

Meeting Pedestrian Needs: The “BRT Station”

Perry D. Gross

Abstract: The MAX bus rapid transit (BRT) line began operations June 30, 2004, in the northeast Las Vegas valley. Ridership remains strong, demonstrating BRT’s viability for the Las Vegas metro area. The Regional Transportation Commission of Southern Nevada (RTC) sought better coordination of successful BRT systems by improved integration of pedestrian, land use, and transit components. This effort generated the “BRT Station” concept, which examines BRT transit stops from the pedestrian perspective. In the pedestrian realm, BRT and fixed-route stops, adjacent land use, and auto-oriented transportation infrastructure within an intersection are considered elements of the BRT Station. Currently, pedestrians cross Las Vegas Boulevard using the shortest path to reach their destinations. From the pedestrian perspective, this is appropriate and must be accommodated through the BRT Station. The BRT operates in a dedicated shoulder lane, which is proposed to be curbing separated with the BRT Station concept. The combination of transit way medians on both sides of the roadway and the median pedestrian crossing provides a safe mid-block pedestrian crossing that highlights the transit stop and conveys the presence of pedestrians to motorists. Way-finding and positive guidance, at a pedestrian scale, delineate and brand the BRT Station. Branding is important for enlisting adjacent land uses; landscaping and hardscaping are introduced for positive vehicle speed control. The BRT Station concept will be realized on a station district by station district basis in conjunction with recommended neighborhood planning and context-sensitive solutions (CSS) principles. When each BRT Station community generates its individual transit identity, Las Vegas Boulevard North will realize its true potential as a genuine transit corridor.

Overview

Pedestrians behave in a manner that maximizes individual benefits in their environment. From an auto-oriented perspective, the pedestrian is a jaywalker who is probably violating the law. From the pedestrian perspective, they are merely traveling where they want and need to go. Which perspective predominates? Historically, engineers have been auto-oriented, rendering the pedestrian environment almost hostile. The case study this paper is based on sought to connect BRT, land use, and pedestrian activities for better integrating MAX BRT service along Las Vegas Boulevard North.

This paper includes:

- Current MAX BRT service components/operation
- Project issues, goals, and objectives
- BRT Station elements and ideas for implementation
- Conclusions on creating pedestrian environments in auto-dominated corridors

Current Las Vegas Boulevard North MAX BRT Service Components/Operation

The following information provides detailed analysis of current Las Vegas Boulevard North MAX BRT service. This information is provided to establish the context and challenges addressed with this corridor case study.

Running Ways

Transit route 501, MAX, is a BRT service line that operates daily from 5 a.m. to 10 p.m. on a fixed route. The total system route length is 7.6 miles, with 2.9 miles in mixed-flow lanes and 4.7 miles in a fully dedicated transit-only lane. The trip starts or ends at the Downtown Transportation Center and ends or starts near the intersection of Las Vegas Boulevard North and Craig Road. Figure 1 shows the relationship between running way, vehicle, and station.

Stations

The Las Vegas Boulevard North BRT system has 22 stations: 10 in the northbound direction and 12 in the southbound direction. Twenty of the stations are designated stations, and only two are shared with the regular bus route. Amenities at the designated stations include seating, trash containers, ticket vending machines, and space for beverage vending machines.

Vehicles

The 501 MAX line uses distinctive articulating (60-foot) vehicles manufactured by Irisbus Cavis. Branded with blue, white, and gold colors, the vehicles have full low floors with four doors for boarding and alighting. Once inside the transit vehicle, passengers experience look, feel, and sound similar to light rail. The total seated capacity is 31, and crush capacity is 120. Bicycles are accommodated with hooks at the rear door section.



Figure 1. Running Way, Vehicle, and New Station

Fare Collection

Ticket vending machines are located at the bus station. The MAX ticket vending machine sells and validates RTC Transit 30-day full fare passes, reduced fare passes, one-day passes, and one-

ride passes. The machine accepts Visa/Master Card, debit cards, U.S currency, and coins. Purchase instructions are listed on the vending machine, and drivers often assist patrons by explaining the purchase process steps. The fare collection system is with proof of payment through policing efforts, and the transaction media is magnetic stripe. Figure 2 shows the ticket vending machine.

Intelligent Transportation Systems (ITS)

Transit signal priority is implemented in 12 of 20 intersections along the route. Vehicles have precision docking technology and an optical vehicle guidance system. It is not certain if the drivers take advantage of these automation technologies. The system has an automated scheduling dispatch system and automatic GPS vehicle tracking. Traveler information is provided at the bus station and on the transit vehicle. The vehicles are also equipped with silent alarms and voice and video monitoring. Supporting technologies include advanced communication system, archived data, and passenger counter.



Figure 2. Off-board Ticketing Machine

Service and Operation Plan

MAX vehicles depart approximately every 12 minutes between 5 a.m. and 7 p.m., approximately every 17 minutes between 7 p.m. and 9 p.m., and approximately every 20 minutes between 9 p.m. and 10 p.m. Average station spacing is 0.8 miles.

Transit Frequency and Connectivity

The average wait time to transfer from/to BRT to/from another line varies from 15 minutes to 30 minutes, except transfer from/to the Deuce, which varies from 3.5 to 6 minutes. BRT Stations at several locations are situated at a significant distance from the intersection, making connectivity difficult. The peak-hour frequencies along Las Vegas Boulevard North and its crossing routes are shown in Table 1.

Ridership

MAX ridership remains strong, with some fluctuations. The following items highlight the analysis of recorded ridership volumes:

- Ridership in Las Vegas Boulevard North 501 MAX Line was 2,480,903 during 2007, which is 27% higher than 2005 ridership.
- Ridership in Las Vegas Boulevard North 113 transit line was 981,506 during 2007, which is 57% lower than 2004 ridership. The MAX BRT line opened in 2004.
- The total transit ridership along Las Vegas Boulevard North decreased by less than 1% from 2005 to 2007.

Table 1. MAX BRT Peak-hour Frequencies

Route Number	Route Name	Peak-Hour Frequency
110	Eastern Avenue	20min/30min
111	Green Valley /Pecos	20min/30min
112	Desert Inn/Lamb	30min
113	North Las Vegas Boulevard	35min
115	Nellis	30min
209	Vegas/Owens	60min/45min
210	Lake Mead Boulevard	25min
211	Smoke Ranch/Carey	60min
218	Cheyenne	45min
219	Craig Road/Centennial Hills	30min
301	The Deuce – Strip Transit	8-12min/7min
501	Max Line – Las Vegas Boulevard North	12min/17min

Onboard Transit Survey

An onboard transit survey was performed by Cambridge Systematics in 2007. The survey's purpose was to provide data for the Regional Travel Demand Model, and the information was beneficial in identifying some transit trends and customer satisfaction issues on the Las Vegas Boulevard North transit lines and connectors. The on board transit survey included the following results:

- The 501 MAX line ridership is approximately 63% higher than the ridership in the regular 113 line.
- The number of automobiles available in a household, the age of transit users, household income, and trip fare type did not appear to influence the choice of using the BRT line versus the regular line.
- Home-based work is the trip purpose of 33% of the BRT line users versus 24% of the regular transit line.
- 87% of the BRT line users do not transfer to reach their destination, compared to 76% of the regular bus line users. 10% of the BRT line users transfer once to another line to reach their destination, compared to 20% on the regular bus line.
- The an analysis of origin and destination points and boarding and alighting points 113 transit line and 510 MAX BRT line users was performed. The analysis revealed the following:

- Although the majority of riders have origins/destinations along Las Vegas Boulevard North, many use these lines to transfer to/from another line. Transfer routes include Las Vegas Boulevard South, Craig Road, Eastern/Civic Center, Pecos, and Lake Mead Boulevard.
- Origin/destination points are clustered around Downtown Las Vegas, Jerry’s Nugget, the Government Center, Civic Center Shopping Center, K-Mart, and Wal-Mart.
- 43% (average) of transit riders along Las Vegas Boulevard North and its crossing routes said they would like to have a more frequent service; 21% wanted more reliability.

Project Issues, Goals, and Objectives

The Las Vegas Boulevard North Corridor Study investigated available opportunities for achieving a transit corridor including transit-supportive development and infrastructure. The success of BRT lies in a transit operation characteristics emulating light-rail transit and in the integration of transit lifestyle characteristics such as transit-supportive development, pedestrian amenities and scale, and supportive public policy. The historical nature of the corridor as an interregional thoroughfare and the future desire for generating a transit- oriented corridor result in several issues/challenges:

- Nellis Air Force Base safety zone overlays (50 people/hour for 24 hours/day)
- Commercial frontage land use
- Historic H-2 zoning
- Annexation of industrial land
- MAX station locations fixed
- MAX station design fixed
- Challenging pedestrian circulation (see Figure 3)
- Need for park and ride facilities
- Park and ride liability concerns
- Suburban oriented land use
- Ill-defined MAX station district definitions.

The goals and objectives of the *Las Vegas Boulevard North Corridor Study* are to address each of these issues, identify opportunities for transitioning toward a transit corridor, and develop implementation strategies for achieving a transit corridor. These goals/objectives will be accomplished in concert with the visions developed in the related planning efforts for the area, specifically focusing on the transit and pedestrian environment. It is anticipated that the success of the MAX system will continue to be the catalyst for transitioning Las Vegas Boulevard North into a viable, vibrant, and desirable transit corridor.



Figure 3. Pedestrian Activity

A recent article in the *Las Vegas Sun* newspaper highlights the challenges and opportunities for the Las Vegas Boulevard North corridor:

“The Air Force would like to see very low density...where planes fly, but I’m not sure if that’s reasonable because we would have to stop development where we’re at and not proceed further. Nellis tests weapons systems and serves as something akin to a graduate school for pilots...He has prepared a map identifying areas of high noise and accident potential, which Clark County has used to establish compatible land uses within these zones. Analysis working with North Las Vegas on one as well but these agreements are limited.” (*Las Vegas Sun, December 8, 2008, Area’s Growth a Threat to Nellis*)



Figure 4. Original Station Design with Fence Blocking Pedestrian Access

Figure 4 shows the effect the Nellis Air Force Base environs overlays have on adapting land uses for a transit corridor. The vacant property behind the BRT Station must have low-intensity development.

Pedestrian Scale and the “BRT Station”

The BRT Station must meet pedestrian needs, accommodate transit operations, and allow for automobiles. This discussion focuses on pedestrian scale and needs and how these are applied to the BRT Station. Automobile circulation is discussed as it applies to pedestrian interactions. Additional planning efforts, discussed below, advocated for a multi-way Boulevard through the downtown portion of Las Vegas Blvd., North. This idea was reshaped to form transit ways, curb separated transit lanes, North and southbound. Once a discussion of how the downtown study was incorporated into this case study the description of the pedestrian circulation and environment is provided. This section concludes by detailing the elements of the BRT Station concept.

Concepts for the Las Vegas Boulevard North MAX BRT Stations draw on the efforts of the *City of North Las Vegas Downtown Master Plan/Investment Strategy* study, which detailed the need for following strategies:

- A. Streetscape and public space improvements
- B. Zoning, development standards, and guidelines
- C. Vehicular circulation and parking
- D. Ways, signage, and wayfinding
- E. Housing and neighborhood enhancement
- F. Image, identity, and branding

G. District management and event programming

H. active transportation" (City of North Las Vegas, 2009, p. 71)

While each of these strategies applies to MAX station strategies, A, C, D, F, and H are essential in developing the transit districts beneficial to Las Vegas Boulevard North. The North Las Vegas downtown study noted that “vibrant colors that work well with, but contrast with the warm nine of the desert landscape will make each design highly visible day and night” (City of North Las Vegas, 2009, p. 79). The concepts of gateways and wayfinding naturally extend to MAX BRT Stations. The requirements in title 17 for building setbacks to be oriented to the street demonstrate the planning community’s understanding of the need to implementation these ideas.

Pedestrian Station Access

MAX BRT Stations are located along Las Vegas Boulevard North typically 200 to 400 feet on either side of major cross streets. Pedestrian access from residential communities is limited. The fence-induced out-of-direction travel in these residential communities can be quite severe, as shown in Figure 5.

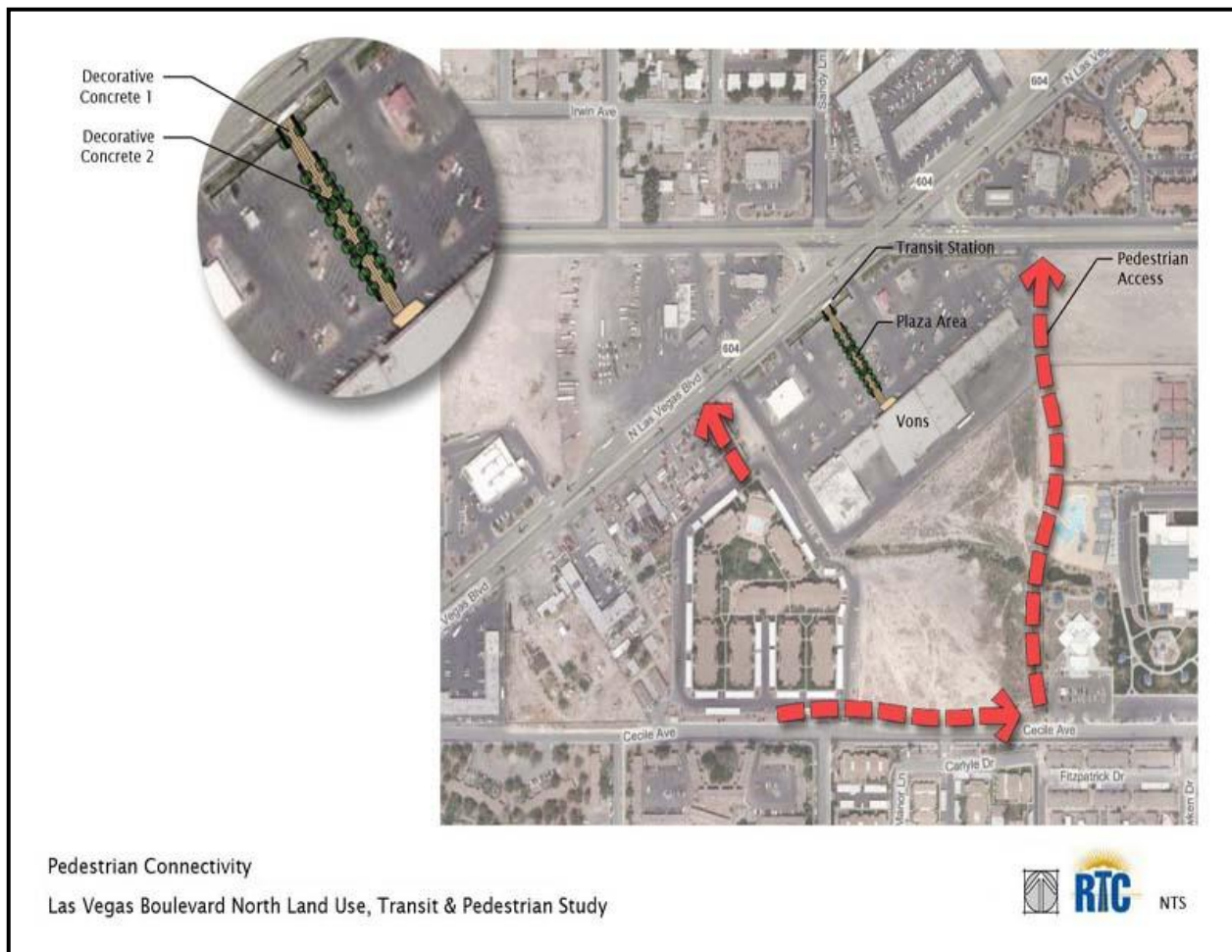


Figure 5. Pedestrian Out-of-Direction Travel and Commercial Pedestrian Circulation

Improving this condition requires a detailed identification of the pedestrian corridors that provide suitable BRT Station access while meeting the local community's circulation needs.

These corridors will require pedestrian access through residential and commercial fences. Achieving necessary pedestrian circulation and BRT Station access must draw on detailed and collaborative community planning efforts. Figure 6 reveals conceptual ideas for pedestrian amenities for commercial property access within the corridor. Sidewalk widths are wider and landscape and hardscape provide an inviting and interesting walking environment. The scale and form serve as a catalyst for the specific elements of the BRT Station.

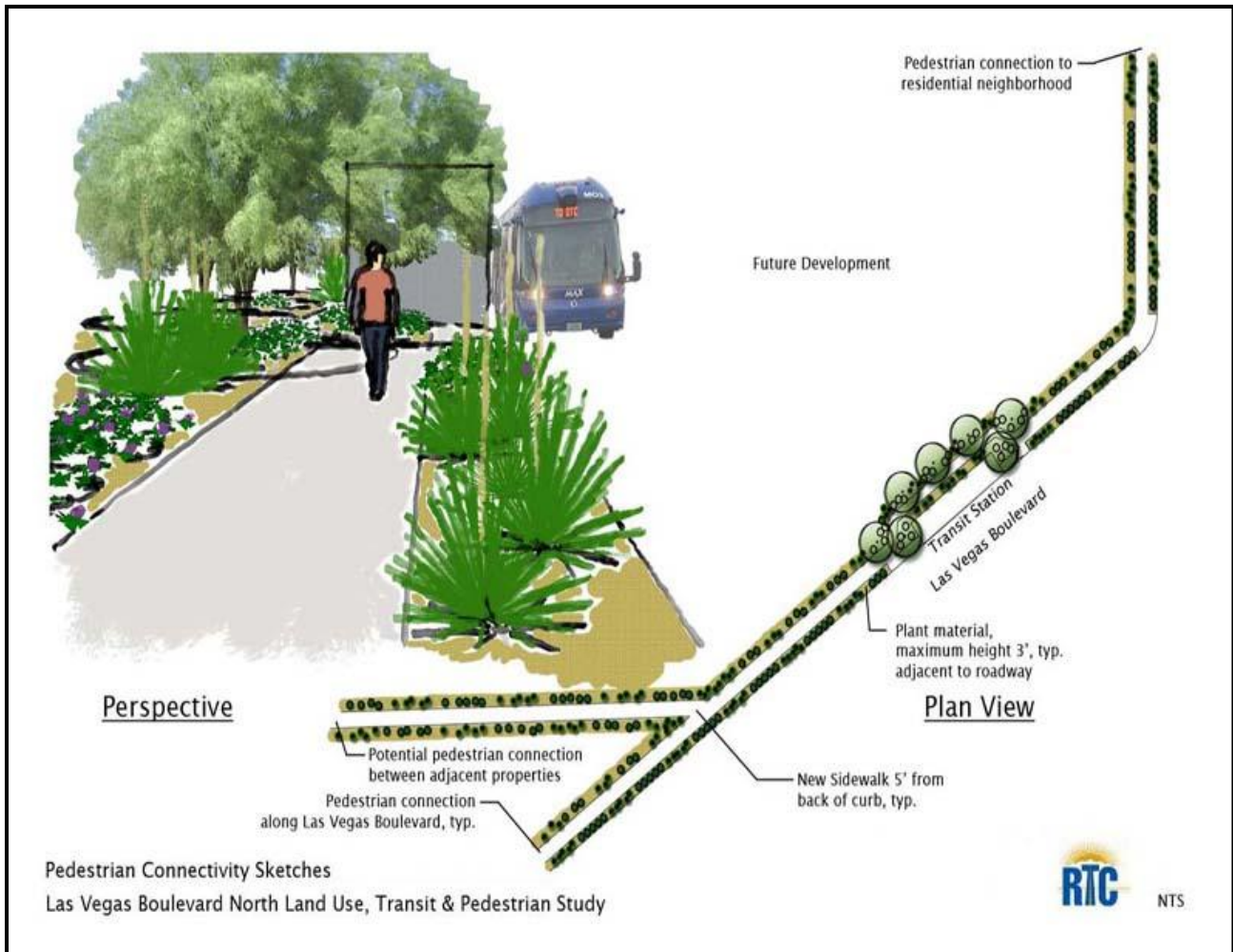


Figure 6. Pedestrian Connectivity Amenities

The MAX BRT Station

The BRT Station concept builds on and enhances Las Vegas Boulevard North's existing suburban form. The BRT Station provides transit amenities at the pedestrian scale. These amenities work in unison to provide the BRT transit patron with the look and feel of a light rail transit station. This is accomplished within the realm of an auto-oriented corridor. The MAX BRT service uses a dedicated transit lane for much of its route. Las Vegas Boulevard North's historical use as an interregional route provided a wide roadway that could accommodate a

dedicated transit way. This historical width provides the opportunity for the BRT Station. The BRT Station has several elements: midblock crossings, medians and refuge islands, bicycle lanes, wayfinding, fixed-schedule transit, abutting properties, and neighborhood and station planning. Each of these elements is discussed below; a conceptual plan is shown in Figure 7.

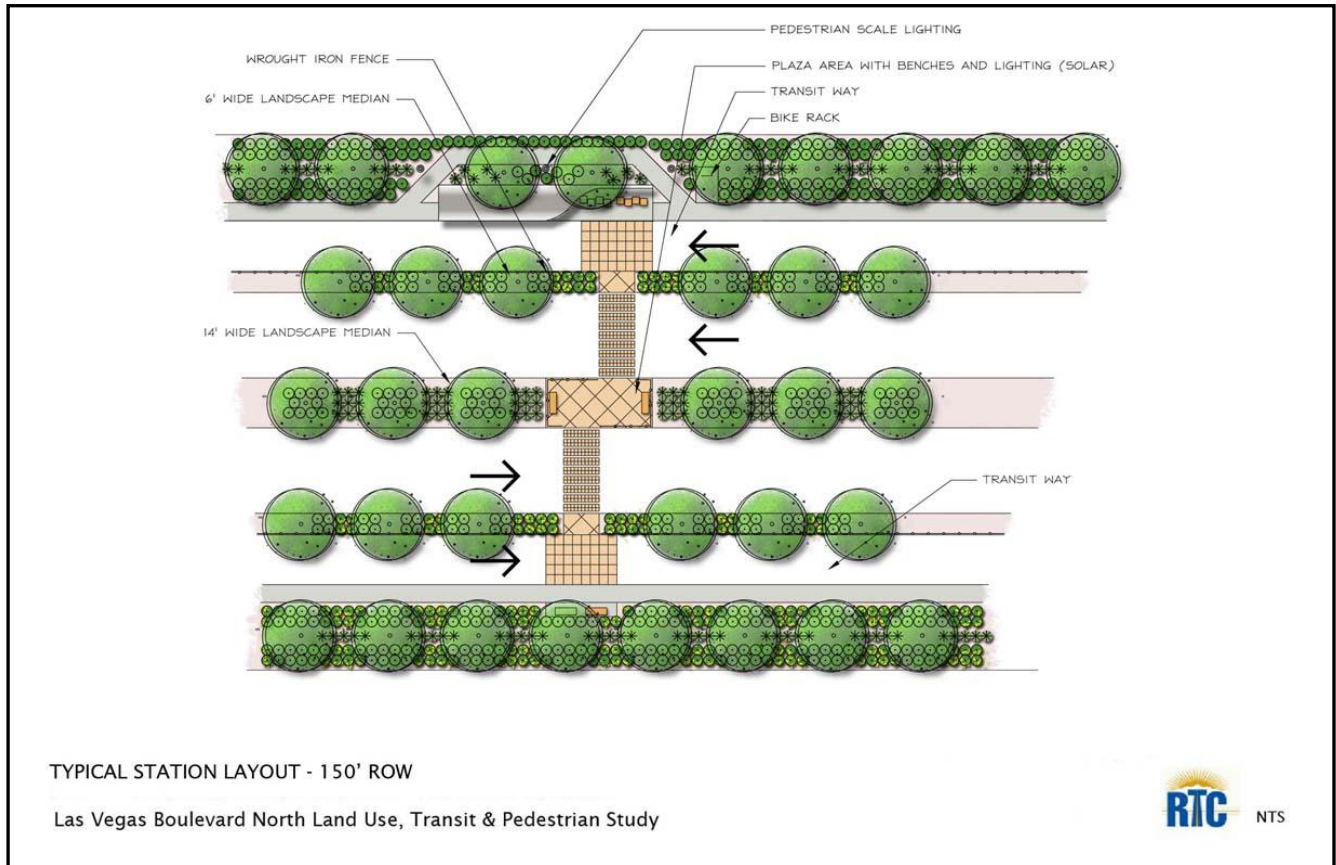


Figure 7. BRT Station Layout (one direction)

Midblock Crossings

BRT transit patrons spend significant portions of their transit trip as pedestrians. Many studies indicate that this pedestrian portion of the trip is the most influential in determining how pleasurable the experience is. One significant means of improving this pedestrian portion of the transit trip is to reduce out-of-direction travel by providing direct cross-street access using mid-block pedestrian crossings. These mid-block pedestrian crossings are located in conjunction with existing MAX transit stops, and they use an offset in the median that forces pedestrians to view oncoming traffic before making a decision about crossing. This configuration has become known as a Danish offset. Figure 7 details a Danish offset pedestrian crossing as it would be configured for the Las Vegas Boulevard North MAX RTC Station concept. This configuration capitalizes on the curb separating the transit way as a pedestrian refuge that dramatically shortens the crossing distance. This proposed 24-foot crossing distance provides two 12-foot general purpose

automobile lanes that reflect the presence of pedestrians, thus harmonizing the pedestrian environment.

Medians and Refuge Islands

Achieving pedestrian scale with the long crossing distances that exist on Las Vegas Boulevard North draws on the two new medians separating the transit way from the general purpose lanes northbound and southbound. These new medians delineate and elevate the existence of the MAX BRT system by distinguishing the transit stations. They shorten the pedestrian crossing distances to not more than 24 feet, a manageable distance for pedestrians to judge crossing times. They also provide for pedestrian scale landscaping and hardscaping, improving the pedestrian experience of the transit patron. Combined with the median between northbound and southbound travel directions, the pedestrian is afforded three refuge areas for crossing Las Vegas Boulevard North. Tying these areas together aesthetically alerts pedestrians and motorists that a pedestrian-oriented environment exists. The narrowing effect of the landscaping positively reinforces this pedestrian orientation while improving motorists' behavior around the Max BRT Stations. The landscaping, with perhaps a short fence in the transit way median, further delineates the BRT Station realm. These elements would help provide pedestrian and transit users safe, attractive pathways, enhancing their transit trip.

Incorporating Bicycles

The Las Vegas valley is currently experiencing an increase in bicyclists using transit. Regular transit vehicles are being refitted with bike racks that can accommodate three bicycles. These are often full during peak periods. Bicycles are accommodated on MAX vehicles by loading at the rear doors, where hooks are located.

The adopted bicycle plan has Las Vegas Boulevard North operating as a bicycle route. With a bicycle route designation, the facility provides an extra wide (typically 14 feet) right lane, incorporated in the transit way lane provided for the MAX BRT Stations. This will likely improve the bicycle route by having bicyclists operate in a lane with professional drivers. The only other vehicles allowed in the transit way lane would be those turning from general purpose lanes into adjacent driveways.

It is likely that bicyclists will continue to be an integral component of the Max BRT Station, with several intersecting streets designated for bicycle lanes and the Las Vegas Wash providing additional bicycle and pedestrian circulation. As such, BRT Stations will have bicycle amenities such as bicycle racks and lockers. Fully incorporating the bicycle mode within the transit element provides a robust multimodal transportation environment characteristic of genuine transit corridors.



Figure 8. Bicycle Rack at MAX BRT Station

Wayfinding

Transit stations have a longstanding practice of providing trip guidance in an artistically pleasing manner. While adhering to broader system requirements, these wayfinding elements in transit stations often incorporate design elements from the local community. This allows local communities to communicate their sense of identity. With the relatively long distances between the stopping points for both BRT and fixed-schedule transit stops, wayfinding becomes an essential component of the BRT Station. Pedestrian-oriented signs should provide maps, directions, and information for assisting pedestrians, bicyclists, and park-and-ride transit patrons. This information helps transit patrons navigate to their destinations and beyond into the BRT Station community. Wayfinding is not limited to signs; it can include sidewalk treatments, color schemes, or symbols incorporated into the hardscape elements. Collectively, signage and other wayfinding elements provide a powerful method of comprehensively integrating BRT Station components.

Integrating Fixed-Schedule Transit

Many BRT trips begin and end via the fixed-schedule transit service. “Scheduled public transportation can be viewed as a series of movements and waits, where the relative importance of each varies with the length of the trip and the nature of the waits” Further. “numerous studies show that people perceive waiting time is more onerous than in vehicle travel time” (Bruun, D.,



Figure 9. Potential Time Transfer Operations

2007, p. 57). The time transfer concept “requires the various routes arrive and depart at the center of radial and diametrical lines at approximately the same time, sometimes referred to as ‘pulsing’ The travel time between hubs must be slightly less than a multiple of the headway between timed transfer connections in order to provide time for passengers to alight, walk, and board another vehicle. In addition to cutting the wait time, it provides connections from origins on one route to destinations on every other route sharing a time transfer meet” (Bruun, D., 2007, p. 61).

Incorporating the time transfer concept into the BRT Station would improve the potential for collecting additional passengers from traditional transit routes by providing an improved transit experience. Lower demand and less popular routes would operate as a sub-multiple of the higher frequency MAX system.

Abutting Properties

Las Vegas Boulevard North currently appears as an indistinguishably bland, nondescript series of neighborhoods. Properties developing around the transit station concept will be important in beginning to distinguish these individual neighborhoods.

The distinctions will be accomplished by adding gateway elements—including signage and banners—for each transit station’s neighborhood. Gateways contribute to quicker recognition, are visually appealing, and improve circulation as users are able to tell at a glance where they are within the larger context of the corridor. A major component for achieving a neighborhood BRT Station is focusing on gateways, monuments, and directional information in greeting visitors, guests, and citizens. Each neighborhood station will develop its own individual brand, capturing cultural heritage and raising awareness of the area’s rich history.



Figure 10. Challenging/Oppportunistic Build Form

Neighborhood and Station Planning

The City of North Las Vegas and Clark County strongly advocate for active mixed-use neighborhood centers emphasizing residential neighborhood diversity. The goal is the achievement of a balanced land use mix so that residents can live and work within the area. These town centers supply goods, services, jobs, and opportunities for a diverse range of households. The principal strategy for generating these new desirable town centers is developing a neighborhood planning strategy.

Neighborhood planning strategies are complementary with developing MAX BRT Stations. It is understood that neighborhoods vary in age, development pattern, and proximity to civic



Figure 11. Collaborative Community Planning

amenities within the corridor. This situation leads to establishing a Neighborhood Planning Strategy that prioritizes areas along the corridor for additional neighborhood-level planning. Neighborhood-level planning activities emphasize timelines, procedures, and stakeholder involvement and are clearly determined in advance.

Major components of neighborhood planning are transportation and mobility. The transportation system directly impacts corridor residents’ quality of life

through mobility, air quality, opportunities for exercise, safety, and transportation choice.

Accordingly, the City of North Las Vegas specifically plans on preparing a Transportation Master Plan for providing a comprehensive approach to achieving a multimodal transportation system serving all parts of the City and regional connections. One particular focus is the improvement of pedestrian connections. Working actively with developers and Homeowners’

Associations improves the level and quality of pedestrian connections throughout the City, for both existing and new developments. As noted, this is a crucial issue for developing effective MAX BRT Stations.

Conclusions

Transportation infrastructure continues to benefit from technology, and BRT is near the top of the list. The caution stems from the need to keep the human factor in mind as we progress forward. This case study and the ideas embodied in the BRT Station concept demonstrate how planners and engineers can integrate technology with human behavioral needs. With this insight, planners and engineers can facilitate communities as they implement their individual BRT Stations along the Las Vegas Boulevard North corridor.

As transit advocates note, "...community involvement enhances the mutual learning that can take place during the planning and design process....Because the community is the best and most important source of local knowledge, community members are the actors best equipped to help a project attained that intangible 'sense of place' that will capture value for all partners" (Selzer, D., et al., 2004, P. 52).

Transportation infrastructure and innovation have direct impacts on human behavior and communities. "Cities...are now being seen as vital, resource rich places, in part because urban density creates the opportunity for a more diverse mix of amenities than is available in a one-dimensional suburban location. A larger trend, however, is just underneath this change in attitude. The demographics of this country are gradually shifting, and these shifts portend a fundamental change in the demand for housing and community". These four demographic shifts are: (1) immigration, (2) "empty nesters " and "echo boomers", (3) non-family households, and (4) the transit "boom"" (Dittmar, Belzer, & Aulter, 2004, p. 10). Considering this intergenerational change potential, an attractive transit corridor can reduce automobile domination, leading to reduced living expenses and/or partially offsetting higher rental and mortgage costs. Viewing situations from different perspectives opens up new opportunities. The BRT Station concept is such an opportunity, one that places pedestrians and transit users in positions to mutually benefit from technology and innovative planning.

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Author's Information:

Perry D. Gross
Principal Planner/Analyst
PBS&J
2270 Corporate Circle, Suite 100
Henderson, NV 89074
(702) 263-7275