Tucson BikeHAWK

Adapting the Pedestrian Hybrid Beacon to Assist Bicyclists in Crossing Arterial Streets

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INTRODUCTION

The Pedestrian Hybrid Beacon (PHB) or HAWK has been successfully used by communities around the nation to facilitate safe, convenient crossings of busy, high-speed roadways by pedestrians since its inclusion in the 2009 edition of the Manual on Uniform Traffic Control Devices (MUTCD). While not excluding their use, standard PHBs have never explicitly accommodated another large user group in need of the same facilitation to cross arterials: bicyclists. In 2012, the City of Tucson began efforts to modify select PHBs to allow for the clear and safe crossing of both user groups.

Starting in the 1980s, the City of Tucson shifted its focus from simply providing bike lanes along arterial and collector roadways to identifying existing residential streets that could be enhanced to provide a network of calm, low-stress bikeways. Having identified these routes (now termed bike boulevards), the city endeavored to improve this network by reducing automobile traffic, encouraging bicyclist use, and most critically, addressing how to safely and conveniently cross major streets where they intersect these bike boulevards.

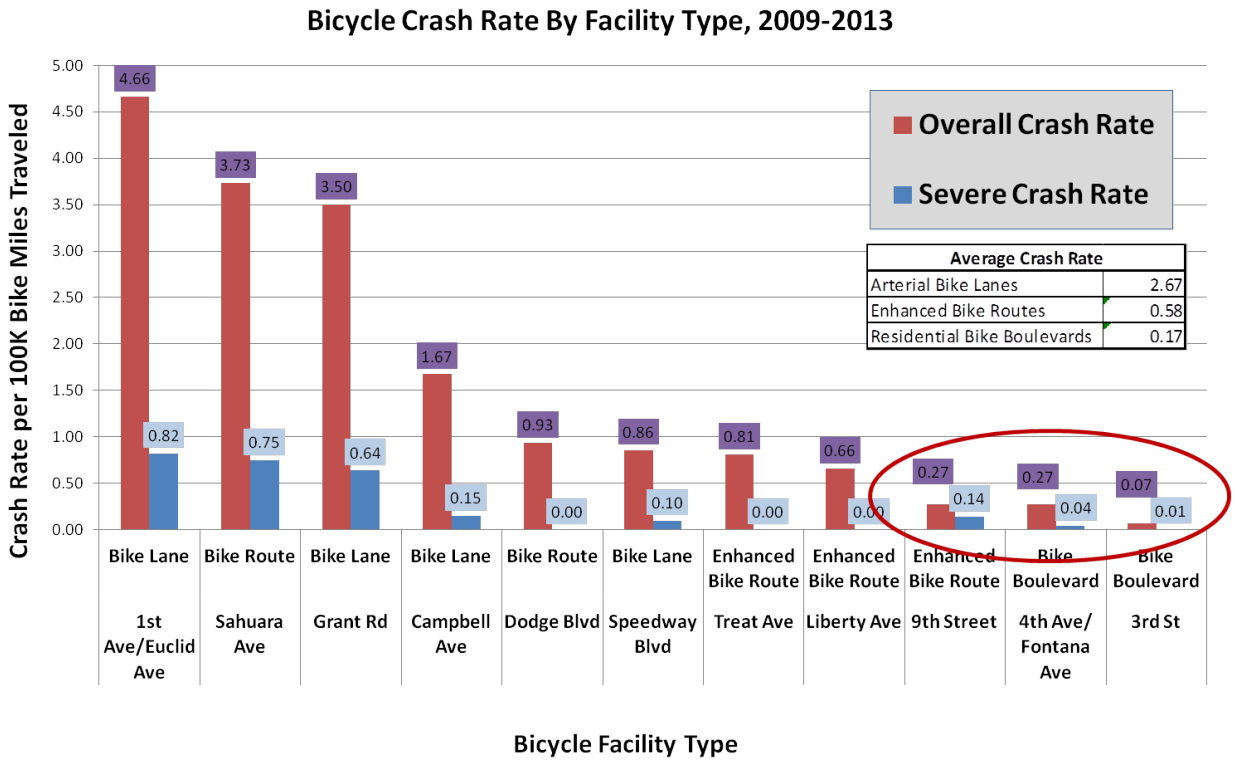
BACKGROUND

Bicycle boulevards function as residential streets along cycling "desire" lines designed to prioritize bicycling. The bicycle boulevard network serves as the backbone for biking in the Tucson region. Bicycle boulevards support several community values, including improving the health of Tucsonans, and providing safe and equitable transportation options. The Tucson Department of Transportation and Mobility has identified over 200 miles of existing and future bicycle boulevards along over 60 corridors that improve connectivity to schools, parks, libraries, commercial zones, County bike paths and other key destinations.

Bicycle boulevards typically include the defining features and traffic engineering tools to:

- Lower residential speeds with special 20 mph limits posted
- Traffic control devices and designs to reduce or eliminate "cut-through" arterial traffic desires
- PHBs to assist walkers and cyclists in crossing arterial streets in ease and safety

Bicycle boulevards vary in character to reflect the unique neighborhoods they travel through. Most importantly, however, they experience a significantly lower crash rate compared to facilities with arterial bicycle lanes.



While traditional traffic signals can sometimes be utilized as a method to provide safe crossings, they have the undesirable effect of attracting traffic to the residential streets they serve, increasing car traffic, and ultimately running contrary to the inherent purpose of bicycle boulevards.

In Tucson, prior to the implementation of the Bike HAWK, many crossing locations already had a Pedestrian Hybrid Beacon (PHB), alternatively known as a HAWK (**H**igh intensity **A**ctivated cross**W**al**K**), to assist crossing pedestrians. Federal studies noted that HAWK crossings have a consistently high driver yielding rate and are an approved traffic control device (use and operation detailed in "Signals" part 4 of the Manual of Uniform Traffic Control Devices (MUTCD)). Methods on how to achieve the same excellent driver response and facilitate bicycle crossings was undertaken by the City of Tucson and Pima Association of Governments (PAG), the Metropolitan Planning Organization for the Tucson region, to improve the operation and safety of the bicycle boulevard concept. The design was ultimately named the BikeHAWK.

A key to the BikeHAWK's success is that it is designed to match the observed behavior of bicyclists crossing at locations with existing HAWKs. The conversion of a HAWK into a BikeHAWK operation is easily accomplished. The first BikeHAWK was installed in 2012, with many currently installed throughout the city and more planned for or in design thanks in part to a new, voter-approved bond program.

The following section explains Tucson's experience with the BikeHAWK design, which uses a combination of MUTCD-approved signs, signals, and markings to guide bicyclists through the intersection of bike boulevard residential streets and arterial streets.

PURPOSE

As the MUTCD notes, the PHB or HAWK does not control a whole intersection, but rather controls only a crosswalk at an intersection, like other pedestrian crossing beacon devices. As a result, bicyclists using a PHB find that for one direction of travel they are not on the same side of the road as the PHB. As previously noted, the BikeHAWK design took a human factors approach, observing bicyclists' behavior at a number of existing HAWK crossing locations. The BikeHAWK design was then developed by trying to match what the crossing bicyclists actually do to help further ensure high compliance and safety.

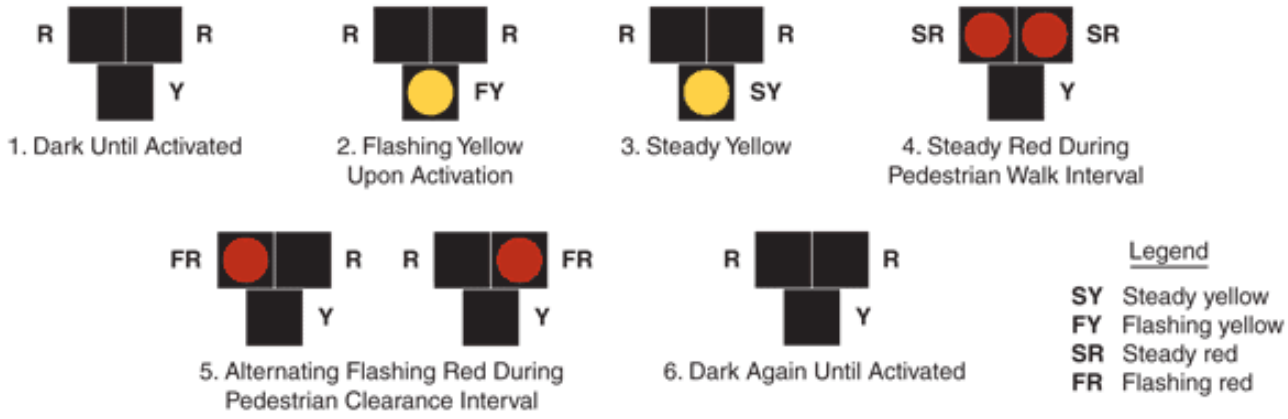
METHOD

Each entrance to the BikeHAWK on the low volume residential street has a clearly marked, two-way separated contra-flow bike lane painted green. Vertical separation is provided by a channelized curb and flexible delineator posts. This design technique slows vehicles and keeps the motor vehicles away from the entrance to the BikeHAWK. The green separated bike lane legitimizes the observed, or normal, movement by the approaching bicyclist frequently from the

near center of the residential street toward the BikeHAWK crossing, regardless of whether the bicyclist is on the left side or right side of the residential street. The green lane guides bicyclists to the proper position to activate the beacon at a curb-side pushbutton allowing the bicyclist to avoid dismounting to use the pedestrian pushbutton on the sidewalk. The separated contra-flow bike lane also narrows the width of the residential street at the major street intersection which provides the added benefit of traffic calming on the residential street.

At the crossing point itself, bicyclists see adjacent to the high-visibility crosswalk an eight-foot wide high-visibility green path designated for their use. The bicyclist is directed to observe the pedestrian signal (MUTCD R9-5 sign: [BIKE SYMBOL] USE PEDESTRIAN SIGNAL). The BikeHAWK timing is identical to the PHB operation. After the normal YELLOW clearance warnings and optional clearance buffer the BikeHAWK shows solid RED indications to the arterial traffic and a WALK indication with R9-5 signs for the bicyclist and pedestrian, sequence 4. When the PHB moves to the flashing RED interval, the pedestrian WALK indication becomes the flashing DON'T WALK clearance interval, sequence 5. After a second optional buffer period the beacon returns to the dark mode again, until reactivated. (source: MUTCD 2009 Signals part 4, Figure 4F-3)

Figure 4F-3. Sequence for a Pedestrian Hybrid Beacon



In order to provide further guidance to the bike rider and discourage late entries into the crossing a supplemental sign was developed to further explain the operation. In Tucson, a dynamic supplemental illuminated sign was developed since word messages are MUTCD allowed to inform and/or educate roadway users of regulatory requirements. The supplemental sign is coordinated with the pedestrian signal circuit and reads orange BIKES WAIT or white BIKES OK depending upon the appropriate interval of the PHB crossing. BIKES WAIT is illuminated during the PHB dark period and the solid RED period. When the pedestrian is shown a WALK indication, the supplemental illuminated sign displays a BIKES OK indication. The supplemental illuminated sign then displays a flashing orange BIKES WAIT during the pedestrian clearance interval and rests in solid BIKES WAIT when the PHB is resting in the dark mode and the pedestrian signal rests in the DON'T WALK HAND.

As previously mentioned, the sign was not required since the MUTCD approved R9-5 is available, however the city chose to provide the additional dynamic safety message under the authority granted by the MUTCD part 2B.02 where other regulatory messages may be developed to aid the enforcement of other laws or regulations.

Even though the majority of the bicyclists entered the crossing area at the PHB in a nearly identical fashion, they left the crosswalk using a variety of paths. Thus, the final design of the BikeHAWK encourages the better of the various exiting behaviors via signs and markings. The same green separated bike lane that serves the entering bicyclists is also used by exiting bicyclists. As the bicyclist leaves the separated bike lane they normally gravitate back to the center or just right of center on the narrow residential street. The two-way separated bike lane segment allows bicyclists to ride a short distance in the contra-flow direction before crossing; this return movement is similar to a left turn into or out of a driveway on the side street and does not need any special warning; even so, “sharrows” are installed to provide warning. At the end of the contra-flow lane, signs advise bicyclists that they are about to be riding in the wrong direction and that they need to ride the appropriate direction with traffic. To provide further protection to the cycling traffic as they return to the residential street, drivers are not allowed to turn-right-on-RED from the arterial onto the residential street. Initially, there was a concern about bike riders having to enter and leave the contra-flow lane, however safety issues did not materialize since the bicycle boulevard residential street was a small, low speed 20 mph street and the cyclists frequently rode near the center of the street away from the parked cars making entry into and exit from the contra-flow green lane a convenient and safe maneuver.

RESULTS

In summary, the key elements of the BikeHAWK include:

- A short, separated green contra-flow bike lane to position bicyclists into an area delineated by flexible posts.
- Placement of curbside signal detection buttons in easy reach of bicyclists.
- Use of green pavement markings in a high-visibility crosswalk pattern adjacent to the high-visibility white crosswalk.
- MUTCD-approved signing advising cyclists to observe pedestrian signals (R9-5).
- MUTCD-approved signs encouraging bicyclists to ride with traffic after the crossing has been completed and it is safe to make the maneuver (R5-1b and R9-3cP).
- Supplemental illuminated sign to further support the (R9-5) sign and assist the rider in crossing

Because the design matches bicyclists' observed behavior and current traffic laws, along with the MUTCD, Tucson has found that very little education has been necessary to achieve high compliance by all road users.

See news video report, *Stop lights can... RUIN a street for bicyclists?* YouTube https://www.youtube.com/watch?v=Dk8uhfFCtM0

CONCLUSIONS AND OTHER CONSIDERATIONS

The BikeHAWK has been well-received by the bicycle advisory groups, law enforcement, and pedestrian safety and neighborhood support community groups. Back in 2012, local news media interviewed bicyclists at one of the busier BikeHAWKs, and all bicyclists indicated they understand and appreciate the new traffic control device. The most common theme in their response is that it makes them feel safer when crossing the busy arterial street. Peak-period pedestrian and bicycle counts conducted at the BikeHAWK, which serviced a transit stop, community college and medical center were done by the Pima Association of Governments. During their normal counting program, it was noted that:

- 96% of the riders use the BikeHAWK as designed.
- 100% of family riders with children or children alone use the BikeHAWK;
- 94% of the crossers were bicyclists and 6% were pedestrians.
- The device was easily understood by all users and bicyclists followed the designated paths with ease.
- There was the normal high level of driver compliance to the crossing device, especially at the high-speed crossings in the range from 97% to 100% yielding behavior by drivers.
- 50% of riders using the BikeHAWK were males, 46% were females, and 6% were children. (This level of female ridership is significantly higher than the average regional percentage and is considered an indication of perceived safety)

Late entries by the pedestrians with the current pedestrian and countdown signal happen often at traditional traffic signals. The same behavioral issue is occasionally true for the PHB crossings. Thus, it was felt that cyclists were better informed of the clearance interval requirement to not enter the crossing by the supplemental dynamic BIKES WAIT and BIKES OK illuminated sign that was powered in parallel with the pedestrian signal circuit.

Initially, it was attempted to time the supplemental bicycle illuminated sign separately from the pedestrian signal to provide a longer bicycle crossing interval. However, common timing of the illuminated bike supplemental sign with the pedestrian signals was found more desirable. The common operation reduced pedestrian error danger if a pedestrian inadvertently presses the curbside bicycle button and only receives the shorter clearance crossing time.

Pedestrian and bicycle compliance jumped from approximately 70% to over 90% when the city converted the operation to a “HOT” command operation. This change in operation significantly improved traffic operations by reducing the false stop for an empty crosswalk since the pedestrian or cyclist crossed during a natural gap. The hot button operation had no significant impact upon the level of service for the vehicular movement along the arterial which remained in the upper LOS (level of service) ranges.

To date, there have been no reported bicycle or pedestrian crossing fatal crashes or injuries at a BikeHAWK installation. One never knows what is going to happen tomorrow, but these devices have been in successful operation for the last 10 years.

The Tucson BikeHAWK is a recognized as a best practice and in the University of North Carolina Safety Research Center - FHWA Pedestrian and Bicycle Information Center, https://www.pedbikeinfo.org/resources/resources_details.cfm?id=4950

Human factors have played a significant role in the design of the BikeHAWK traffic control device technique. It is better to design to what the people will do, not what they are supposed to do. The BikeHAWK design matched the behavior of cyclists currently using the PHB when crossing an arterial. It was observed pedestrians, especially children, push all the buttons on the corner. The pedestrian dangers of receiving a shorter bicycle clearance time accidently instead of the full pedestrian clearance time if the wrong button was pushed was eliminated with the common operation. This parallel circuit operation resulted in no ill effects for the bicycle or arterial LOS. The placement of the supplemental illuminated sign provided further information to the assist the cyclist in following the pedestrian signal indication.

In addition, people respond well to “immediate response” and the city has now removed nearly all the PHB units from a background double cycle synchronization program and operates them with a “HOT” demand button. This technique of providing immediate recognition of a crossing request gives the system credibility, reduces delay to the pedestrians, who frequently cross when a natural gap occurs, and drivers no longer are forced to wait at an empty crosswalk.

RECOMMENDATIONS

The Tucson BikeHAWK employs traffic control devices and techniques that are already approved by FHWA and the MUTCD (note: the green pavement marking currently requires interim approval) and are widely understood by the public.

The green two-way separated bike lane section further protects the bicyclists by identifying their area and keeping vehicles from encroaching into the bikes' area. In addition, the flexible posts were observed to result in slower vehicular turning movements on to and off of the residential street, creating an additional traffic-calming effect for the residential street and crossing protection.

The Tucson region has over 150 PHBs or HAWKs in operation since their initial installation in 2000, including 31 BikeHAWKs currently in operation since their first installation in 2012. Another 18 BikeHAWKs are programmed to be in operation by the beginning of 2023 and 34 more programmed by Fiscal Year 26.

Most importantly, the Tucson BikeHAWK technique meets the current MUTCD 2009, matches the natural behavior of the bicyclists and pedestrians, helps maintain residential neighborhood traffic calming, and is available for use by the profession now.

With bicyclist and pedestrian traffic fatalities growing alarmingly high in recent years, innovative and effective treatments like the Tucson BikeHAWK are in desperate need. The Tucson BikeHAWK is another technique to get everyone home safe and sound.