2024 CITY OF ALBUQUERQUE BIKEWAY AND TRAIL FACILITIES PLAN

APPENDIX E: BIKE BOULEVARD TOOLKIT

BIKEWAY & TRAIL FACILITIES PLAN
CITY OF ALBUQUERQUE

ONE ALBUQUERQUE municipal development

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Introduction

Bike boulevards are low-speed, low-volume local streets that are comfortable places for people of all ages and abilities to ride bikes. Bike boulevards are shared facilities that do not separate people biking from people driving, but instead depend on moderating vehicle speeds and creating as much awareness as possible of the presence of people biking. They are generally located parallel to major streets that are desired paths of travel and are intended to provide low-stress connections to community destinations.

Over the last decade, the City of Albuquerque has introduced a series of bike boulevards that now connect Old Town, Downtown, the University of New Mexico (UNM), Nob Hill, the Fair Heights neighborhood, and Uptown. This toolkit provides guidance for what types of streets are appropriate candidates for bike boulevards and how to design these streets to function effectively as bike boulevards. This toolkit is intended to be accessible to a wide audience of community members and stakeholders, including engineers, planners, bicycle advocates, and curious residents, and draws from the lessons learned through bike boulevard development in the City of Albuquerque and emerging best practices from around the US. The toolkit was developed alongside the update to the City of Albuquerque Bikeways and Trails Facilities Plan.

This design toolkit is intended to complement local technical design manuals, such as:

- City of Albuquerque *Development Process Manual* Chapter 7 (2020)
- City of Albuquerque *Neighborhood Traffic Management Program* (NTMP) (2020)
- City of Albuquerque *Bicycle and Trail Crossing Guide* (2022)

This toolkit begins with an overview of the principles of a bike boulevard, followed by key bike boulevard design elements and traffic controls for major and minor streets. This toolkit also includes strategies to calm traffic by managing vehicular speed and divert traffic by managing vehicular volumes. Table 1 includes the main features included in a bike boulevard.

Table 1. Summary of Bike Boulevard Elements Within The Toolkit

Bike boulevard design elements	Route identification
	Reduced speeds
	Narrow drivable or operating width (e.g., striped on-street parking
	Prioritized travel along bike boulevard
Traffic controls for major street crossings	Traffic signals and enhanced crossings
	Offset intersection treatments
Traffic calming strategies to manage vehicle speeds	Horizontal deflection treatments (e.g., traffic circles)
	Vertical deflection treatments (e.g., speed humps)
Traffic calming strategies to manage traffic volumes	Major street medians
	Regulatory signs
	Diagonal diverters and partial closures

1) Principles of a Bike Boulevard

The purpose of bike boulevards is to provide low-stress bicycling routes that are intuitive to use and connect people to community destinations and other bikeways that appeal to people biking of all ages and abilities, such as multi-use trails. The principles below form the basis for selecting bike boulevard candidate corridors and ensuring that the facility design serves the needs of all users.

Manage Traffic Volumes and Speeds

One of the most important reasons someone will choose whether or not to bike on a street is the speed and volume of motor vehicle traffic on that street. To provide the most comfortable bicycling experience for all ages and abilities, bike boulevards need to have low volumes of motor vehicle traffic, and people driving motor vehicles along the bike boulevard should be moving slowly enough to maintain a comfortable environment for people biking.

Table 2 shows the preferred thresholds for traffic volumes and speeds along bike boulevards and at major street crossing opportunities in Albuquerque. The traffic volumes assume the bike boulevard is on a two-way street. The volumes should be divided in half if the bike boulevard is on a one-way street.

Table 2. Bike Boulevard Traffic Speed and Volume Thresholds

Peak Hourly Traffic Volume	Average Daily Traffic: *Preferred*	Average Daily Traffic: *Acceptable*	Operating Speed
≤120 vehicles	≤1,000	1,000-2,000	≤20 mph

A daily traffic volume of 1,200 roughly equates to 120 vehicles in the peak hour, or one vehicle traveling down the street every 30 seconds on average. This level of volume is low enough that people biking will infrequently be passed by people driving a motor vehicle. Lower vehicle operating speeds (e.g., 18 or 20 MPH compared to standard 25 MPH on local roads in Albuquerque) increases safety by reducing the speed differential between people biking (which generally travel at 8 to 12 mph on flat terrain) and people driving a motor vehicle. This leads to a lower likelihood of a crash occurring and improves the sense of comfort for people biking.

If candidate bike boulevard streets do not currently meet the criteria outlined in Table 2, they should be redesigned to achieve these target traffic volume and speed thresholds by using the strategies outlined in Chapter 4) Traffic Calming Strategies and Chapter 5) Traffic Diversion Strategies.

Potential measures include restricting through movements for motor vehicles at major intersections and using traffic calming to reduce the current operating speeds on the street. In cases where the candidate street is too wide, with too high of traffic volume, and too high of motor vehicle speeds, it may be necessary to evaluate adjacent corridors to find a street that is a better candidate for a bike boulevard.

Traffic Counts and Speed Data Collection

The collection of traffic counts and speed data along potential bike boulevard routes is recommended to determine both the viability of the route as a bike boulevard and whether traffic volume and speed should be further managed to make the corridor comfortable for people who are biking.

Make the Network Intuitive Through Wayfinding and Branding

In addition to designing the streets to be safe and convenient, bike boulevards should include wayfinding and branding. Bike boulevard wayfinding should be frequent enough to guide people to community destinations. Bike boulevard streets should be branded with the standard purple Albuquerque bike boulevard signage (see Figure 1) to communicate to people biking where the routes are and to demonstrate to people driving that they can expect to see people bicycling on the street.

The wayfinding and branding elements of bike boulevards also help establish a network where people biking do not have to spend excessive time ahead of their trip planning a safe route. Rather, people bicycling can walk out the door and follow the signs and pavement markings that confirm they are on an optimal route for biking toward their destination.

Designing for Bicycle Priority at Local Street Crossings

One of the benefits of bike boulevards being located along local streets is that they mostly cross other low-traffic volume local streets until people biking arrive at a major street crossing. In much of Albuquerque, these major street crossings are located every half-mile. To encourage local trips by bicycle, bike boulevards should generally have the right of way at local street intersections and stop signs should be placed on the roads intersecting the bike boulevard. This approach minimizes stops for people biking, as getting back up to speed on a bicycle after stopping requires more energy than in a motor vehicle. Additionally, if stop signs are placed for people biking in locations where there are low cross-traffic volumes, people biking may disregard stop signs.

It is important to note that by changing the right of way for people biking on local streets alone, streets may inadvertently become good cut-through routes for people driving. Therefore, changing the right of way at local street intersections should be coupled with traffic calming elements, such as traffic circles, and volume management elements, such as medians restricting through motor vehicle traffic at major street crossings.

Figure 1: Conditions along Silver Ave Bike Boulevard

Provide Safe and Convenient Crossings at Major Streets

Major street crossings are often a barrier that prevent people from biking to community destinations. Providing safe and convenient crossings at major streets is an equally important principle to managing traffic volumes and speeds along the bike boulevard. Bike boulevard candidate streets are chosen specifically because they have low existing traffic volumes. This often means that low-volume streets do not have existing bicycling or pedestrian crossing infrastructure when intersecting with major streets because traffic signals are located at intersections of other major streets with higher vehicular volumes. Planners and designers should evaluate major street crossing locations based on crossing street traffic volume and speed, as well as the number of lanes to cross, to determine how to improve the safety and convenience of the crossing for people biking. The City of Albuquerque *Bicycle and Trail Crossings Guide* should be used to determine the appropriate crossing treatment at major streets.

Promote Bicyclist Comfort

In addition to designing safe infrastructure and signing and branding for bike boulevard streets, there are other factors that help make bike boulevards comfortable for everyone. These include the concepts of creating a sense of enclosure and accounting for natural topography and barriers as part of route decisions.

Create Enclosure Using Existing Narrow Streets or Adding Street Design Features to Narrow a Wider Street

Local streets in Albuquerque have been built with a variety of pavement widths, sidewalk configurations, and plantings. Narrower streets feel more comfortable for people biking and naturally slow motor vehicle traffic. The presence of street trees also increases the feeling of enclosure and safety along a narrow street. When selecting candidate bike boulevard streets, designers should evaluate the existing street width and character to determine if additional techniques to narrow the roadway are necessary to increase the sense of enclosure.

In addition to landscaping, a sense of enclosure can be created by reducing the paved area of a roadway that is open to people driving through striping on-street parking or installing design interventions such as diverters. In some cases where a local street is sufficiently low-volume and low-speed, but the street is too wide, a parallel street should be considered if it is narrower and still connects well with the overall bike network.

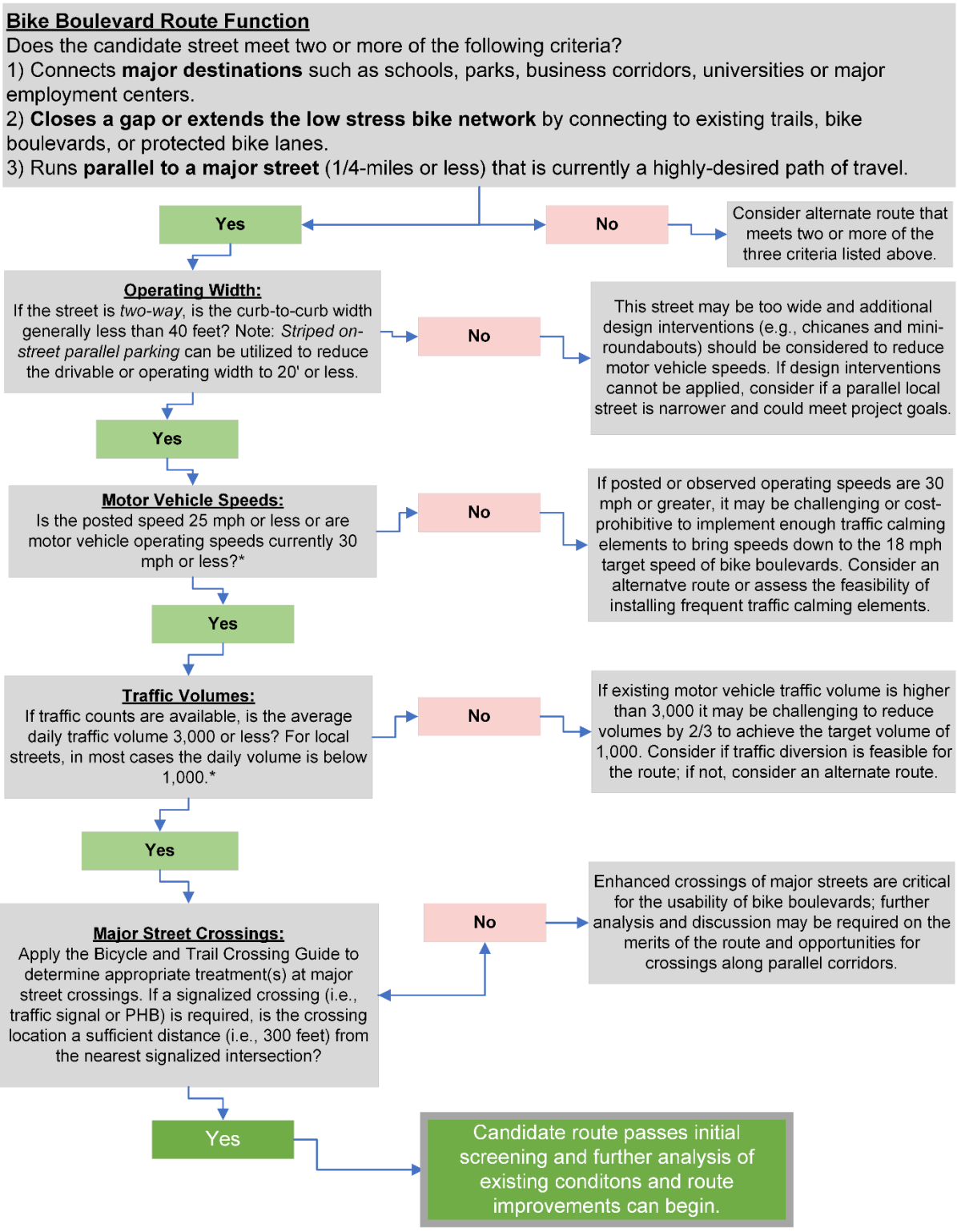
Considering Natural and Infrastructure Barriers and Topography

Bike boulevard routes should be chosen to use existing crossings of natural barriers (such as arroyos and rivers) and infrastructure barriers (such as railroad tracks and highways) where possible. Additionally, major inclines can present a barrier to people biking on a street. Route topography should therefore be considered to determine the route with the most gradual grade changes.

Build a Network That Connects People to Community Destinations

The bike boulevard network should conveniently connect people to community destinations and other low-stress bikeways, including multi-use trails. In Albuquerque, the best candidate streets for bike boulevards can be challenging to implement due to the high cost of improving major street crossings. However, the bike boulevard network should strive to connect people as directly as possible to community destinations. Re-routing a candidate bike boulevard to a different street should not create a more indirect route because it will likely be used less than a more direct route.

Figure 2: Candidate Bike Boulevard Route Screening Flow Chart



**Consider collecting information on vehicle speeds and traffic counts for candidate routes if no data is available.*

2) Bike Boulevard Design Elements

Baseline bike boulevard design elements include route identification, reduced speed limits, and traffic controls for minor street crossings. A summary of these elements, as well as their specific treatments, their level of benefits, their level of effort regarding implementation, and notes on the appropriateness of the treatments, is shown in Table 3. Each element is described in detail in the following sections. Note that standard bike boulevard features should be paired with other treatments to reduce traffic volume and manage vehicle speeds.

Elements of a Bike Boulevard

Table 3. Summary of Bike Boulevard Design Elements

	Treatment	Level of Benefit	Ease of Implementation	Appropriateness and Benefit
Route Identification	Wayfinding and Branding	●	○	**Core feature of bike boulevard:** Identifies bike boulevards as streets where people biking are present and should be given priority.
	Shared Lane Markings	◐	○	**Core feature of bike boulevard:** Builds awareness that people biking are present and for navigation.
	Bicycles May Use Full Lane Signs	○	○	**Core feature of bike boulevard:** Creates further awareness that people biking are present and should be given priority.
Reduced Speed and Traffic Volumes	Traffic Calming	●	◐	**Use depends on street conditions:** In many cases, some level of traffic calming is desired to lower motor vehicle speeds to make it comfortable for people biking.
	Traffic Diversion	●	◐	**Use depends on street conditions:** Median and partial road closures reduce vehicle cut-through traffic and create lower-stress conditions for people biking.
	Reduced Speed Limits	◐	○	**Core feature of bike boulevard:** Communicates to people driving that bike boulevards are unique streets and slower vehicle speeds are required.
	Striped Parking Lanes	◐	○	**Use depends on street conditions:** Creates sense of enclosure and narrows drivable space on local roads with on-street parking.
Street Crossings	Enhanced Crossings at Intersections with **Major Streets**	●	●	**Core feature of bike boulevard:** Ensure crossing opportunities for people biking of all ages and abilities; extends network to connection between neighborhoods.
	Prioritize Travel at Crossings with Other **Local Streets**	●	○	**Core feature of bike boulevard:** Appropriate to communicate bicycle priority on the route to people biking and driving.

High ● Medium ◐ Low ○

Route Identification

Route identification is comprised of multiple elements working in conjunction to communicate the location and path of a bike boulevard. These elements include:

- Wayfinding and branding
- Shared lane markings
- "Bicycles May Use Full Lane" signs

Wayfinding and Branding

Definition: Wayfinding is a system of navigational signs that aid people bicycling in reaching their destinations (see Figure 3). Wayfinding signs on bike boulevards should work in conjunction with the rest of the bicycle network, such as bike lanes and multi-use trails and should be designed for people biking of all ages and abilities. The frequency of this treatment should be every two to four blocks, in addition to before and after every turn.

Complementary Treatments: Wayfinding signs should not be considered a stand-alone alternative to, or substitute for, safety improvements. For this reason, it may be desirable to supplement bicycle wayfinding signs with other roadway improvements to accommodate bicycle travel, depending upon motor vehicle speeds and volumes along the route.

Route Based: Many bike boulevard wayfinding systems are route-based, meaning they are designed to identify all routes within a signed bicycle network uniquely. This approach, similar to an interstate system, may be accomplished for bicycle routes by providing a unique sign identifier – a route name, number, letter, shape, color, logo, or some combination of these features.

Figure 3: Wayfinding Sign with Route Name Identification and Advance Turn Notice

Figure 4: Mile Markers along Silver Ave Bike Boulevard

Figure 5: Street Sign Toppers as part Albuquerque Bike Boulevard Network

Shared Lane Markings

Definition: Shared lane markings, sometimes referred to as "sharrows," are roadway stencils that communicate to both the person biking and the person driving. For the person biking, it is one element that communicates the road is a designated bike boulevard (other elements include wayfinding and traffic signage). For people driving, it alerts them to expect people biking on the roadway.

Application and Design Considerations: Shared lane markings should be placed along each block (in each direction of travel), in accordance with guidance from the Manual on Uniform Traffic Control Devices (MUTCD) and may be complemented by bicycle stencils. Shared lane markings can also be used in conjunction with ***wayfinding markings*** to indicate when people biking should make a turning movement. In these cases, the pavement marking can be modified to include a turn arrow that indicates the direction of the turning movement (shown in Figure 7).

Figure 6: Shared Lane Markings with Striped Parking Lanes

Figure 7: Wayfinding Markings

Figure 8: Bicycle Stencil Markings

Shared lane markings should not be considered bikeways unless they are installed with other design features that slow and reduce motor vehicle traffic. The lateral placement of a shared lane marking is measured from the center of the chevron marking to the face of the curb or edge of the pavement. On bike boulevards, shared lane marking placement should be in the middle of the motor vehicle travel lane. This placement guidance is only applicable to bike boulevards and should be reevaluated if they are to be placed on other roadway types.

Guiding Principles for an Effective Bicycle Wayfinding System

Simplicity: Intuitive wayfinding helps people biking navigate and understand where they are in relation to nearby landmarks and destinations. Information should be clear, legible, and simple enough to be understood by a wide audience. In addition, bicycle wayfinding must provide concise messages, revealing enough information without overwhelming the user. Information on each sign should be kept to a minimum to avoid confusion and facilitate quick comprehension. Wayfinding should be placed efficiently to minimize sign clutter.

Legibility: Legibility is a key goal of bicycle wayfinding sign design. Title case (upper and lowercase letters) should be used on all destination signs. Where signs will be read by moving people biking, a font height of 2 in. for the lowercase letters is the minimum height, with 2.5 in or larger recommended to provide adequate sight distance and response time.

Consistency: Wayfinding systems should have common styles, fonts, colors, materials, and placement to promote continuity and help users quickly understand and interpret messages without having to stop their bicycle. Sign frequency and placement should be consistent, so users know what to expect.

Bicycles May Use Full Lane Signs

Definition: Being overtaken by a motor vehicle in a shared lane can cause significant stress to a person bicycling, particularly if they are passed too closely by a vehicle traveling at a higher speed. Some states and cities have passed legislation requiring motor vehicles to provide a minimum clearance when passing a bicycle; the City of Albuquerque's Traffic Code states a minimum passing distance of five feet (§ 8-3-3-10). The frequency of these signs should be approximately two every four blocks (one in each direction of travel).

Application and Design Considerations: To emphasize priority for people biking on a bike boulevard, the BICYCLES MAY USE FULL LANE sign (R4-11 of the Manual on Uniform Traffic Control Devices) may be used in situations where people driving must wait behind slower moving people biking or change lanes to pass a person biking at a safe distance.

Figure 9: Bicyclist May Use Full Lane Sign

Figure 10: Bike Boulevard Speed Limit Sign in Albuquerque

Reduced Speed Limits

Definition: Reduced speed limits do not by themselves reduce vehicle speeds. The standard speed limit on residential streets in Albuquerque is 25 miles per hour (mph); however, bike boulevards currently have a designated speed limit of 18 mph. While 18-mph is not a federally recognized speed limit since it is not an increment ending in 5 or 0, its application is intended to be unique and to catch the attention of people driving on bike boulevards.

Application and Design Considerations: Where lower speed limits are authorized, a Speed Limit sign (R2-1) should be located at the beginning of the bike boulevard and on each block where the reduced speed limit applies to ensure people driving are aware of the reduced limit (see Figure 10). The frequency of regulatory speed limit signs should be two every two blocks (one in each direction of travel).

Narrow Drivable Space and Sense of Enclosure

Striped On-Street Parking

Definition: Striping parallel on-street parking lanes on local roads can narrow the drivable or operating width of a street, causing people driving to slow down. Striped on-street parking also encourages people bicycling to ride more towards the center of the road and avoid colliding with any unexpectedly opened car doors. This treatment should be paired with shared lane markings, wayfinding and branding signage, and other bike boulevard treatments to be considered part of the bike boulevard route identification.

Application and Design Considerations: Striped parking lanes are a preferred technique on bike boulevards and should be implemented throughout a bike boulevard where on-street parking is present. See Figure 6 for an emaple of striped on-street parking in Albuquerque.

Sense of Enclosure Through Design Interventions

Definition: A sense of enclosure can also be created through street trees and traffic calming measures that reduce the drivable area of a street, such as diverters and chicanes.

Application and Design Considerations: See the Traffic Calming Strategies (Speed Management) chapter for additional details.

Parking on Bike Boulevards

Striping parking lanes also creates a sense of enclosure for people in general traveling on the road. Bike boulevards generally travel through low-stress, local roads that have residential homes or small-scale commercial shops. On residential streets, parallel parking can help create a sense of enclosure for people biking, though high parking turnover can create stress for people biking. If a bike boulevard travels through a commercial area, or is located on a wider street, reverse angle parking (also called back-in angle parking) is preferred. See 7-4(H)(2)(ii) in the Development Process Manual for additional

Prioritizing Travel for the Bike Boulevard at Crossings with Other Local Streets

Definition: The general goal of a bike boulevard is to prioritize travel for people biking along the corridor. For crossings of bike boulevards with minor streets, defined as a neighborhood street with a functional classification of "Local Road," the right of way should be prioritized for the bike boulevard route.

Application and Design Considerations: On long corridors with a frequent application of all-way or two-way stop control, the efficiency of travel along the bike boulevard can be improved by removing stop controls and requiring the cross street to stop or yield, or by utilizing roundabouts or mini traffic circles. This strategy for prioritizing people bicycling on bike boulevards should be applied throughout the bike boulevard.

The removal of stop signs can result in increased motor vehicle speeds and volumes or induce cut-through motor vehicle traffic when the bike boulevard parallels a congested arterial or is the only route through an area with few connecting streets. It may be necessary to install traffic calming or diversion treatments to discourage or prevent increased traffic volume, speeds, or both.

Additional parking restrictions may be desirable to "daylight" corners and to improve sight distance at locations where stop signs are removed or yield control is provided. It may also be beneficial to supplement stop or yield signs on side streets with the following plaques or branding strategies to highlight the fact that cross-street traffic, including people biking, do not stop:

- Cross Street Traffic Does Not Stop (W4-4P) plaque (Figure 11)
- Bike boulevard wayfinding sign to highlight the presence of people biking

Figure 11: Example of Cross Traffic Does Not Stop Plaque

3) Traffic Controls and Intersection Treatments at Major Street Crossings

Definitions and General Considerations

Crossings of major streets, defined as either collector or arterial roads, can be a significant barrier along bike boulevards. Local streets will typically have stop control at the approach to the major street, while the major street will be uncontrolled. Enhanced crossings at these locations are critical as a bike boulevard designation implies low-stress connections to community destinations and that people biking of all ages and abilities can safely navigate the route. Intersection crossings should also assume that people walking may utilize the crossing and should include crosswalk markings and accessibility features, along with other appropriate design measures to accommodate people walking and bicycling.

A summary of potential treatments at major street crossings, their level of benefits, level of effort for implementation, and notes on the appropriateness of the treatments, is provided in Table 4. Note that these crossing treatments are context-dependent, and they are optimal when paired with other bike boulevard design elements. Included in the guidance are treatments for offset intersections, which are common features of intersections of local and major streets in Albuquerque. The guidance on street crossings should be used in tandem with the City of Albuquerque *Bicycle and Trail Crossings Guide* (2022).

Table 4. Summary of Traffic Control and Intersection Treatments at Major Street Crossings

	Treatment	Level of Benefits	Ease of Implementation	Appropriateness and Benefit
Crossing Treatments	Traffic Signals, Pedestrian Hybrid Beacons, Rectangular Rapid-Flashing Beacons, Warning Signage and Crosswalk Striping	●	●	**Critical feature at major street crossings**. The specific crossing treatment recommendation depends on the traffic speed and volume of the major street and should follow the guidance from the City of Albuquerque *Bicycle and Trail Crossings Guide* (2022)
	Median Refuge Islands	●	◐	**Critical feature at major street crossings.** Median refuge islands allow for allow people biking to complete the crossing movement in two stages, if needed.
Off-set Intersection Treatments	Bicycle Lane with Two-Stage Bicycle Turn Box	◐	◐	Can be paired with a street median at major street crossings when bike boulevards must follow a major street for short segments.
	Two-Way Separated Bike Lane or Sidepath Connection	●	●	Option for low stress travel when bike boulevards must follow a major street for short segments.
	Staggered Crossing with Raised Median	●	◐	Option for enhancing crossing opportunities at major streets; allows for two-stage crossings.

High ● Medium ◐ Low ○

Traffic Signals and Enhanced Crossings

Definition: Where no crossing treatment for an intersection of a bike boulevard and a major street is present, an evaluation is needed to determine if an enhanced crossing treatment should be installed and/or intersection design improvements to aid people biking to cross the collector or arterial street. All crossings of major streets should include some form of designated crossing.

Application and Design Considerations: Depending on the traffic volume, travel speeds, and number of lanes, a pedestrian hybrid beacon (PHB), or a rectangular rapid flashing beacon (RRFB), or traffic signals may be present to control the major street (see Figure 12). Refer to the *Bicycle and Trail Crossings Guide* for additional details on each crossing treatment types and for the preferred treatment based on street conditions. In general, a PHB should be at least 300 feet or one block from the nearest traffic signal.

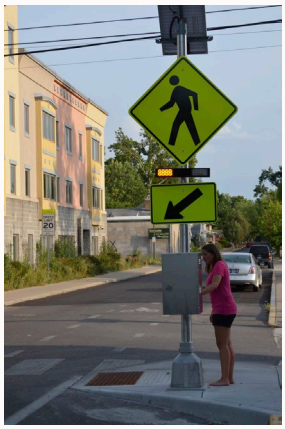
Where traffic signals are present at bike boulevard crossings, it may be desirable to allow coordinated traffic signals to operate on half cycle lengths or to operate in "free" or uncoordinated mode during off-peak hours to reduce delays for people biking and provide frequent service.

In locations where a new crossing is being evaluated, it is appropriate to consider projected bicycle volumes instead of existing volumes when evaluating signal and pedestrian hybrid beacon warrants. The existing volumes may be too low to meet the requirements of a traffic signal warrant but the existing volumes are typically low because there is no existing safe crossing which leads to people biking avoiding the crossing location altogether.

Enhanced Crossings Treatments on Bike Boulevards

A **pedestrian hybrid beacon** (PHB) is an overhead signal that is push-button activated to stop vehicles and allow a safe crossing. See Figure 12 for an example. PHBs are also known as a High-Intensity Activated Crosswalk Beacon (HAWK).

A **rectangular rapid flashing beacon** (RRFB) is a push-button activated beacon that alerts people driving to yield to people walking or biking. See photo below.



Traffic signals are car-oriented lights that indicate when vehicles are allowed to cross an intersection. They are marked with red, yellow, and green lights.

Figure 12: Pedestrian Hybrid Beacon along Fair Heights Bike Boulevard

Source: Google Maps

Offset Intersection Treatments and Travel along Major Streets

In some cases, bike boulevards may not continue directly through an intersection, requiring people biking to make turns or travel for a brief distance on an arterial or collector street before continuing along the same street on the other side of the intersection. These "offset" or asymmetrical intersections require special consideration and treatments to provide a continuous, comfortable path for people biking. Without effective design treatments, offset intersections can become a barrier along the corridor, creating a less attractive bike boulevard.

The following treatments provide examples for improving offset intersections and supporting the needs of people biking of all ages and abilities. In most cases this will require a protected bike lane, off-street sidepath, or a staggered crossing with a raised median to create a high level of comfort while riding along the major street.

Bike Lane with Two-Stage Bicycle Turn Box

Definition: Where roadway space is limited and bike lanes are the preferred treatment or only practical option, the addition of two-stage bicycle turn boxes may be used to create space for people biking to do the following:

- Wait for gaps in traffic at uncontrolled crossings outside of the path of moving traffic or people biking
- Actuate an activated beacon, pedestrian hybrid beacon, or traffic signal via passive detection or a curbside push button

Application and Design Considerations: Space for a two-stage bicycle turn box may be created by restricting parking or recessing the curb to place the two-stage bicycle turn box within the sidewalk buffer (see Figure 15).

Figure 13: Example of a Two-Stage Bicycle Turn Box

Sidepath or Two-Way Separated Bike Lane Connection

Definition: To connect bike boulevard segments across and along major streets, sidepaths and two-way separated bike lane may be considered for short distances on one side of the street (see Figure 16). Since bike boulevards should generally avoid traveling along major streets, this facility type should be used selectively. Where appropriate, sidepaths and separated bike lanes ensure a higher level of user comfort than typical on-street bike lanes and better support travel by people biking of all ages and abilities.

Application and Design Considerations: Where a sidepath or a two-way separated bike lane is provided, the street buffer between the street and bikeway should be made as wide as practical to:

- Improve comfort for people biking operating counter-flow to traffic
- Create queuing space for people biking
- Allow the construction of a protected intersection at the terminus of the bikeway

On-street parking should be eliminated where right-of-way is constrained or where sight lines would be limited with the preservation of parking. Consideration should be given to the use of green-colored pavement within the bikeway, and a bike crossing should be marked to improve visibility and help people biking navigate the facility.

Locating the sidepath or separated bike lane on one side allows for crossings to be concentrated to one location. Where it is determined that traffic control is necessary at the end of the bikeway entering the minor street, yield control is recommended. Where an activated beacon, PHB, or traffic signal is required to cross the street, detection may be passive or provided by a curbside push button.

Figure 14: Example Two-Way Sidepath along Neighborhood Street

Staggered Crossing with Raised Median

Definition: Where a center turn lane is present along the major street, a staggered crossing with a raised median may be provided to facilitate crossings by people walking and biking. The typical configuration of a staggered crossing requires a two-stage crossing action and has the benefit of forcing people walking and biking to turn slightly toward traffic before crossing.

Application and Design Considerations: For crossings of lower volume two-lane streets, a couplet of center bicycle-only left turn lanes may be used to facilitate an offset crossing along a bike boulevard (see). Center-

left turn lanes are appropriate where there are sufficient gaps between vehicles to allow bicycles to enter the left turn lane.

To improve comfort and safety, a raised curb or other form of vertical separation between the bike lane and adjacent travel lane is strongly recommended. A striped buffer may also be considered; however, this treatment places people biking in the middle of the major street and should be limited to locations where major road vehicle speeds 30 mph or lower.

Figure 15: Examples of Staggered Crossings with Raised Medians along Bike Boulevards in Albuquerque

4) Traffic Calming Strategies (Speed Management)

Traffic calming strategies focus on reducing motor vehicle travel speeds and traffic volumes. This section summarizes techniques for reducing speed through horizontal and vertical deflection treatments, including their respective benefits, level of effort for implementation, and notes on the appropriateness of the treatments. Note that these elements are context-dependent and are most effective when paired with other bike boulevard treatments.

Table 5: Summary of Traffic Calming Treatments

	Treatment	Level of Benefits	Ease of Implementation	Appropriateness
Horizontal deflection treatments	One-Lane Pinch-Points	●	◐	Appropriate in mid-block locations on local roads and not adjacent to major streets.
	Chicanes	◐	◐	Appropriate in mid-block locations on long blocks and along street segments with few stop control devices.
	Neighborhood Mini Traffic Circles	●	◐	Appropriate at the intersection of two local streets in periodic locations along the bike boulevard. Desired spacing is every two blocks.
Vertical deflection treatments	Speed Humps	◐	◐	Appropriate at periodic locations throughout a bike boulevard (e.g., every 200-400 feet), depending on existing travel speeds and target design speed); should not be placed on blocks immediately approaching a major street.
	Raised Crosswalks and Speed Tables	●	●	Appropriate near neighborhood destinations with high foot traffic or at intersections of bike boulevards with major streets where the speed limit is 30 MPH or less.
	Raised Intersection	●	●	Appropriate at intersections adjacent to destinations with high foot traffic.
	Speed Cushions	●	◐	Appropriate at periodic locations throughout a bike boulevard (e.g., every 200-400 feet) depending on existing travel speeds and target design speed; speed cushions should not be placed on blocks immediately adjacent to a major street.

High ● Medium ◐ Low ○

Traffic calming strategies are particularly important when the drivable or operating width of the road is greater than 20 feet, assuming on-street parking is striped and the drivable width can be reduced by 16 to 20 feet. Table 6 outlines the need for design interventions based on the curb-to-curb width of the street.

Table 6: Curb-to-Curb Width and Potential Design Interventions

Curb-to-curb Width	Design Interventions
<40 feet	Sense of enclosure can be created through striping on-street parking. Mini-traffic circles should be considered to further
40 to 46 feet	Street is too wide for striped parking to create a sense of enclosure and too narrow for on-street bike lanes. Additional design interventions desired.
>46 feet	Street is likely too wide to achieve modest motor vehicle travel speeds through striped parking and horizontal deflection techniques. Use of bike lanes or an alternative route should be considered.

Horizontal Deflection Treatments

Horizontal deflection treatments require people driving to slow down to adjust to a visually narrower roadway or accommodate a shifting or curving travel lane. Horizontal deflections may require more upfront planning than vertical deflections, but they offer more flexibility in managing vehicle speed and volume. The main strategies for managing automobile speed include:

- One-lane pinch points
- Chicanes
- Neighborhood mini traffic circles

Pinch Points

Definition: Pinch-points require people driving to yield as they approach this treatment (see Figure 17). Treatments to create pinch-points include curb extensions, chokers, and diverters, which narrow a roadway to one travel lane.

Figure 16: Road Narrows Plaque

Application and Design Considerations: This treatment may be most appropriate on two-way streets with more than 18 feet of operating width, streets with low parking demand, or streets with parking on one side.

Pinch-points may benefit from the addition of edge line striping and a ROAD NARROWS sign (W5-1) approaching the location where visibility to the pinch point is limited (see Figure 16). The frequency of pinch points may be one every 600 to 800 feet and should be evaluated based on traffic analyses. For more information on techniques that create pinch-points, see the City of Albuquerque *Neighborhood Traffic Management Program*.

Figure 17: Example of One Lane Pinch Point

Chicanes

Definition: Chicanes are a series of curb extensions, pinch-points, parking bays, or landscaping features that alternate from one side of the road to the other. Chicanes should be designed to reduce vehicle speeds by requiring people driving to shift laterally through narrowed travel lanes (see Figure 18). This can be accomplished by shifting the path of travel from one-half of the street to one full lane width.

Application and Design Considerations: Chicanes require sufficient width within the travel lane and careful consideration of parking availability. Areas where parking is restricted should be clearly identified with signs, and in some cases supplemented with markings or physical features to prevent parking in places that could create conflicts. The addition of curb extensions or islands may help prevent parking near the chicane. Where space permits, chicanes should be placed approximately every 200 to 400 feet.

It may be desirable to add a center line and edge line markings to guide users through a chicane and to encourage people driving to stay in their lane. For more information on chicanes, see the City of Albuquerque *Neighborhood Traffic Management Program*.

Figure 18: Example of Chicane Use as Traffic Calming Treatment

Neighborhood Mini Traffic Circles

Definition: Neighborhood mini traffic circles may be used to slow vehicle approach speeds to intersections with uncontrolled or yield-controlled approaches (see Figure 19). In this configuration, the mini traffic circle is intended to prevent speeding and cut-through motor vehicle traffic while still allowing people biking to continue through minor local street intersections without having to come to a complete stop. It is also acceptable to allow stop control at mini circles in either two-way stop or all-way stop control configurations.

Application and Design Considerations: Mini traffic circles vary in size and have different design criteria than roundabouts. The circle should be designed to slow passenger vehicles while still allowing occasional access for larger emergency vehicles. The frequency of these mini traffic circles should be at every quarter mile or less, with more frequent spacing (e.g., every other intersection) preferred.

To improve safety for people bicycling, mini traffic circles and approach streets should have clear sight lines and should be clearly signed and marked to guide navigation around the circle. Sufficient lighting should be provided to ensure the mini traffic circle is visible to reduce crash risk for people biking who could potentially strike the street element at night. Reflective markers can also be placed along the edges of the traffic circle to increase their visibility in low light and nighttime conditions. For more information on traffic circles, see the City of Albuquerque *Neighborhood Traffic Management Program*.

Figure 19: Mini Traffic Circle along Silver Ave Bike Boulevard

Vertical Deflection Treatments

Vertical deflections, or vertical speed control measures, are wide, slight pavement elevations that result in slower driving speeds. The primary geometric characteristics of vertical deflections are the height, length, width, and approach and departure ramp slopes of the device. Well-designed vertical deflections allow vehicles and people biking to proceed over the device at the intended speed with minimal discomfort. Vertical deflections should be indicated with pavement markings so they are visible to both people driving and people biking. Where visibility is a concern, warning signs should be considered. Vertical deflection treatments include:

- Speed humps, raised crosswalks and speed tables
- Raised intersection
- Speed cushions

See the City of Albuquerque Neighborhood Traffic Management Program for additional guidance on vertical deflection techniques.

Speed Humps, Raised Crosswalks and Speed Tables

Speed humps, raised crosswalks, and speed tables can be effective devices to reduce speeds along a bike boulevard. To have the intended impact, they should be placed strategically along the route. For example, a speed table combined with a pedestrian crosswalk can be an effective gateway treatment at the entrance to a bike boulevard to indicate to a person driving a motor vehicle that they are entering an area where lower speeds are expected (see Figure 20). Raised crosswalks are also an effective strategy to slow the turning speeds of motor vehicles entering a roadway. Where speed humps are used to control speeds, they are most effective when they are placed periodically along the route (e.g., every 200 to 400 feet) to reinforce speed control.

Stormwater flow should be accommodated when considering vertical deflection treatments. To minimize cost during retrofit installations, the raised device may have a side taper to the edge of the street to allow stormwater to continue to flow along existing gutters.

Figure 20: Example of Raised Crosswalk and Raised Intersection

Raised Intersection

Similar to raised crosswalks, raised intersections are constructed to elevate the entire intersection to sidewalk level and are designed to provide approach ramps that are similar to raised crosswalks. This strategy may be appropriate at intersection locations where the following conditions exist:

- Bike boulevards turn to a cross street
- The intersection is offset
- People biking may need to make a diagonal crossing to access a park, school, or other destination
- Locations where trucks and other large vehicles must routinely turn
- Locations where priority for people walking is desired
- Intersections with higher volume streets or signalized locations where speed humps, speed bumps, or raised crosswalks are not appropriate

Raised intersections require careful consideration of pedestrian accessibility requirements. At a minimum, the provision of a continuous detectible warning surface will be required at all locations where a flush pedestrian route intersects the street edge.

Speed Cushions

Speed cushions are similar to speed tables but are designed with cutouts to allow wider wheelbase vehicles and people biking to bypass the raised portion of the device. They may be built with a variety of approach ramp profiles. These devices are typically placed in pairs and centered in a travel lane to prevent people driving from bypassing them. The frequency of speed cushions should be every 200 to 400 feet. See Figure 21 for an example.

Figure 21: Example of Speed Cushion

5) Traffic Diversion Strategies (Volume Management)

Traffic diversion treatments are volume management tools used to reduce through-traffic on bike boulevards. They may consist of "soft" treatments, which rely on compliant behavior (e.g., posting turn restrictions) or hardscape treatments, which force compliant behavior through geometric design. Diversion strategies will typically maintain local motor vehicle access to residences and businesses along the bike boulevard while diverting people driving on through trips to other streets.

A summary of these elements, as well as their specific treatments, their level of benefits, level of effort of implementation, and notes on the appropriateness of the treatments, are contained in Table 7. Note that these bike boulevard elements are context-dependent, and they are optimal when paired with other bike boulevard treatments. Designs can be modified as needed to allow emergency vehicle access by providing cut-through slots to match emergency vehicle wheelbases or by providing lowered curb heights so emergency vehicles can drive over the elements in an emergency.

Table 7. Summary of Traffic Diversion Treatments

Treatment	Level of Benefits	Effort of Implementation	Benefits and Appropriateness
Regulatory Signs	○	○	Signage alone has minimal benefit and is more effective when implemented in conjunction with infrastructure changes.
Major Street Medians	●	●	Medians at intersections of local streets along a bike boulevard and an arterial or collector significantly limits the amount of cut through motor vehicle traffic along the bike boulevard.
Diagonal Diverters	●	●	Diverters are appropriate on bike boulevards with high vehicular volumes as they entirely restrict through access for people driving. Significant outreach to residents is needed.
Forced Turns and Partial Closures	●	◐	Forced turns and partial closures are appropriate at bike boulevard intersections with local and major streets and can reduce the amount of cut through motor vehicle traffic along the bike boulevard.

High ● Medium ◐ Low ○

Major Street Medians

Definition: Raised medians at major street crossings can be constructed to restrict motor vehicle access on local streets while allowing through movements for people bicycling and walking (see Figure 22). Major street medians can be highly beneficial on bike boulevards by limiting through traffic for motor vehicles.

A key consideration is whether it is desired to provide people walking and biking a single-stage or two-stage crossing. A single-stage crossing is when people walking or biking cross the entirety of the street in one stage. A two-stage crossing is when the people walking or biking are given a signal or expected to cross one direction of motor vehicle traffic to the median before waiting for another signal or break in traffic to cross the other direction of traffic in a second stage. In all locations, the median should extend outside the limits of the intersection to prevent people from driving around them.

Application and Design Considerations: A refuge median is desirable to allow a two-stage crossing when used at controlled and uncontrolled crossings of major streets with multiple travel lanes in each direction. The median should be a minimum of 6 feet wide to allow people biking to take refuge in the median without

sticking out into active motor vehicle traffic lanes. A 10-foot or wider median is preferred to accommodate larger groups of people biking as well as people biking with trailers or on larger bikes.

The primary design consideration in a median or hardened centerline opening is the alignment of approaching people driving to the median. Where the median opening is located in the perceived line of travel for a person driving a motor vehicle, the median opening should be designed to discourage people driving from attempting to enter the bicycle crossing.

A secondary design consideration is whether it is desired to provide a median opening space for people biking to pass through the median that is separate from people walking. This can be accomplished by providing separate median openings for each direction of bicycle travel and limiting the opening to a width between 5 and 6.5 feet. At locations where people biking can cross the roadway in a single stage or where there are traffic signals, the median may be a hardened centerline or as narrow as two feet. Median openings can also be designed to allow emergency vehicles to cross them by straddling the island and passing over it while also discouraging people driving from crossing them.

Uncontrolled crossings should be evaluated to confirm whether other treatments may be necessary, including providing active traffic control devices such as PHBs, RRFBs, or traffic signals to facilitate the crossing. For more information, see the City of Albuquerque *Bicycle and Trail Crossings Guide*.

Figure 22: Raised Median along Silver Ave Bike Boulevard

Diagonal Diverters

Definition: Diagonal diverters prevent through motor vehicle movements in all directions at street intersections, requiring people driving to turn left or right while allowing people biking to continue through the intersection at smaller cut-through locations at the ends of the diverter (Figure 23). Diagonal diverters are typically installed at four-way intersections of local streets and require a physical barrier to restrict motor vehicle access and force people driving to turn off the bike boulevard. Diagonal diverters may be constructed with curb extensions with or without drainage channels at the curb, bollards, or a guardrail.

Application and Design Considerations: Like a median or hardened centerline used for traffic diversion, the diagonal diverter must allow people biking to pass through. This can be accomplished by providing a median opening between 5 and 6.5 feet in width for each direction of bicycle travel; a refuge space is not required because of the lower volume and lower speed local street context. A separate accessible pedestrian route should be provided. Diagonal diverters may be placed along a bike boulevard at locations

where traffic volumes exceed acceptable vehicular volumes and where redundant residential access exists. For more information, see the City of Albuquerque *Neighborhood Traffic Management Program*.

Forced Turns and Partial Closures

Definition: The ends of a two-way street can be converted to one-way motor vehicle traffic by installing an island or a curb extension to force people driving to turn. This design also restricts people driving from turning onto or continuing along the bike boulevard. A type of forced turn diversion strategy could involve a "toucan crossing" in which both people biking and people walking (i.e., "two can") cross. This type of crossing requires traffic diversion to restrict left turns and through traffic from the minor street. A simplified version of a toucan crossing is a partial or half closure, which prohibits vehicular traffic from entering a street. This partial closure includes openings for people bicycling or walking to access the street and continue traveling.

Application and Design Considerations: This design may be considered at the intersection of two local streets or at major street crossings if it is not desirable to install a controlled crossing treatment. The geometry of a forced turn or partial closure requires people driving to turn right from the minor street while allowing people biking to proceed. Forced turns and partial closure treatments should minimize the extent to which people biking must pass through a constrained space between curbs or vertical elements.

Figure 23: Example of Diagonal Diverter and Partial Street Closure with Bicycle Cut Through along Local Street

Regulatory Signage

Motor vehicle traffic may be restricted along bike boulevards through the use of mandatory turn signs (R3-1 or R3-2 from the MUTCD), as shown in Figure 24. These should be supplemented by right and/or left turn pavement marking arrows to emphasize the restriction. Signs and pavement markings alone may not be effective at discouraging motor vehicle access. All signs should include an EXCEPT BICYCLES plaque to allow people biking to have access to the bike boulevard. For more information on signed turn restrictions, see the City of Albuquerque *Neighborhood Traffic Management Program*.

Figure 24: Examples of Regulatory Signage