

Signs and graphics should comply with the goals, objectives and provisions of the *CCLRT Design Criteria* and local jurisdictional requirements. Wayfinding signage is addressed in the Stations and Support Facilities chapter.

2.2.15 Noise/Vibration Considerations

The potential for noise and vibration during construction and operation should be considered both during the planning of alignments and when identifying technology, components and materials. Where mitigation measures are determined to be necessary, technology, components, and materials should be considered as potential strategies.

2.3 Addressing Operations of LRT Runningways in Design

Elements of LRT operation which should be addressed during design are noted below.

2.3.1 Communications and Central Control

Infrastructure for communications to facilitate control and monitoring of train traffic, infrastructure conditions and facilities should be incorporated into runningway design, consistent with the facilities and provisions of the *CCLRT Design Criteria*.

2.3.2 System Compatibility

LRT runningways should be designed to be compatible with all existing and planned Twin Cities LRT corridor services. In the event that additional types of rolling stock should be added to the Twin Cities light-rail vehicle (LRV) fleet, the horizontal and vertical clearance requirements of those vehicles should be accommodated within the runningways where such vehicles are planned to operate.

2.3.3 Contingency Planning

Runningway design should consider operational breakdown situations, which may include power outages, storm damage, stalled vehicles within the runningway, crashes, and other unforeseen circumstances. While a contingency plan would be a system operating element, runningway designers should be cognizant of potential needs for access to accommodate:

- Bus boarding and alighting access points of sufficient size to accomplish bus bridges
- Emergency service by first responders.

2.4 Addressing Maintenance of LRT Runningways in Design

Elements of LRT maintenance which should be addressed during design are noted below.

2.4.1 Impact on Design Features

Consistent with best industry practices and the *CCLRT Design Criteria*, LRT runningway infrastructure should be designed and constructed of materials which optimize efficient and cost-effective maintenance of the runningway and the life of the facility.

Capital costs must be based on life-cycle costs, which reflect the true cost over time of design elements. Life-cycle costing also follows recommended practices such as those recommended by APTA's Transit Sustainability Practice Compendium.

2.4.2 Snow Removal

Runningway design should reflect Twin Cities' winter operational procedures, and accommodate the equipment necessary to allow the LRT service to operate as planned during snow events. The transit operating agency should seek to efficiently coordinate snow removal provisions with affected jurisdictions responsible for snow removal from adjacent roadway, bicycle, and pedestrian facilities.

2.4.3 Repairs and Refurbishments/Upkeep

Consistent with best industry practices and Twin Cities operations, runningway design should stipulate cost-effective materials and facilitate cost-effective methods of repair and refurbishment. Runningway design should consider access and space needs for the safe inspection and maintenance of runningways.

2.4.4 Operating/Maintenance Responsibility

Responsibility for the operation and maintenance of LRT runningways should rest with the LRT operating entity (Metropolitan Council/Metro Transit). Wherever possible, the use of existing infrastructure and facilities should be maximized when choosing transit alignments. Maintenance of infrastructure under the jurisdiction of others, such as street/bicycle/pedestrian crossings, should be coordinated with the appropriate jurisdiction.

2.5 Addressing Safety and Security of LRT Runningways in Design

The Twin Cities LRT operator should prepare, implement, and annually update a safety and security plan. The Fire/Life Safety provisions in the *CCLRT Design Criteria* should be followed.

2.5.1 Design Review for Safety and Security

An evaluation of each LRT runningway type should be made using a documented methodology such as that recommended by APTA. Examples of specific design-related elements of runningways to be evaluated include:

- Improved sight distance
- Raised median or divider
- Signage

- Pavement markings
- Curbs
- Roadway surface
- Highway realignment
- Improved cross-section
- Illumination of the crossing
- Crossing surfaces
- Pedestrian and bicyclist access and crossings

2.5.2 Hazard, Threat and Vulnerability Analyses

Early in the design phase, the transit operating agency should conduct a detailed risk assessment to pinpoint the possibility of hazards and potential areas of vulnerability within the runningway. The methodology should identify potential hazards related to persons (employees, passengers, pedestrians, and members of the general public), trains, equipment, highway vehicles, and other property that may exist within each runningway. During the Final Environmental Impact Statement (FEIS)/Preliminary Engineering (PE) phase, the FTA will require this Preliminary Hazard Analysis and a Threat and Vulnerability Analysis. These assessments are early elements which receive continuous attention as components of the Safety and Security Certification Plan, which falls under the Safety and Security Management Plan, which falls under the Project Management Plan as project development proceeds.

A detailed risk assessment assigns a level of risk (frequent, probable, occasional, remote, and improbable) and a level of hazard (negligible, marginal, critical, or catastrophic) to each identified hazard. Each of the risks identified should then be assessed to determine the potential for damage to property, personnel, and operations. Based on the level of risk and the estimated probability of the identified hazard occurring, priorities should be set to mitigate hazards. Recommendations to eliminate or control hazards should be identified and documented.

Runningways on airport property will require early and continuing coordination with the Metropolitan Airports Commission (MAC), Federal Aviation Administration (FAA), and Transportation Security Administration (TSA).

2.5.3 Intersecting Modal Safety and Security

Runningway design should incorporate measures to assure the safe operation of the transitway and intersecting modes.

2.5.4 Agency Coordination

Agency coordination should be established and maintained via a documented plan developed with the concurrence of all agencies with jurisdiction over facilities within or adjacent to which LRT runningways are developed. It is recommended that the transit operating agency establish a peer relationship with one or more other agencies in the United States which operate a similar modern lowfloor LRT system. Periodic communication with such peer agencies to compare system experience may assist the Twin Cities in addressing common issues.

2.5.5 Emergency Preparedness

Access to LRT runningways in an emergency should be a component of overall runningway design.

2.5.6 Intrusion Detection in Sensitive Areas

Runningway design should address the need for an intrusion detection system in sensitive areas along the runningway, for example, where tunnels and bridges are present, or freight rail tracks are adjacent. If the presence of snow or any substance is known to prevent effective detection of vehicle intrusion into the LRT runningway at at-grade intersections or along adjacent facilities, the transit operating agency should take appropriate action to safeguard transit users, roadway users, bicyclists, and pedestrians.

2.6 Providing for Intersecting Modes

2.6.1 Street Intersections

LRT runningways may intersect roadways and/or streets. Designers should provide safety precautions to professionally respond to the safe operation of the intersection. Intersection control may be either active or passive, depending on factors such location context, traffic volume, and sight lines specific to each location. Examples of active intersection control mechanisms include automatic gates, flashing lights, bells, and changeable message signs such as Central Corridor LRT’s blank out signs. When a train is approaching, the black blank out signs will flash a train image. Examples of passive intersection control mechanisms include stop signs, “z-type” pedestrian crossings such as used on University Avenue for Central Corridor LRT unsignalized pedestrian crossings, and signage that is static.

2.6.2 Rail Intersections

In addition to the equipment noted for autos and trucks, AREMA standards should be implemented for crossings with active railroad lines. These crossings fall under FRA jurisdiction.

2.6.3 Bicycle Intersections

Bicyclists should always be considered in the design of rail crossings. Intersecting track should be paved and safe crossing clearance and signal timing for bicycle crossings of runningways should be provided. Crossings should be considered during the design phase at trail or bike lane crossings as well as general roadway crossings. Fencing or other protective barriers should be considered based on local conditions.

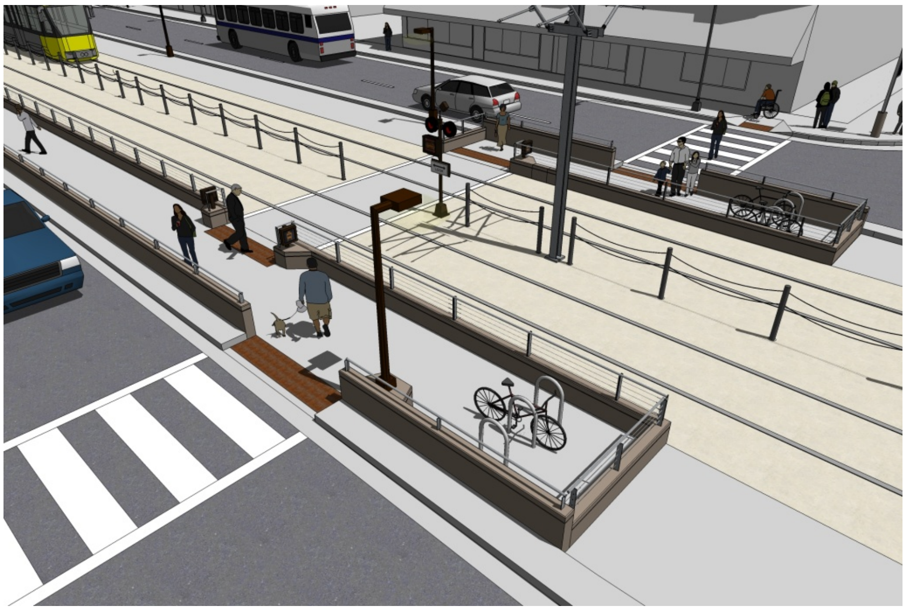
2.6.4 Pedestrian Intersections and Crosswalk Spacing

An analysis should be conducted to address the location, frequency and volume of pedestrian crossings, including wheelchairs, at intersections and recreational trails adjacent to rail runningways. Intersecting track should be paved. ADA provisions establish the minimum requirements for safe crossings, sidewalk dimensions and features, and Mn/MUTCD establishes the minimum requirements for intersection clearance and signal timing for pedestrians. Because transitways are planned and designed to encourage access by customers walking or traveling by bicycle, the established minimum standards may not be appropriate. Transitway planners and designers should assess bicycle and pedestrian needs at all runningway crossings and evaluate whether minimum standards or additional accommodations are appropriate. If additional accommodations are more appropriate, planners and designers should refer to other guidance including, but not limited to, the *Federal Highway Administration's (FHWA) Design*

Guidance Accommodating Bicycle and Pedestrian Travel: A Recommended Approach (http://www.fhwa.dot.gov/environment/bikeped/design.htm).

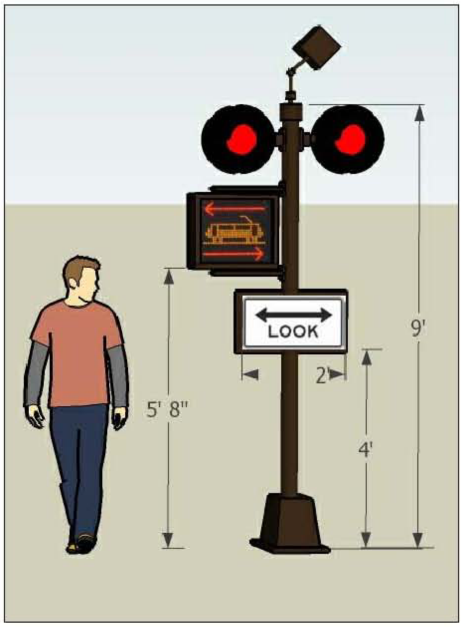
Crosswalks should be located and spaced at stations as directed by the *CCLRT Design Criteria*. Crosswalks between stations should be located at signalized intersections whenever possible. At unsignalized intersections in high-volume pedestrian areas such as downtowns or commercial nodes along University Avenue, crosswalks should be equipped with passive intersection control such as "z-type" directional crossing paths, pavement markings, pedestrian refuge medians, and active train warning signage. Figure 2-2 illustrates a "z-type" pedestrian crossing at an unsignalized intersection on University Avenue. Figure 2-3 illustrates the active warning devices included at these "z-type" crossings.

Figure 2-2 "Z-type" Pedestrian Crossing at Unsignalized Intersection

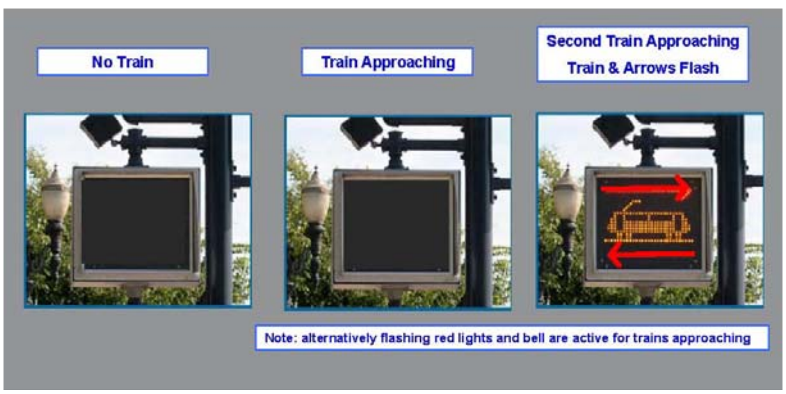


Source: CCLRT Project Office

Figure 2-3 Active Train Warning Devices at "Z-type" Pedestrian Crossings



ACTIVE WARNING DEVICE



Central Corridor Light Rail Transit – At-Grade Pedestrian Crossing Active Warning Signs

AECOM

Train Warning Sign with Second Train Warning

Mid-block crossings between stations and between street intersections should be avoided. Where stations have two exit points, and only one is at a signalized intersection, the other exit point should be equipped with control such as noted above.

Resources such as *Minneapolis Design Guidelines for Streets and Sidewalks* and *St. Paul Central Corridor Bicycle and Pedestrian Plan* provide helpful guidance.

Fencing or other protective barriers should be considered based on local conditions.

3 COMMUTER RAIL

3.1 Fundamental Laws and Underpinning Planning Requirements

All Twin Cities Commuter Rail runningway guidelines should comply with appropriate federal, state, and local regulations. In right-of-way owned by a private railroad, or where other railroad trackage rights affect the design of runningways, Commuter Rail runningways should be designed consistent with railroad requirements.

Where acceptable to the owning railroad, Twin Cities Commuter Rail corridors should follow the *Northstar Corridor Rail Project Design Criteria (Northstar Design Criteria),* September 2006, which is available from Metro Transit on request.

Additional Commuter Rail runningway, or guideway design, resources include:

3.1.1 Laws and Regulations

- United States Department of Transportation (US DOT) Final Rule, Transportation for Individuals with Disabilities
- Americans with Disabilities Act (ADA)
- U.S.C. Title 49, Section 20152- Swift Rail Development Act 1994 Key Regulatory/Legal References Federal Railroad Administration (FRA) (49 CFR 200-299)
- FRA/FTA Joint Policy on Shared Corridors
- Title VI of the Civil Rights Act of 1964
- National Environmental Policy Act (NEPA)
- Minnesota Environmental Policy Act (MEPA)
- Minnesota Statutes 219.46 governing rail clearances

Commuter Rail lines will need to comply with Congressionally-mandated laws concerning Positive Train Control (PTC) by December 2015. Public Law PL 110-432, signed by President October 16, 2008. FRA final rule issued January 12, 2010.

3.1.2 National/State Design Standards

- Relevant American Railway Engineering and Maintenance of Way Association (AREMA) standards and recommended practices, including
- Manual for Railway Engineering and Portfolio of Trackwork Plans
- AREMA Recommended Practices for Highway Rail Grade Crossings
- Relevant American Public Transportation Association (APTA) standards and recommended practices

- Relevant American Association of State Highway and Transportation Officials (AASHTO) standards and recommended practices
- Relevant National Fire Protection Association (NFPA) standards and recommended practices
- Minnesota Manual on Uniform Traffic Control Devices for Streets and Highways (MnMUTCD)
- Mn/DOT Road Design Manual
- Mn/DOT State Aid Manual

3.1.3 Local Design Guidance

3.1.3.1 Northstar Corridor Rail Project Design Criteria, September 2006

For most issues, Commuter Rail design guidance for facilities related solely to Commuter Rail operation is provided in the *Northstar Design Criteria*, September 2008, (available from Metro Transit on request). Design within facilities owned by a private railroad follow AREMA standards and must be coordinated with the owner.

Modifications to AREMA standards due to local conditions may be made with FRA approval. Modifications should be based on a safe operating history, described and documented in the system's safety program plan (or another document that is referenced in the system safety program plan). Documentation of alternate practices should:

- Identify the specific rail transit safety standard requirements that cannot be met
- State why each of these requirements cannot be met
- Describe the alternate methods used
- Describe and substantiate how the alternate methods do not compromise safety and provide a level of safety equivalent to the practices in the APTA safety standard

3.1.3.2 Guidance from Local Jurisdictions

Local jurisdictions may also have design guidance and/or local policies relevant to integrating municipal facilities when transit runningways traverse or cross city streets, sidewalks and bikeways. Current municipal guidance includes:

- *St. Paul Central Corridor Bicycle and Pedestrian Plan* (http://stpaul.gov/index.asp)
- *Access Minneapolis*, Street and Sidewalk Design Guidelines (http://www.ci.minneapolis.mn.us/publicworks/trans-plan/DesignGuidelines.asp)
- *Minneapolis Downtown Action Plan*
- *Minneapolis Pedestrian Master Plan*
- *Minneapolis Bike master Plan and Bicycle Design Guidelines*

The section on transit facilities in the *Access Minneapolis*, Design Guidelines for Streets and Sidewalks, Pedestrian Facility Design, October 26, 2009 provides s a good example of local guidance.

3.2 Physical Characteristics of Commuter Rail Runningways

3.2.1 Number/Direction of Tracks

Commuter Rail runningways should generally be designed as double-track facilities to provide bi-directional service. Where a low level of activity exists, single-track operation may be feasible and should be substituted, with passing sidings as appropriate.

3.2.2 Runningway Width

Commuter Rail runningway widths should be consistent with legal requirements, owning railroad requirements (where applicable), and AREMA and FRA standards.

3.2.3 Pavement Type

Consistent with standards established for the Northstar Line, Commuter Rail runningways are on ballasted track except at-grade crossings, where track may be either embedded or direct fixation. Street reconstruction in a public street or intersection to accommodate Commuter Rail tracks should be accomplished in coordination with the agency with jurisdiction over the roadway and owning railroad.

3.2.4 Pavement Depth

Where Commuter Rail runningways contain paved track, pavement depth should be consistent with the *Northstar Design Criteria*.

3.2.5 At Grade/Grade Separated

Commuter Rail runningways will be at-grade to minimize cost, using existing railroad grade separations. Additional grade separations will be considered where dictated by safe operating conditions and in coordination with the host railroad following a complete assessment of potential benefits and costs. Costs for additional grade separations benefitting the broader transportation system should be shared among benefitting organizations, including any transit authority.

Grade separations are limited to major barriers by cost and physical constraints. Major barriers include other railroads, water bodies, freeways, and principal arterials.

Where structures or tunnels are required, clearance requirements and all design considerations should be consistent with Northstar Corridor design criteria.

Where Commuter Rail runningways are proposed on pre-existing structures not owned by the Metropolitan Council or Metro Transit, such structures should be evaluated or modified to accept intended loads. Any evaluation or modification is subject to review and approval by the owning entity.

Opportunities for future grade separations should be considered as congestion on both intersecting facilities and the Commuter Rail runningway builds. Right-of-way preservation should be considered when projected Commuter Rail headways and/or train consists modeled during the design phase indicate grade separation may be needed by the end of the projection period (eg. 2030).

3.2.6 Runningway Placement/Direction Relative to Other Transportation Rights of Way

Clearances are governed by Minnesota Statutes 219.46 and reflected in AREMA standards. For Minnesota, minimum clearances for tangent track vary from 14- to 19-feet, center line to center line of track. (source: *AREMA Manual for Railway Engineering, Methods and Procedures*, Table 28-3-3, Legal Clearance Requirements by State.) Increased clearances are required for non-tangent track. Guidelines cited below are for general guidance and should be confirmed based on project-specific conditions.

Rail – Commuter Rail runningways may include LRT tracks within the railroad right-of-way, or have LRT tracks adjacent to the railroad right-of-way. When within Commuter Rail runningway, the private railroad will stipulate the clearance and barrier type requirements to separate the two types of facilities. Typically 25- to50-foot minimum from center line of both freight and LRT trackage is required. A crash barrier between the two types of service is also usually required. (source: *BNSF Railway – Union Pacific Railroad Guidelines for Railroad Grade Separation Projects*, and *Resor , Catalog of "Common Use" Rail Corridors*, sponsored by US DOT, FRA).

When the Commuter Rail runningway is adjacent to LRT right-of-way, recommended minimum clearance required is 15-feet from center line of outside freight rail track to near edge of LRT right-of-way. The 15 feet allows for a safety walkway between the track and the fence. If a full ballast section with a drainage ditch is used, 25 feet is needed. (source: CH2M Hill rail engineering staff). A fence would be located on the right-of-way line.

Pedestrian/Bicycle Path – For pedestrian and bicycle paths adjacent to Commuter Rail runningway, minimum 15 to 25 feet from center line of outside track to edge of pedestrian/bike right-of-way is recommended. Fencing is preferred.

3.2.7 Interlock/Crossover/Special Requirements

Design considerations should be consistent with the *Northstar Design Criteria*.

3.2.8 Time-of-Day Runningway Controls

Time-of-day, or temporal, separation will depend on both freight and Commuter Rail service frequencies and speeds. When temporal separation is a planned operating strategy, design considerations should be coordinated with the operating freight railroad and should be consistent with the *Northstar Design Criteria*.

3.2.9 Traffic Signal Type and Interaction

Railroad signaling should be as prescribed by FRA and AREMA standards.

3.2.10 Backup Power for Corridor Runningway Systems

Commuter Rail runningways do not include power outside of stations, as power is in the locomotive powering the train, consistent with the *Northstar Design Criteria*.

3.2.11 Lighting

Design considerations should be consistent with the *Northstar Design Criteria*.

3.2.12 Barrier Types/Setbacks: Physical, Roadway Striping, Fencing

Design considerations should be consistent with the *Northstar Design Criteria*, and as noted in Section 3.2.6 above.

3.2.13 Landscaping
Design considerations should be consistent with the *Northstar Design Criteria*.

3.2.14 Signage
Design considerations should be consistent with the *Northstar Design Criteria*.

3.2.15 Noise/Vibration Considerations
Because Commuter Rail operates in a freight railroad environment, the potential for noise and vibration is anticipated to be minimal. Where mitigation measures are determined to be necessary, technology, components, and materials should be considered as potential strategies.

3.3 Addressing Operation of Commuter Rail Runningways in Design

3.3.1 Communications and Central Control
As *Northstar Design Criteria* is silent on this element, design considerations should be consistent with *CCLRT Design Criteria* guidance.

3.3.2 System Compatibility
Design considerations should be consistent with *Northstar Design Criteria* guidance.

3.3.3 Contingency Planning
Runningway design should consider operational breakdown situations, which may include power outages, storm damage, stalled vehicles within the runningway, crashes, and other unforeseen circumstances. While a contingency plan would be a system operating element, runningway designers should be cognizant of potential needs for access to accommodate:

- Bus boarding and alighting access points of sufficient size to accomplish bus bridges
- Emergency service by first responders

3.4 Addressing Maintenance of Commuter Rail Runningways in Design

3.4.1 Impact on Design Features
Design considerations should include selecting materials for impact resistance, wear, strength, weathering qualities, and standardized to facilitate repair or replacement, consistent with *Northstar Design Criteria* guidance.

3.4.2 Snow Removal
Arrangements for snow removal are not typically necessary within Commuter Rail runningways due to track and vehicle design and because, on the rare occasion when it is necessary, it is a responsibility of the owning railroad (which is typically an organization other than the transit authority). Snow removal at stations is addressed in the Stations and Support Facilities chapter.

3.4.3 Repairs and Refurbishments/Upkeep
Responsibility for track improvements, repairs and refurbishments within runningways should be negotiated and documented in an agreement with the right-of-way owner, typically a freight railroad. Responsibility for repairs within publicly-owned Commuter Rail runningways should also be

documented in a negotiated agreement between the owning agency and the transit operator, if different parties.

3.4.4 Interagency Agreements/Protocols

Commuter Rail operations within private right-of-way are to be coordinated, negotiated, and agreements documented with the host railroad or other right-of-way owner. Agreements are to document responsibility for maintenance of Commuter Rail runningways. Agreements are to stipulate that inspection and maintenance of runningways should not interfere with the normal functioning of the rail service, either passenger or freight, unless alternate safety measures approved by FRA, the owning railroad, and the lead agency have been implemented.

3.5 Addressing Safety and Security of Commuter Rail Runningways in Design

3.5.1 Design Review for Safety and Security

The FRA will require a collision hazard analysis. Such analysis becomes part of the overall project management plan as the project progresses through the design process.

For non-FTA- funded projects, early in the design process, a safety evaluation should be made using a documented methodology such as that recommended by Operation Lifesaver. Operation Lifesaver is a non-profit, international continuing public education program first established in 1972 to end collisions, deaths and injuries at places where roadways cross train tracks, and on railroad rights-of-way. Operation Lifesaver programs are sponsored cooperatively by federal, state, and local government agencies; highway safety organizations, and the nation’s railroads.

The methodology should identify potential hazards related to persons (employees, passengers, pedestrians, and members of the general public), trains, equipment, highway vehicles, and other property. Recommendations affecting the design of runningways to eliminate or control hazards should be identified and documented.

3.5.2 Agency Coordination

Agency coordination should be established and maintained via a documented plan developed with the concurrence of all agencies with jurisdiction over facilities within or adjacent to which Commuter Rail operates. Coordinating entities are expected to include the host railroad, Mn/DOT, county and municipal authorities, the State Police, local police, and fire departments.

3.5.3 Emergency Preparedness

Runningway design should provide for access for emergency vehicles, and emergency access should be a component of an overall safety plan. All aspects of the system safety plan should be coordinated with emergency service providers including law enforcement, fire and life safety equipment, and other first responders.

3.5.4 Intrusion Detection in Sensitive Areas

Runningway design should address the need for an intrusion detection system in sensitive areas along the runningway, for example, where tunnels and bridges are present, or LRT tracks are adjacent. If the presence of any substance is known to prevent effective detection of vehicle intrusion into the Commuter Rail runningway at at-grade intersections or along adjacent facilities, the transit operating agency should coordinate with the owning railroad to take appropriate action to safeguard transit users, roadway users, bicyclists, and pedestrians.

3.6 Providing for Intersecting Modes

3.6.1 Street Intersections

AREMA standards should be implemented for all at-grade crossings. Commuter Rail runningway grade crossings should incorporate the following:

- Grade crossing warning system, which may include gate arms, warning bells, flashing lights, and other stationary audible warning devices
- Roadway traffic signal pre-emption interconnections (if applicable)
- Vehicle intrusion detection systems

A backup power supply should be provided, with the capacity to operate the warning system for a reasonable length of time during a period of primary power interruption.

Modifications to AREMA standards may be made due to local conditions, subject to FRA, FTA, railroad, and local jurisdiction approval.

3.6.2 Rail Intersections

AREMA standards should be implemented for crossings with active railroad lines.

3.6.3 Bicycle Intersections

Safe crossing clearance and signal timing for bicycle crossings of Commuter Rail runningways should be provided.

3.6.4 Pedestrian Intersections

Safe crossing clearance and signal timing for pedestrian crossings of Commuter Rail runningways should be provided . ADA provisions establish the minimum requirements for safe crossings, sidewalk dimensions and features, and MnMUTCD establishes the minimum requirements for intersection clearance and signal timing for pedestrians. Designers need to consider the multiple uses to be accommodated within sidewalk zones when designing pedestrian interacting points with transit runningways. Because transitways are planned and designed to encourage access by customers walking or traveling by bicycle, the established minimum standards may not be appropriate. Transitway planners and designers should assess bicycle and pedestrian needs at all runningway crossings and evaluate whether minimum standards or additional accommodations are appropriate. If additional accommodations are more appropriate, planners and designers should refer to other guidance including, but not limited to, the FHWA’s Design Guidance Accommodating Bicycle and Pedestrian Travel: A Recommended Approach" (http://www.fhwa.dot.gov/environment/bikeped/design.htm)."Design considerations should be consistent with the *Northstar Design Criteria*.

4 HIGHWAY BRT

This section discusses runningways for BRT located within freeway and other multi-lane highway corridors designed for posted speeds equal to or greater than 45 miles per hour, consistent with the *Mn/DOT Road Design Manual* definition of highways. This includes runningways supporting Highway BRT station-to-station and express services.

The Twin Cities roadway network is subdivided into principal and minor arterials, and collector and local streets. Categories are based on the amount of local access provided, the lengths of trips accommodated, and the traffic volumes carried. Highway BRT runningways are typically located on principal and minor arterial roadways.

4.1 Types of Highway BRT Runningways

Highway BRT runningways provide transit with a travel-time advantage under congested roadway conditions and include:

- Managed lane: BRT within a managed lane such as a high occupancy vehicle (HOV), high occupancy toll (HOT) lane, or priced dynamic shoulder lane (PDSL).
- Bus shoulder lane: BRT along a designated bus-shoulder, where the shoulder is the regular runningway for the bus regardless of adjacent traffic conditions. Buses are the exclusive users of the roadway shoulder except for general traffic turning movements and incident management or emergency shoulder use. Current legislation limits speeds in bus-shoulder lanes to 35 miles per hour or 15 miles per hour over the speed of general traffic, whichever is less.

The following sections also provide information for bus-only shoulder operation, which is an operational strategy, not a type of BRT runningway, and is a special use of highway shoulders for buses only when congested conditions exist on the highway or freeway. Current legislation states buses may use shoulders in posted areas only when traffic in general purpose lanes is moving at speeds lower than 35 miles per hour; speeds during bus only shoulder operation are limited to 35 mile per hour or 15 miles per hour above general traffic speeds, whichever is less. This operational strategy is shown as a benchmark comparison for bus-shoulder lane and managed-lane runningways.

Some facilities will connect into another form of BRT runningway. For example, the I-35W managed lane will connect in downtown Minneapolis to the Marquette and Second dual bus lanes. The dual bus lanes are addressed in the Arterial BRT section of this document.

Information relevant to each type of Highway BRT runningway is provided in tables later in this section.

These guidelines do not discuss dedicated busways, which are fixed guideway runningways completely separate from the roadway network and dedicated to bus traffic only. While the Twin Cities has a dedicated busway connecting the Minneapolis and St. Paul campuses of the University of Minnesota and the region's long-range transportation plan, the *2030 Transportation Policy Plan* (TPP) includes it as a type of transitway to be considered for development in the region, no new dedicated busways have been advanced beyond conceptual engineering to-date. Guidelines for dedicated busway runningways can be developed in the future as lessons are learned in the region.

4.2 Fundamental Laws and Underpinning Planning Requirements

A number of applicable national, state, and local regulations, standards, and practices presently shape BRT facility design. Most Highway BRT runningway design topics are addressed in these documents, which include but are not limited to those listed below.

4.2.1 Laws and Regulations

- US DOT Final Rule, Transportation for Individuals with Disabilities
- Americans with Disabilities Act (ADA)
- Title VI Regulations of the Civil Rights Act of 1964
- National Environmental Policy Act (NEPA)
- Minnesota Environmental Policy Act (MEPA)

4.2.2 National/State Design Standards

- *AASHTO Geometric Design of Highways*
- National Academy of Sciences, *Transportation Research Board (TRB) Highway Capacity Manual*
- Relevant APTA standards and recommended practices, including
    - *APTA Guidelines for Design of Rapid Transit Facilities*
    - *APTA Transit Sustainability Guidelines*
- *Minnesota Manual on Uniform Traffic Control Devices for Streets and Highways* (MnMUTCD)
- *Mn/DOT Road Design Manual*
- *Mn/DOT State Aid Standards Minnesota*
- *Guidelines for the Design of Transit Related Roadway Improvements* (Metropolitan Transit Commission, 1983)
- *Metro Transit Bus System Safety Program Plan*

4.2.3 Local Design Guidance

Highway BRT runningways should be developed in accordance with the current specifications and design standards of the entity with jurisdiction over the facility. BRT highway runningway elements generally reflect Mn/DOT road design standards and guidelines such as those listed below, though designs for runningway elements may adhere instead to the standards of the county or city roadway jurisdiction.

- *Mn/DOT Road Design Manual*
- *Mn/DOT Traffic Engineering Manual*

- *Mn/DOT I-94 Managed Lanes Study Final Report*
- Minneapolis/ St Paul Metropolitan Area Public Transportation Memo of Understanding - Mutual Aid

Bus facility design documents also direct that design be consistent with the type of BRT vehicle to be used. Conflicts should be addressed during the runningway design process. Designers will need to work with both the roadway jurisdiction (Mn/DOT or county) as well as the transit operating agency (Metro Transit and/or suburban transit provider) to evaluate the trade-offs inherent in multimodal roadway design. The *Mn/DOT Highway Design Manual* and/or the *Mn/DOT Traffic Engineering Manual* should be used for state highways and state-aid guidance, along with local guidance, should be used for county highways. Mn/DOT resource documents are available from the Minnesota Department of Transportation website (www.dot.state.mn.us). Other national and state design standards should be used as applicable.

Components of BRT runningways not included in the sources cited are addressed in the material which follows.

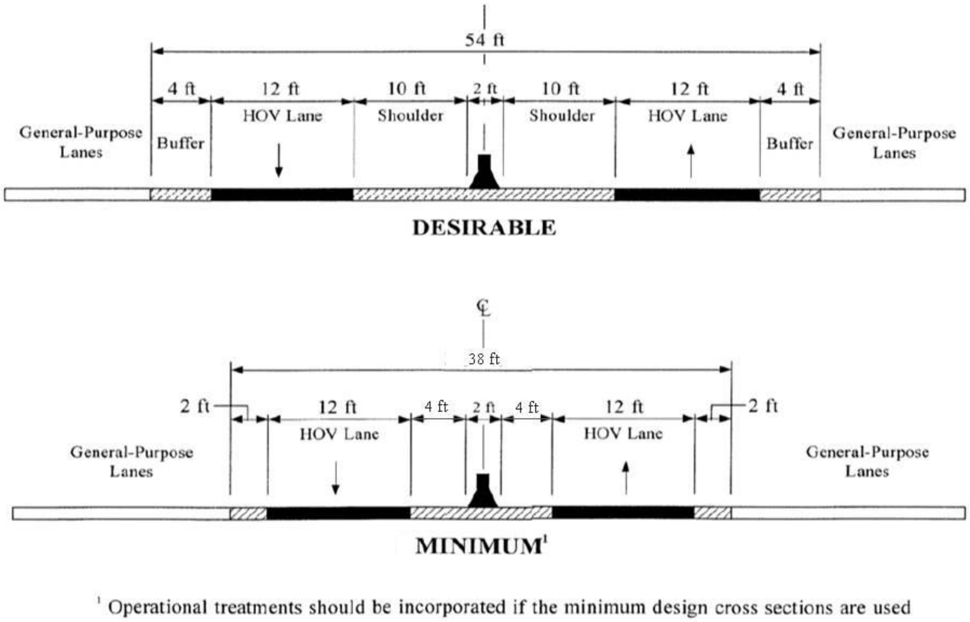
4.3 Physical Characteristics of Highway BRT Runningways

4.3.1 Corridor/Lane Width

Highway BRT runningway widths are summarized below. Lane width should be sufficient to accommodate required horizontal clearance for the types of buses operating in the facility, as described in Mn/DOT guidance. Buses shall not stop in managed lanes in freeways; sufficient pull off lanes or passing lanes shall be provided to facilitate a station.

Figure 4-1 illustrates example managed-lane cross-sections for freeways with active traffic management. (source: S. Pedersen, Mn/DOT, modified from graphic incorporated in I-94 Managed Lanes Study, Fig. 2)

Figure 4-1 Example Managed-Lane Cross-Sections for Freeways with Active Traffic Management



Lane widths identified in the table below do not include the width of gutters when a curbed section is used.

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
12’ standard plus buffers	12’ desirable and required in areas of new construction or reconstruction, 10’ minimum, 11.5’ minimum on structures	

4.3.2 Number, Placement and Direction of Lanes

Managed Lane	Bus-Shoulder Lane	Bus–Only-Shoulder Operation (Benchmark)
One lane in each direction in most cases. May be a single-lane or dual-lane reversible facility where indicated by significant one-way directional split of traffic and right-of-way constraints.	One lane in each direction, same direction as traffic flow. Generally outside (right) shoulder placement. Shoulder lanes within at-grade facilities present shared use-conditions with right-turning vehicles.	

Depending on station locations and service plan characteristics, it may be desirable to have more than one type of runningway in a corridor. For example, station-to-station service on a Highway BRT corridor may have offline stations that do not allow extensive use of a managed lane prior to build-out of all online stations. If right-of-way allows, bus only shoulder operation may be desired under these circumstances. In the case of reversible managed-lane situations such as I-394, bus only shoulder operation is particularly necessary in the off-peak direction for station-to-station services to allow competitive travel time and efficient bus cycling.

4.3.3 Drainage Systems

Highway BRT runningway drainage should be designed to state standards and coordinated with host highway drainage design.

4.3.4 Pavement

Highway BRT will typically operate on normal roadway pavement. For all types of Highway BRT runningways, pavement should be designed and maintained to deliver the desired ride quality, have sufficient strength to support repeated wheel loadings from transit and any other vehicles using the runningway, and its mix design should be consistent with *Mn/DOT Road Design Manual* provisions (source: *Guidelines for the Design of Transit Related Roadway Improvements*, Metropolitan Transit Commission, 1983).

4.3.5 At Grade/Grade Separated

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
Sufficient to provide active demand and system management, generally fully access-controlled (grade-separated)	May be grade-separated or at-grade, consistent with roadway facility in which the lane is located	

4.3.6 Interlock/Crossover/Special Requirements/Reverse Direction Running

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
In reversible facilities such as I-394 HOT lane, directional flow is controlled by time of day, gates and signage In median BRT implementation, signal- and/or gate-controlled crossovers may be implemented at stations.	N/A	

4.3.7 Separation via Time of Day Runningway Controls

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
May include time of day restrictions. Examples: I-35W, I-394	N/A	May include time of day restrictions to facilitate transit reliability during regular periods of congestion while maintaining general travel capacity during uncongested periods. Within allowed periods, only used by transit when general travel lanes are congested (speeds below 35 mph).

4.3.8 Traffic Signal Type and Interaction

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
Controlled at system access points (ramp meters intersection signals)	When in access-controlled facility (grade-separated), controlled at system access points. Within at-grade facilities, traffic signal interaction should be coordinated with the jurisdictional authority, to give transit every feasible travel advantage while maintaining reasonable traffic operations when applicable.	

4.3.9 Backup Power for Corridor Runningway Systems

Backup power sources for Highway BRT runningways are typically integrated into overall facility power for signals, lighting, etc, consistent with the design and maintenance standards of the jurisdictional authority.

4.3.10 Lighting

Lighting for Highway BRT runningways is typically integrated into the lighting for the overall highway facility, consistent with the governing standards of the jurisdictional authority.

4.3.11 Barrier Types/Setbacks: Physical, Roadway Striping, Fencing

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
Vary depending on vehicle characteristics, speeds, amount of traffic, right-of-way and other conditions, and should follow Mn/DOT and local jurisdictional guidelines	Not barrier-separated. Dictated by MnMUTCD provisions. May include driver-eye-level roadway signage and lane striping/pavement markings. May also include overhead lane signage and distinctive pavement treatment such as colored pavement.	

4.3.12 Landscaping

Landscaping for Highway BRT runningways is typically integrated into the landscaping of the overall highway facility, consistent with the governing standards of the jurisdictional authority.

4.3.13 Signage

Signs and graphics should comply with MnMUTCD requirements and the goals, objectives, and provisions of the jurisdictional authority.

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
Signage for BRT operation to be included in managed-lane signage	Following MnMUTCD requirements, BRT shoulder lane operation should be clearly and regularly signed to clearly identify BRT lane designation, including areas dedicated to buses. Signage may include specific transit logo or text on lanes and/or signs. Turn areas should be identified.	

4.3.14 Noise/Vibration Considerations

The potential for noise and vibration reduction within BRT runningways should be considered both during the planning of alignments and when identifying the operating characteristics of BRT vehicles.

4.4 Addressing Operating and Maintenance of Highway BRT Runningways in Design

4.4.1 Enforcement Strategy

Enforcement plans should be implemented with performance targets and interagency agreements. Managed lane enforcement in particular should be tailored to corridor needs and requirements to maintain posted speeds in the managed segments.

4.4.2 Runningway Support Infrastructure Considerations

Runningway infrastructure necessary to the operation of the BRT system should be maintained by the owning entity, with participation in design and maintenance coordinated with transit lead agency. Wherever possible, the use of existing infrastructure and facilities should be maximized when choosing transit alignments.

4.4.3 Snow Removal

Snow removal will be the responsibility of the roadway owner, handled as an integral part of snow removal on the overall highway. Snow removal at stations is addressed in the Stations technical document.

4.4.4 Repairs and Refurbishments/Upkeep

Responsibility for BRT runningway repairs and refurbishments should be negotiated and documented in an agreement with the agency with jurisdiction over the roadway.

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
Coordinated with Mn/DOT, Mn State Patrol, and/or local jurisdictional law enforcement	Depending on facility jurisdiction, coordinated with Mn/DOT, Mn State Patrol, and/or local law enforcement	

4.5 Providing for Intersecting Modes

4.5.1 Intersecting Auto, Truck, Pedestrian and Bicycle Traffic

<table>
<tr><th>Managed Lane</th><th>Bus-Shoulder Lane</th><th>Bus-Only-Shoulder Operation (Benchmark)</th></tr>
<tr><td>N/A</td><td colspan="2">N/A in grade-separated facilities.

Within at-grade facilities, intersections should be designed to provide safe, efficient transitway crossings for all transportation modes. Special attention should be given to providing convenient and safe at-grade accommodations for pedestrians or people on bicycles crossing transitway runningways. In general, bicycle and pedestrian crossings should be located at signalized street intersections whenever possible. Mid-block crossings between stations and street intersections should be avoided. At-grade bicycle and pedestrian features may include, but are not limited to:

• Improved bicycle and pedestrian facilities such as more visible crossings using pavement treatments, colors, markings, and/or warning signals/signage; pedestrian refuge medians; roadway curb extensions; intersection countdown timers, or crosswalks with passive crossing control (e.g., “z-type” crossings proposed on University Avenue)
• Roadway modifications such as intersection traffic signal timings adjusted to give equal importance with other traffic, additional traffic signals, elimination of conflicting turn movements – especially free-right turn movements, and other intersection modifications that improve convenience and safety for pedestrians and bicyclists.

Grade-separated bicycle/pedestrian crossings may be considered where there is no technically feasible at-grade crossing option, where benefits to the broader transportation system are shown to be significant, or where required by the runningway’s owning entity (e.g., railroad). Evaluation criteria that should be considered when assessing the need for grade-separated crossings include:

• High pedestrian volumes
• Long pedestrian crossing distances
• Presence of poor sight distance to see crossing transit patrons
• Roadway average daily traffic volumes of more than 35,000 and 80th percentile speeds documented at more than 40 mph
• Distance of greater than 600-feet to the nearest alternative “safe” crossing (i.e., controlled intersection or existing under-/over-pass
• Potential to coordinate with adjacent facilities such as a bike trail or sidewalk system

If an at-grade crossing is feasible, provision of a grade-separated bicycle/pedestrian crossing may be a local betterment.</td></tr>
</table>

4.5.2 Intersecting Rail Traffic

<table>
<tr><th>Managed Lane</th><th>Bus-Shoulder Lane</th><th>Bus-Only-Shoulder Operation (Benchmark)</th></tr>
<tr><td>N/A</td><td colspan="2">N/A in grade-separated facilities.

. Within at-grade facilities where FRA has jurisdiction over the railroad, in addition to the equipment noted for autos and trucks, AREMA standards should be implemented for crossings with active railroad lines.</td></tr>
</table>

4.5.3 Adjacent Bicycle Paths

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
N/A	Where adjacent to a bicycle lane, separation should be distinguished by striping and signage.	

4.5.4 Adjacent Pedestrian Paths

Managed Lane	Bus-Shoulder Lane	Bus-Only-Shoulder Operation (Benchmark)
N/A	Where adjacent to a sidewalk or other walkway, separation should be distinguished by curbing.	

5 ARTERIAL BRT

This section discusses runningways for BRT located within established, neighborhood-scale thoroughfares that typically have significant commercial nodes at major intersections. Arterial BRT runningway guidelines apply to roadways designed for posted speeds less than 45 miles per hour, consistent with *Mn/DOT Road Design Manual* definitions. The TPP identifies a network of potential Arterial BRT corridors as part of the 2030 Transitway System.

The Twin Cities roadway network is subdivided into principal, minor arterial, collector, and local street functional classification categories, based on speeds, the amount of local access provided, the lengths of trips accommodated, and the traffic volumes carried. Arterial BRT runningways are typically classified as minor arterials and major collector streets, and are surface facilities without grade separations for intersecting traffic, pedestrians or bicycles.

5.1 Types of Arterial BRT Runningways

Arterial BRT runningways are usually within existing roadways. These roadways are typically undivided, with or without median barriers at intersections. The BRT runningway may be in dedicated lanes, shared-use lanes, managed lanes, or general purpose mixed traffic lanes with operational advantages. Traffic control is accomplished with signalized, at-grade intersections. Local property access points (i.e., driveways or alleys) are common along Arterial BRT runningways. These local access points are not signalized.

5.1.1 Operation in Mixed Traffic

Arterial BRT generally operates in mixed traffic, but with travel-time advantages to improve travel time on a corridor-by-corridor basis. An Arterial BRT runningway is likely to include combinations of managed-lane options appropriate to available right-of-way, roadway traffic conditions, and adjoining land use requirements such as on-street parking.

Roadway management options to provide transit advantages to facilitate Arterial BRT include flexibility in the degree of exclusivity:

- In mixed traffic
- In a shared-use lane (for example, shared with right-turning vehicles or shared with bicycles)

Roadway management options also include time-of-day controls:

- Peak-period dedication of one lane in both directions to bus operations and possibly turning traffic
- Peak-period dedication of a lane in the peak-direction only to bus operations and possibly turning traffic

Intersection Treatments include:

- Signal priority - extended green time or shortened red time for BRT vehicles
- Queue jumps, also known as leading bus intervals, allow buses to bypass queued traffic at intersections through a separate signal phase

5.1.2 Operation in Dedicated Lanes

Arterial BRT may operate in dedicated lanes within lower-speed roadways. The Marquette and Second Avenue paired bus lanes in downtown Minneapolis are an example of Arterial BRT operation in dedicated lanes.

Dedicated-lane operation may be within one-way or two-way streets. Within one-way streets, BRT operates best opposite the flow of general traffic lanes (contra-flow). Contra-flow operation facilitates both right and left turning traffic movements for general traffic as well as BRT. Intersection treatments supporting dedicated lane operations may include signal priority.

5.2 Fundamental Laws and Underpinning Planning Requirements

A number of applicable national, state, and local regulations, standards, and practices presently shape BRT facility design. Most Arterial BRT runningway design topics are addressed in these documents, which include but are not limited to:

5.2.1 Laws and Regulations

- Americans with Disabilities Act (ADA)
- Title VI of the Civil Rights Act of 1964
- National Environmental Policy Act (NEPA)
- Minnesota Environmental Policy Act (MEPA)

5.2.2 National/State Design Standards

- *AASHTO Geometric Design of Highways*
- *TRB Highway Capacity Manual*
- Relevant APTA standards and recommended practices, including
    - *APTA Guidelines for Design of Rapid Transit Facilities*
    - *APTA Transit Sustainability Guidelines*
- *Mn/DOT Road Design Manual*
- *Mn/DOT Traffic Engineering Manual*
- *Mn/DOT State Aid Standards*
- *Minnesota Manual on Uniform Traffic Control Devices for Streets and Highways* (MnMUTCD)

5.2.3 Local Design Guidance

- *Guidelines for the Design of Transit Related Roadway Improvements* (Metropolitan Transit Commission, 1983)
- *Metro Transit Bus System Safety Program Plan*
- *St. Paul Central Corridor Bicycle and Pedestrian Plan* (http://stpaul.gov/index.asp)
- *Access Minneapolis*, Street and Sidewalk Design Guidelines (http://www.ci.minneapolis.mn.us/publicworks/trans-plan/DesignGuidelines.asp)
- *Minneapolis Downtown Action Plan*
- *Minneapolis Pedestrian Master Plan*
- *Minneapolis Bicycle Master Plan and Bicycle Design Guidelines*
- Local jurisdictional codes, requirements and procedures

Arterial BRT runningways should be developed in accordance with the current specifications and design standards of the entity with jurisdiction over the roadway which incorporates the runningway. While roadway design generally reflects AASHTO guidelines, bus facility design documents also direct that design be consistent with the type of vehicle to be used. Conflicts between guidance should be addressed during the runningway design process. Designers are encouraged to work with transit operators to evaluate the trade-offs inherent in multimodal roadway design. For cases where a local jurisdiction does not have design guidelines, the *Mn/DOT Road Design Manual* and/or the *Mn/DOT Traffic Engineering Manual* should be used.

Mn/DOT resource documents are available from the Minnesota Department of Transportation website (www.dot.state.mn.us).

5.3 Physical Characteristics of Arterial BRT Runningways

5.3.1 Number/Direction of Lanes

Arterial BRT should typically operate in one lane in each direction, unless the operational technique proposes operation in the peak-direction only. Arterial BRT can operate in dual lanes, and contra-flow, in high-volume locations such as downtowns. Because this condition requires major roadway reconfiguration, it is considered an exception to the goal of maximizing the transit capacity of the region’s minor arterial commercial corridors identified as candidates for Arterial BRT implementation.

5.3.2 Corridor/Lane Width

Arterial BRT should operate within the ten- to 12-foot travel lanes typical within minor arterial and major collector roadways.

5.3.3 Pavement

Arterial BRT should be presumed to operate on normal roadway pavement. Special pavement treatment such as markings and/or color may be used to indicate bus-only operation. Where street reconstruction is feasible, pavement on which Arterial BRT will operate should be designed and maintained to deliver the desired ride quality and have sufficient strength to support repeated wheel loadings from transit (including larger, branded buses) and other vehicles using the runningway.

5.3.4 Runningway Placement Relative to Roadway Lanes

For outside (right) lane Arterial BRT and in one-way streets where BRT operates in the direction of traffic, several runningway placement options exist, depending on available right-of-way, traffic conditions, and surrounding land use access conditions:

- BRT operates with mixed traffic adjacent to parking, makes limited curb stops at designated BRT stations only (may pull into parking lane or may stop in traffic at curb extensions)
- BRT operates with mixed traffic adjacent to curb, makes limited curb stops at designated BRT stations only, stopping in the traffic lane
- Dedicated BRT and right-turning traffic use the outside (right) travel lane, adjacent to on-street parking (may pull into parking lane or may stop in traffic at curb extensions)
- Dedicated BRT and right-turning traffic replaces on-street parking with a travel lane (may be all day use or just use during peak periods) and stops in traffic lane

In median runningway lanes on two-way streets:

- BRT operates with mixed traffic, shares median travel lane with left-turning traffic.
- Dedicated BRT use of the median travel lane, with separate left-turn bays for traffic (median bus lane)
- Dedicated BRT and left-turning traffic use of the inside travel lane

Under median running, median stations should be located at intersections where left turns are prohibited to reduce conflicts with turning traffic.

5.3.5 Reverse Direction Running

On one-way streets, Arterial BRT may operate in the reverse direction from general traffic direction (“contra-flow”). BRT operation may be in single or dual lanes, such as the Marquette and Second dual bus lanes in downtown Minneapolis.

Contra-flow running should not be used on two-way streets.

5.3.6 Time-of-Day Runningway Controls

Time-of-day lane controls, also called temporal separation, is a frequently-used strategy which provides a dedicated runningway for BRT during peak travel periods, while allowing on-street or curb side parking during other periods to accommodate adjacent land uses. Time-of-day lane control is recommended when dedicated BRT runningway segments are not feasible and mixed flow cannot provide a reliable travel-time advantage over local bus.

5.3.7 Traffic Signal Type and Interaction

Signal priority for both Arterial BRT and local bus service is preferred wherever it can be implemented without significant operational impact to other traffic. Traffic signal interaction should be coordinated with the roadway jurisdictional authority.

5.3.8 Backup Power for Corridor Runningway Systems

Backup power sources for Arterial BRT runningways are typically integrated into the overall roadway facility power for signals, lighting, etc. consistent with the design and maintenance standards of the jurisdictional authority.

5.3.9 Lighting

Arterial BRT runningways are incorporated into the roadway in which they operate, which have lighting based on appropriate facility design standards. Where additional runningway lighting is desired for passenger comfort and convenience, lighting height, intensity, and shielding should be coordinated with the local jurisdiction(s) with authority over both the roadway and the neighborhood.

5.3.10 Barrier Types/Setbacks

Arterial BRT encourages convenient, simple and direct access for transit patrons within the corridor. As such, physical barriers other than those created by station shelters should not be included in runningway design.

Roadway striping is appropriate where the BRT runningway is in a location other than in mixed traffic, for example, in a runningway segment dedicated to BRT, or to complement signage in a time-of-day lane control such as BRT peak period/curbside parking off-peak condition. Barrier types should be consistent with MnMUTCD provisions for pavement markings, signs, and signals.

Fencing is generally not appropriate along Arterial BRT runningways.

5.3.11 Landscaping

Landscaping and streetscaping added to a roadway as a result of Arterial BRT operation is considered a local betterment.

5.3.12 Signage

Signage and graphics to identify the BRT service operating in the runningway should comply with MnMUTCD requirements and the goals, objectives, and provisions of the jurisdictional authority, prevailing design standards for the facility, and the transit operator.

5.4 Addressing Operations and Maintenance of Arterial BRT Runningways in Design

5.4.1 Enforcement Strategy

As with Highway BRT, enforcement plans should be coordinated with the owning roadway jurisdiction, implemented with performance targets, interagency agreements, and coordinated with law enforcement.

5.4.2 Runningway Support Infrastructure Considerations

As Arterial BRT will predominantly operate in mixed traffic, infrastructure support necessary for its operation should be coordinated with the owning roadway entity through interagency agreements.

5.4.3 Snow Removal

Snow removal will be the responsibility of the roadway owner, handled as an integral part of snow removal on the overall roadway. Snow removal at stations is addressed in the Stations and Support Facilities chapter.

5.4.4 Repairs and Refurbishments/Upkeep

Responsibility for BRT runningway repairs and refurbishments should be negotiated and documented in an agreement with the agency with jurisdiction over the roadway.

5.5 Providing for Intersecting and Adjacent Modes

5.5.1 Intersecting Auto, Truck, Pedestrian and Bicycle Traffic

Intersections should be designed to provide safe, efficient transitway crossings for all transportation modes. Special attention should be given to providing convenient and safe at-grade accommodations for pedestrians or people on bicycles crossing transitway runningways. In general, bicycle and pedestrian crossings should be located at signalized street intersections whenever possible. Mid-block crossings between stations and street intersections should be avoided. At-grade bicycle and pedestrian features may include, but are not limited to:

- Improved bicycle and pedestrian facilities such as more visible crossings using pavement treatments, colors, markings, and/or warning signals/signage; pedestrian refuge medians; roadway curb extensions; intersection countdown timers, or crosswalks with passive crossing control (e.g., “z-type” crossings proposed on University Avenue, see Figure 2-2)

- Roadway modifications such as intersection traffic signal timings adjusted to give equal importance with other traffic, additional traffic signals, elimination of conflicting turn movements – especially free-right turn movements, and other intersection modifications that improve convenience and safety for pedestrians and bicyclists.

Grade-separated bicycle/pedestrian crossings may be considered where there is no technically feasible at-grade crossing option, where benefits to the broader transportation system are shown to be significant, or where required by the runningway’s owning entity (e.g., railroad). Evaluation criteria that should be considered when assessing the need for grade-separated crossings include:

- High pedestrian volumes

- Long pedestrian crossing distances

- Presence of poor sight distance to see crossing transit patrons

- Roadway average daily traffic volumes of more than 35,000 and 80th percentile speeds documented at more than 40 miles per hour

- Distance of greater than 600-feet to the nearest alternative “safe” crossing (i.e., controlled intersection or existing under-/over-pass

- Potential to coordinate with adjacent facilities such as a bike trail or sidewalk system

If an at-grade crossing is feasible, provision of a grade-separated bicycle/pedestrian crossing may be a local betterment.

The major modal conflict area for Arterial BRT is likely to be direct auto and truck property access at driveways and alley entrances to commercial loading and parking areas. Driveways and alley entrances are typically not signalized, and may be frequent as well as mid-block. The lead agency should coordinate with the local jurisdiction and surrounding property owners to identify options to minimize or mitigate conflict points. Options to consider may include left-turn restrictions during peak periods, loading zone restrictions and cross-street access improvements, and in rare occasions, access closure or relocation to a side street.

5.5.2 Intersecting Rail Traffic

Where active railroad lines intersect Arterial BRT runningways, safe crossing clearance should be provided and FRA-compliant, AREMA standards should be followed for signage, crossing lights and crossing gates.

5.5.3 Adjacent Bicycle Lanes

Where Arterial BRT runningways are adjacent to a bicycle lane or recreational trail, separation should be accomplished following the guidelines of local jurisdictions, such as the Minneapolis Bike Master Plan and the St. Paul Central Corridor Bicycle and Pedestrian Plan.

5.5.4 Adjacent Pedestrian Paths

Where Arterial BRT runningways are adjacent to a pedestrian path/sidewalk, the sidewalk should be at a higher (curb height) elevation than the BRT runningway. Runningway design with adjacent pedestrian facilities should be accomplished following the guidelines of local jurisdictions, such as the Minneapolis Pedestrian Master Plan and the St. Paul Central Corridor Bicycle and Pedestrian Plan.

5.5.5 Crosswalk Spacing Guidance

Crosswalks should be located at Arterial BRT stations, with pedestrians directed to cross at signalized intersections whenever possible. Crosswalks may also be provided at unsignalized intersections, with the addition of, at minimum, pavement markings and pedestrian refuge medians.

The location of safe crossing areas for pedestrians should be determined through design/collaborative review prior to establishing BRT station locations.

Mid-block crossings should be avoided.