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MISSISSIPPI GULF COAST
METROPLOITAN PLANNING ORGANIZATION

Transportation Safety Management Program
Get To B

Mississippi Gulf Coast
Metropolitan Planning Organization
Gulf Regional Planning Commission

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I. INTRODUCTION

National Initiatives

AASHTO's Strategic Highway Safety Plan (SHSP) identifies 22 key emphasis areas, identified on the Table 1.0 below, are that broadly address the Four Es of Safety – Education, Enforcement, Engineering and EMS. Each emphasis area targets a specific set of factors that contribute to a significant number of deaths on the nation's roadways and also includes general strategies for reducing these fatalities.

State of Mississippi Initiatives

This Strategic Highway Safety Plan (SHSP), Part I was prepared jointly by the Mississippi Department of Transportation (MDOT) and Mississippi Department of Public Safety (DPS), in cooperation with safety partners representing national, state and local agencies as well as private safety advocacy groups and representatives of the State Legislature. Based on crash statistics and input by Mississippi's safety partners, critical emphasis areas were identified to represent areas with the greatest potential to significantly reduce traffic fatalities in Mississippi.

Mississippi Gulf Coast MPO Emphasis Areas

The first step in the safety management planning process is to select a limited number of emphasis areas that a direct impact to safer mobility for all users based on the resources available to the MPO. Based on the 22 emphasis areas identified by AASHTO's SHSP, MPO staff selected four areas that would make the most impact in the MPO planning process.

Emphasis Area #1 Keeping Vehicles on the Roadway

The common solution to this emphasis area is to keep the vehicle in the proper lane and prevent run of the road crashes. Run off the road crashes involve vehicles that leave the travel lane and encroach onto the shoulder and beyond and hit one or more of any number of natural or artificial objects, such as bridge walls, poles, embankments, guardrails, parked vehicles, and trees. Run of the road crashes usually involve only a single vehicle. They typically consists of a vehicle encroaching onto the right shoulder and roadside, can also occur on the median side where the highway is separated or on the opposite side when the vehicle crosses the opposing lanes of a non-divided highway.

Emphasis Area #2 Reducing Head-On and Across-Median Crashes

One of the most severe types of crashes occurs when a vehicle shifts into an opposing traffic lane and crashes head-on with an oncoming vehicle. There were 3,986 fatal head-on crashes in 2003, killing 5,063 people. Severe crashes of this sort occur primarily on rural two-lane highways and freeways with narrow medians. The severity of these crashes is compounded by the additive nature of vehicle speeds at the time of collision.

Emphasis Area #3 Improving the Design and Operation of Highway Intersections

Intersections constitute only a small part of the overall highway system, yet intersection related crashes constitute more than 20 percent of fatal crashes. It is not unusual that crashes are concentrated at intersections, because intersections are the point on the roadway system

where traffic movements most frequently conflict with one another. Good geometric design combined with good traffic control can result in an intersection that operates efficiently and safely.

Emphasis Area #4 Ensuring Safer Bicycle Travel

Bicyclists are recognized as legitimate roadway users. Bicyclists are part of the transportation system and should be included as a matter of routine in the planning, design, and operation of transportation facilities the safety interests of bicyclists are sometimes in conflict with the interests of motorists. This conflict arises primarily from the substantially different characteristics of the two modes of transportation. Although bicycles can be ridden on most types of roads, the design interests of accommodating higher motor vehicle traffic volumes and speeds during peak hour congestion may create conditions that are less safe for bicyclists.

Emphasis Area #5 Making Walking and Street Crossing Safer

Even though pedestrians are legitimate roadway users, they are frequently overlooked in the quest to build more-sophisticated transportation systems. Whether building new infrastructure or renovating existing facilities, it should be assumed that people will walk, and plans should be made to accommodate pedestrians. The need to reduce pedestrian deaths and injuries, even in the face of ongoing efforts to increase levels of walking, continues to be an important goal. Specific groups that do not or cannot drive primarily depend on walking for transportation, including children, the elderly, and low-income populations are particularly in need of a safe walking environment to help lower their risk of injury and death.

Emphasis Area #6 Increasing Driver Safety Awareness

It is clear that many drivers fail to understand the seriousness and potential adverse consequences of aggressive driving, DUI, and failing to properly use safety belts—all of which are major factors in crashes and their resulting injuries and fatalities. Research indicates that approximately 85 percent of causation factors associated with crashes are attributed to the driver. Many drivers are unaware of or have underestimated the risks and consequences associated with various unsafe driving behaviors. States have a vested interest in ensuring their drivers are as knowledgeable of high way safety issues as is reasonably possible. The Mississippi Gulf Coast MPO will expand the scope of this emphasis area to increase safety awareness for bicyclists and pedestrians. We will focus on educating bicyclist and pedestrians on proper ways to interact with vehicular traffic as well as making vehicles more aware of the rights of bicyclists and pedestrians.

Emphasis Area #7 Reducing Vehicle-Train Crashes

Each year, hundreds of fatalities occur at highway-rail grade crossings. In 2003, there were 324 highway-rail grade crossing fatalities, an all-time low that represented a 9 percent decline from 2002 and a 47 percent decrease from 1994. Many grade crossing crashes are the result of drivers deliberately circumventing or otherwise purposely violating active control devices, such as flashing lights, bells, and crossing arms. There also exists a general lack of public awareness about highway-rail crossings. The Mississippi Gulf Coast MPO has chosen to include strategies in its safety program that concentrate on railroad-highway crossing initiatives.

Table 1.0: AASHTO's Strategic Highway Safety Plan's 22 key emphasis areas and selected emphasis areas by the State of Mississippi and the MS Gulf Coast MPO

Drivers		
Instituting Graduated Licensing for Young Drivers		
Ensuring Drivers are Licensed and Fully Competent		
Sustaining Proficiency in Older Drivers		
Curbing Aggressive Driving	**State**	
Reducing Impaired Driving	**State**	
Keeping Drivers Alert		
Increasing Driver Safety Awareness		**MPO**
Increasing Seat Belt Usage and Improving Airbag Effectiveness	**State**	

Special Users		
Making Walking and Street Crossing Safer		**MPO**
Ensuring Safer Bicycle Travel		**MPO**
Vehicles		
Improving Motorcycle Safety and Increasing Motorcycle Awareness		
Making Truck Travel Safer		
Increasing Safety Enhancements in Vehicles		

Highways		
Reducing Vehicle-Train Crashes		**MPO**
Keeping Vehicles on the Roadway	**State**	**MPO**
Minimizing the Consequences of Leaving the Road	**State**	
Improving the Design and Operation of Highway Intersections		**MPO**
Reducing Head-On and Across-Median Crashes	**State**	**MPO**
Designing Safer Work Zones		

EMS		
Enhancing Emergency Medical Capabilities to Increase Survivability		

Management		
Improving Information and Decision Support Systems		
Creating More Effective Processes and Safety Management Systems		

TIP Safety Group

A "safety group" will be created in the Mississippi Gulf Coast Transportation Improvement Program (TIP) consisting of 10% of the Surface Transportation Program (STP) funds apportioned to gulf coast urbanized areas. The independent safety projects will focus on low-cost measures that may be quickly implemented to enhance the safety of motorists and users of non-motorized modes.

TIP Bicycle, Pedestrian and Transit Group

The Mississippi Gulf Coast MPO will set aside 10% or $500,000 of the Gulf Coast's Surface Transportation Program (STP) funds for projects to improve bicycle, pedestrian and transit accessibility and mobility in the region.

Federal Participation

The STP funds in this group will be available for use at 100% federal share for the following measures described in 23 U.S.C. 120 (c):

- Traffic control signalization,
- Traffic circles (aka roundabouts)
- Safety rest areas,
- Pavement marking,
- Shoulder and centerline rumble strips and stripes
- Commuter carpooling and vanpooling,
- Rail-highway crossing closure,
- Installation of traffic signs,
- Traffic lights,
- Guardrails,
- Impact attenuators,
- Concrete barrier end treatments,
- Breakaway utility poles,
- Priority control systems for emergency vehicles or transit vehicles at signalized intersections

Pedestrian and bicycle projects described in 23 CFR 652.9 including: independent walkway projects, independent bicycle projects and non-construction bicycle projects would also be eligible for this funding.

Process

Program development begins with gathering data and identifying safety concerns. Based on the emphasis areas and identified indicators, potential areas will be identified for consideration of measures for mitigation. The two approaches to identifying safety problems are:

Responsive Approach (RA) – This approach is based on identifying existing problems. Confirmation that a problem exists that is proven by basic crash records that show people and vehicles have already injured themselves or life has already been lost as a result of a crash.

Proactive Approach (PA) – This approach is based on identifying problems that may or may not have become apparent yet but conditions indicate that the potential for them to surface is evident. The proactive approach seeks to identify developing safety problems before people and vehicles experience injury or loss of life.

II. KEEPING VEHICLES ON THE ROADWAY / REDUCING HEAD-ON CRASHES

A. Identify Problem Areas

High occurrence of "run off the road" and "head-on" accidents (RA)
Accident data that that indicated a high occurrence of accidents that were caused by vehicles running off the road or into opposing travel lanes in a certain location should be investigated further to see what could be causing the problem.

MPO public survey (PA)
The public survey maintained by the Mississippi Gulf Coast MPO asks the question: What visibility improvements need to be made? The survey provides the MPO with insight into problems on the roadway that can be proactively mitigated before accidents become prevalent at a site.

Local agency consultation (PA or RA)
Consultations by the use of interviews or surveys to local law enforcement, local engineering staff, and local roadway maintenance staff will be used to help indentify safety concerns that exist on gulf coast roadways.

High degree in roadway curvature (PA)
Run off the road crash risk on two-lane roads increases with degree of curvature. A review of the study area's roadways that have sharp curves will show areas with a risk of run off the road accidents. The degree of a curve has an impact on the safety of the curve. Studies from an Iowa Department of Transportation's 2001 study "Systematic Identification of High Crash Locations" found that crash rates increase as the degree of the curve increases, even when traffic-warning devices are used to warn motorists of the upcoming curve. The study suggested that curves with curvature degrees of 15 or greater are hazardous. When the degree of curvature drops between 9 and 15 degrees, the probability of the curve being hazardous falls. According to the "Mississippi Design Manual" the degree of curvature (D) (arc definition) is defined as the central angle which subtends an arc length of 100 ft. The Mississippi Design Manual shows maximum degrees of curvature based on design speed below:

B. Identify Causes

Review accident data for high instances of nighttime accidents
About half of traffic fatalities occur at night, although only about one quarter of travel occurs after dark. Although intoxication and fatigue contribute to the high rate of nighttime crashes, nighttime driving is inherently hazardous because of decreased driver visibility. Adequately maintained retroreflective signs and pavement markings improve highway safety and prevent roadway departure crashes by bouncing light from vehicle headlights back toward the vehicle

and the driver's eyes, making the signs and markings appear brighter and easier to see and read.

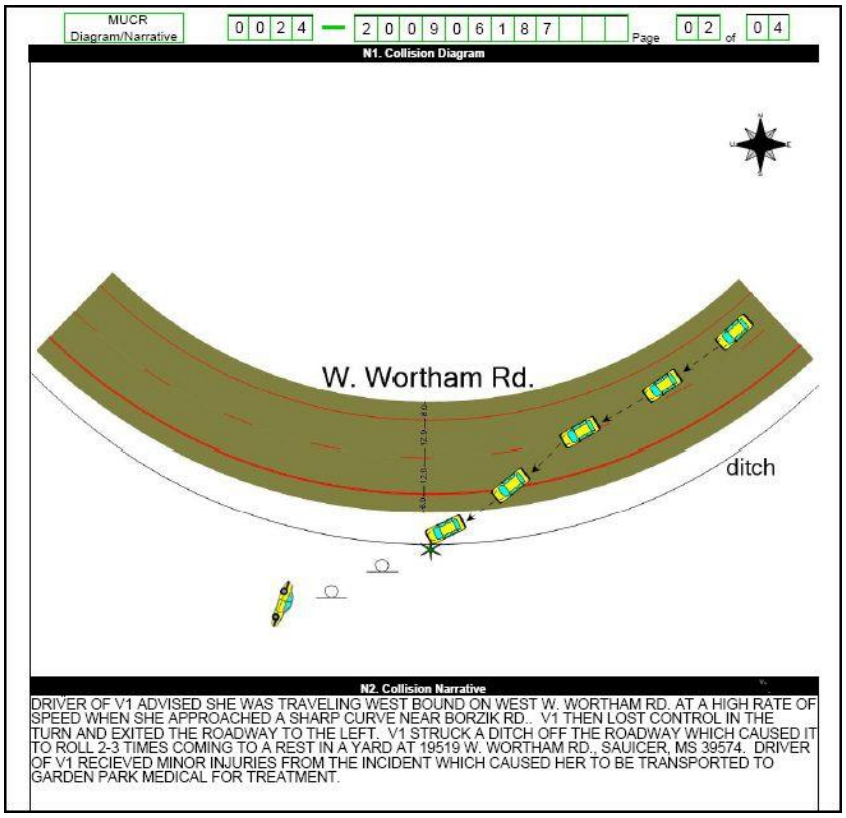
Review accident data for high instances of wet road accidents
Identify and investigate locations with elevated wet-weather crash rates relative to comparable locations for the purposes of minimizing locations with elevated friction-related crash rates. Using the same criteria as referenced below, we will see if a connection exists between low roadway friction and vehicles leaving the roadway.

The *New York State DOT (NYSDOT)* implemented a program to identify sites statewide with a low skid resistance and treat them with overlays as part of their maintenance program. A site is eligible for treatment if its 2-year wet accident proportion is 50% higher than the average wet crash proportion for roads in the same county. Between 1995 and 1997, NYSDOT treated 36 sites, which reduced the annually recurring wet road crashes by more than 800. These results, and others throughout the State, support earlier findings that treating wet-road crash locations can reduce this type of crash by 50% and reduce total crashes by 20%. http://safety.fhwa.dot.gov/roadway_dept/pavement/pavement_friction/

Review accident data for other contributing circumstances
Accident data may shed light on other contributing factors such as excessive speed, failure to keep proper lane, improper passing, etc. An overrepresentation of any one factor may lead to the recommendation of potential solutions to address the reoccurring problem.

Determine if a high degree horizontal curve exists
Studies from an Iowa Department of Transportation's 2001 study "Systematic Identification of High Crash Locations" found that crash rates increase as the degree of the curve increases, even when traffic-warning devices are used to warn motorists of the upcoming curve. The study suggested that curves with curvature degrees of 15 or greater are hazardous. When the degree of curvature drops between 9 and 15 degrees, the probability of the curve being hazardous falls.

State of Mississippi Uniform Crash Report
Review crash diagrams to determine crash type and cause assumptions.



Field Assessment

Perform a field audit of the hazardous location to help determine what is causing the safety problem**.**

Vertical drop offs

Pavement edge drop-off on highways has been linked to many serious crashes, including fatal collisions. To mitigate vertical drop-offs, FHWA advocates installing the Safety Edge on pavements during paving or resurfacing projects. This technology allows drivers who drift off highways to return to the pavement safely. Roadway departures account for over half of all fatal crashes. Not all of these crashes involve speeders and drunk drivers. Some could have been easily prevented if a vertical pavement edge drop-off had not been present.

Pavement marking damage

Damage from trucks, vehicles or maintenance machinery. Edge rut maintenance can have a detrimental impact on marking reflectivity (edge line). Gravel is typically dumped or bladed onto the driving surface and then bladed off smoothly over the shoulder.

Proper signage

Adequately maintained retro-reflective signs improve highway safety and prevent roadway departure crashes by bouncing light from vehicle headlights back toward the vehicle and the driver's eyes, making the signs and markings appear brighter and easier to see and read.

"Keeping Vehicles on the Roadway" and "Reducing Head-On and Across-Median Crashes"
Safety Assessment

Road Name: Near Intersection:	Curve radius:

Accident Data Review	High accidents wet weather	Yes	No	
	High accidents in dark conditions	Yes	No	
Speed Survey	85th percentile / Speed Limit			
Road Surface	Slippery	Yes	No	
	Pot holes	Yes	No	
	Uneven pavement	Yes	No	
	Wash boarding	Yes	No	
	Rutting or cracking	Yes	No	
	Narrow lanes	Yes	No	
	Pavement marking worn or faded	Yes	No	
Shoulder	Paved shoulder present	Yes	No	Width:
	Soft shoulder present	Yes	No	
	Edge drop off >2"	Yes	No	
	Recovery area	Yes	No	
	Drainage ditch <2 ft from road	Yes	No	
	Hazard if leave road	Yes	No	
		Yes	No	
Signs	Curve ahead sign	Yes	No	
	Curve ahead sign in bad condition	Yes	No	
	Chevrons at curve	Yes	No	
	Chevrons in bad condition	Yes	No	
	Obstructed view of signs	Yes	No	
Other Existing Features	Road edge pavement marking	Yes	No	
	Raised Centerline	Yes	No	
	Rumble Stripes	Yes	No	
Comments				

C. Approaches to Addressing the Problem

Objective 1: Keep vehicles from encroaching on the roadside

Shoulder or Edge line Rumble Strips

Rumble strips are crosswise grooves in the road shoulder. Vehicle tires passing over shoulder rumble strips produce a sudden rumbling sound and cause the vehicle to vibrate, thereby alerting inattentive, drowsy, or sleeping drivers of encroachment on the shoulder and possibly onto the roadside.

Rumble Stripe

A rumble strip becomes a "rumble stripe" when an edge line or center line pavement marking is placed on it. The contour of the rumble strip drains water, and provides a reflective back wall that allows the pavement marking to maintain its retroreflectivity at night during rain and post-rain events (when normal pavement markings lose their function).

Midlane Rumble Strips

Midlane rumble strips have the same intent as shoulder rumble strips. When the driver tracks a path leading to an encroachment on the roadside, the rumble strip acts on the inside tire (as opposed to the outside tire for shoulder rumble strips) to alert the driver. Since midlane rumble strips should also affect head-on crashes, they might be considered at locations with both an ROR and a head-on crash problem. Details of shoulder rumble strips that could be considered for use midlane can be found on the FHWA web site at http://safety.fhwa.dot.gov/programs/rumble.htm

Install Advanced Curve Warning Signs

Installing warning signs in advance of a curve or turn provides information to motorists before they enter the curve, giving them a chance to modify their approach speed as they enter the new horizontal alignment. Roadway departure crashes attributed to motorists running off the road while attempting to negotiate a curve or turn in the roadway. In some situations, the driver was not aware they were approaching a curve or turn. They should be used on any curve or turn with a history of roadway departure crashes, and curves or turns with similar geometry or traffic volume yet to experience crashes.

Provide Curve Delineation Signing (Chevrons)

Installing alignment delineation within a curve or turn provides information to motorists where they need it most – within the actual horizontal alignment. The signs show the shape and degree of curvature, and they guide drivers through the entire curve or turn. Roadway departure crashes attributed to motorists running off the road while attempting to negotiate a curve or turn in the roadway. In some situations, the driver was not aware of the severity of the curve in relation to their operating speed.

Install Center Line and Edge Line Pavement Markings

Pavement markings provide motorists important guidance information regarding the edge of the traveled way on the right and the location of the opposing lane on the left. When used around curves, pavement markings serve as curve delineation. These help prevent roadway departure crashes attributed to motorists running off the right side of the road, crossing the center line, or dropping off the roadway on an edge drop-off. Contributing circumstances include speed and inattention

Improved Highway Geometry for Horizontal Curves General Description

Flattening of curves involves reconstructing a road section and changing the alignment. This strategy is among the higher-cost alternatives of those considered. Reconstruction may also entail the environmental process and will often include right-of-way acquisition, both of which require substantial time.

Skid-Resistant Pavements

Improvements that can be made to sites that have, or are expected to experience, skidding related run off the road crashes. These usually involve improvements to increase skid resistance (higher friction factor). Such improvements should have high initial skid resistance, durability to retain skid resistance with time and traffic, and minimum decrease in skid resistance with increasing speed. Countermeasures to improve skid resistance include asphalt mixture (type and gradation of aggregate as well as asphalt content), pavement overlays on both concrete or asphalt pavements, and pavement grooving. Roadway departure crashes account for the majority of roadway fatalities, and many of them occur on wet pavements. 70% of wet pavement crashes can be prevented or minimized by improving pavement friction. More on friction management technology can be found at http://www.fhwa.dot.gov/pavement/t504038.cfm

Shoulder Treatments

If a vehicle that has intentionally or unintentionally left its lane and entered the shoulder area is allowed to safely recover, run off the road crashes can be reduced. The probability of such a safe recovery is increased if the errant vehicle is provided with a wider and smoother area in which to initiate such a recovery and if the recovery is not impeded by a pavement irregularity that causes the driver to either fail to re-enter the lane or to enter it at such an angle that the vehicle crosses into the opposing lane. Shoulder treatments that promote safe recovery include shoulder widening, shoulder paving, and the reduction of pavement edgedrops (i.e., differences in lane pavement and shoulder surface heights, whether paved or not).

Provide Safety Edge for Pavement Edge Drop-off

As earth or gravel falls away from the edge of a typical pavement, a vertical edge drop-off is exposed. The Safety Edge eliminates the vertical edge by providing an angled edge to the side of the roadway, also providing a more durable pavement edge. A motorist can more safely re-enter the traveled way after the tires leave the pavement. Roadway departure crashes attributed to motorists dropping off the roadway due to an edge drop-off.

Contributing circumstances include speed, weather issues, and inattention.

Enhanced Sign and Markings to Reduce Roadway Departures on Curves
Providing adequate visibility of signs and signals also aids in drivers' advance perception of the upcoming curve.

Objective 2: Keep vehicles from encroaching into opposite lane

Centerline rumble strips for two-lane roads - Centerline rumble strips are similar to shoulder rumble strips. The purpose of rumble strips is to alert drivers who may inadvertently stray or encroach into opposing lanes. Although there is no standard design, the rumble strip is generally wider than the center markings, extending into the travel lane by 5 in. to as much as 1.5 ft. Since centerline rumble strips do not require changes in the overall cross section of the roadway, they would be compatible with other strategies such as shoulder rumble strips and horizontal curve improvements. This strategy, although fairly widely used, has not been sufficiently evaluated to be considered "proven."

Install Raised Pavement Markers (RPMs) - During certain conditions, particularly on wet roads in the dark, it is sometimes difficult for motorists to determine the location of the center line and edge line pavement markings. This increases the likelihood of the vehicle departing the roadway. By installing RPMs, the pavement markings are much more prominent in adverse weather conditions, providing important information to the driver. Crashes attributed to roadway departure in wet and/or dark conditions, due to driver inability to see lane markings. This treatment is most applicable in situations where the crashes have occurred at night or on wet pavement.

Profiled thermoplastic stripes for centerline - This treatment provides an audible/tactile effect, but it is less noticeable for larger vehicles, especially trucks. This effect is similar to that experienced with raised pavement markers with short spacing. While the audible/tactile effect can be advantageous, its principal benefit is apparently the longer visibility distance provided at night, especially during wet conditions, when compared with standard pavement markings. However, as with standard raised pavement markers, this treatment would be

limited to areas where there is little or no snow, as snow plow blades will easily scrape off the stripe.

Two-lane highways with wide cross sections – These designs include wider lanes, wider full-strength shoulders, and high-speed alignment with100-percent passing sight distance. A common design for the United States includes 14-ft travel lanes, 10-ft shoulders, and a design speed of 70 mph. The design may also include alternating passing lanes and sometimes two-way left-turn lanes. The combination of alignment and cross section is intended to minimize the potential adverse effects of cross-centerline conflicts and to reduce excursions onto the roadside. However, it is noted that such designs employ high design speeds (75 mph, or 120 km/h). As such, their application would be incompatible with other strategies intended to lower speeds and reduce crash severity.

Center two-way, left-turn lanes on four-lane and two-lane roads - This strategy involves the development of two-way, left-turn lanes (TWLTLs) on existing roadways. It can be accomplished either by the conversion of four-lane undivided arterials to three-lane roadways with a center left-turn lane or by the more conventional reconstruction of a two-lane road to include the TWLTL. Since the latter could be a costly conversion because it may require new right-of-way, the four-lane road conversion is considered more appropriate to the AASHTO emphasis on low-cost alternatives. However, where right-of-way cost is not a major consideration, the inclusion of TWLTLs on existing two-lane roads may be an even more effective treatment for head-on collisions since more of such collisions would likely occur on two-lane roads than on four-lane roads.

Reallocation of total two-lane width (lane and shoulder) to Include a narrow "buffer median" - Head-on fatalities are affected both by the number of vehicles that cross the centerline and by the speed of oncoming vehicles. A particularly effective strategy might be affecting both factors by reallocating the existing cross section—narrowing lanes to encourage slower speeds while incorporating a narrow buffer median between opposing flows. For example, a high-speed rural two-lane roadway with a cross section consisting of 12-ft lanes and 10-ft paved shoulders could be restriped to provide narrower shoulders (e.g., 8 ft) or slightly narrower lanes (e.g., 11 ft), with the difference forming a 6-ft flush median divider. The median could include milled-in centerline rumble strips to help prevent inadvertent crossings.

Objective 3: Minimize the likelihood of crashing into an oncoming vehicle

Alternating passing lanes or four-lane sections at key locations - This strategy involves improving two-lane locations that experience many passing-related collisions. It involves constructing either alternating passing lanes or short four-lane sections that allow passing for

both flows. While the treatment is designed to reduce passing-related, head-on crashes (a relative low percentage of all head-on crashes), it should also positively affect non-passing head-on collisions at the treated sections since the passing lanes would provide extra “clear zone” for vehicles inadvertently leaving their through lanes. It may also affect other types of crashes such as rear-end crashes involving a turning vehicle, since the passing lane provides some protection for the left-turning vehicle.

Median barriers for narrow medians on multilane roads - This strategy involves providing barriers on multilane roads with narrow or no medians. Barriers can be rigid (e.g., concrete median barrier, guardrail) or semi-rigid (e.g., cable barrier). The treatment would be designed to prevent head-on collisions from occurring. The treatment is also used on high-speed, two-lane roads during construction (e.g., during freeway reconstruction, both directions of traffic are often shifted to one roadway, with temporary barriers provided between the opposing traffic).

III. IMPROVING THE DESIGN AND OPERATION OF HIGHWAY INTERSECTIONS

A. Identify Problem Areas

High occurrence of vehicle accidents (RA)
Sites with higher than expected accident frequencies which may indicate the presence of safety concerns that are potentially correctable in a cost-effective manner,

High occurrence of vehicle accidents with "injury" (RA)
Identify sites with high accident severities

MPO public survey (PA)
The public survey maintained by the Mississippi Gulf Coast MPO asks the question: What visibility improvements need to be made? The survey provides the MPO with insight into problems on the roadway that can be proactively mitigated before accidents become prevalent at a site.

Local agency consultation (PA)
Consultation with local law enforcement, local engineering staff, and local roadway maintenance staff will be used to help indentify intersection safety concerns.

B. Identify Causes

State of Mississippi Uniform Crash Report
Review crash diagrams to determine crash type and cause.

Perform roadway safety audit
A road safety audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team. It reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.

C. Approaches to Addressing the Problem

Objective 1: Reduce frequency and severity of intersection conflicts through traffic control and operational improvements

Employ multiphase signal operation
A two-phase signal is the simplest method for operating a traffic signal, but multiple phases may be employed to improve intersection safety. Left turns are widely recognized as the highest-risk movements at signalized intersections. Protected left-turn phases (i.e., the provision for a specific phase for a turning movement) significantly improve the safety for left-turn maneuvers by removing conflicts with the left turn. Split phases, which provide individual phases for opposing approaches may also increase the overall delay experienced at an

intersection. However, this strategy may improve intersection safety, as it allows conflicting movements to proceed through the intersection independently, on separate phases.

Optimize clearance intervals

The clearance interval is the portion of a signal cycle between the end of a green phase and the beginning of the next green phase for a conflicting movement. Clearance times provide safe, orderly transitions in ROW assignment between conflicting streams of traffic. The clearance interval can include both yellow and all-red time between conflicting green phases.

Restrict or eliminate turning maneuvers

Safety at some signalized intersections can be enhanced by restricting or prohibiting turning maneuvers, particularly left turns. This strategy can be applied during certain periods of the day (such as peak traffic periods) or by prohibiting particular turning movements altogether.

Employ signal coordination

Coordinated signals produce platoons of vehicles that can proceed without stopping at multiple signalized intersections. Reducing the number and frequency of required stops and maintaining constant speeds for all vehicles reduce rear-end conflicts. In addition, signal coordination can improve the operation of turning movements. Drivers may have difficulty making permitted turning maneuvers at signalized intersections because of lack of gaps in through traffic.

Employ emergency vehicle preemption

Signal preemption allows emergency vehicles to disrupt a normal signal cycle in order to proceed through the intersection more quickly and under safer conditions. Any type of crash could occur as emergency vehicles try to navigate through intersections and as other vehicles try to maneuver out of the path of the emergency vehicles.

Remove unwarranted signal

It is possible that a signal may no longer be warranted due to changes in traffic conditions. Problems created by an unwarranted signal, such as excessive delay, increased rerouting of traffic to less-appropriate roads and intersections, higher crash rates, and disobedience of the traffic signal can be addressed by removing the signal if doing so would not create worse problems.

Objective 2: Reduce frequency and severity of intersection conflicts through geometric improvements

Provide or improve left-turn channelization

This strategy includes the following:

- Providing left-turn lanes,

- Lengthening left-turn lanes,
- Providing positive offset for left-turn lanes,
- Providing positive guidance with channelization, and
- Delineating turn path.

Provide or improve right-turn channelization

Many collisions at signalized intersections are related to right-turn maneuvers. A key strategy for minimizing such collisions is to provide exclusive right-turn lanes. It is also important to ensure that the right-turn lanes are of sufficient length to allow vehicles to decelerate before turning, ideally without affecting the flow of through traffic. Right-turn lanes remove slow vehicles that are decelerating to turn right from the through-traffic stream, thus reducing the potential for rear-end collisions.

Revise geometry of complex intersections

Some geometric problems with signalized intersections will not be remedied using signing, channelization, or signal phasing. Physical modifications to all or part of an intersection may be needed to reduce severe crash rates. There may be multiple problems associated with one or more movements at the intersection that can be best addressed with significant improvements to intersection design. Because of the extensive reconstruction required to implement these strategies, they will not be appropriate for agency programs designed for quick low-cost action

Construct special solutions

Signalized intersections may have such a significant crash problem that the only alternative is to change the nature of the intersection itself. These types of projects will be high cost and require substantial time for implementation. This strategy includes the following:

- Providing indirect left turn,
- Reconstructing intersections, converting intersections to roundabouts,
- Convert two-way streets to a one-way pair, and
- Constructing interchanges.
- Convert to Roundabout

Objective 3: Improve sight distance at signalized intersections

Clear sight triangles

The most difficult aspect of this strategy is the removal of sight restrictions located on private property. The legal authority of highway agencies to deal with such sight obstructions varies widely, and the time (and possibly the cost) to implement sight distance improvements by clearing obstructions may be longer if those obstructions are located on private property.

Redesign intersection approaches

Realigning both of the minor-road approaches so that they intersect the major road at a different location, or a different angle, can help address horizontal sight distance issues.

Objective 4: Improve driver awareness of intersections and signal control

Improve visibility of intersections on approach

The ability of approaching drivers to perceive signalized intersections immediately downstream can be enhanced by signing, delineation, and warning devices. This strategy includes the following:

- Improving signing and delineation,
- Installing larger signs,
- Providing intersection lighting,
- Installing rumble strips on approaches, and
- Installing queue detection system.

Improve visibility of signals and signs at intersections

Lack of visibility of traffic control devices may contribute to crash experience at signalized intersections. Visibility of traffic signals and signs at intersections may be obstructed by physical objects (such as signs or other vehicles) or may be obscured by weather conditions, such as fog or bright sunlight. Also, drivers' attention may be focused on other objects at the intersection, such as extraneous signs. Poor visibility of signs and signals may result in vehicles not being able to stop in time for a signal change or otherwise violating the intended message of a regulatory or directional sign.

Objective 5: Improve driver compliance with traffic control devices

Provide public information and education

Providing targeted public information and education (PI&E) on safety problems at intersections is a preventive measure that can help improve driver compliance with traffic control devices and traffic laws. PI&E programs generally add effectiveness to targeted enforcement programs, as well.

Provide targeted conventional enforcement of traffic laws

Traffic law enforcement agencies will often select locations for targeted enforcement when crash, citation, or other sources of information suggest that the site is unusually hazardous due to illegal driving practices, such as speeding or red-light running.

Implement automated enforcement of red-light running

Automated enforcement refers to the use of photo radar and video camera systems connected to the signal control. Such systems record vehicles proceeding through the intersection after the signal displays red.

Implement automated enforcement of approach speeds

Crash types that might indicate speeding as a concern include right-angle and rear-end collisions. Speed-enforcement cameras (also known as photo radar) are a potential method to use in these locations.

Control speed on approaches

Slowing vehicle speeds on intersection approaches can improve safety for motorists, pedestrians, and bicyclists. Various techniques for attempting to control speeds on approaches involve geometric design, signal control technology, and other traffic calming treatments.

Restrict access to properties using driveway closures or turn restrictions

Restricting access to commercial properties near intersections by closing driveways on major streets, moving them to cross streets, or restricting turns into and out of driveways will help reduce conflicts between through and turning traffic.

Restrict cross-median access near intersections

When a median opening on a high-volume street is near a signalized intersection, it may be appropriate to restrict cross-median access for adjacent driveways. For example, left and U-turns can be prohibited from the through traffic stream, and left turns from adjacent driveways can be eliminated. Restrictions can be implemented by signing, by redesign of driveway channelization, or by closing the median access point via raised channelization.

IV. ENSURING SAFER BICYCLE TRAVEL

A. Identify Problem Areas

High occurrence of "bicycle" accidents (RA)
Accident data that that indicated a high occurrence of accidents where vehicles hit pedestrians should be indentified and considered for improvements.

High average speeds (PA)
Urban roadways with vehicles traveling at speeds higher than the posted or "free-flow" speeds are problems for bicyclist safety. Speeds surveys, particularly in high pedestrian activity areas, should be taken on urban roadways to determine if a problem exists.

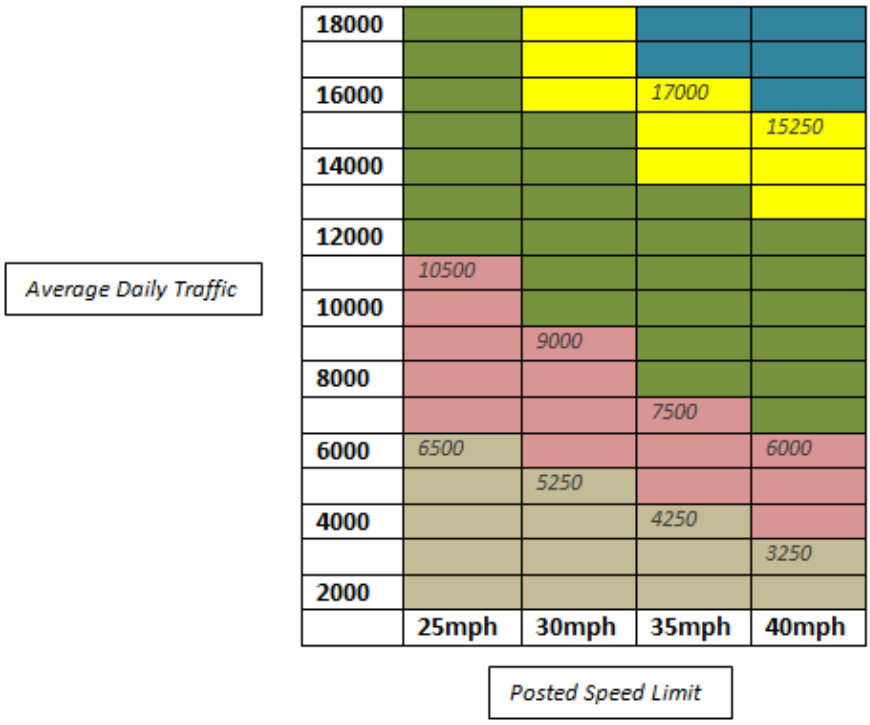
MPO public survey (PA)
The public survey maintained by the Mississippi Gulf Coast MPO asks the question: What visibility improvements need to be made? The survey provides the MPO with insight into problems on the roadway that can be proactively mitigated before accidents become prevalent at a site.

Local agency consultation (PA or RA)
Consultation with local law enforcement, local engineering staff, and local roadway maintenance staff will be used to help indentify intersection safety concerns.

High bicycle activity roadways (PA)
Identify roadways of high bike use such as transit service areas, commercial centers, recreation and schools should be evaluated to determine if additional or improved pedestrian amenities are warranted.

Bicycle Suitability Assessment (PA)
The MPO refers to American Association of State Highway and Transportation Official's "Guide for the development of Bicycle Facilities" to support the goals of the MPO and this TIP Handbook. The guidelines below will be used and promoted by the MPO in the development of federal-aid projects to better accommodate bicycles on gulf coast roadways:

	Standard lane	Standard-width travel lane that both bicycles and motor vehicles share. Cyclists would either operate in the margins or take the lane. No special provisions are provided for the cyclist (Share the road).
	Wide curb lane	An outside travel lane with a width of at least 14 ft (15ft is preferred) to accommodate both bicyclists and motorized vehicles. Cyclists generally can operate alongside vehicles without the motorist having to change lanes to pass a bicyclist. A wide curb lane also provides more room when drivers are exiting form driveways into the travel lane. In situations where more than 15 feet of pavement width exists, consideration should be given to striping bike lanes or shoulders
	Shoulder	A shoulder for bicycle use should be a minimum 3 foot wide paved portion of the roadway. However, any shoulder width is better than none at all. Facility is adjacent to travel lane with no separation.
	Bike lane	A bike lane is a portion of the roadway designated by striping, signing, and/or pavement markings for preferential or exclusive use by bicycles. For roadways with no curb and gutter the minimum width should be 5 feet. Facility is adjacent to travel lane with no separation.
	Wide bike lane separated path	Bike lanes over 5 foot wide or path that is physically separated from the roadway and intended for use by bicyclists, pedestrians, and others.



Roadway diet opportunities (PA)

Use MPO data to review Gulf Coast roadways for areas that have a large amount of capacity with low traffic volume. Opportunities to restripe roadways to include bike lanes or shoulders can be identified.

B. Identify Causes

State of Mississippi Uniform Crash Report

Review crash diagrams to determine crash type and cause for locations identified from bicycle accidents:

Motorist failure to yield – intersection
Bicyclist failure to yield – intersection
Bicyclist failure to yield – midblock
Motorist failure to yield – midblock (driveway/alley)
Turning errors – bicyclist and motorist
Bicyclist failure to clear intersection
Motorist turned/merged into path of bicyclist
Motorist overtaking bicyclist
Bicyclist turned/merged into path of motorist
Bicyclist overtaking motorist
Operator wrong side/head-on (motorist or bicyclist)
Motorist loss of control
Bicyclist loss of control

Perform roadway safety audit

A road safety audit is a formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team. It reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. FHWA's *Bicycle Road Safety Audit Guidelines and Prompt Lists* report from May 2012 provides a list of considerations for the field audit:

A. Street or Path	B. Structures	C. Intersections, Crossings, and Interchanges	D. Transitions	E. Transit
1. Presence & Availability				
Are cyclists accommodated?				
2. Design & Placement				
Are design features present that adversely impact the use of the facility by cyclists?	Are bridges/tunnels designed with adequate bicycle accommodations on both sides? Does the gradient of the cycling accommodations impact the use of the facility?	Are intersection/interchange accommodations designed to reduce conflicting movements and communicate proper bicycle positioning through the crossing?	Are transition areas designed with logical termini or do they end abruptly, potentially contributing to sudden and difficult merges, midblock crossings, or behaviors such as wrong-way riding?	Are transit facilities designed and placed to minimize conflicts with other modes?
3. Operations				
Are there suitable provisions for cyclists given the characteristics of the roadway or path (speed, volume, traffic, and functional classification)? Do access management practices detract from cycling safety?		Do traffic operations (especially during peak periods) create a safety concern for cyclists?	Do shared roadway geometrics change substantially or frequently?	Are transit facilities designed and placed to minimize conflicts with other modes?
4. Quality & Conditions				
Is the riding surface smooth, stable, and free of debris and is drainage adequate? Are drainage grates designed for cyclists?	Is the grating/bridge surface designed for cyclists? Is drainage adequate to accommodate bicyclists? Are there longitudinal or transverse joints that may cause cyclists problems?	Are there any obstacles at crossings? Are the manhole covers properly designed?	Is there an abrupt change in riding surface?	Are transit stops maintained during periods of inclement weather?
5. Obstructions				
Are there any horizontal or vertical obstructions (temporary or permanent) along the facility?	Is there adequate horizontal and vertical clearance?	If bollards or other physical terminal devices are used, is the risk of occasional motorized vehicles greater than the risk of a fixed object within the travel way?		Is the waiting area free of temporary/permanent obstructions that constrict its width or block access to the bus stop?

A. Street or Path	B. Structures	C. Intersections, Crossings, and Interchanges	D. Transitions	E. Transit
6. Roadside				
Is the clear zone for cyclists' operating space adequate?	Are railings, guardrail, and/or parapets and other structures installed at an appropriate height and shy distance?	If bollards or other physical terminal devices are used, is the risk of occasional motorized vehicles greater than the risk of a fixed object within the travel way?		Are bicycle accommodations connected and convenient for transit users?
7. Continuity & Connectivity				
Are bicycle accommodations continuous? Do bicycle accommodations provide adequate connectivity to major destinations?	Are bicycle accommodations continuous, or do they end abruptly at bridge/tunnel crossings?	Are bicycle accommodations continuous, or do they end abruptly at crossings/intersections/interchanges?	Is there a safe way for cyclists from both directions to access connections or continue to other destinations along the street network?	Are crossings convenient and free of potential hazards for cyclists?
8. Lighting				
Is the riding surface adequately lit?	Are bridges and tunnels adequately lit?	Are the intersection/transition and paths leading to the transition adequately lit?		Are transit access ways and facilities adequately lit?
9. Visibility				
Is the visibility of cyclists using the facility adequate from the perspective of all road users?	Can cyclists see approaching vehicles/pedestrians, and vice versa?	Can cyclists see approaching vehicles/pedestrians at all legs of an intersection/crossing, and vice versa?	Is the visibility of cyclists as they make the transition from one facility or roadway geometry to another adequate from the perspective of all road users?	Is the visibility of cyclists using the facility adequate from the perspective of all road users?
10. Signs & Pavement Markings				
Are signs and markings along the riding surface visible, well-maintained, easily understood, and adequate?	Are adequate warning signs posted at entrances?	Do signs and markings along the cycling facility clearly indicate the cyclist path and right-of-way at intersections?	Are signs and markings at transition areas appropriate?	Are signs and markings at designated areas for cyclists using transit appropriate?
11. Signals				
If bicycle traffic signalization and detection are present, are they properly positioned, functioning, and effective? Does the traffic signal design accommodate all users?				
12. Human Factors / Behavior				
What are all roadway users (vehicles, bicyclists, pedestrians, transit, etc.) doing with regards to bicycle traffic, and vice versa?				

C. Approaches to Addressing the Problem

Objective 1: Reduce bicycle crashes at intersections

Improve visibility at intersections

The visibility at intersections can be enhanced by improving the sight distance/sight lines near the intersection and/or by improving the conspicuity of traffic control devices at and near intersections. For example, improving the visibility at intersections could involve:

- Increasing the sight distance along the approach to an intersection so that drivers have a better view of the geometric and cross sectional features of the intersection;
- Clearing sight triangles so that users have better views of vehicles operating on side streets;
- Improving the visibility of traffic control devices which could involve removing vegetation or other roadside objects that obstruct the view of signs and signals or improving the conspicuity of traffic control devices (e.g., installing larger signs, additional signal heads, larger signal lenses, or signal backplates); or
- Improving the lighting along the approaches to the intersection and at the intersection proper.

Improve signal timing and detection

At signalized intersections bicycle traffic should be considered during the development of the traffic signal timing. In many cases of mixed flow traffic, bicyclists can safely travel through a signalized intersection when the phasing plan is timed strictly to accommodate motor vehicles; however, the signal timing at all signalized intersections where bicycle traffic is present or is anticipated should be reviewed to determine if bicycle traffic is sufficiently accommodated. In those cases where it is not, the signal timing should be modified. When the signal is actuated, detection of bicycles is crucial for safety. Several ways to improve signal timing and detection to better accommodate bicycle traffic include:

- Providing an adequate clearance interval
- Providing a leading bicycle phase or bicycle-only phase (which will also involve installation of bicycle signals)
- Providing sensors that detect the presence of a bicycle

Improve signing

Signs are placed within the right of way to provide regulation, warning, and guidance information to road users. This strategy focuses on providing additional regulatory and warning signs to improve bicycle safety at intersections and on modifying existing signage.

The AASHTO *Bicycle Guide* (1999) and MUTCD (2003) should be consulted concerning bicycle-related signs that can improve safety at intersections.

Improve pavement markings at intersections
In addition to the typical bicycle lane treatments that may be installed at intersections, several innovative (i.e., non-typical or non-traditional) pavement marking treatments have been installed to improve bicycle safety at intersections. These innovative pavement marking treatments include: Advance stop lines (or bicycle box), combined bicycle lane/right-turn lanes, and colored bicycle lanes.

Improve intersection geometry
There are several ways to modify the geometry of an intersection to improve bicycle safety, including:

- Reducing the crossing distance for bicyclists
- Realigning intersection approaches to reduce or eliminate intersection skew
- Modifying the geometry to facilitate bicycle movement at interchange on-ramps and off-ramps
- Providing refuge islands and raised medians

Objective 2: Reduce bicycle crashes along roadways

Road diets
Roadways with excess vehicular capacity should be considered for road dieting. Taking out or narrowing lanes in order to provide adequate space for bicyclists on the roadway should be a priority.

Provide safe roadway facilities for parallel travel
Roadway facilities that better identify appropriate travel areas for all road users and their expected behavior may provide a safer environment for bicyclist travel along parallel paths and help reduce crashes. The MPO refers to American Association of State Highway and Transportation Official's "Guide for the development of Bicycle Facilities" to support the goals of the MPO.

Improve bicyclists' visibility
Improved roadway lighting may help to reduce crashes that occur under less than optimal light conditions. Intersections may warrant higher lighting levels than roadway segments.

Improve roadway signage
Signs are placed along roadways to provide regulation, warning, and guidance information to road users, including bicyclists such as, Shared Roadway Signage Bicycle Route Signage

Provide bicycle-tolerable shoulder rumble strips

Bicycle-tolerable shoulder rumble strips are rumble strip configurations that decrease the level of vibration experienced by bicyclists when traversing rumble strips, while at the same time providing an adequate amount of stimuli to alert inattentive/drowsy motorists.

Objective 3 Reduce motor vehicle speeds with traffic calming techniques

Speed humps are rounded raised areas placed across the roadway. They are generally 10 to 14 feet long (in the direction of travel), making them distinct from the shorter "speed bumps" found in many parking lots, and are 3 to 4 inches high. The profile of a speed hump can be circular, parabolic, or sinusoidal. They are often tapered as they reach the curb on each end to allow unimpeded drainage. Good for: Locations where very low speeds are desired and reasonable, and noise and fumes are not a major concern. Advantages: relatively inexpensive, easy for bicycles to cross if designed appropriately; and they are very effective in slowing travel speeds. Disadvantages: They cause a "rough ride" for all drivers, and can cause severe pain for people with certain skeletal disabilities, they force large vehicles, such as emergency vehicles and those with rigid suspensions, to travel at slower speeds, and they have questionable aesthetics. Effectiveness: Average of 22% decrease in the 85th percentile travel speeds, or from an average of 35.0 to 27.4 miles per hour, average of 11% decrease in accidents, or from an average of 2.7 to 2.4 accidents per year. Cost Estimates: $2,000-$2,500

Speed tables are flat-topped speed humps often constructed with brick or other textured materials on the flat section. Speed tables are typically long enough for the entire wheelbase of a passenger car to rest on the flat section. Their long flat fields, plus ramps that are sometimes more gently sloped than speed humps, give speed tables higher design speeds than speed humps. The brick or other textured materials improve the appearance of speed tables, draw attention to them, and may enhance safety and speed-reduction. Good for:

Locations where low speeds are desired but a somewhat smooth ride is needed for larger vehicles.

Raised crosswalks are Speed Tables outfitted with crosswalk markings and signage to channelize pedestrian crossings, providing pedestrians with a level street crossing. Also, by raising the level of the crossing, pedestrians are more visible to approaching motorists. Good for: Locations where pedestrian crossings occur at haphazard locations and vehicle speeds are excessive. Advantages: Raised Crosswalks improve safety for both pedestrians and vehicles and if designed well, they can have positive aesthetic value. They are effective in reducing speeds, though not to the extent of speed humps. Cost Estimate: $4,000

Raised intersections are flat raised areas covering an entire intersection, with ramps on all approaches and often with brick or other textured materials on the flat section. They usually rise to the level of the sidewalk, or slightly below to provide a "lip" that is detectable by the visually impaired. By modifying the level of the intersection, the crosswalks are more readily perceived by motorists to be "pedestrian territory". Good for: Intersections with substantial pedestrian activity; and areas where other traffic calming measures would be unacceptable because they take away scarce parking spaces. Cost Estimate: $12,500 (Sarasota, FL)

Textured and colored pavement includes the use of stamped pavement or alternate paving materials to create an uneven surface for vehicles to traverse. They me be used to emphasize either an entire intersection or a pedestrian crossing, and are sometimes used along entire street blocks. Good for: "Main Street" areas where there is substantial pedestrian activity and noise is not a major concern. Textured pavements are often combined with speed tables, raised crosswalks, and raised intersections. Textured pavements are occasionally combined with speed humps.

Roundabouts require traffic to circulate counterclockwise around a center island. Unlike traffic circles, roundabouts are used on higher volume streets to allocate right-of-way between competing movements. Good for: Locations with a history of accidents, intersections where queues need to be minimized, intersections with irregular approach

geometry. Provide inexpensive-to-operate traffic control as an alternative to a traffic signal and handles a high proportion of U-turns. Advantages: Roundabouts can moderate traffic speeds on an arterial. They are generally aesthetically pleasing if well landscaped. They enhanced safety compared to traffic signals. They can minimize queuing at the approaches to the intersection and are less expensive to operate than traffic signals. Disadvantages: They may be difficult for large vehicles (such as fire trucks) to circumnavigate. They must be designed so that the circulating lane does not encroach on the crosswalks. They may require the elimination of some on-street parking and landscaping must be maintained, either by the residents or by the municipality. Effectiveness: Average 29% reduction in overall accidents, with a reduction from 9.3 to 5.9 accidents per year (source: "Roundabouts: An Informational Guide"). Average 39% reduction in overall accidents and 76% in injury producing crashes *(Source: State Farm)*

Chicanes are curb extensions that alternate from one side of the street to the other, forming S-shaped curves. Chicanes can also be created by alternating on-street parking, either diagonal or parallel, between one side of the street and the other. Each parking bay can be created either by restriping the roadway or by installing raised, landscaping islands at the ends of each parking bay. Good for: Locations where speeds are a problem but noise associated with speed humps and related measures would be unacceptable. Advantages: Chicanes discourage high speeds by forcing horizontal deflection; and they are easily negotiable by large vehicles (such as fire trucks) except under heavy traffic conditions. Disadvantages: They must be designed carefully to discourage drivers from deviating out of the appropriate lane; Curb realignment and landscaping can be costly, especially if

there are drainage issues; and they may require the elimination of some on-street parking. Cost Estimates: $14,000

Realigned intersections are changes in alignment that convert T-intersections with straight approaches into curving streets that meet at right-angles. A former "straight-through" movement along the top of the T becomes a turning movement. While not commonly used, they are one of the few traffic calming measures for T-intersections, because the straight top of the T makes deflection difficult to achieve, as needed for traffic circles. Advantages: Realigned Intersections can be effective reducing speeds and improving safety at a T-intersection that is commonly ignored by motorists. Disadvantages: The curb realignment can be costly; and they may require some additional right-of-way to cut the corner.

Neckdowns are curb extensions at intersections that reduce the roadway width from curb to curb. They "pedestrianize" intersections by shortening crossing distances for pedestrians and drawing attention to pedestrians via raised peninsulas. They also tighten the curb radii at the corners, reducing the speeds of turning vehicles. Good for: Intersections with substantial pedestrian activity; and areas where vertical traffic calming measures would be unacceptable because of noise considerations. Advantages: Neckdowns improves pedestrian circulation and space; through and left-turn movements are easily negotiable by large vehicles. They create protected on-street parking bays; and they reduce speeds, especially for right-turning vehicles. Disadvantages: Effectiveness is limited by the absence of vertical or horizontal deflection. They may slow right-turning emergency vehicles. They may require the elimination of some on-street parking near the intersection. They may

require bicyclists to briefly merge with vehicular traffic. Cost Estimate: $40,000 - 80,000 for four corners.

A **center island narrowing** is a raised island located along the centerline of a street that narrow the travel lanes at that location. Center island narrowings are often landscaped to provide a visual amenity. Placed at the entrance to a neighborhood, and often combined with textured pavement, they are often called "gateway islands." Fitted with a gap to allow pedestrians to walks through at a crosswalk, they are often called "pedestrian refuges."

Chokers are curb extensions at midblock locations that narrow a street by widing the widewalk or planting strip. If marked as crosswalks, they are also known as safe crosses. Two-lane chokers leave the street cross section with two lanes that are narrower than the normal cross section. One-lane chokers narrow the width to allow travel in only one direction at a time, operating similarly to one-lane bridges. Good for: Areas with substantial speed problems and no on-street parking shortage. Advantages: Chokers are easily negotiable by large vehicles (such as fire trucks). If designed well, they can have positive aesthetic value; and they reduce both speeds and volumes. Disadvantages: Their effect on vehicle speeds is limited by the absence of any vertical or horizontal deflection; they may require bicyclists to briefly merge with vehicular traffic; and they may require the elimination of some on-street parking. Cost Estimate: $7,000 - $10,000

Median barriers (island diverters) are islands located along the centerline of a street and continuing through an intersection so as to block through movement at a cross street. Good for: Local street connections to main streets where through traffic along the continuing local street is a problem. Main streets where left-turns to and/or from the side street are unsafe. Advantages: Median Barriers can improve safety at an intersection of a local street and a major street by prohibiting dangerous turning movements; and they can reduce traffic volumes on a cut-through route that crosses a major street. Cost Estimate: $15,000 - 20,000 per 100 feet

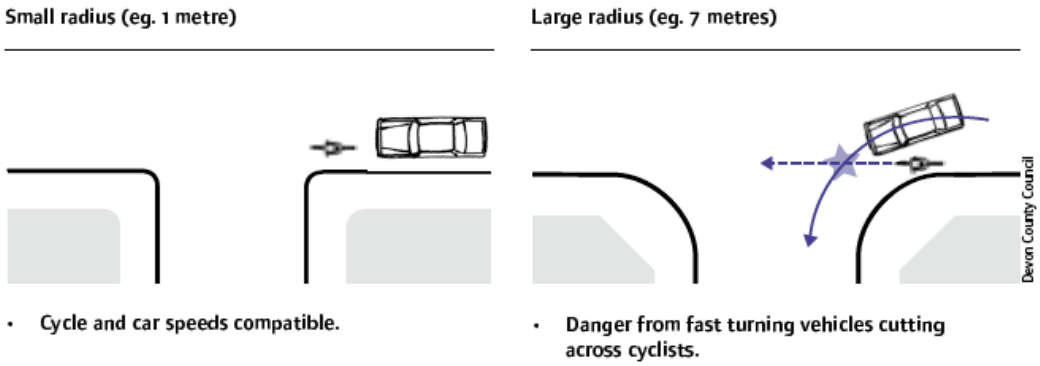
Forced Turn Islands are raised islands that block certain movements on approaches to an intersection. Good for: Local street connections to main streets where through traffic volume along the continuing local street is a problem. Main streets where left-turns or through movements out of the side street are unsafe. Cost Estimate: $3,000 - 5,000

Objective 4 Reduce bicycle crashes at midblock crossings

Improve driveway intersections

Examples of driveway intersection improvements include:

- Tighter turn radii at driveways that slow vehicle speeds. Curb cuts should have sufficient flare, however, for bicyclists to complete turns into the driveway or into the nearest lane without "swinging wide" into the adjacent lane.
- On streets with sidewalks, the walkway should continue at grade across the driveway to provide for clear pedestrian movement and make it clear to motorists and bicyclists that pedestrians have the right-of-way.
- Paved driveway approach aprons may be better suited for intersections with unpaved streets and driveways so that gravel and debris can be contained and prevented from accumulating in the bikeways, where it can lead to unsafe riding conditions at the driveway intersection.
- Driveway right-of-ways should also be kept cleared of foliage, signs, and other objects that obscure visibility.
- Pavement markings may improve conditions for bicyclists at driveway intersections;



Implement access management

Every driveway connection is a potential conflict point among motorists, bicyclists, and pedestrians. Access management strategies such as providing raised/non-traversable medians and limiting driveway access may be useful in promoting safe bicycle travel, particularly on arterial or major collector streets, since they help reduce the number of potential conflict points.

Objective 5: Improve safety awareness and behavior

Provide bicyclist skill education

Bicyclist educational programs can be carried out at many levels from distributing brochures or showing videos, to comprehensive school-based on bike programs, to community or adult education or recreation facility-based program. Bicyclist educational programs can also target audiences from young preschool-age children to seniors. They may touch on a number of issues, including: safety-related training, bicycle-related laws, helmet information, and nearly any other behavioral aspects of bicycling.

Improve enforcement of bicycle related laws

Along with engineering and education approaches to improving bicyclist safety, enforcement of traffic laws can help to create a safer riding environment, whether this enforcement is directed at the motorist or the bicyclist

Objective 6: Increase use of bicycle safety equipment

Increase use if bicycle helmets

Helmet use varies widely across the country, due to the local variation in educational campaigns and the presence of helmet laws. Education of bicycle helmet effectiveness in preventing head injury is one popular method used in the attempt to increase and sustain bicycle helmet use. Mandatory helmet use laws are an effective means of increasing helmet use. Legislation is quite effective in increasing helmet use, and the effect is not heavily dependent on enforcement.

Increase rider and bicycle conspicuity

Some bicyclist education programs teach bicyclists that they can improve their detection and recognition by riding in a prominent position on the road. But the most effective way for bicyclists to make themselves more conspicuous, and hence more detectable and recognizable, is to use headlights and rear lights and to wear retroreflective clothing.

Objective 7: Reduce effects of hazards

Fix or remove surface irregularities

At-grade railroad crossings can cause serious problems for bicyclists. On diagonal railroad crossings, the gap next to and on the inside of the rail (called the flangeway) can catch the front wheel of a bicycle resulting in a sudden fall for the bicyclist. Drainage grates and utility covers can also cause serious problems for bicyclists in several ways. Raised or sunken grates and covers can stop or divert the front wheel of a bicycle, potentially causing a crash.

Provide routine maintenance of bicycle facilities

Maintenance programs and activities are critical for successful bicycle facilities. Bicycles and bicyclists tend to be particularly sensitive to maintenance problems (i.e., loss of control type crashes). Most bicycles lack suspension systems and so potholes that motorists would hardly notice can cause serious problems for bicyclists. In addition, since bicyclists often ride near the right edge of the road, they use areas that are generally less well maintained than the main travel lanes. On higher speed facilities, motor vehicle traffic tends to sweep debris to the right, where most bicyclists travel.

VI: MAKING WALKING AND STREET CROSSING SAFER

A. Identify Problem Areas

High occurrence of "pedestrian" accidents (RA)
Accident data that that indicated a high occurrence of accidents where vehicles hit pedestrians should be indentified and considered for improvements.

Pedestrianized intersections (PA)
Urban area Intersections will be indentified to evaluate ways to "pedestrianize" them. Some characteristics to consider area:

- If a person would have cross 48' or more lanes then bulbouts or pedestrian refuges should be provided to shorten the distance to cross. *("Walkable Communities, 12 Steps for and Effective Program". Florida DOT April 1995)*
- Marked cross walks
- Crosswalk illumination in areas of nighttime pedestrian activity
- Pedestrian signals
- No barriers that restrict pedestrian movements
- Signing such as school warning signs, advance pedestrian warning signs, guide signs to direct pedestrians to sidewalks.
- Traffic calming measures in place

Pedestrian sheds (PA)
Areas such as transit stops, school zones, and commercial activity should be evaluated to determine if additional or improved pedestrian amenities or ADA improvements are warranted. Pedestrian sheds are often defined as the area covered by a 5-minute walk (about 0.25 miles). They may be drawn as perfect circles, but in practice pedestrian sheds have irregular shapes because they cover the actual distance walked, not the linear (crow flies) distance. Vehicle turning movements should below 20mph for left turns and below 10 mph for a right turn. Pedestrian signals should provide for 3.5' per second walking speed. For ADA considerations, two curb ramps should be installed on each street corner. All intersections should have adequate lighting to provide clear visibility of pedestrians. Side street driveways should be at least 230 feet from intersections.

High average speeds (PA)
Urban roadways with vehicles traveling at speeds higher than the posted or "free-flow" speeds are problems for pedestrian safety. Speeds surveys, particularly in high pedestrian activity areas, should be taken on urban roadways to determine if a problem exists.
MPO public survey (PA)

The public survey maintained by the Mississippi Gulf Coast MPO asks the question: What crosswalk improvements need to be made? The survey provides the MPO with insight into areas that people are walking and have experienced firsthand difficulties crossing a roadway.

Local agency consultation (PA)

Consultations by the use of interviews or surveys to local planning and administration staff will be used to help indentify pedestrian safety concerns that exist on gulf coast roadways.

B. Identify Causes

Perform roadway safety audit

A road safety audit is a formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team. It reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. The audit questions listed below come from "Pedestrian Mobility and Safety Audit Guide" by ITE.

Crossing Distance

- Street crossings should be direct, intuitive and as straight as possible.
- Are there ways to minimize crossing distances with narrower lanes and curb extensions?

Sight Distance

- Are there objects at the side of the road or in the median that may obstruct sight-lines between approaching drivers and pedestrians beginning to cross the roadway? Objects may include trees and other landscaping, street furniture such as signal cabinets, transit shelters, utility poles and snow banks.
- Are there obstructions that would prevent a driver from seeing a child or a person in a wheelchair who are approaching intersections and driveways?
- Are pedestrian crossings located in an area where sight distance may be a problem?
- Can pedestrians see vehicles at all legs of the intersection/crossing and vice versa?

Lighting

- Does the sidewalk have adequate lighting? Adequate lighting is especially important on narrow pedestrian paths, underpasses and bridges where nighttime security is an issue. Additional lighting on the sidewalk is particularly important where trees obscure light from street lights. Commercial sidewalks should be more brightly lit than streets.
- Are intersections and crosswalks well-lit? Intersections (including mid-block crosswalks) should be twice as bright as the adjacent roadway.

- Are there illuminated signs at night? Do these signs assist pedestrians using the crosswalks?

Speed and Other Driver Behavior

- Is vehicle travel speed a problem for pedestrians? How?
- Are there any traffic devices in the study area to slow down traffic?
- Are any vehicles running red lights?
- Do you observe illegal passing?
- Is there evidence of drunk driving?
- Is there evidence of aggressive driving?
- Is there evidence of distracted driving or cell phone use?
- Is traffic congestion so severe that backed-up traffic is blocking the crosswalks at signalized/unsignalized crossings or at mid-block crossings?
- Do vehicles that are turning right on green yield to pedestrians in the crosswalk?
- Are drivers who are trying to turn right on red pulling into and blocking the crosswalk?

Use of Shoulders as Pedestrian Facilities

- Is there a walkable shoulder along the road? Is it wide enough to accommodate cyclists and pedestrians?
- Is the walkable shoulder continuous and on both sides of the streets?
- If a walkable shoulder is present, consider the following:

- Is the shoulder wide enough to accommodate pedestrian and bicycle volumes?
- Is the shoulder continuous and on both sides of the street?
- Does it provide a link to other pedestrian facilities?
- Is the shoulder adequately maintained (free of mud, severe pavement deterioration and plowed snow)?
- Is the shoulder clearly delineated by clear and well-maintained pavement markings?

Sidewalks

- Are sidewalks provided beside the road?
- Are sidewalks continuous and on both sides of the streets?
- Is the sidewalk width adequate for pedestrian volumes?
- Is the sidewalk pleasant, with a landscape strip between the sidewalk and the roadway, or is there a narrow sidewalk right beside the road?
- Does the sidewalk end abruptly? Is there a break or missing section in the sidewalk?
- Do the sidewalks provide at least a 48-inch minimum accessible width (level, smooth, without poles in the middle)?
- Are the walking surfaces adequate? For example, do unsafe conditions exist such as uneven surfaces, tripping hazards, minor uplifts, or lips in the pavement surface? Are the surfaces poorly maintained, with loose debris, snow, or ice?

- Are sidewalks smooth and slip resistant? Does the area use brick and bumpy textures? These are not good walking surfaces. Textures should only be used for edging and trim.
- Steep walking surfaces (both running slopes and cross slopes) can affect pedestrian stability and control, especially for persons with disabilities. Are sidewalks designed to minimize slopes? Do they provide intermittent level landings (places to stop and rest)?

Driveways

- Does the number of driveways make the route undesirable for pedestrian travel?
- Driveways and smaller cross streets should raise to sidewalk level, not vice-versa – think of wheelchair access and going up and down at every driveway.
- Are drivers at driveways endangering pedestrians on the sidewalk?

Signs and Other Features

- Are signs worn, missing, or damaged?
- Is the visibility of signs adequate during the day and night? If there is poor visibility, what is the issue? Poor sign visibility may result from damage, vandalism, poor maintenance, or obstruction by vegetation or other structures.

Corners

- Is the waiting area sufficient to accommodate pedestrians, including those in wheelchairs or those with strollers, during peak pedestrian times?
- When pedestrian crossing is prohibited, are pedestrians directed to better crossings with physical barriers, such as fencing, barriers, bollards, shrubs and signs?

Pedestrian Crossings

- Do steep grades (either perpendicular or parallel to crossings) cause problems for pedestrians, especially those in wheelchairs?
- Do curb ramps on islands or other refuge areas line up with each other?
- If a raised median or island is present, is it accessible for all pedestrians? Does it have curb ramps or cutthroughs of an appropriate width for wheelchair users, with enough room to wait? Does it have detectable warnings so blind users can detect the median? Are there pushbuttons on the median to call the WALK signal?

Crosswalk Markings

- Is paint on stop bars and crosswalks worn?
- Is the visibility of pavement markings adequate during the day and night?
- Are marked crosswalks wide enough?
- Are the walking surfaces in the crosswalks smooth and slip resistant? Does the area use brick and bumpy textures? Are the crosswalk markings slippery?
- Are crossings free from puddles, holes, cracks and other discontinuities in the pavement that could trip pedestrians or snag wheelchairs?

- Are the crosswalk markings of the high-visibility type, either ladder or continental style? (Ladder type markings are shown in the photo above and can be easier for people with low vision to see and use).

Look at the photos of crosswalks.

- Do you see obstacles that might present themselves for wheelchair users, two persons walking side-by-side, or a person who is blind or visually impaired?
- How would the median island affect a person using a wheelchair, or someone who has difficulty with stepping up on a curb?
- Are there pedestrian signals here?
- Is there a curb ramp on the other side of the street?
- Is the sidewalk wide enough? Does the sidewalk seating block the passageway?
- Does the crossing on the right look easy to use?
- Is the pavement smooth?
- Are the markings clear?
- Is there a curb ramp?
- Are there pedestrian signals?
- Can you see and use the signal for vehicles?

Curb Ramps

- Do all crosswalks have curb ramps to provide a transition from the sidewalk to the roadway?
- Look at the curb ramps at the intersection. Are there separate curb ramps for each crossing? There should not be a single diagonal ramp unless intersection angle is very acute.
- Are the curb ramps aligned with the crosswalk? Why do you think this would be a good idea?
- Is there a flush transition at the gutter so pedestrians who are walking or using wheelchairs are not tripped or stopped by a lip or curb?
- Is there adequate drainage at the gutter of each curb ramp so water, dirt and gravel do not accumulate at the base of the ramp?
- Does each curb ramp have a level landing at the top?
- Are truncated dome detectable warning surfaces provided on curb ramps? Detectable warnings should be installed wherever there is a flush transition between street and sidewalk, such as at base of curb ramps, the cut-through on a median or island, raised crosswalks, or raised intersections. The strips should be 24-inches wide and extend the width of the flush area.

Pedestrian Signals

- Are there pedestrian signals at the intersection?
- Do pedestrian signals provide adequate time for slower pedestrians to cross the street without feeling rushed?
- Are the pedestrian signals easy to see? Are they within the crosswalk area?

- Do signals count down the flashing DON'T WALK time? Do you think that is helpful?
- If there are no pedestrian signals, can pedestrians see the vehicle signal? Does it provide adequate time for a pedestrian to cross the street?
- Are the pedestrian signals audible?
- Is there a sign posted explaining the pedestrian signals and pushbuttons?

Pedestrian Pushbuttons

- Do pedestrian signals have pushbuttons?
- Can you tell which crosswalk the pushbutton is for?
- Are the pushbuttons close to the crosswalk?
- Is there a level maneuvering space beside each pushbutton? A level area is needed to allow wheelchair users to let go of the wheels in order to push the button and maintain their balance.
- Are accessible pedestrian signals (APS) provided? New types of signals, called pushbutton-integrated APS, have new features and are helpful to all pedestrians.
- Are APS pushbuttons provided in a location that is easy to reach from the crosswalk and in line with the crosswalk that the pushbutton controls?

Unsignalized Crosswalks

Unsignalized crosswalks may be located mid-block or at an intersection. They may or may not be marked with crosswalk lines. In most states, a legal crosswalk exists between two corners of an intersection even when it is not marked.

- Is it necessary to cross more than two lanes of traffic without a refuge (an island or safe place to wait)?
- Are there sufficient gaps in the traffic for a pedestrian to cross all the way to the other side or to the refuge?
- Is the distance from the stop line (or yield line) to a crosswalk sufficient for drivers to see pedestrians?
- At mid-block crossings, are driveways placed between the stop bar and pedestrian crossing?

Pedestrian Behavior - Crossing Roads

- Do pedestrians cross the road without looking?
- Do pedestrians cross the road at unsafe locations?
- Generally, do pedestrians walk or run across the road?
- Do any of the pedestrians appear intoxicated or under the influence of a substance? If yes, please explain.
- Do entertainment items such as cell phones and iPods distract pedestrians? Are pedestrians wearing headphones crossing intersections?
- Do pedestrians regularly misuse or ignore pedestrian facilities?
- Do the pedestrians generally hesitate or abort the crossings?
- Do you observe the pedestrians or vehicle collide? Do they have to stop or maneuver to avoid a collision?

Bus Stops

- Are bus stops clearly marked?
- Do signs provide any route or schedule information?
- Are there sidewalks or pathways to easily access the bus stop?
- Are there safe crossings to access the bus stop?
- Do pedestrians near the bus stop take risks such as crossing the street in front of the bus or running across the street to catch a bus?

Bus Shelters

- Is there adequate seating?
- Are sidewalks blocked near bus shelters?
- Is the bus shelter waiting area and seating area at a safe and comfortable distance from vehicle and bicycle lanes?
- Can you easily get to the shelter from the sidewalk (or to the sidewalk from the shelter or the bus stop)?
- Is the path cluttered and narrow or blocked by signs, trees, or trash cans?

Bus Stops and Shelters

- Is there a wheel chair landing area of at least 5-feet wide and 8-feet deep?
- Is the landing area paved and free of problems such as uneven surfaces, standing water and steep slopes?
- Are there any obstacles that would limit the mobility of a wheelchair (trash receptacle, newspaper boxes, landscaping, etc.) on the landing area?

Location

- Where is the bus stop in relation to the nearest intersection?
- Is there a companion bus stop across the street?
- Do the bus stop and the surrounding area have sufficient lighting?

Traffic Issues

- What is the posted speed limit of the roadway in miles per hour?
- Where does the bus stop or pull off to stop? Is it stopping in the travel lane or is there a parking lane or separate bus pull off area?
- What are the traffic controls at the nearest intersection to the bus stop?
- Is there on-street parking permitted just before or after the bus stop zone?
- What are potential traffic hazards in the vicinity of the bus stop or pull off area?

Bicycles

- Do you observe people riding bicycles on roadways?
- Do you observe people riding bicycles on sidewalks?
- Are there on-road bicycle lanes?
- Are shoulders marked for bicycle use?
- Are there separate bicycle signals?

Review Pedestrian Accident Data

- Did the crash occur at an intersection or driveway?
- Did the crash involve a vehicle turning at an intersection?
- Did it occur because of a driver violation?
- If the accident occurred at a midblock location, did the pedestrian dart into the intersection or was the motorist's view blocked?
- Did the accident involve a pedestrian walking along the roadway?
- Did the pedestrian step out from between parked cars?
- Was the pedestrian walking or running in the wrong direction with traffic?
- Did the motorist fail to yield to the pedestrian or back up improperly?
- Was the pedestrian struck by a bus?

C. Approaches to Addressing the Problem

Objective 1: Reduce pedestrian exposure to vehicular traffic

Provide sidewalks, curb ramps, and protective barriers

Sidewalks and curb ramps should be part of every new and renovated roadway, and every effort should be made to retrofit streets that currently do not have sidewalks or walkways. Other measures may also be needed to help protect pedestrians on sidewalks or walkways such as various types of posts, bollards, or protective barriers

Install or upgrade traffic and pedestrian signals

This strategy includes countermeasures including: traffic signals, pedestrian signals, pedestrian signal timing, accessible pedestrian signals, signal enhancements, and right-turn-on-red restrictions.

Construct pedestrian refuge islands and raised medians

Crossing the street can be a complex task for pedestrians. Pedestrians must estimate vehicle speeds, adjust their own walking speeds, determine adequacy of gaps, predict vehicle paths, and time their crossings appropriately. Drivers must see pedestrians, estimate vehicle and pedestrian speeds, determine the need for action, and react. At night, darkness and headlamp glare make the crossing task even more complex for both pedestrians and drivers. Raised medians and pedestrian refuge islands allow pedestrians to cross one direction of traffic at a time. This significantly reduces the complexity of the crossing. Slip lanes should be considered to provide added refuge on wide roadways.

Provide vehicle restriction/diversion measures

This strategy involves the installation of physical features in the roadway to force or prohibit specific motorist actions such as turns or through movements.

Install overpasses/underpasses
Pedestrian overpasses and underpasses (i.e., bridges and tunnels) allow for the uninterrupted flow of pedestrians separate from vehicular traffic

Improve operation of pedestrian and bicycle facilities at signalized intersections
Traffic control improvements that can be made to an intersection to increase pedestrian safety include the following:

- Pedestrian signs, signals, and markings,
- Crossing guards for school children,
- Lights in crosswalks in school zones,
- Pedestrian-only phase or pedestrian-lead phase during signal operation,
- Prohibition of right turn on red

Objective 2: Improve visibility between motor vehicles and pedestrians

Provide crosswalk enhancements
The intent of marked crosswalks is to indicate the optimal or preferred locations for pedestrians to cross. They also help designate right-of-way and may encourage motorists to yield to pedestrians.

Implement lighting/crosswalk illumination measures
Good placement of lighting and adequate lighting levels can enhance an environment for walking, as well as increase pedestrian safety and security.

Eliminate screening by physical objects
A parked vehicle can screen the view of a pedestrian beginning to cross the roadway. To solve this problem is to install curb extensions at intersection and midblock crosswalk locations.

Signals to alert motorists that pedestrians are crossing
Electronic pedestrian signs that show the driver the direction the pedestrian is crossing and remind him to look for pedestrians is an effective way to increase driver yielding behavior.

Improve reflectorization/conspicuity of pedestrians
Vests and other clothing for pedestrians have also been made with reflective materials

Objective 3: Reduce vehicle speed

Implement road narrowing measures

Road narrowing can reduce vehicle speeds along a roadway section and enhance pedestrian movement and safety. Bicycle travel will also be enhanced, and bicyclist safety might improve when bicycle lanes are added.

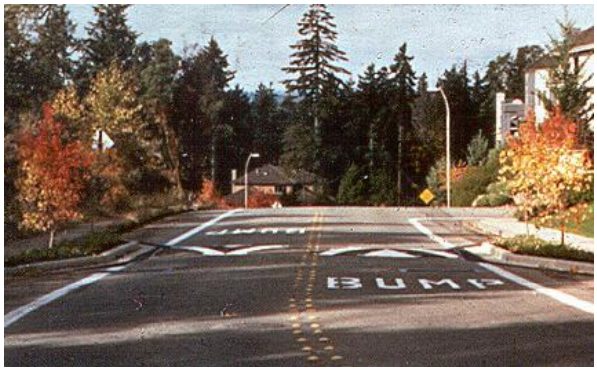
Install traffic calming

Traffic-calming encompasses a series of physical treatments that are meant to lower vehicle speeds and volumes by creating the visual impression that certain streets are not intended for high-speed or "cut-through" traffic.

Provide school route improvements

Sidewalks or separated walkways are essential for a safe trip from home to school on foot or by bike. Ideally, schools should be sited in locations where it is easy and safe for students to walk or bike. Schools should develop "safe routes to school" plans (including creating school walking-route maps that can be sent home to parents) and work with local agencies to identify and correct problem areas and locations.

Combined Measures



Speed Hump with Choker

Center Island with Neckdown

Raised Intersection with Neckdown

Center Island with Speed Tables

VII: INCREASING DRIVER SAFETY AWARENESS

The MPO will initiate, develop, and market a coordinated regional campaign that targets driver safety awareness. It is expected that a theme, marketing and camera-ready material, a deployment strategy, a defined measure of effectiveness, and an education plan will be established for each emphasis area in this plan. This outreach and education program will create awareness efforts to deal with less understood and emerging safety concerns.

A. Outreach and Education for the General Public

Objective 1: Identify, support and disseminate regional transportation safety activities

Campaign
The MPO will initiate, develop, and market a coordinated regional campaign that targets driver safety awareness. It is expected that a theme, marketing and camera-ready material, a deployment strategy, a defined measure of effectiveness, and an education plan will be established for each emphasis area in this plan. This outreach and education program will create awareness efforts to deal with less understood and emerging safety concerns.

Database
Develop and maintain an electronically accessible, regional clearing house of safety education resources, providers, educators, funding sources, etc.

Objective 2: Increase general public awareness of regional safety concerns and encourage participation in available event and training activities

Community events
Interact with members of the community at public places and events such as shopping malls, libraries, fairs, etc. to increase general safety awareness as well as share regional program progress and encourage event participation

B. Transportation Workforce Development

Objective 1: Increase local level awareness of risk mitigation techniques and countermeasures

Workshops
Coordinate a quarterly professional development workshop that highlights a regionally important transportation safety topic.

Newsletter
Share industry updates, safety hot topics, legislation updates and other news and information through the safety program regular communications

Strategies
Changes in driver behavior, technology, and society itself are ongoing. In order to effectively deal with these changes, traffic safety professionals must be able to continually identify safety concerns and mitigation measures.

C. Website, blog, newsletter, social media

Objective 1: Provide regular safety program communications to stakeholders

Notices
Notices for meetings, workshops and conferences will be provided through digital outreach.

Objective 2: Connect stakeholders with transportation safety resources

Information
Links to transportation safety resources and discussion are provided.

VIII: REDUCING VEHICLE-TRAIN CRASHES

A. Identify Problem Areas

Quiet zones
Consult with local communities to determine if quiet zones are needed.

Rail crossing accidents
Use accident data to identify rail crossings that have experienced accidents.

Rail crossing inventory
Inventory all rail crossings and identify what safety devices they are equipped with. Determine crossings with inadequate safety devices.

B. Identify Causes

Safety devices standards
Review State rail crossings to determine if they are equipped with proper safety devices.

Quiet zone criteria
Identify and review standards or criteria used by rail companies to initiate quiet zones

C. Approaches to Addressing the Problem

Objective 1: Improve existing railroad crossings to improve safety for trains and vehicles.

Development and deployment of improved rail crossing warning devices
A number of crashes occur at crossings that only have signing. Initially, top candidate crossings will be identified, deployed in demonstrations, and evaluated to determine the most effective safety devices for implementation.

Priority rail crossings
Work with MDOT to build list of priority rail crossings for improvement on the Gulf Coast.

Adopt more advanced technology for enforcement and crash prevention at appropriate railroad locations to minimize motorist violation of railroad warning devices.
A significant number of crashes occur at railroad crossings where motorists knowingly violate an active rail road traffic control device. This initiative will identify the most promising candidate systems to impact this problem, field-test and evaluate those systems, and define the

most effective, cost-efficient system. In addition, model state legislation will also be prepared, if necessary, for implementation.

Objective 2: Build relationships with railroad companies to facilitate improved coordination with roadway plans

MPO Technical Coordinating Committee (TCC) meetings
Consider agenda items, policies, planning processes and other means that will be beneficial to rail companies that will help get them involved in MPO meetings.

Objective 3: Implement quiet zones in communities that desire it.

Install quiet zones
Work with MDOT, rail companies and local communities to install quiet zones where needed

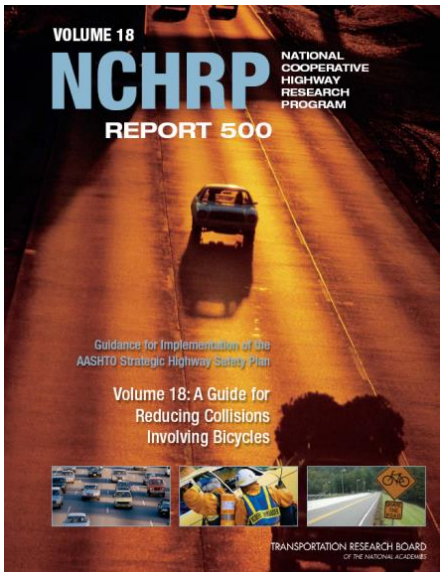
APPENDIX

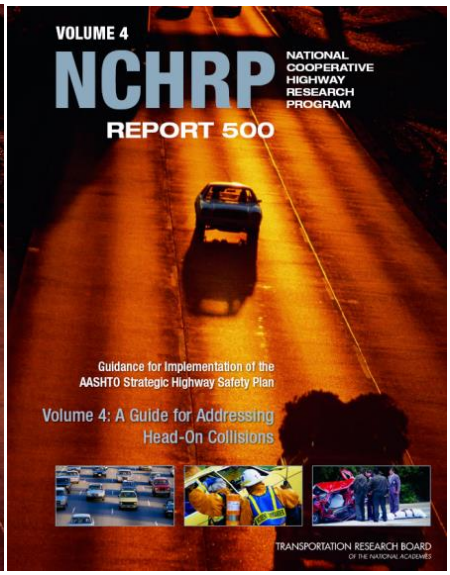
Collision Reduction Factors

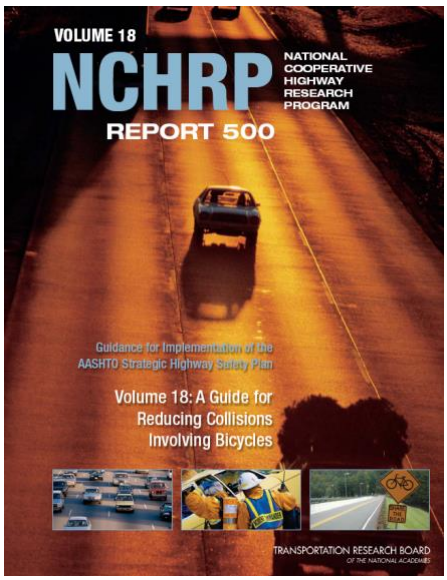
Hamilton and Associates (2004)

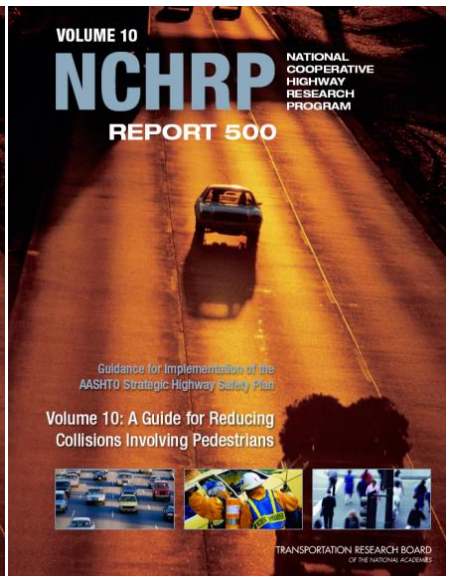
Improvement Measures	All Collisions	Pedestrian Collisions
Replacement of two-way left turn lanes with raised median	25% - 45%	55%
Sidewalks	1%	65% - 75%
Added/Improved pedestrians crosswalks	13% - 25%	19%
Reduced speed limits	1% - 3%	15% - 30%
Access control: service road/frontage road	5% - 12%	10% - 30%

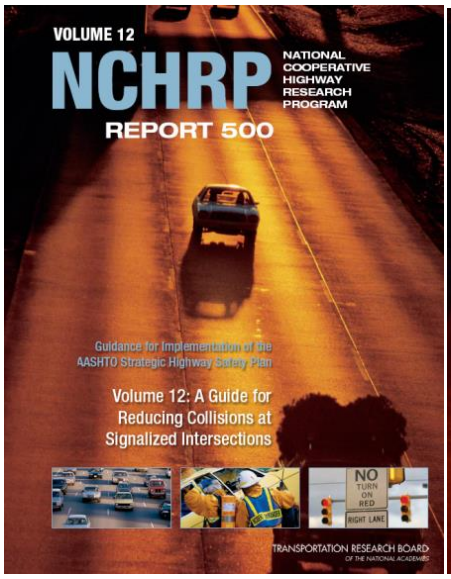
Resources










VOLUME 12
NCHRP
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
REPORT 500
Guidance for Implementation of the AASHTO Strategic Highway Safety Plan
Volume 12: A Guide for Reducing Collisions at Signalized Intersections
NO TURN ON RED
RIGHT LANE
TRANSPORTATION RESEARCH BOARD
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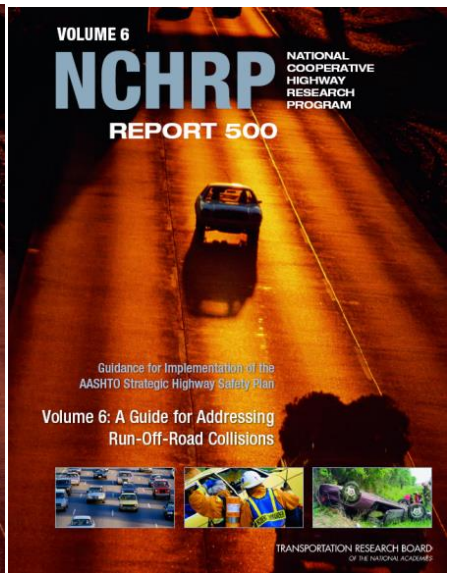
VOLUME 6
NCHRP
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
REPORT 500
Guidance for Implementation of the AASHTO Strategic Highway Safety Plan
Volume 6: A Guide for Addressing Run-Off-Road Collisions
TRANSPORTATION RESEARCH BOARD
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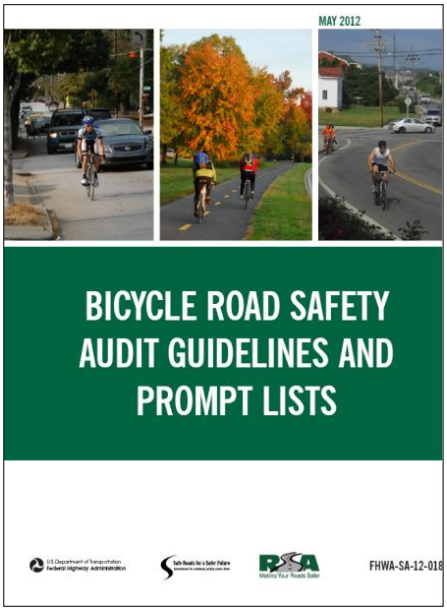
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BICYCLE ROAD SAFETY AUDIT GUIDELINES AND PROMPT LISTS
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