

BICYCLE & PEDESTRIAN DATA COLLECTION PROJECT: Phase II (Road Diet Analysis) Final Report

San Antonio, Texas

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Prepared for:



Prepared by:



Background and Introduction

The San Antonio area has a need for alternate means of transportation other than single-occupant motor vehicles, including the non-motorized modes of bicycling and walking. Toward that end, the San Antonio-Bexar County Metropolitan Planning Organization (MPO) funded the first phase of this Bicycle & Pedestrian Data Collection Project (fully documented in a separate final report) to evaluate existing bicycling and pedestrian conditions in the region and provide its member jurisdictions with data necessary to improve those conditions.

Reallocating existing pavement to create space for new bicycle lanes is one of the most popular and cost-effective ways that jurisdictions throughout the United States are improving bicycling conditions within their communities. The data collected during the first phase of the project included all of the geometric and traffic characteristics needed to identify candidates for these “road diet” and roadway restriping projects. Accordingly, this second phase of the project (the Road Diet Analysis) carries out that identification process.

The results of the analyses indicate that there exists a significant opportunity to improve bicycling conditions in the San Antonio region at a potentially very low cost to the implementing jurisdictions. In fact, of the nearly 1,700 centerline miles of roads on the study network, more than 1,100 (68%) either have an existing facility (as defined herein), currently provide an acceptable level of bicycling accommodation, or can be retrofitted to include new bicycle facilities through non-construction projects that reallocate existing pavement. These findings make it evident that San Antonio can become a leading major U.S. city in providing an extensive bicycle network with the potential to make bicycling a viable mode of transportation.

This Phase II final report is comprised of two sections: 1) a description of the methodology and the resulting recommendation types, and 2) representative case studies from throughout the San Antonio region that illustrate conceptual examples of

how some of the identified candidate projects could be implemented. The companion Roadway Pavement Reallocation Implementation Guide is included for reference as an appendix. The analysis database and corresponding results (tabular and graphical) are separately available through the MPO.

Bicycle Facility Recommendation Types and Implementation Methodology

Road diets typically involve the removal of travel lanes (where excess motor vehicle capacity exists) to create space for paved shoulders or designated bike lanes. A similar technique, roadway restriping, reduces existing lane widths to create these same bicycle facilities. While the stated intent of this project is to identify candidate roadways for road diets and roadway restriping projects, the Project Oversight Committee,¹ at the suggestion of the consultants, decided to broaden the analyses and subsequent recommendations to include a bicycle facility recommendation for each of the study network segments.

The analysis results, contained in a separate spreadsheet, include six possible recommendations for each evaluated segment:

- Existing/Programmed Facility;
- Bicycle Level of Service Met;
- Roadway Restripe Candidate;
- Road Diet Candidate;
- Add Paved Shoulders; and
- Detailed Corridor Study Needed (DCSN).

The analysis was carried out in accordance with the decision tree shown in Figure 1. The remainder of this section describes the processes involved for each of the decision points.

¹ This Committee, the same as the Phase I Committee, is comprised of MPO staff and members of the MPO's Bicycle Mobility Advisory Committee (BMAC).

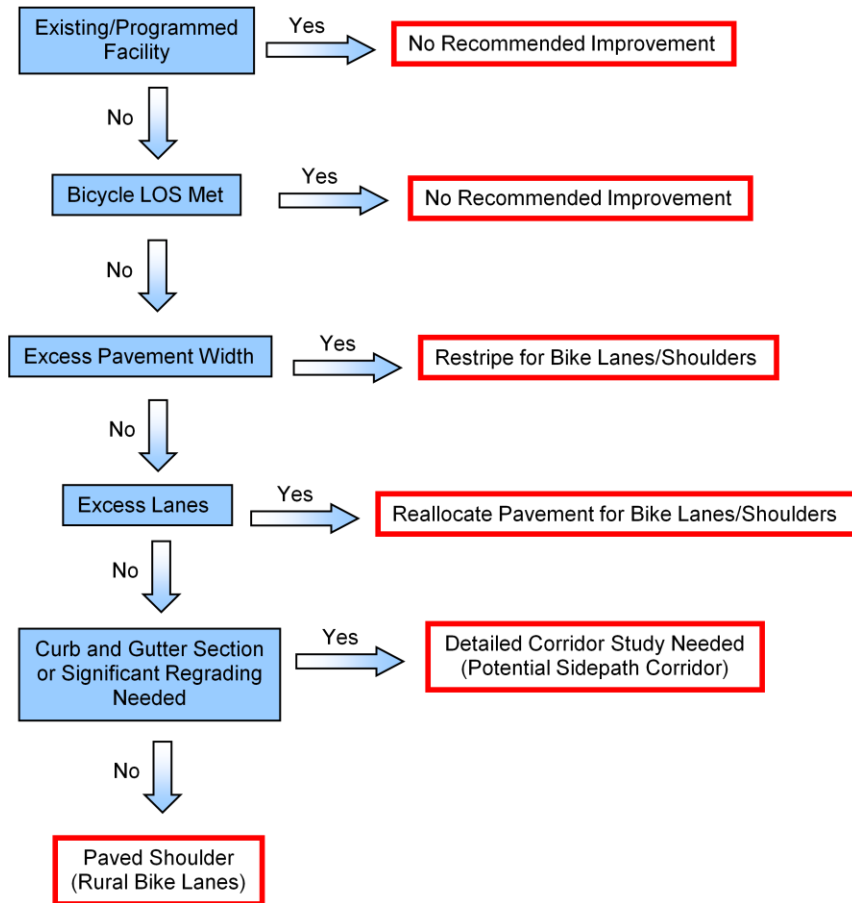


FIGURE 1 Bicycle Facility Decision Tree

Existing/Programmed Facility

The three primary implementing jurisdictions for the study network (City of San Antonio (CoSA), Bexar County, and Texas Department of Transportation (TxDOT) have indicated that a paved shoulder or designated bike lane must be at least four feet wide (exclusive of any space within a striped shoulder where occupied on-street parking occurs) to be considered an existing facility for the bicycle mode. As the primary purpose of this second phase of the study is to identify study segments where new bicycle facilities can be retrofitted, locations where a facility already exists were identified as such and filtered out of the subsequent steps of the analysis. Locations where paved shoulders or designated bike lanes are already programmed for construction (*i.e.*, funding has been secured and a construction timeline has been set)

were also included in this category. Sources for programmed facilities include the Bexar County Capital Improvement Program, the TxDOT Project Tracker Database, the CoSA Infrastructure Management Program, and CoSA bond projects. This category includes 395 miles, or approximately 24% of the study network.

Bicycle Level of Service Met

The consultants analyzed every study network segment during Phase I to determine the existing level of accommodation provided to bicyclists. A bicycle level of service score, ranging from “A” (best) to “F” (worst), was calculated. The bicycle level of service methodology is the same technique that has been applied for two prior MPO studies; the method is now slated for inclusion in the 2010 *Highway Capacity Manual*. There are many cases where a relatively high level of accommodation can be achieved even in the absence of a striped shoulder or bike lane. This situation frequently occurs on low-volume (including low-truck volume) local and minor collector streets with typical or greater than typical lane widths.

The Oversight Committee collectively established, for this study, a bicycle level of service threshold of “B” for local and collector streets and “C” for arterial streets. Arterials located within one mile of the existing/planned linear creekway system have been assigned, for the purposes of this MPO study, a higher threshold of “B.” All segments without an existing or programmed facility where the threshold level of service is nonetheless met (396 miles, or approximately 24% of the study network) are included in this category.

Roadway Restripe Candidates

Among strategies commonly used to improve bicycling conditions, roadway restriping is frequently considered the most desirable solution. This is because of the very low (or effectively non-existent, if performed in concert with scheduled resurfacing) associated cost and the existence of excess lane width on many streets. For this reason, roadway restriping was the first option analyzed for the study network after those segments with

existing/programmed facilities and those where the threshold accommodation level has been met were filtered out of the process.

The implementing jurisdictions provided different minimum lane widths to be used for the identification of excess lane widths for conversion to paved shoulders or bike lanes. Bexar County set a minimum width of 12 feet, TxDOT 11 feet, and CoSA 10 feet.² Based on the controlling jurisdiction, each segment was assigned a minimum lane width. The analysis spreadsheet was then programmed to determine whether the total pavement width (TPW) of each roadway segment is sufficient to leave space for four feet of bicycle facility in each direction of travel while preserving the minimum lane width for all other travel lanes. Several other specifications were considered in this portion of the analysis:

- The TPW is typically the width from one edge of the roadway to the other edge, but for divided roadways is only from one edge of the roadway to the raised median. This is done because roadway restriping assumes that no median reconstruction will occur.
- For segments that include a two-way left turn lane, a minimum width of 14 feet was designated to maintain the two-way left turn lane.
- For segments with existing striped on-street parking, a minimum width of eight feet in each direction was designated to maintain the parking lanes.
- Segments with existing un-striped on-street parking which are ultimately identified as restripe candidates have been given a special designation in the database indicating that a more detailed parking study will need to be performed to confirm feasibility of the restripe project.

All segments that were shown to have space for bicycle facilities while meeting the above requirements have been designated roadway restripe candidates. A total of 258

² CoSA roads that either coincide with VIA Metropolitan Transit bus routes or have significant horizontal curvature should maintain a minimum lane width of 11 feet, per the Oversight Committee.

miles of restripe candidates, or approximately 16% of the study network, have been identified.³

Road Diet Candidates

While the removal of travel lanes to create bicycle facilities is also relatively inexpensive to implement, restriping is typically a less noticeable change to a roadway and should generally be considered first. Road diets are frequently considered when a preliminary analysis indicates that sufficient capacity exists to effectively accommodate motor vehicle traffic for the foreseeable future with the reduced number of lanes. Such preliminary planning-level analyses have been performed for this project to identify road diet candidates. Significantly more detailed operational analyses should be carried out for individual sections before moving forward with any of the identified projects.

The motor vehicle capacity analyses use the projected 2025 model year volume for each segment, as supplied by the MPO. Such volumes exist for approximately 85% of the study network. For the remaining 15%, the existing (base year 2007) volume was projected out to 2025 by applying a 3.2% annual growth rate.⁴

Planning-level estimates of future year motor vehicle capacity are feasible through the use of generalized level of service tables. Generalized level of service tables are based upon default values using the *Highway Capacity Manual*. One state agency, the Florida Department of Transportation, has developed generalized motor vehicle level of service tables⁵ that are widely utilized throughout the United States, and in fact formed the basis for a similar earlier project for the San Antonio-Bexar County MPO. The tables use default values for different area types for many traffic variables such as K-factor, D-factor, peak hour factor, and g/C ratio. The lookup tables produce a level of service

³ An additional 177 miles of segments represent restripe candidates where the bicycle level of service threshold is already met. These roadways could be restriped, but the benefit would not be as great because of the relatively good existing bicycling conditions on those roadways.

⁴ This value represents the average growth for the segments for which 2025 model volumes were available. It is also similar to the average growth rate used in Phase I of this project.

⁵ *2009 Quality/Level of Service Handbook*, Florida Department of Transportation.

result based on roadway class (determined through average signal spacing, which was field-collected during Phase I), traffic volume, and number of lanes. These lookup tables were programmed into the analysis database.

For segments that do not fall into one of the previously described categories, the number of lanes was hypothetically reduced (e.g., 4-lane to 2-lane) to determine the resulting future year motor vehicle level of service. The results were compared against the adopted level of service standard (“C” for all implementing jurisdictions) to see where excess capacity exists. A total of 90 miles of study network (5%) fall into this category.⁶

Add Paved Shoulder

This analysis goes beyond the original scope of the project to identify two additional facility type recommendations. One of these is the addition of paved shoulders to roadways with rural (without curb and gutter) cross-sections. While more expensive than restriping and road diet projects, constructing paved shoulders on the outside of the existing edge of pavement is still much less expensive than projects that involve reconstruction of the roadway. For a network segment to be considered a candidate for adding paved shoulders, it must meet two criteria: 1) have an open shoulder cross-section, and 2) have a relatively flat roadside profile (a value of 1 on the 1-3 scale used during the Phase I data collection) to eliminate the need for significant regrading. Of the remaining unclassified segments, 123 miles (7% of the study network) meet these criteria. For these potential projects, each implementing jurisdiction should perform a follow-up detailed feasibility review.

Detailed Corridor Study Needed (DCSN)

Many study segments present minimal opportunity for improving bicycling conditions through any of the identified roadway retrofit strategies discussed above. Specific

⁶ An additional 17 miles of segments represent road diet candidates where the bicycle level of service threshold is already met. These roadways could potentially have a road diet applied, but the benefit would not be as great because of the relatively good existing bicycling conditions on those roadways.

bicycling-related improvements to these segments (401 miles representing the remaining 24% of the study network) will require extensive and detailed operational-level investigations of the constraints and opportunities along these corridors. Several specific opportunity options, which are briefly discussed below, can and should be investigated by the implementing jurisdictions to better accommodate bicycling on the DCSN-designated corridors. Closing these challenging gaps can greatly increase connectivity of the bicycling network and improve neighborhood linkages, thereby promoting increased bicycling activity and leading to associated public health, environmental, and energy savings benefits.

Many of the DCSN corridors have 4-lane undivided cross-sections wherein the interior lanes function as de facto left turn lanes into commercial driveways and side streets. It is possible some of these segments would benefit from a road diet, not only from the bicycle perspective but also for motorists. This can occur because removing the interior lanes and replacing them with a two-way left turn lane can reduce delays associated with blockages caused by left turns. In addition to reducing delays, converting undivided roads into roads with two-way left turn lanes has been shown to significantly improve roadway safety. Consequently, implementing jurisdictions should consider more detailed operational analyses of these undivided DCSN corridors to determine whether a road diet would be feasible and desirable.

Other DCSN corridors may be potential “sidepath” candidates. Sidepaths are shared use paths adjacent to the roadway (*i.e.*, in the same right-of-way). General estimates of right-of-way width were collected during Phase I, but individual corridor studies would be needed to verify the extent of available rights-of-way as well as the design options and feasibility of developing a sidepath⁷ along any given segment.

⁷ While sidepaths appear to many to be appropriate bicycle facility alternatives, crash statistics and operational challenges from across the United States and around the world provide ample warning that in many settings, they are not (see AASHTO *Guide for the Development of Bicycle Facilities*, pp.33-35). Preliminary corridor-specific design is needed for each to determine their feasibility from an operational/safety standpoint. For more information on the design requirements of sidepaths see Petritsch, T.A., B.W. Landis, H.F. Huang, and S. Challa, “Sidepath Safety Model: Bicycle Sidepath

Finally, in a limited number of cases, jurisdictions should consider the use of alternative parallel routes for DCSN corridors. Provision of a bicycle facility on a built-out urban arterial may be financially or otherwise infeasible. However, there may be a parallel lower-volume local street, perhaps offset by only a block, that could sufficiently accommodate bicycle travel while still providing reasonable access to commercial destinations along the arterial roadway. A parallel street might be made to better accommodate bicyclists through geometric or operational improvements, such as implementation of a bicycle boulevard design. Again, a detailed operational analysis would be required to confirm whether the potential implementation of the improved parallel routes could be applied along a particular corridor.

Summary

Table 1 below a summary of the facility recommendations by segment and by associated mileage. The results indicate that there is ample opportunity to improve bicycling conditions for the San Antonio Region’s residents and visitors at a potentially very low implementation cost.

TABLE 1 Summary of Results

Facility Type	# of Segments	Segment %	# of Miles	Mileage %
Existing/Programmed Facility	274	16%	395	24%
LOS Met	458	28%	396	24%
Restripe Candidate	311	19%	258	16%
Road Diet Candidate	83	5%	90	5%
Add Paved Shoulders	109	7%	123	7%
DCSN	417	25%	401	24%

Design Factors Affecting Crash Rates” *Transportation Research Record 1982*, Transportation Research Board, Washington, DC, 2007.

Analysis Database and Graphic Display of Findings

The companion spreadsheet illustrates, in tabular format, the analysis procedure that was carried out for the nearly 1,700 network segments. It includes several of the data items from the Phase I data collection, including segment length, number of lanes, roadway configuration, lane widths, and the calculated bicycle level of service (existing bicycling conditions). It also shows some of the newly collected items necessary for the recommendation of a facility type including the level of service target, the minimum lane width, and the projected 2025 traffic volume. The final column of the database shows the recommended facility type for each network segment.

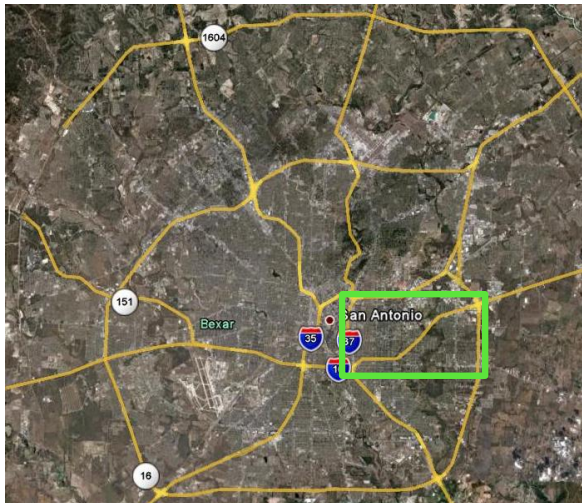
These recommended facility types are also shown in a GIS display of the results. Specific line types have been developed for the recommendations; these are designed to show both the existing bicycle network and the abundant opportunity for new connections.

Representative Case Studies

The series of analyses described in the previous section led to the identification of numerous potential roadway restriping and road diet projects throughout the San Antonio region. From this group of opportunities, the Project Oversight Committee selected numerous roadway restripe and road diet candidates as “case studies” for further discussion and the development of proposed reconfigured cross sections. Each case study discussion in this section provides the candidate location’s setting, the existing multi-modal characteristics, the specifics of the proposed modification, and the benefits to bicycling conditions that would be achieved. Finally, a “before” photo and companion “after” photo show the existing and potential future cross sections.

Beyond identification of opportunities, this MPO study also offers guidance regarding implementation of the recommendations. Several of the operational aspects introduced in these case studies are further discussed in the Roadway Pavement Reallocation Implementation Guide appendix.

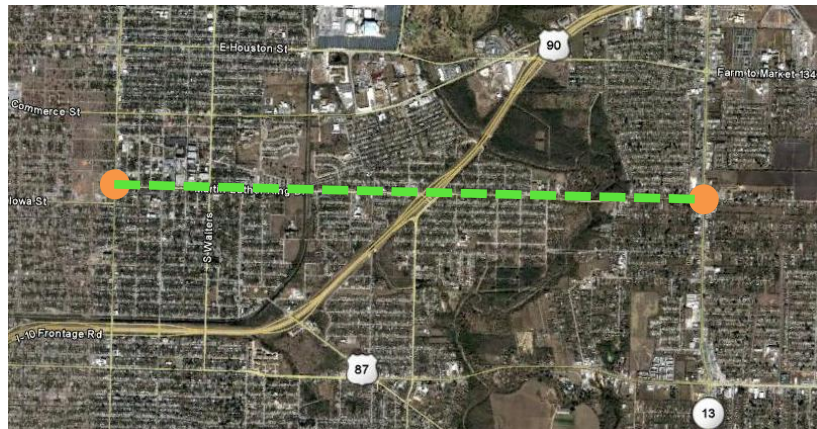
Martin Luther King (New Braunfels to W.W. White)



Martin Luther King is a four-lane undivided roadway. It extends for more than three miles from New Braunfels eastward to W.W. White, as shown in the Google Earth image below. Throughout its length it passes through residential areas of small-lot single-family homes. The posted speed limit is 35 mph and the current daily traffic volume is approximately

7,000 vehicles. Transit service is provided by VIA Route 26, which has 30-minute headways during peak periods. Aside from a couple of small gaps, sidewalks are present throughout the corridor. Bicycling conditions are relatively poor; the bicycle level of service is “D.”

The detailed examination of Martin Luther King’s geometric and traffic characteristics performed during Task 2 indicates that it is a potential road



diet candidate. Road diets, as stated in the December 2009 Analysis Report, involve the removal of travel lanes (where excess motor vehicle capacity exists) to create space for bike lanes. Where feasible, they are an inexpensive and quickly implementable solution for improving bicycling conditions. The traffic volume for Martin Luther King is expected to increase by several thousand vehicles (to as high as 13,000) by 2025. Nonetheless, this projected volume

indicates that it may provide acceptable level of service for the automobile mode as a two-lane road, thereby making it a road diet candidate. In its current configuration, the total pavement width is 42 feet.

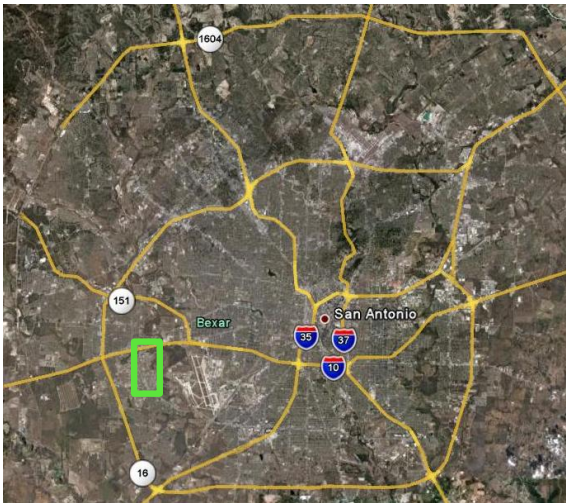
It may be desirable, as part of a road diet project on Martin Luther King, to add five-section cluster signals at signalized intersections to allow for protected left turn movements. If this is done, then the signal loops should be evaluated, and relocated if necessary, to prevent the false detection of through motorists as left turning vehicles. In addition, the signal timing should be reviewed as some additional green time may be needed on Martin Luther King after the road diet is implemented.

The proposed road diet configuration, shown in the accompanying graphic, would include a four-foot bike lane and an 11-foot lane in each direction with a new 12-foot two-way left turn lane.

The proposed road diet would improve bicycling conditions on Martin Luther King by 22% to level of service “C,” which meets the identified target for this roadway.



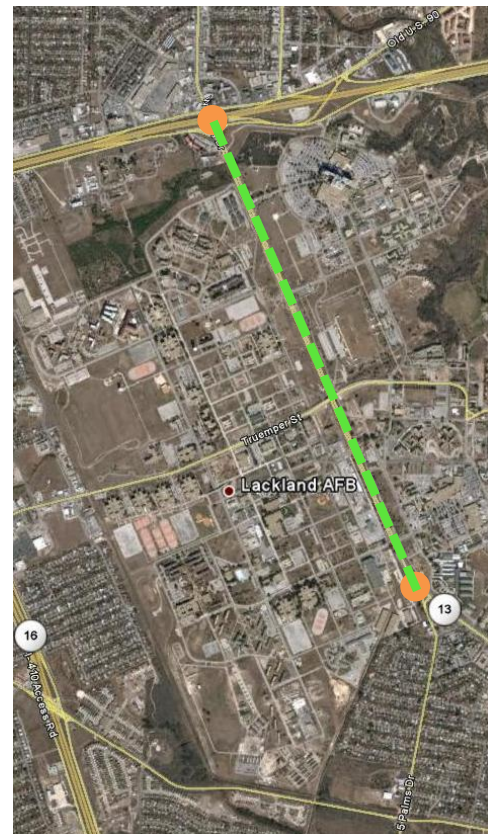
Military Drive (US 90 to Five Palms)



This section of Military Drive is a six-lane divided roadway. It serves as the western portion of a major east-west corridor in Southern San Antonio. This section of Military Drive is approximately two miles long and passes through the middle of Lackland Air Force Base. The current daily traffic volume is approximately 43,000 vehicles, which operate with a posted

speed limit of 45 mph. Local transit service is provided by VIA Routes 614 and 619, supported by regional circulation routes 550 and 551. Sidewalks are largely absent along the corridor. Bicycling conditions are poor; the bicycle level of service is “E.”

The detailed examination of Military Drive’s geometric characteristics, performed during Task 2 of this study, indicates that it is a potential roadway restriping candidate. As described in the December 2009 Analysis Report, roadway restriping involves the narrowing of existing travel lanes (where surplus pavement exists) to create space for bike lanes. Where feasible, restriping is an inexpensive and quickly implementable solution for improving bicycling conditions. Military Drive’s projected 2025 daily traffic volume of nearly 46,000 precludes the possibility of reducing its number of lanes as part of a road

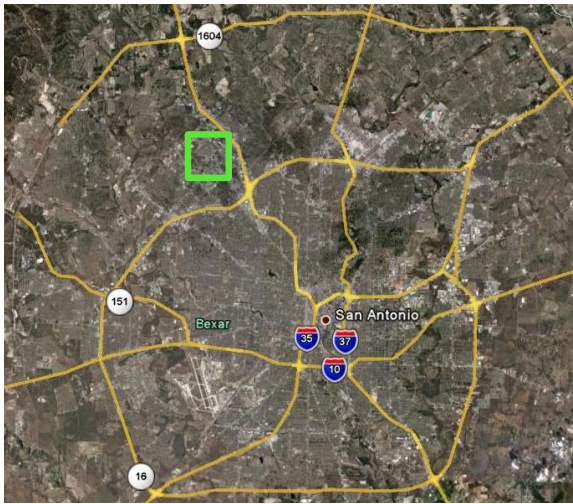


diet. However, the existing pavement width of 37 feet on either side of the raised median does allow sufficient space for roadway restriping. As shown in the accompanying graphic, a four-foot bike lane can be created while maintaining 11-foot lanes, which is the minimum identified for this study for TxDOT roadways.

While this roadway restriping strategy would improve bicycling conditions by 13% along this section of Military Drive, the level of accommodation provided to bicyclists would nonetheless remain poor, primarily because of the very high traffic volume and operating speed. Compounding this situation is the lack of alternative parallel routes because of the presence of the air force base. In addition to the roadway restriping, it may be appropriate to conduct a more detailed feasibility analysis for a shared use path adjacent to the roadway, as it appears that right-of-way may be available.



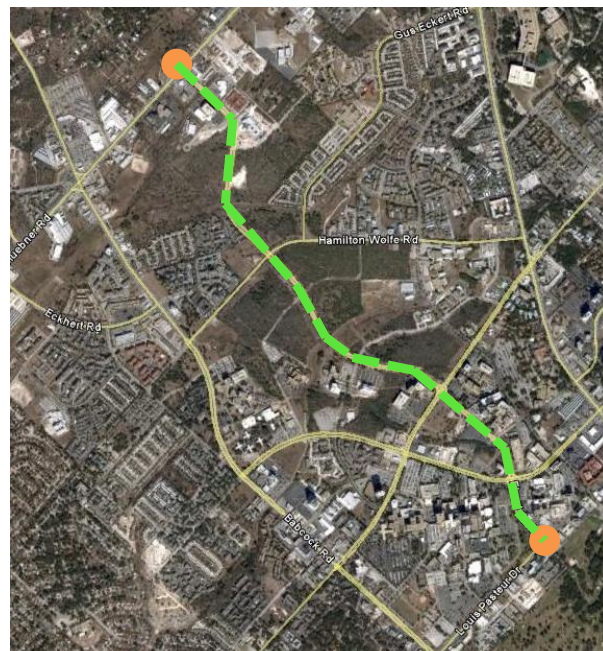
Floyd Curl (Louis Pasteur to Huebner)



Floyd Curl is a four-lane divided roadway located outside Loop 410 in northwestern San Antonio. The southern portion of the road provides access to the Medical Center area. Most of the land immediately adjacent to the northern portion is currently vacant, although several residential communities are nearby. The current daily traffic volume is approximately

9,000 vehicles, which operate with a posted speed limit of 30 mph. Transit service is provided by VIA Route 522, which has 30-minute headways during peak periods. Medical Drive, which crosses Floyd Curl, has been identified as a candidate for future Bas Rapid Transit (BRT) service. Sidewalks are present for more than half of the length of the corridor. The existing bicycle level of service is “D” (relatively poor bicycling conditions).

The Task 2 detailed examination of Floyd Curl’s geometric and traffic characteristics indicates that it is a potential road diet candidate. As described in the December 2009 Analysis Report, road diets involve the removal of travel lanes (where excess motor vehicle capacity exists) to create space for bike lanes. Where feasible, they are an inexpensive and quickly implementable solution for improving



bicycling conditions. The traffic volume for Floyd Curl, which is projected to remain fairly constant (near 10,000 vehicles per day) in the coming decades, indicates that it may provide acceptable level of service for the automobile mode as a two-lane road, thereby making it a road diet candidate. In its current configuration, each side of the divided roadway has 25 feet of pavement. Even with the inclusion of a five-foot bike lane, space remains abundant. This situation makes Floyd Curl an ideal candidate for the installation of buffered bike lanes, also known as “comfort lanes.” Comfort lanes provide a painted separation between the newly created bike lane and the remaining travel lane. The accompanying graphic shows the proposed cross-section, which consists of a 15-foot lane and a five-foot bike lane with a five-foot area of separation between them.

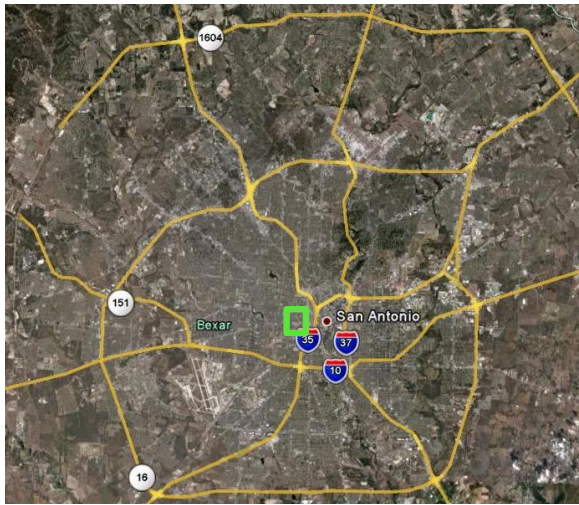
As part of a road diet project on Floyd Curl, the signal timing should be reviewed as some additional green time may be needed on Floyd Curl after the road diet is implemented. Additionally, as right turning motorists will likely (and operationally should) move into the buffered bike lane area to make right turns, the signal loops should be evaluated. If the false detection of right turning motorists as through vehicles is likely, a delayed detection should be implemented to allow for the right on red or, if necessary, the loops in the bike lane should be relocated or removed.

The benefits that this proposed road diet offers to bicyclists on Floyd Curl are immense. As mentioned above, the current configuration provides a bicycle level of service of “D.” The provision of a bike lane in the post-road diet configuration would improve the level of service to “A,” representing a 100% improvement in bicycling conditions. The true benefits of the additional buffer of comfort lanes have not been fully researched. It is expected that comfort lanes offer an additional psychological benefit to bicyclists (beyond simply the additional space provided between the bicyclist and the motor vehicles) because of the striping of

the buffered area. Further, it provides many of the benefits of a separated but adjacent shared use pathway, possibly without many of the operational problems (AASHTO *Guide for the Development of Bicycle Facilities*, pp. 33-34) associated with those types of facilities.



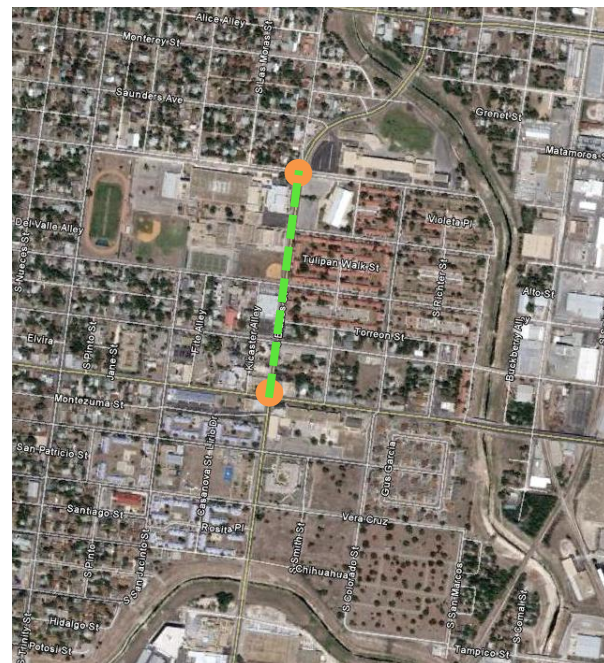
Brazos (Guadalupe to Durango)



This section of Brazos is a four-lane undivided roadway. It runs for approximately three-tenths of a mile through a residential area (single-family and multi-family) just west of downtown San Antonio. The northern half of the corridor fronts the property of Lanier High School, with Tafolla Middle School and Brackenridge Elementary School also within close

proximity. The current daily traffic volume is approximately 8,000 vehicles and the posted speed limit is 30 mph. Transit service is provided by VIA Route 66, which has 15-minute headways. Sidewalks are present throughout the corridor. The existing bicycle level of service is “D” (relatively poor bicycling conditions).

The Task 2 detailed examination of the geometric and traffic characteristics of Brazos indicates that it is a potential road diet candidate. As described in the December 2009 Analysis Report, road diets involve the removal of travel lanes (where excess motor vehicle capacity exists) to create space for bike lanes. Where feasible, they are an inexpensive and quickly implementable solution for improving bicycling conditions. The traffic volume for this section of Brazos, which is projected to increase only minimally (to near 10,000 vehicle per day)



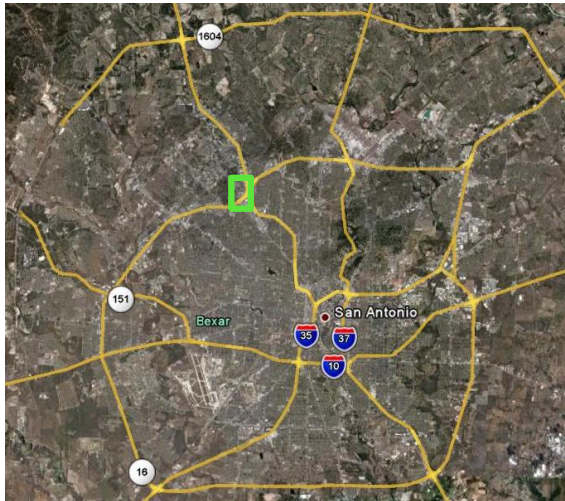
between the present and 2025, indicates that it may provide acceptable level of service for the automobile mode as a two-lane road. In its current configuration, the total pavement width is 42 feet. The proposed road diet configuration, shown in the accompanying graphic, would include a four-foot bike lane and an 11-foot lane in each direction with a new 12-foot two-way left turn lane.

It may be desirable, as part of a road diet project on Brazos, to add five section clusters at signalized intersections to allow for protected left turn movements. If this is done, then the signal loops should be evaluated, and relocated if necessary, to prevent the false detection of through motorists as left turning vehicles. In addition, the signal timing should be reviewed as some additional green time may be needed on Brazos after the road diet is implemented.

The proposed road diet would improve bicycling conditions on this section of Brazos by 23% to level of service “C,” which meets the identified target for this roadway.



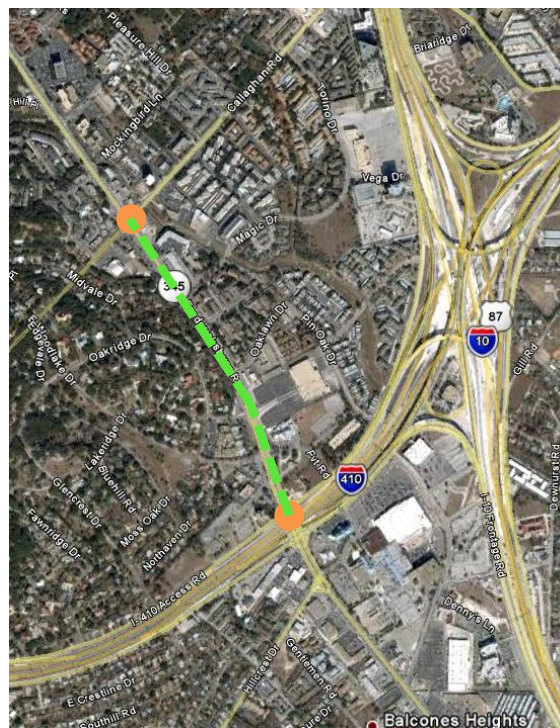
Fredericksburg (Loop 410 to Callaghan)



This section of Fredericksburg is a six-lane roadway with a two-way left turn lane. It begins at the highly commercial interchange of IH 10 and Loop 410. As it runs northwestward, the frontage continues to be commercial but the surrounding area becomes residential. The current daily traffic volume is approximately 53,000 vehicles with a posted speed limit of 40 mph. Frequent

transit service is provided by VIA Routes 91, 92, and 509. This section is part of a corridor that has been identified as a candidate for future Bus Rapid Transit (BRT) service. Sidewalks are present throughout the corridor. The existing bicycle level of service is “E” (poor bicycling conditions).

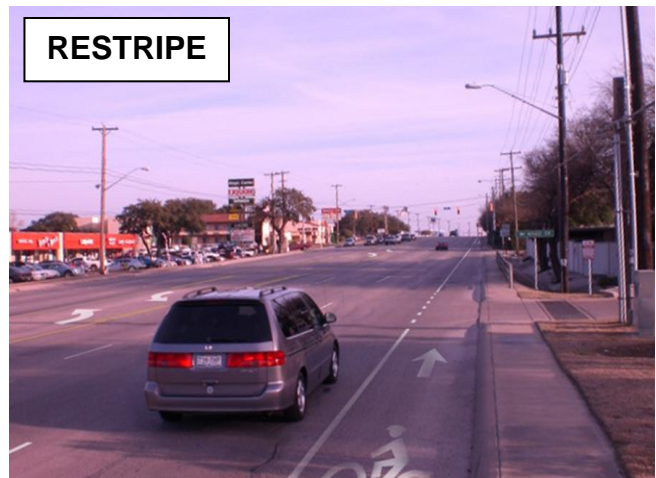
The Task 2 detailed examination of Fredericksburg’s geometric characteristics indicates that the corridor is a candidate for roadway restriping. The December 2009 Analysis Report describes roadway restriping as the narrowing of existing travel lanes (where surplus pavement exists) to create space for bike lanes. Where feasible, restriping is an inexpensive and quickly implementable solution for improving bicycling conditions. The projected 2025 daily traffic volume of nearly



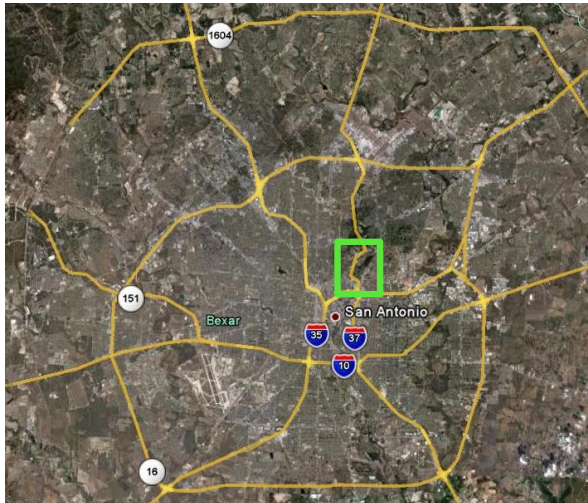
54,000 precludes the possibility of performing a road diet by reducing the number of lanes. However, the existing pavement width of 90 feet (including the two-way left turn lane) does allow sufficient space for roadway restriping. As shown in the accompanying graphic, a five-foot bike lane can be created while maintaining a 14-foot two-way left turn lane and 11-foot lanes, which is the minimum identified for this study for TxDOT roadways.

It may be desirable, as part of a road diet project on Fredericksburg, to add five section cluster signals at signalized intersections to allow for protected left turn movements. If this is done, then the signal loops should be evaluated, and relocated if necessary, to prevent the false detection of through motorists as left turning vehicles. In addition, the signal timing should be reviewed as some additional green time may be needed on Fredericksburg after the road diet is implemented.

The proposed road diet would improve bicycling conditions on this section of Fredericksburg by 26% to level of service “D,” and very close to the target bicycle level of service “C.”



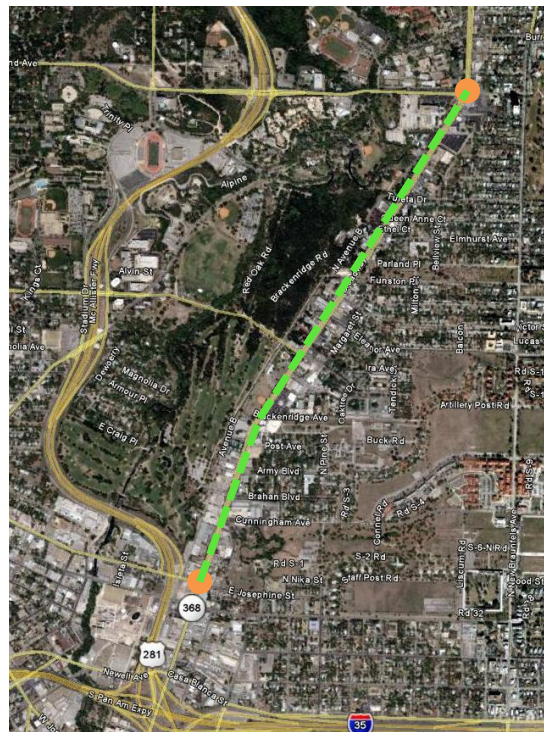
Broadway (Josephine to Hildebrand)



This section of Broadway is a six-lane roadway with a two-way left turn lane. It begins just northeast of downtown San Antonio and extends northeastward for more than 1.5 miles with Brackenridge Park, the San Antonio Zoo, Trinity University, and the University of the Incarnate Word to the west and Fort Sam Houston to the east. Land use along

the corridor consists of varied and relatively low-density commercial properties. The current daily traffic volume is approximately 24,000 vehicles with a posted speed limit of 35 mph. Frequent transit service is provided by VIA Routes 9, 10, and 14. It should be noted that this section of Broadway is under study as a later phase for the streetcar service planned for the section of Broadway immediately to the south. Sidewalks are present throughout the corridor. The existing bicycle level of service is “D” (relatively poor bicycling conditions).

The detailed examination of Broadway’s geometric and traffic characteristics, performed as part of Task 2 of this study, indicates that it is a potential road diet candidate. The December 2009 Analysis Report describes road diets as the removal of travel lanes (where excess motor vehicle capacity exists) to create space for bike lanes. Where feasible,

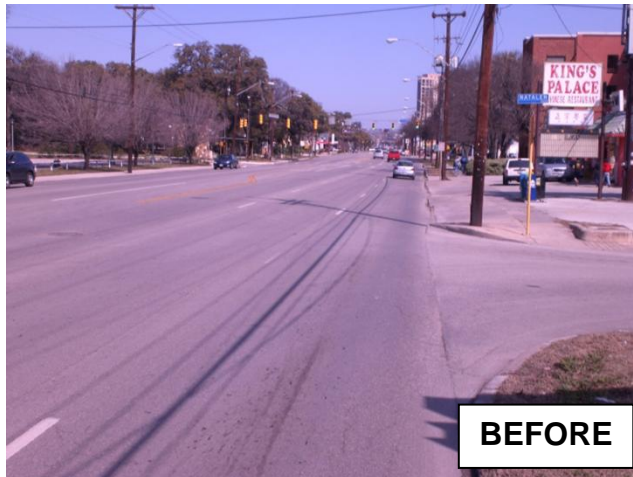


they are an inexpensive and quickly implementable solution for improving bicycling conditions. The daily traffic volume for this section of Broadway is expected to increase to approximately 28,000 thousand vehicles by 2025. Nonetheless, this projected volume indicates that it may provide acceptable level of service for the automobile mode as a four-lane road. In its current configuration, the total pavement width (including the two-way left turn lane) is 72 feet. The proposed road diet configuration, shown in the accompanying graphic, includes a five-foot bike lane and two 11-foot lanes in addition to the existing two-way left turn lane. This leaves six additional feet, rendering this section of Broadway a candidate for the installation of buffered bike lanes, also known as “comfort lanes.” Comfort lanes provide a painted separation between the newly created bike lane and the remaining travel lanes. In this case, three feet of space can be striped adjacent to the bike lane to create a comfort lane.

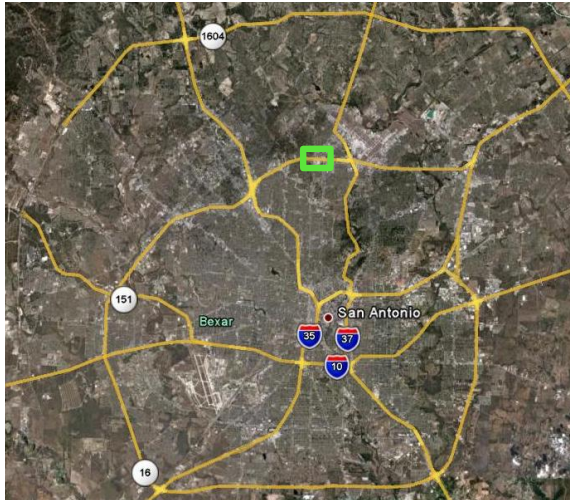
As part of a road diet project on Broadway, the signal timing should be reviewed as some additional green time may be needed on Broadway after the road diet is implemented. Additionally, as right turning motorists will likely (and operationally should) move into the buffered bike lane area to make right turns, the signal loops should be evaluated. If the false detection of right turning motorists as through vehicles is likely, a delayed detection should be implemented to allow for the right on red or if necessary the loops in the bike lane should be relocated or removed.

The benefits that this proposed road diet offers to bicyclists on Broadway are immense (a 66% improvement in conditions). As mentioned above, the current configuration provides a bicycle level of service of “D.” The provision of a bike lane in the post-road diet configuration would improve the level of service to “A.” The true benefits associated with the additional buffer of comfort lanes have not been fully researched. It is expected that comfort lanes offer an additional psychological benefit to bicyclists (beyond simply the additional space provided

between the bicyclist and the motor vehicles) because of the striping of the buffered area. Further, it provides many of the benefits of a separated but adjacent shared use pathway, possibly without many of the operational problems (AASHTO *Guide for the Development of Bicycle Facilities*, pp. 33-34) associated with those types of facilities.



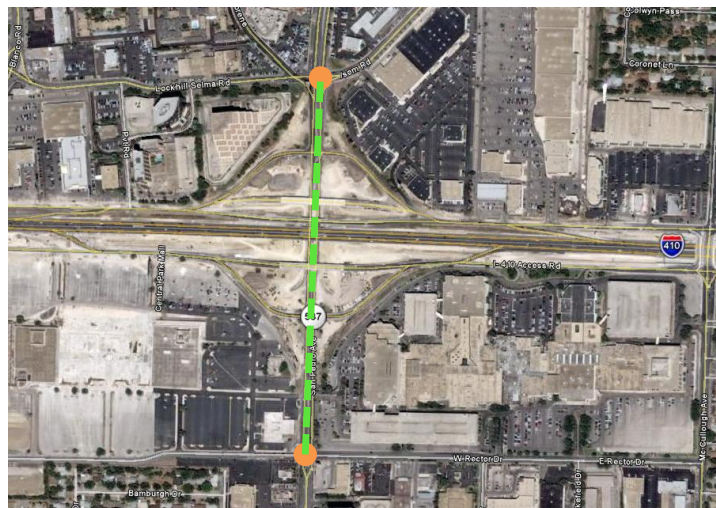
San Pedro (Rector to Lockhill-Selma)



This section of San Pedro spans the interchange of San Pedro and Loop 410. The interchange and its vicinity are in a highly commercial area of the region which includes the North Star Mall. The six-lane roadway has a raised median in this area, although the median is replaced by a two-way left turn lane as San Pedro continues southward. The current daily traffic

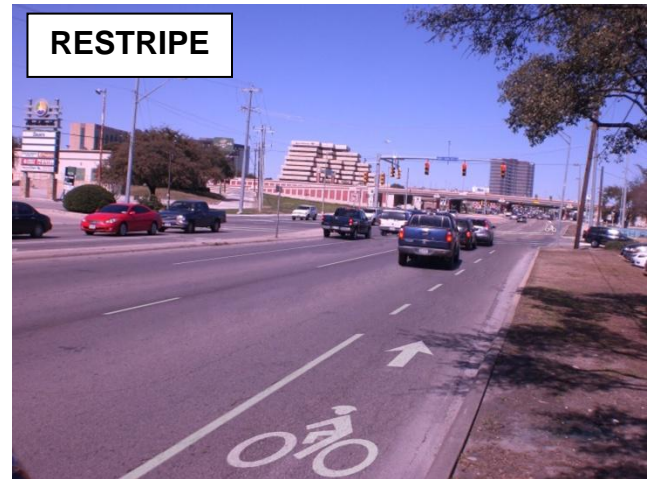
volume is approximately 56,000 vehicles and the posted speed limit is 40 mph. The corridor is well-served by more than a half-dozen VIA routes, and the North Star Transit Center is expected to open soon, which will increase the frequency of buses. Sidewalks are largely present along the corridor. The existing bicycle level of service is “E” (poor bicycling conditions). Providing bicycle access across Loop 410 in this area of San Antonio is a priority.

The detailed examination of San Pedro’s geometric characteristics in this area, performed during Task 2 of this study, indicates that it is a roadway restriping candidate. As described in the December 2009 Analysis Report, roadway restriping involves the narrowing of existing travel lanes (where surplus pavement exists) to create space for bike lanes. Where feasible, restriping is an inexpensive and quickly

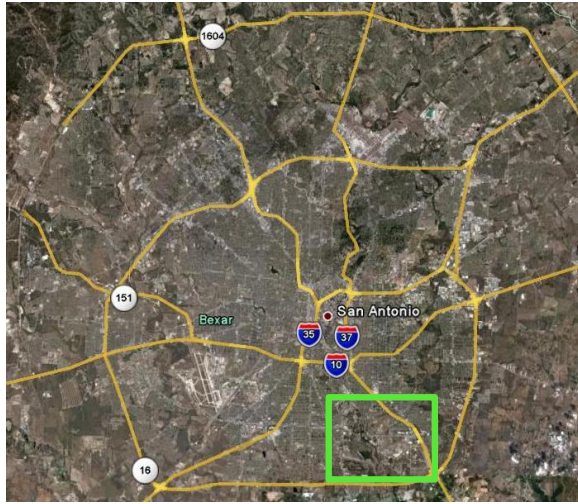


implementable solution for improving bicycling conditions. The high traffic volumes (which are projected to remain well above 50,000 vehicles per day) within this section of San Pedro suggest that it is not a road diet candidate. However, the existing pavement width surplus does allow space for roadway restriping. As shown in the accompanying graphic, a four-foot bike lane can be created while maintaining 11-foot lanes, which is the minimum identified for this study for TxDOT roadways. As noted in the implementation guide, the through and right turn lane use arrow shown in the “before” condition would be inappropriate when bike lanes are added to the roadway cross section.

The proposed road diet would improve bicycling conditions on this section of San Pedro by 15% to level of service “D.” It should be noted that the section of San Pedro extending south to Basse also has sufficient width for roadway restriping, which would lead to a comparable improvement in bicycling conditions.



Military Drive (Roosevelt to Goliad)

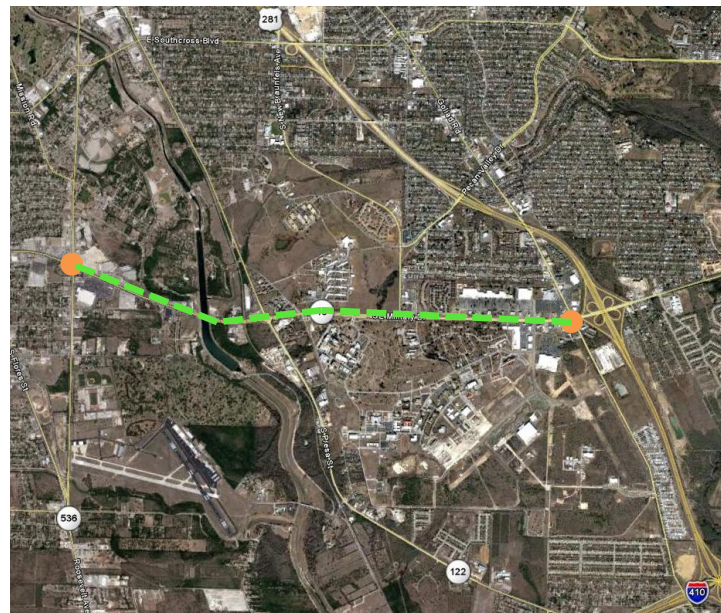


This approximately three-mile section of Military Drive is a six-lane roadway in southeastern San Antonio that passes through a mix of low-density commercial areas, residential areas, and some vacant land. The majority of the section has a raised median, though some portions instead have a two-way left turn lane. The posted speed limit is 45 mph and the current

daily traffic volume is approximately 28,000 vehicles. The entire corridor is served by VIA Routes 550 and 551, while several other routes travel along smaller portions of the corridor. Sidewalks are intermittently present on both sides of the road. Bicycling conditions are poor; the bicycle level of service is “E.”

The Task 2 detailed examination of this section of Military Drive’s geometric and traffic characteristics indicates that it is a potential road diet candidate. As

described in the December 2009 Analysis Report, road diets involve the removal of travel lanes (where excess motor vehicle capacity exists) to create space for bike lanes. Where feasible, they are an inexpensive and quickly implementable solution for improving bicycling conditions. The westernmost portion of the corridor (west of the San



Antonio River) may have sufficient space for roadway restriping while maintaining minimum lane widths. However, this is not the case for the majority of the corridor (east of the San Antonio River where the road has a raised median). This eastern portion does, however, have a sufficiently low projected 2025 daily traffic volume (just under 30,000) to indicate that it may function adequately as a four-lane road. The proposed road, shown in the accompanying graphic, would convert the existing 33 feet of pavement on either side of the raised median into two 12-foot lanes and a five-foot bike lane. The resulting remaining space makes this section of Military Drive an ideal candidate for the installation of buffered bike lanes, also known as “comfort lanes.” Comfort lanes provide a painted separation between the newly created bike lane and the remaining travel lanes.

As part of a road diet project on Military Drive, the signal timing should be reviewed as some additional green time may be needed on Military Drive after the road diet is implemented. Additionally, as right turning motorists will likely (and operationally should) move into the buffered bike lane area to make right turns, the signal loops should be evaluated. If the false detection of right turning motorists as through vehicles is likely a delayed detection should be implemented to allow for the right on red or if necessary the loops in the bike lane should be relocated or removed.

The benefits that this proposed road diet offers to bicyclists on this section of Military Drive are immense. As mentioned above, the current configuration provides a bicycle level of service of “D.” The provision of a bike lane in the post-road diet configuration would improve the level of service to “A,” representing a 75% improvement in bicycling conditions. The true benefits associated with the additional buffer of comfort lanes have not been fully researched. It is expected that comfort lanes offer an additional psychological benefit to bicyclists (beyond simply the additional space provided between the bicyclist and the motor vehicles) because of the striping of the buffered area. Further, it provides many

of the benefits of a separated but adjacent shared use pathway, possibly without many of the operational problems (AASHTO *Guide for the Development of Bicycle Facilities*, pp. 33-34) associated with those types of facilities.



Appendix: Roadway Pavement Reallocation Implementation Guide

Introduction

The San Antonio-Bexar County MPO's "Road Diet Analysis" includes an intricate and extensive analysis of the region's roadways that identifies opportunities for low cost, quickly implementable improvements to the existing bike network. By reallocating pavement space roadways can be "optimized" to better serve all modes of transportation. Two primary types of pavement reallocation projects were identified as part of this effort. Both types of projects involve restriping of existing pavement to create paved shoulders or designated bike lanes: 1) roadway restriping, which reduces existing lane widths to create striped shoulders or bike lanes for bicyclists, and 2) road diets, which involve the removal of travel lanes (where excess motor vehicle capacity exists) to make available surplus space for bike lanes. Approximately 300 miles of roads in the San Antonio region are identified as roadway restriping candidates, and more than 80 additional miles are candidates for road diets.

While implementing each of these techniques is a relatively inexpensive way to improve bicycling conditions, there are several aspects that should be considered to ensure proper functioning in the post-improvement condition. These considerations include taking advantage of scheduled resurfacing projects, pavement marking removal, adjusting traffic control devices, and treatment of existing on-street parking.

Repaving Projects

One way to implement a pavement reallocation project is to wait for a roadway to be resurfaced. During resurfacing projects, an existing pavement surface is either overlain or replaced. This provides fresh, unmarked asphalt (or concrete) for striping – essentially, creating a blank canvas upon which to paint new roadway stripes. Waiting for roadway repaving projects has advantages and disadvantages; some of these are discussed below.

Pavement reallocation projects have minimal impacts to design and construction efforts associated with repaving projects. During a roadway resurfacing projects there is no need to grinded/blast off existing markings from the roadway; thus eliminating potential “ghost markings.” Traffic signal loops are cut and installed anew. Signs and signals adjustments may already be included in the projects’ scopes. All of these things simplify the pavement reallocation process and result in bike lanes for essentially no cost.

The disadvantage of resurfacing projects is timing. The design life of paving varies – from as little as 3 years for overlays to as much as 20 years for some major milling and resurfacing projects. The reality, however, is that actual roadway resurfacing schedules typically lag significantly behind any schedule that might be implied by a project’s design life. Consequently, while resurfacing projects are an efficient way of implementing pavement reallocation concepts, they are typically supplemented by restriping projects.

Pavement Marking Removal Methods

In most cases, provision of on-street bicycle lanes will require retro-fit of the existing roadway markings to adjust lane widths and centerline location or eliminate lanes to mark bicycle lanes. Removal of existing pavement markings is often an issue of both quality and costs.

Removal of pavement markings involves one of four basic methods:

- Flail Milling
- Sand or shot-blasting
- Hydro-blasting
- Hot compressed air

While no research exist that cross evaluates all these methods and compares them to one another, each can reportedly provide acceptable results. Additional information concerning each is provided below.

Flail Milling Flail Milling requires a mechanical device, either self-propelled or walk-behind, that has milling flails to mechanically remove the existing pavement marking.

The equipment is usually low cost. Complete removal of the pavement marking almost invariably results in a noticeable scar on the pavement often referred to as a “ghost marking.” These scars, whether on asphalt or concrete surfaces, may conflict with the new markings causing confusion for motorists as to what path to follow. These ghost marking effects can be minimized with proper milling technique and quality control.

Sand or Shot-blasting Sand or shot-blasting involves directing a scouring material such as silica (sand) or metal shot onto the marking to be removed. A great deal of quality control is required to remove the marking without significantly scarring the pavement surface. Also, additional effort is usually required to vacuum the sand or shot from the pavement to avoid negative environmental or aesthetic consequences. This method is perhaps preferred to grinding but frequently is more expensive.

Hydro-blasting Hydro-blasting is similar to sand-blasting except high pressure water is directed at the marking for removal. Again, a great deal of quality control is required to successfully remove the marking without scarring the pavement surface and leaving a ghost marking. Also, vacuuming of the water and removed marking material is usually required to avoid negative environmental or aesthetic effects. Hydro-blasting usually requires specialized equipment and close attention to pressures used for removal. Costs are comparable to sand-blasting.

Ultra-high pressure water blasting has been demonstrated to be an efficient way to remove markings from pavement. Pavement scarring is likely to occur, although operator skill can dramatically impact the results. In one research project,⁸ hydro-blasting (36,000 psi, 4.5 gal/min, 2800 rpm, single pass) was able to remove only 20 mil of material, with a minimal change in surface texture. The resulting scarring, while noticeably darker, was not so severe as to cause confusion for motorists. Since equipment operator skill is so important, operators should be made to demonstrate

⁸ Ralf Ellis and Byron Ruth, *Development of Improved Procedures for the Removal of Pavement Markings During FDOT Construction Projects*. Florida Department of Transportation Summary of Final Report, 1999.

proficiency on a test strip of roadway before being allowed to hydro-blast an entire section of roadway.

Hot Compressed Air Hot Compressed Air (HCA) is another method of removing pavement markings from asphalt. Hot compressed air is used to vaporize marking. To avoid burning the markings, no flame is used. This technique should be avoided on thin bituminous road surfaces as the high temperatures used may damage the road surface. Disadvantages of HCA include fumes and smoke. Additionally, the HCA operation is quite loud (120dba).

Summary The removal of existing roadway pavement markings allows for roadway reallocation projects to occur even when a resurfacing project is not being conducted. While the process may damage (scar) the pavement surface creating ghost-markings, proper removal techniques can minimize these effects. Hydro-blasting removal appears to offer the greatest success for removal of marking materials from asphalt without pavement scarring but requires a high degree of quality control for optimal results.

Adjusting Traffic Control Devices

Pavement reallocation projects involve changing the location of lanes on the roadway and the purpose of those lanes. Consequently, existing traffic controls – signing, markings, and signals – will likely require some adjustment to be compliant and effective. The following sections address some of the adjustments that may be required as part of roadway pavement reallocation projects.

Signing and Pavement Markings

When a roadway pavement reallocation project is undertaken some pavement markings will need to be removed and reinstalled. The most obvious traffic control devices which need to be adjusted are the lane stripes. Turn arrows for two-way left turn lanes or intersection turn lanes will be required, as well as the TWO-WAY LEFT TURN LANE ONLY sign (see figure below) Bike lane markings, BIKE LANE signs and comfort stripes (where applicable) will also be needed. Beyond these obvious marking modifications, some

other traffic markings and signs may need to be adjusted as well. These additional adjustments typically involve right turn movements.



R3-9a



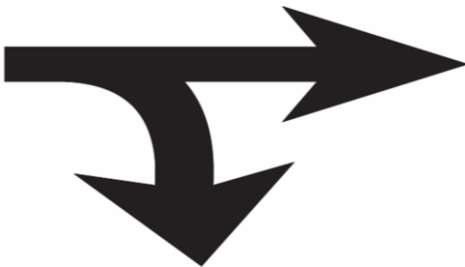
R3-9b

The turn and through movement pavement marking is not appropriate in lanes adjacent to bike lanes. This is because the rules of the road require the operators of vehicles turning right to approach and turn from the rightmost side of the roadway.⁹

Motorists must merge into the

Two-Way Left Turn Lane Only Signs

bike lane area to turn, yielding to bicyclists before do so. (The San Pedro Road case study shows an example of where the turn and through lane-use arrow has been removed to provide for the bike lane.)



Turn and Through Lane Use Arrow

On road diet roadways with on-street parking (such as in the San Pedro case study) it may be desirable to provide right turn lanes at intersections. At these locations space limitations may require the bike lane to end prior to the right turn lane. In such a location, a RIGHT LANE MUST TURN Right sign supplemented with an EXCEPT

FOR BIKES plaque may be appropriate.

Signals

Typically traffic signal hardware will not be impacted by the pavement reallocation projects. Some possible exceptions include projects which add on street parking, new

⁹ Texas Statutes, Section 545.101.

left turn lanes at intersections, or contra-flow bike lanes. Additionally, potential signal timing changes may be appropriate as a result of some pavement reallocation projects.

For roads where on-street parking or two-way left turn lanes are added, it is possible that some adjustment may be needed to ensure the lateral placement of the signals is still within the prescribed 20° angle to the approach roadway centerline.¹⁰

Where road diets are being implemented on undivided roadways, left turn lanes will be created. It is also possible that a jurisdiction may wish to replace the three-section through signals on these approaches with five-section clusters to provide for protected left turns at intersections with these newly created turn lanes.

Road diet candidates will result in fewer through lanes on the roadway. Consequently, retiming traffic signals to provide for additional green time for the remaining lanes will likely be appropriate.

Loops

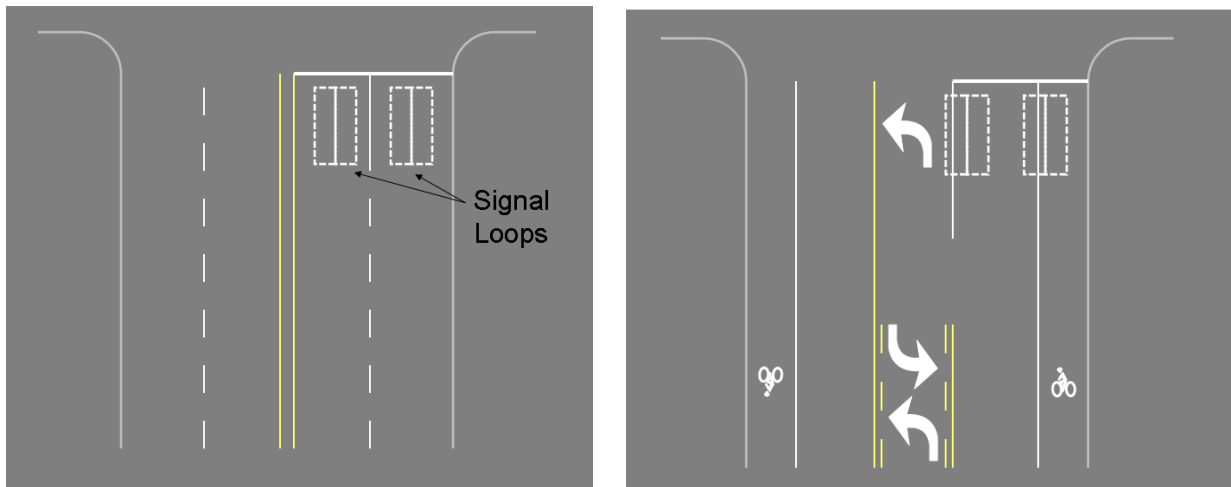
Traffic detection at signalized intersections is much more likely to need adjustment than the signals themselves. Traffic signal loops use inductive fields to detect the presence of metal objects above the loops.¹¹ Because pavement reallocation nearly always realigns travel lanes, the sensitivity of the loops to traffic will need to be checked.

In addition to ensuring that vehicles are detected it is also necessary to ensure “false” detections that could adversely impact the intersection capacity are not occurring. This would most likely occur on a road diet roadway and can be associated with right or left turn movements.

¹⁰Texas Manual on Uniform Traffic Control Devices, Section 54D.15

¹¹ Because the loops measure changes in the inductive fields, any conductive material may be detected using loops. All metals are detectable by loops if present in adequate quantities. Bicycles made of steel or aluminum should be detectable by loops. In fact, just a bicycle rim is usually detectable.

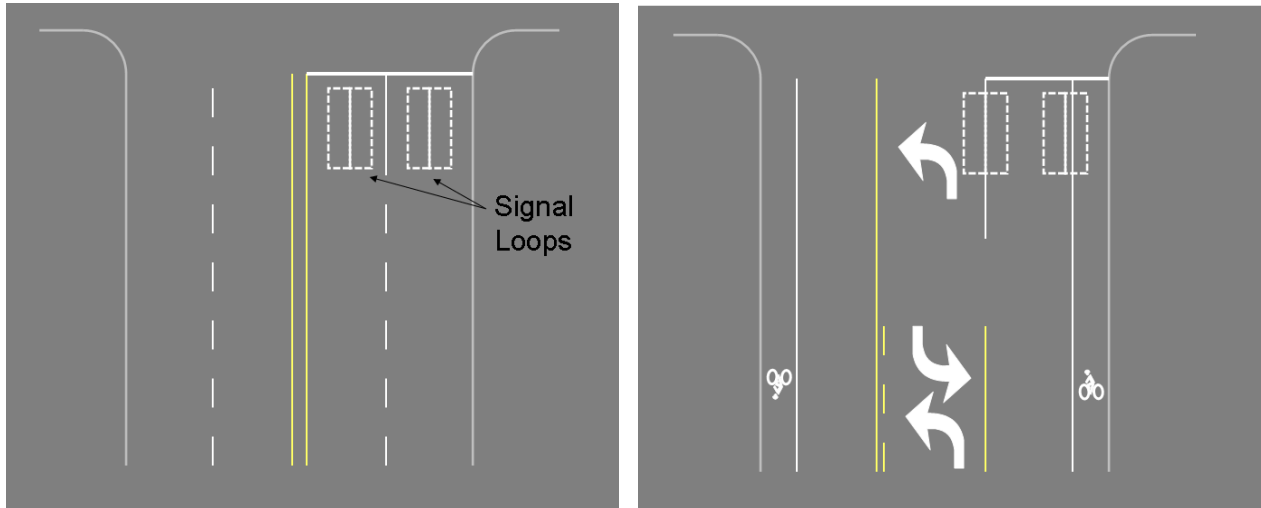
Right Turns One possibility is where space to the right of the rightmost (non-bike lane) through lane may be created that would allow right turners to stack and turn right on red and thus not require a green light. These false calls can be accommodated by removing and replacing the potential problem loop. Alternatively, a delayed call could be applied to the potential problem loop; this would require a car/bike's constant presence over the loop for several seconds to initiate the signal call. The advantage of the latter solution is that it allows the loop to remain for the purpose of detecting through bicyclists.



Potential loop misalignment in right turn lanes

Left turns

On formerly undivided roadways that have been restriped to include a two-way left-turn lane, “false” detections could occur for an exclusive left turn phase (if one is provided). This would occur because the left turn lane is centered on the old double yellow solid line, beside which was a through lane in either direction. At intersections the new left turn lane is located over half of an old approach through lane. The loop for the old through lane is, therefore, partially within the left turn lane. Where no exclusive left turn phase is provided, this should not be an issue.



Potential loop misalignment in left turn lanes

Important locations for bicyclist detection

Just as detection of motor vehicles is not necessary for all movement approaches to signalized intersections, the same is true for the detection of bicycles. A discussion of which approaches may or may not need to be able to detect bicycles is provided below:

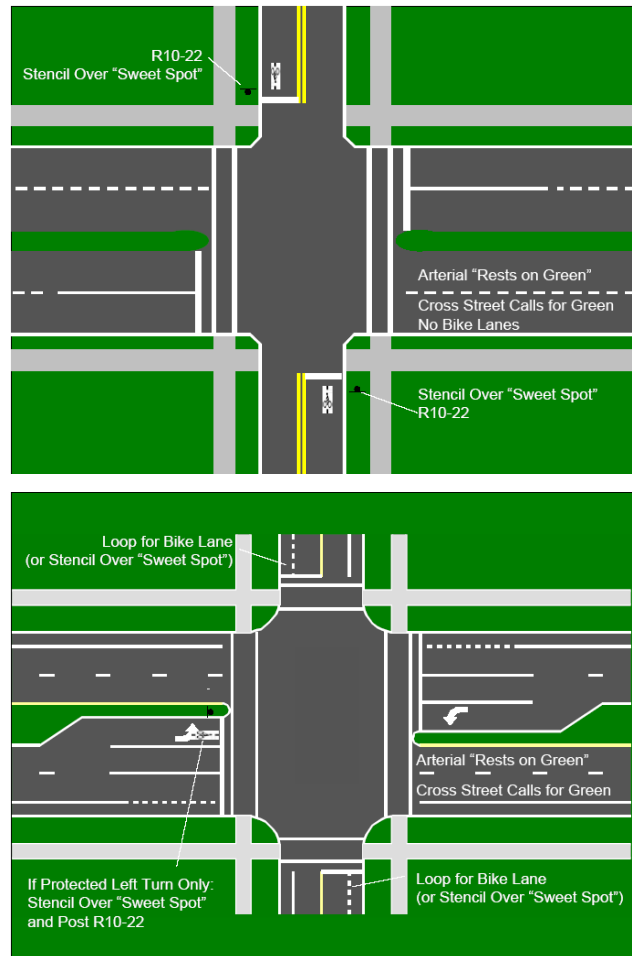
Through movements Typically, signals along arterial roadways are programmed to “rest on green” for the arterial roadway. This means that if the signal hardware does not detect a vehicle on a side street approach, the signal facing the arterial roadway will remain green indefinitely. At other roadway intersections, however, signals are programmed for “automatic recall,” which gives each approach through movement a green signal every cycle, whether a vehicle is detected or not. On arterial roadways employing either of these two approaches to signal timing, it is frequently not necessary to be able detect a bicycle (or any other vehicle) on some through movement approaches for the purposes of providing a green signal. Travelers on non-arterial side streets do not often enjoy the benefit of automatic recall. Consequently, if through-moving cyclists on a side street are not detected by the signal hardware, they will not receive a green light and will then likely treat the signal like a STOP sign type control. Therefore, on signalized intersections without automatic recall, the signal hardware should be adjusted to detect cyclists.

Right turn movements In right turn lanes it may not be necessary to detect bicyclists; the ability to perform a right turn on red (RTOR) provides ample opportunity for bicyclists to turn. As was described earlier, during those time periods when traffic volumes on the cross street are so high as to prevent an RTOR, there is also likely to be detectable motor vehicle traffic on the approach the cyclist is using, sufficient to call the green light for that approach. If, however, there is a prohibition against RTOR, then the detection of bicyclists once again becomes an important consideration.

Left turn movements On roadways with automatic recall, it may not be necessary for hardware to be able to detect bicyclists in left turn lanes that have a permitted or protected/permitted operation. This is for the

same reasons as stated for the right turn lanes: under low volume conditions, the permitted left turn should provide adequate opportunities to turn and under higher volume conditions motor vehicles will likely be present to call the signal.

In those left turn lanes that provide for protected-only left turns the signal hardware should be able to detect bicycles; the same is true for left turn lanes on roadway approaches that are not set up for automatic recall.



Marking of the Sweet Spot

The accompanying figures show those movements where the detection of bicycles is an important consideration.

Methods for the Detection of Bicycles

For traffic signals to operate efficiently they must be able to detect when vehicles are present on approaches to the intersection. In response to detecting the presence (and consequently the absence) of vehicles, traffic signal hardware can adjust signal phasing and timing plans to accommodate fluctuating traffic conditions throughout the day and week. Inefficient signal operations can arise when vehicle detection hardware is not operating optimally, such as when a loop fails. When this happens, the detector hardware will usually compensate by providing an automatic recall to the movement formerly monitored by the failed detector; this means that the lane over the failed loop will receive a green light during every cycle, whether a vehicle is there or not.

Alternatively, there are some signal loop installations which may detect cars, but do not detect some trucks, motorcycles or bicycles. If they are not detected, these vehicles may not receive a green light. This section describes common detector types and how their detection of bicycles can be optimized.

Marking the Sweet Spot One of the simplest ways to facilitate the detection of bicyclists at traffic signals is to mark that spot on the roadway where a given loop will detect a bicycle. The MUTCD provides for a symbol that may be placed on the pavement to indicate the optimum position for a bicyclist to actuate the signal.¹² Used in conjunction with the BICYCLE SIGNAL ACTUATION sign (R10-22)¹³, this symbol can eliminate the problem of bicycle detection for any intersection movement where the loops can detect bicyclists.

This sweet spot can be located by two people in the field using the following process. First, have one person open the controller cabinet and note the light indicating detection

¹² MUTCD, Section 9C.05 Bicycle Detector Symbol, FHWA, Washington, D.C., 2009.

¹³ MUTCD, Section 9B.13, Bicycle Signal Actuation Sign, FHWA, Washington, D.C., 2009.

for the lane of interest. Next, place a bicycle at the right edge of the lane with the front tire overhanging the stop line. Then move the bicycle slowly to the left in the lane until the controller indicates the bike is detected by the signal loop (see figures below).



Finding the “Sweet Spot”

Continue moving the bike until the bicycle can no longer be detected. Finally, mark the pavement at the middle of this range of detection. In many cases an entire bicycle is not needed to locate the sweet spot, just a bicycle wheel may do. However, until it can be determined if a single wheel will be detected by local loops, an entire bike – and initially both a mountain bike and a road bike – may be appropriate for experimentation.

Loops for Bike Lanes Placement of signal loops within bike lanes is not always necessary. As stated above, frequently bicycles only need to be detected in situations where no motor vehicle is present; in those situations, bicyclists could exit the bike lane and wait to be detected over the standard signal loop. Even so, changing lanes at an intersection to call for a signal change is not a normal vehicular behavior. Consequently, in the interest of providing consistent treatments and promoting consistent vehicular behavior, bike lane detection should still be considered at locations where signal change is unlikely without detection.

The most commonly recommended loop type for bike lanes is a quadripole loop of reduced size. These loops are highly sensitive to objects in the area immediately above them, but detection falls off rapidly outside of this sensitivity field; this means that cars in

adjacent lanes will not be detected. Quadripole loops, when placed in a bike lane, typically detect within an area two feet wide by 10 feet long.

Treatment of Existing On-Street Parking

Some roadway reallocation projects will involve placing bike lanes on roadways that have existing on street parking. In some cases parking on one side of the street may need to be restricted to make space for the bike lanes; in others, not. However, in all cases adequate space must be provided to ensure cyclists can ride safely between the general travel lane and a line of parked cars.

Restricting Parking on One Side of the Street

In some locations it may be necessary to restrict parking on the street to provide space for bike lanes. This is most typically accomplished on roadways where the parking space occupancy is less than 50% during most periods. Even with limited parking occupancy, if any is to be removed the agencies with jurisdiction should coordinate with the local property owners.

Designating the Parking and Bike Lane

Bike lanes adjacent to on-street parking require special consideration to ensure they operate safely and efficiently. Of primary importance is space for bicyclists to ride outside the “door zone” of parked cars. Several methods of striping the parking areas have been tried by agencies around the country; examples include: narrow bike lane with wide parking, wide bike lane with narrow parking/inverted-T striping (the long leg of the T is used to emphasize the door zone), and diagonal door zone striping (shown on the Dwyer Road case study). These striping techniques are non-standard (*MUTCD*) and while some of the various striping techniques have been evaluated results have been inconclusive and in some cases contradictory.

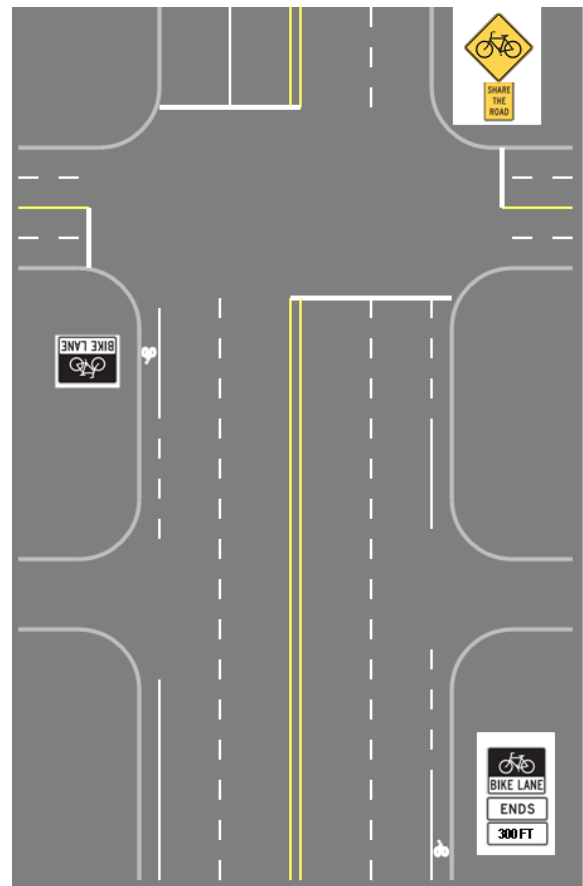
At intersections, the space provided for the bike lane and parking lane will likely act as a de facto right turn lane. Providing a dotted line across the between the bike lane and the through lane will help reinforce to motorists that they are exiting their lane and entering a conflict. A right turn arrow should not be used if a full width right turn lane cannot be

developed next to the bike lane. If it is determined that a marked (with an arrow) right turn lane is necessary, a RIGHT LANE MUST TURN Right sign supplemented with an EXCEPT FOR BIKES plaque may be appropriate.

Ending the Bike Lane

San Antonio's bike network will not likely include bike lanes on all roadways.

Consequently, there must be a consistent treatment to integrate bicyclists back into the regular, or shared, travel lanes when the bike lane ends. It is recommended that a BIKE LANE ENDS XX FT sign assembly be installed in advance of the termination of the bike lane. On a major roadway, this sign assembly should be placed at a location that allows a bicyclist to turn onto a lower volume roadway prior to the bike lane ending. Shortly after the termination of the bike lane a Share the Road assembly should be installed to inform motorists that they are now sharing the lane with bicyclist (see figure).



Signing to end a Bike Lane