PUBLIC ROADS

https://highways.dot.gov

Summer 2025

Opportunities, Challenges of Safer Speeds and Speed Management

PUBLIC ROADS

Summer 2025 | Vol. 89, No. 2

FEATURES

DEPARTMENTS

ABOVE: © *sheilaf2002 / AdobeStock.com.*

Recommended citation: Federal Highway Administration, *Public Roads*, Summer 2025 (Washington, DC: 2025) https://doi.org/10.21949/dcyw-1y59

COVERS: Implementing safer speeds and advancing speed management tactics leads to fewer crashes and deaths on our Nation's roads.
© Bijac / Michael C/peopleimages.com / Jelena / Michael O'Keene / pvl0707 / Gorodenkoff / Sensvector / AdobeStock.com. Modifications by FHWA.

U.S. Department of Transportation
Federal Highway Administration

U.S. Department of Transportation
Sean Duffy, *Secretary*

Federal Highway Administration
Sean McMaster, *Administrator*
Gloria Shepherd, *Executive Director*

Office of Research, Development, and Technology
Joey Hartmann, *Associate Administrator*
Heather Shelsta, *Director, Office of Research Services*
TaMara McCrae, *Editor-in-Chief*
TaMara McCrae, *Distribution Manager*

Editorial and Design Contractor:
Schatz Strategy Group
D. Davis; A. Jacobi; K. Fitzgerald; J. Love; C. McCoy; M. Mitchell; R. Nemec; T. Tolbert; C. Williams

Public Roads (ISSN 0033-3735; USPS 516-690) is published quarterly by the Office of Research, Development, and Technology, Federal Highway Administration (FHWA), 6300 Georgetown Pike, McLean, VA 22101-2296. The business and editorial office of *Public Roads* is located at the McLean address above. Phone: 202-493-3382. Email: tamara.mccrae@dot.gov.

The electronic version of *Public Roads* can be accessed through the Turner-Fairbank Highway Research Center home page (https://highways.dot.gov/research).

The Secretary of Transportation has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this department.

MANAGING SPEED:
A Special Issue for a Complex Issue

Speed is often celebrated in literature, lauded in cinema, and marketed and promoted throughout media. Its promise of freedom is as much a part of our collective consciousness as the heartbreak that follows a speed-related crash. Speed-related fatalities consistently represent almost 30 percent of all roadway fatalities and have increased recently—from 9,696 in 2013 to 12,151 in 2022. Beyond the human toll, there is the economic burden of speed-related crashes. In 2019, speed-related crashes caused $46 billion in economic costs and contributed to the $36 billion economic cost of congestion. Combining all societal costs, including the valuation for lost quality-of-life, speed-related crashes cost $225 billion.

Speeding is a complex issue and a safety concern for all road users and on all roads. In 2022, 87 percent of speed-related fatalities occurred on non-interstate roadways. Further, at higher speeds, drivers are less able to perceive and react to roadway surroundings—braking distances are longer, and crash energy is greater.

Though a driver's speed may be informed by their personal choices and societal attitudes, when and where a driver speeds can reflect the built environment and roadway design. Many of our Nation's roads were built with a focus on moving goods and vehicles quickly and safely. While communities and their needs change over time, the roadways serving those communities might not be able to support the changing environment.

This issue of PUBLIC ROADS is a continuation of the holistic focus of a Safe System Approach, which provides an opportunity to rethink speed by designing infrastructure that will move people, vehicles, and goods; grow a more vibrant economy; and keep families intact. Promoting safe speeds requires identifying risks and helping drivers manage those risks to save lives (see "Introducing Speed Management" on page 4). Managing the impacts of kinetic energy in a crash allows us to conceive additional solutions—such as roundabouts, which can reduce vehicle speeds at intersection approaches and achieve as much as 80 percent reduction in fatal and injury crashes—and raise greater public awareness around safer speeds.

Addressing speed-related crashes is not just about limiting speeds. Crashes lead to congestion and poor operations. Preventing crashes helps get people and goods to where they need to go, efficiently and on time. As part of a broad speed management plan, setting an appropriate and safe speed limit is important; can help set expectations for the operating speed of a roadway (see "Engineering Appropriate Speed Limits" on page 18) and supports safe operations.

Several cities and counties have improved the management of speeds on their roadways (see "Transforming Communities: Proven State, Local, and Tribal Strategies for Safe Speeds" on page 10). Proven methods and tools have already begun to show impact. More technology is coming online that will help curb speeding and improve traffic operations and safety. Meanwhile, we can all do our part: encourage safe speeds through engineering and enforcement, promote speed management measures, and implement roadway infrastructure to help reduce speed-related crashes so that everyone arrives home safely.

Robert Ritter
Associate Administrator for Safety
Federal Highway Administration

TOP: Speeding is a safety concern on all roads.
© Aevan / AdobeStock.com.

INSET: *Source: FHWA.*

Real-World Applications, Case Studies Wanted by Readers

State DOTs, send us your story ideas.

The 2024 Reader Survey revealed what audiences need and want to do their jobs better, and to make their daily tasks safer, easier, and more cost-effective—case studies, case studies, case studies!

We invite State DOT engineers, planners, and regional Public Information Officers to submit their story ideas—on real-world applications of new processes, innovations, and major project successes—to be considered for a feature article in a future issue of PUBLIC ROADS.

For more information on the process or to submit your story idea, email PublicRoads@dot.gov.

INTRODUCING SPEED MANAGEMENT

Visualizing speed in terms of kinetic energy may save lives by helping drivers better recognize the risks of speeding.

by **JEFFREY KING** and **ANYESHA MOOKHERJEE**

Traffic crashes are a daily occurrence in the United States, with 116 people dying on the Nation's roadways every day on average. Motor vehicle crashes are communicated via traffic reports, daily news broadcasts, public media, and, unfortunately, from persons directly involved in a crash. The most recent data, released in April 2025, shows that, in 2023, there were nearly 6.1 million police-reported traffic crashes, in which 40,901 people were killed and 2,442,581 people were injured. During that year, on average, one person was killed every 12 minutes and five people injured every 60 seconds.

Crashes impact our Nation and society in many ways. The National Highway Traffic Safety Administration (NHTSA) published *The Economic and Societal Impact of Motor Vehicle Crashes* in 2023 based on its 2019 data. The total economic cost of motor vehicle crashes in the United States was $340 billion in 2019, which translates to a cost of $1,035 per person for the 328 million people in the United States at that time. When quality-of-life valuations are considered, the total value of societal harm from motor vehicle crashes in 2019 was nearly $1.4 trillion.

Over the past decade, the U.S. Department of Transportation began incorporating the Safe System Approach (SSA) into its programs and initiatives to recognize that deaths and serious injuries occurring on roadways is unacceptable and to seek their reduction. The SSA embodies six principles: death and serious injuries are unacceptable; humans make mistakes; humans are vulnerable; responsibility is shared; safety is proactive; and redundancy is crucial. At the core of this strategy are five key objectives: safer people, safer roads, safer vehicles, safer speeds, and post-crash care. "Since the Safe System Approach was adopted, more communities are applying the principles and objectives at local, Tribal, and State levels. This is a great advancement because this internationally recognized best practice will reduce traffic fatalities and serious injuries, keeping more of our loved ones safe on the roads every day," states Derek Voight, safety engineer for the Federal Highway Administration.

The USDOT multimodal Speed Management Team, comprised of NHTSA, FHWA, and Federal Motor Carrier Safety Administration, plays a vital role in conducting research, data analysis, and implementing evidenced-based countermeasures to reduce speeding-related crashes.

ABOVE: When a vehicle is in motion, it possesses KE. *© Mariusz Blach / AdobeStock.com.*

LEFT: The Safe System Approach considers all five elements of a safe transportation system in an integrated and holistic manner. *Source: FHWA.*

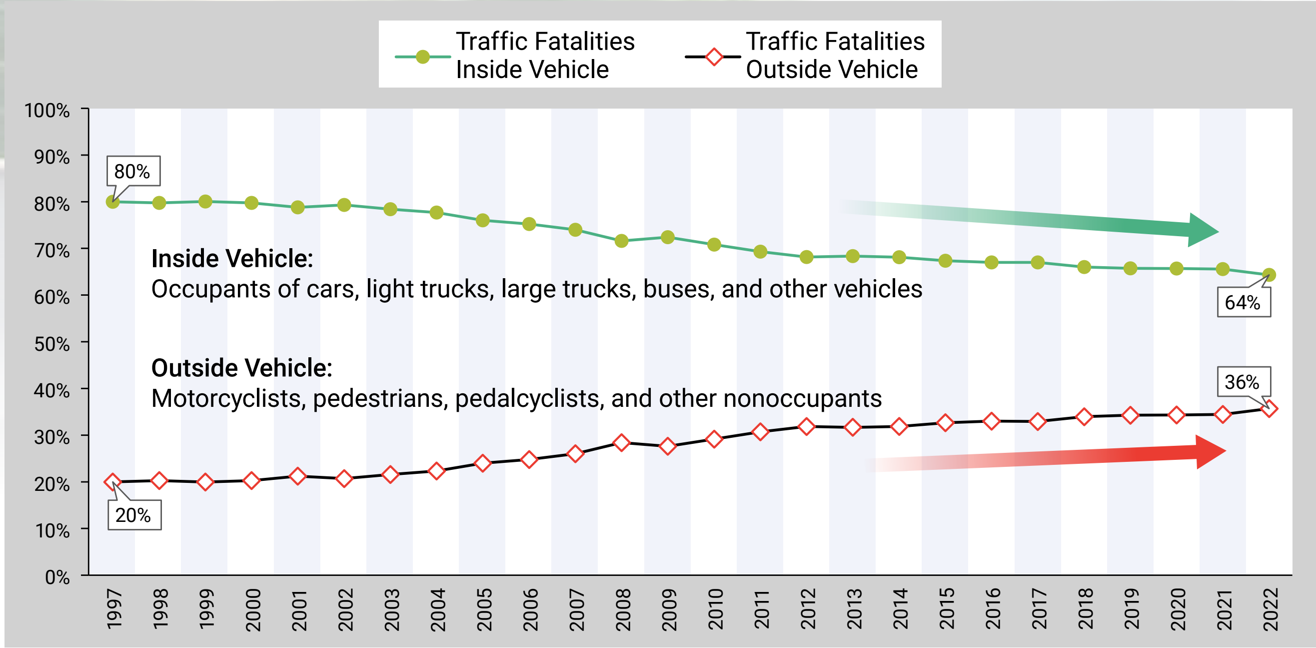
Throughout the last several decades, data confirm that speeding-related crashes contributed to nearly one-third of all fatalities each year. Despite traffic safety professionals' efforts to reduce speed-related crashes, that trend continues to hold true. For example: In 2023, of the 40,901 fatalities that occurred, 11,775 (or nearly 29 percent) were speed-related. A crash is deemed "speed-related" when the crash investigation indicates racing, exceeding the posted limit or driving at a speed that is unsafe for the road, weather, traffic, or other environmental conditions at the time of the crash.

Defining "Motor Vehicle Crash"

As the definition of a "motor vehicle crash" states, for a motor vehicle crash to occur, at least one motor vehicle must be in-transport, meaning it is in motion. When a vehicle is in motion, it possesses kinetic energy (KE). The amount of KE it possesses at impact, or more accurately, the amount of KE it expends doing damage or harm during a crash, determines the severity of a crash. Regardless of the cause, speed plays a role in the outcome of all crashes.

Motor Vehicle Crash: A motor vehicle crash is a transport crash that (1) involves a motor vehicle in-transport, (2) is not an aircraft accident or watercraft accident, and (3) does not include any harmful event involving a railway train in-transport prior to involvement of a motor vehicle in-transport.

There is a direct linkage between safe speeds and the ability to survive a crash. Simply put, humans have a limited ability



Since the late 1990s, fatalities among vulnerable road users have steadily increased.

Sources: Fatality Analysis Reporting System 1975-2021 Final Rule / 2022 Annual Report File. Modified by FHWA.

to tolerate crash impacts. Adjusting travel speeds can better accommodate human injury tolerances in three ways: reducing impact forces, providing additional time for drivers to stop, and improving driver's ability to see and process information.

> *"Speed is at the heart of a forgiving road transport system. It transcends all aspects of safety: without speed there can be no movement, but with speed comes kinetic energy and with kinetic energy and human error come crashes, injuries, and even deaths."*
>
> Organization for Economic Co-operation and Development

Speed Management

Managing speed and speeding was recognized early in the development of the Nation's surface transportation system. In 1901, Connecticut was the first State to pass a speed limit law for motorized vehicles. The State law limited the speed of motor vehicles to 12 miles per hour (mph, 19 kilometers per hour (kph)) in cities and 15 mph (24 kph) on country roads. Since then, setting speed limits has become the foundation for managing speeds on all public roadways across our Nation. Today, the 11th edition of the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) provides guidance for setting appropriate non-statutory speed limits. Although speed limits generally govern the speed of motorized vehicles, it is especially important to ensure safety for all road users in varying contexts including vulnerable road users (pedestrians, bicyclists, and other non-motorized users).

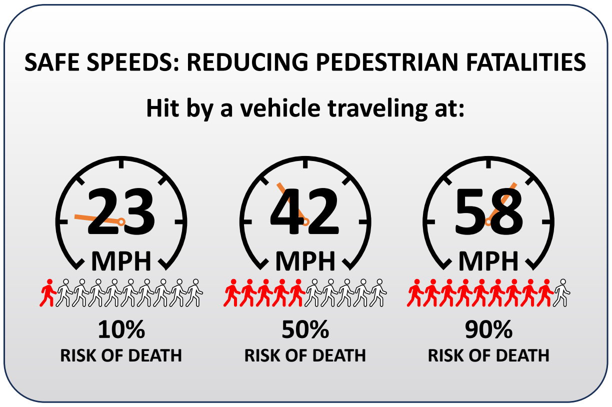
Achieving safe speeds involves understanding the relationship between speed, speeding, and safety; applying road design and engineering measures to obtain appropriate speeds; setting speed limits that are safe and reasonable; and applying enforcement efforts and appropriate technology measures that effectively address speeders and deter speeding.

Introducing KE

Regardless of their position, inside or outside of a vehicle, people involved in crashes have a limited ability to tolerate crash impacts before death and serious injuries occur. Human tolerance to the effects of crashes is central to the SSA. The management of KE transfer within survivable limits is important for understanding how to design and operate the road system consistently with the SSA philosophy. The SSA focuses not only on managing speed but also on managing the transfer of KE. Many advancements have occurred in this area, particularly in vehicle design related to seatbelts, airbags, and engineered vehicle crumple zones, all of which are designed to minimize crash energy from reaching the occupants inside the vehicle.

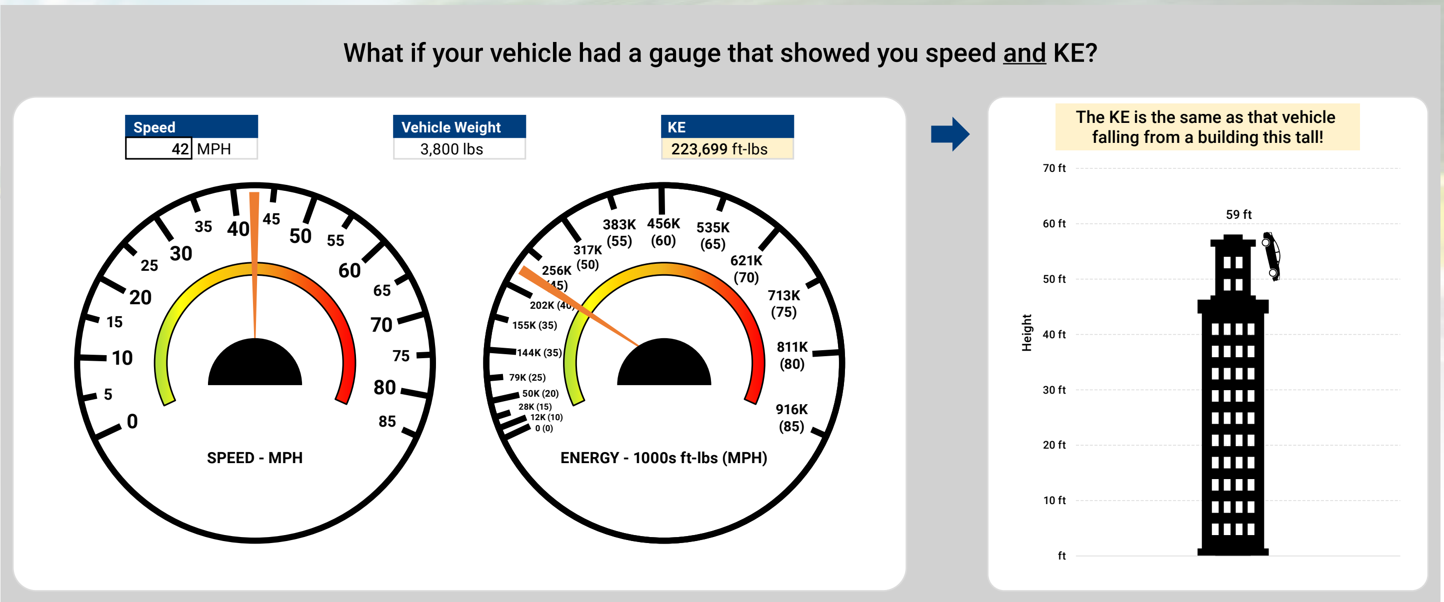
Speed is an integral and necessary part of an efficient transportation system. However, when drivers travel at speeds that exceed the posted limits or are too fast for road conditions (e.g., weather, peak-hour traffic, and work zones), it becomes speeding, and as mentioned, speeding has been a factor in nearly one-third of all fatal crashes over the last several decades.

A 2023 AAA Foundation survey found that while most drivers (over 75%) believe people close to them would disapprove of speeding, nearly half (49%) admitted to driving



RIGHT: The risk of death to a pedestrian struck by a vehicle at 23, 42, and 58 mph increases from 10 percent to 50 percent and 90 percent, respectively.

Source: FHWA; based on 2011 data provided by B.C. Tefft.

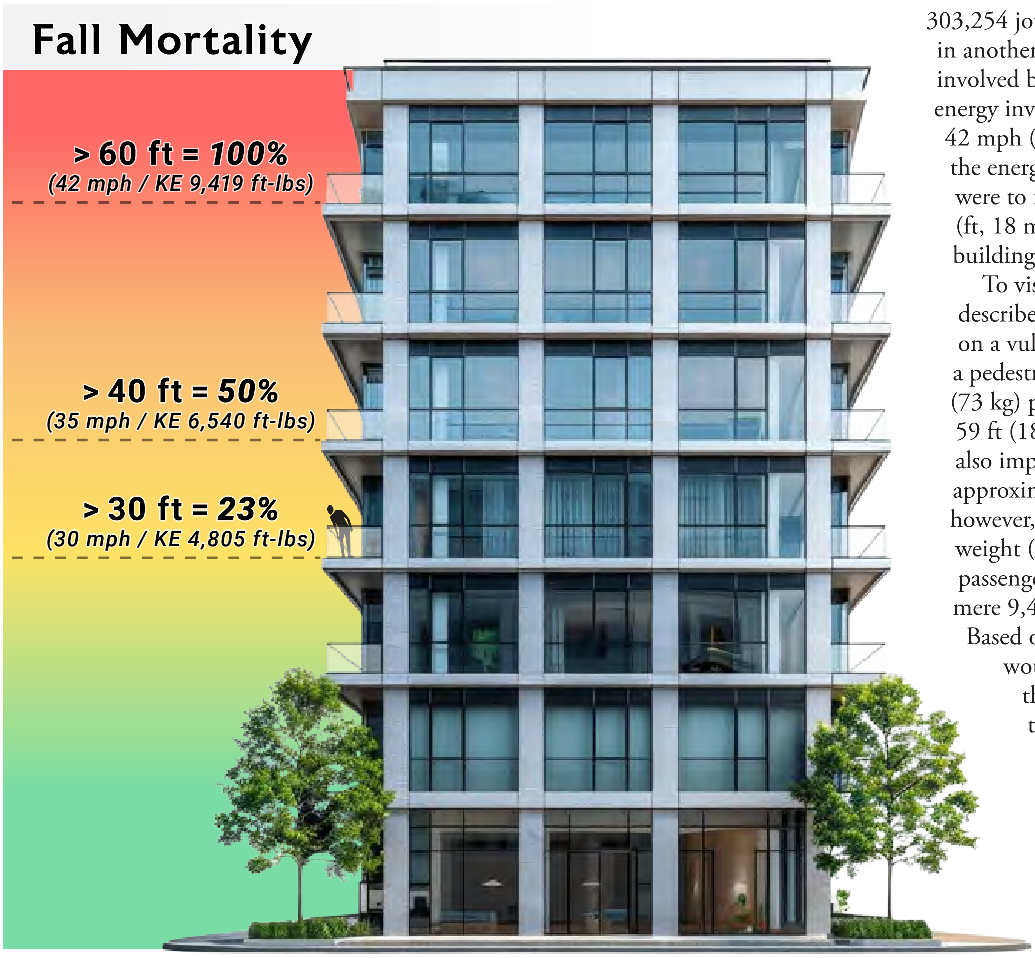


15 mph (24 kph) over the speed limit on freeways in the past month. Similarly, the 2022-23 National Survey on Speeding Attitudes and Behaviors from NHTSA found that 60% of drivers called themselves "speeders" or "sometime speeders." Even so, 85% strongly agreed it's unacceptable to exceed the speed limit by more than 20 mph, and 87% said "everyone should obey the speed limit because it's the law." Despite people's attitudes against speeding, these surveys show speeding is still common. This is concerning because speed doesn't just increase the chance of a crash—it also increases the force of a crash. Thinking about speeding in terms of kinetic energy (KE) can help make clear just how much higher the risk becomes as speed increases.

Visualizing speed in terms of KE may also be a new concept for the average driver. To better illustrate, imagine a passenger car weighing 3,800 pounds (lbs; 1,724 kilograms (kg)) and traveling at 42 mph (68 kph). At impact, the vehicle would have 223,699 foot-pounds (ft-lbs; 303,254 joules (J)) of KE. When stated in another way, the amount of KE involved becomes eye-opening: The energy involved in a car traveling at 42 mph (68 kph) is equivalent to the energy dissipated if the same car were to fall from a height of 59 feet (ft, 18 meters (m); i.e., a six-story building) and hit the ground.

To visualize the impact described in the example above on a vulnerable road user, such as a pedestrian, imagine if a 160 lb (73 kg) person fell from a height of 59 ft (18 m). That person would also impact the ground traveling approximately 42 mph (68 kph); however, due to their reduced weight (as compared to the average passenger car), they would possess a mere 9,419 ft-lbs (12,770 J) of KE. Based on research, most humans would not survive the fall if they absorbed 100 percent of the energy.

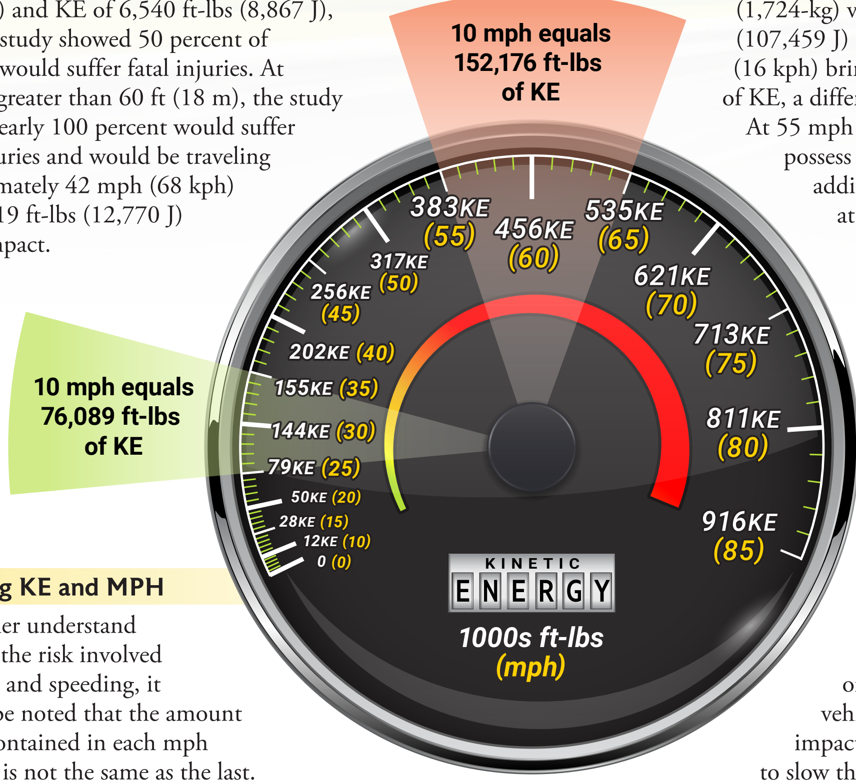
Moreover, a study published in the World Journal of Emergency Medicine found that the average mortality rate for falls from varying heights was



ABOVE: Relating speed to KE may help in understanding speed management. *Source: FHWA.*

LEFT: A survey found that at heights greater than 60 ft (18 m), nearly 100 percent of humans would be traveling at 42 mph (68 kph) and suffer fatal injuries upon impact. *© Rattanathip / AdobeStock.com. Data source: FHWA.*

approximately 23 percent from heights greater than 30 ft (9 m) and KE of 4,805 ft-lbs (6,515 J). An object or person falling from such heights would reach a speed of approximately 30 mph (48 kph) upon impacting the ground. When falling from heights greater than 40 ft (12 m), a person would reach approximately 35 mph (56 kph) and KE of 6,540 ft-lbs (8,867 J), and the study showed 50 percent of persons would suffer fatal injuries. At heights greater than 60 ft (18 m), the study found nearly 100 percent would suffer fatal injuries and would be traveling approximately 42 mph (68 kph) and 9,419 ft-lbs (12,770 J) upon impact.



RIGHT: Depicts KE between 25 and 35 mph (40 and 56 kph) compared to KE between 55 and 65 mph (89 and 105 kph) by a vehicle weighing 3,800 lbs (1,724 kgs).
© savanno / AdobeStock.com. Data source: FHWA.

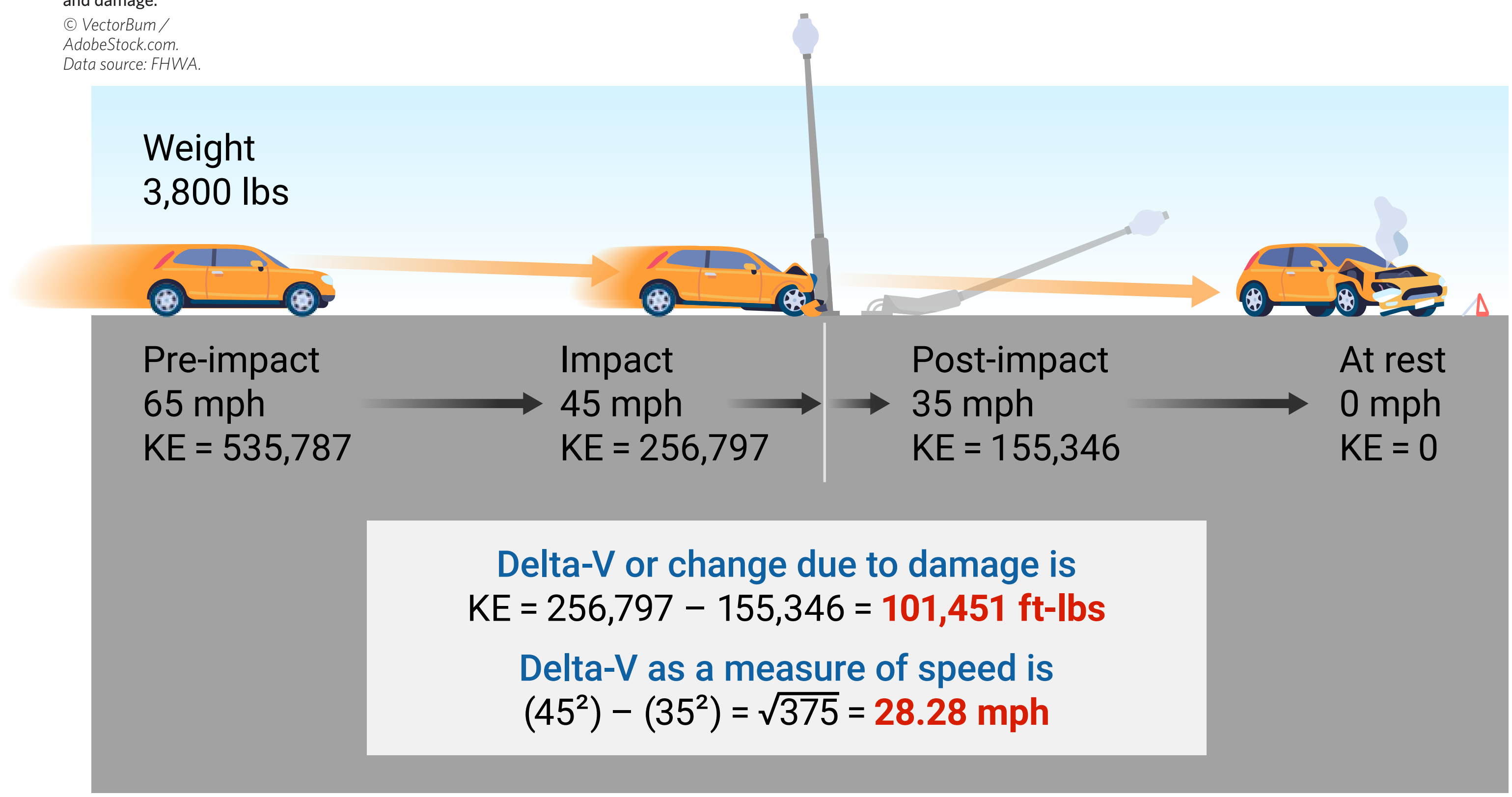
Merging KE and MPH

To further understand KE and the risk involved in speed and speeding, it should be noted that the amount of KE contained in each mph increase is not the same as the last. In other words, as speed increases, KE increases exponentially. For instance, driving 10 mph (16 kph) over the posted speed limit at 25 mph (40 kph) may seem no different than driving 10 mph (16 kph) over the speed limit at 55 mph (89 kph) as it is still just 10 mph (16 kph) more than the limit. However, when these two 10 mph (16 kph) increments are examined in terms of KE, they are far from being the same.

For example, at 25 mph (40 kph), a 3,800-lb (1,724-kg) vehicle possesses 79,258 ft-lbs (107,459 J) of KE; adding an additional 10 mph (16 kph) brings about 155,347 ft-lbs (210,622 J) of KE, a difference of 76,089 ft-lbs (103,163 J). At 55 mph (86 kph), the vehicle would possess 383,611 ft-lbs (520,107 J) of KE, adding an additional 10 mph (16 kph) at that speed and adding another 152,176 ft-lbs (206,323 J; a total of 535,787 ft-lb (726,429 J)) of KE. The 10 mph (16 kph) between 55 and 65 mph (89 and 105 kph) possesses 76,087 ft-lbs (103,160 J) more KE than the 10 mph (16 kph) between 25 and 35 mph (40 and 56 kph) or nearly twice as much KE available to cause damage or injury.

Fortunately, when motor vehicle crashes occur, rarely do the occupants or vulnerable road users absorb 100 percent of the KE possessed by the motor vehicle involved. Often, prior to impact, a driver can take evasive action to slow the vehicle, reducing the total impact energy available to transfer into damage or injury. Additionally, impacting at an angle can also deflect impact energy away from causing injury and into other

BELOW: Delta V describes the change in energy during a crash, causing injury and damage.
© VectorBum / AdobeStock.com. Data source: FHWA.



property damage and post-impact movement. Impact angles can be both horizontal (e.g., two vehicles colliding at 45 degrees versus 90 degrees) or vertical (e.g., a pedestrian being struck by the low front end of a sports car instead of by the high front end of a pickup truck). The "change in velocity" or energy during impact that is expended (causing injury and doing damage) is often referred to as "Delta-V." Delta-V can be calculated when a crash is reconstructed and is determined by subtracting the post-impact energy from the impact energy.

Depicting Delta-V in terms of the reduction of "speed" can be deceiving. Consider a vehicle that was traveling at 45 mph (72 kph), and after striking a utility pole, the vehicle slowed to 35 mph (56 kph), doing damage—a reduction in actual speed of 10 mph (16 kph). However, if reviewed in terms of energy, 101,451 ft/lbs (137,671 J) of energy was expended doing damage when the vehicle struck the pole. If that energy is converted back in terms of Delta-V, it would be the equivalent of the vehicle striking an immovable object or barrier while traveling at 28.28 mph (45.51 kph).

Several government and local agencies, including NHTSA, recommend that motorists slow down and prioritize safety. *Source: NHTSA.*

The Goal of Speed Management

The goal of speed management has been to improve public health and safety by reducing speeding-related crashes and the resulting injuries and fatalities. Speeding is a complex issue involving engineering, driver behavior, education, and enforcement. As discussed, the human body is vulnerable and very susceptible to injury and death when acted upon by even small amounts of energy. Speed management efforts are needed to reduce the impact of harmful speeds and control speeding behavior. Addressing safe speeds in terms of energy management can provide practitioners with additional opportunities to reduce injuries and fatalities by redirecting crash energy in addition to reducing involved speed.

The most successful countermeasures are typically the ones that can reduce the speeds involved in a collision while also modifying or managing the angle of impact to be less direct. The combined effect is less KE imposed on the people involved in the collision and, hence, less likelihood of major trauma to them. "Roundabouts are one of the best examples of this combined safety effect, which explains their amazing safety record and why they are often cited as an illustration of the Safe System Approach," states Hillary Isenbrands, an FHWA safety engineer.

Understanding the problems related to speed management begins with exploring the available data related to speed-related crashes, road design, road context, and driver behavior. Using data will allow practitioners to set safe speed limits and deploy countermeasures that reduce the overall energy and Delta-V, in the event of a crash.

Presented in this special thematic addition of Public Roads are speed management-related focuses such as speed limit setting and engineering roadways for safer speeds. Also included are best practices from Federal, Tribal, State, and local agencies to address speed-related crashes and fatalities.

JEFFREY KING is a former safety specialist in the FHWA Office of Safety's Speed Management Team. Prior to his time with FHWA, he retired from the Arizona Department of Public Safety after 28 years of service. He is a graduate of Northwestern University's School of Police Staff and Command as well as the Federal Bureau of Investigation National Academy and has a bachelor of science degree from Arizona State University.

ANYESHA MOOKHERJEE serves as a team leader in the FHWA Office of Safety. Prior to joining FHWA, she worked for 10 years at the Maryland State Highway Administration in traffic safety and engineering roles. She holds a master's in transportation engineering from the University of Massachusetts Amherst.

For more information, see https://highways.dot.gov/safety/speed-management, https://www.nhtsa.gov/risky-driving/speeding, or contact Anyesha Mookherjee, 202-366-2833, anyesha.mookherjee@dot.gov.

ABOVE: A roundabout is one example of how agencies can manage speeds at an intersection, creating safe roads and safe speeds. *© 2024 Google® Earth™.*

TRANSFORMING COMMUNITIES: Proven State, Local, and Tribal Strategies for Safe Speeds

Using the Safe System Approach to manage kinetic energy and improve safety.

by **BRANDY SOLAK** and **GUAN XU**

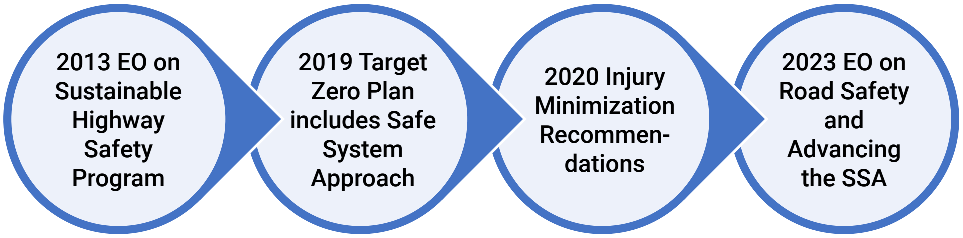
As a guiding principle to address road user safety, the Safe System Approach involves a paradigm shift to improve safety culture and increases collaboration across safety stakeholders. The Safe System Approach refocuses transportation system design and operation on anticipating human mistakes and lessening the impact forces to reduce crash severity and save lives. In alignment with the Safe System Approach, achieving safe speeds requires a multifaceted approach that leverages road design and other infrastructure interventions, appropriate speed limit setting, education, and enforcement. Highlighted within this article are the bold actions agencies have taken to successfully implement safer speeds in their communities.

Embracing a Safe Speed Culture

A critical step to successfully managing speeds is understanding barriers within existing policies and then establishing a vision for safer speeds within the community and building consensus for changing the speed management culture. Washington was one of the earliest States to begin the safe system journey with a series of actions that put the wheels in motion for transformational change.

In the multiagency working group's report, *Washington State Injury Minimization and Speed Management Policy Elements and Implementation Recommendations*, the State recommends to "establish injury minimization target speeds for all roads based on the road and land use context, potential for different crash types, the impact forces that result, and the human body's tolerance to withstand those forces."

The framework calls on owners of public roads, streets, and highways in Washington State to use their recommended injury minimization and speed management policy elements to create, adopt, and implement policies applicable for their agencies. In 2023, the Washington Department of Transportation (WSDOT) issued a State executive order (EO) directing WSDOT employees to revise agency policies and procedures and adjust the allocation of agency resources to align with the Safe System Approach to road safety across all divisions and regions. The State EO specifically calls on WSDOT to:



- Prioritize design and operational decisions that support safety for users based on the context of the road.
- Identify explicitly and address a project's expected effects on crash exposure and network connectivity for vulnerable road users.
- Update manuals, policies, processes, procedures, and plans to incorporate the Safe System Approach.
- Rescind, replace, or reaffirm all ranked lists of potential safety projects as necessary to achieve the goals and objectives of the Safe System Approach.

WSDOT has moved quickly to implement actions outlined in the State EO, showing their commitment to making a cultural change to how roadway safety has traditionally been approached. In September 2024, revisions were issued to the WSDOT Design Manual, incorporating principles of the Safe System Approach and providing guidance on design elements for pedestrians and bicyclists to improve the quality of service, safety, and comfort. The chapter on roundabouts was significantly expanded to communicate the effectiveness of the intersection type to reduce fatal and serious injury collisions and provide a greater degree of safety for active transportation users (those who bike, walk, or roll), with fewer conflict points, lower speeds, and easier decision-making than other intersection types. The chapter also includes illustrations for marked crossings, splitter islands, and signing that will aid practitioners in properly designing roundabouts to improve the safety and comfort of active transportation users.

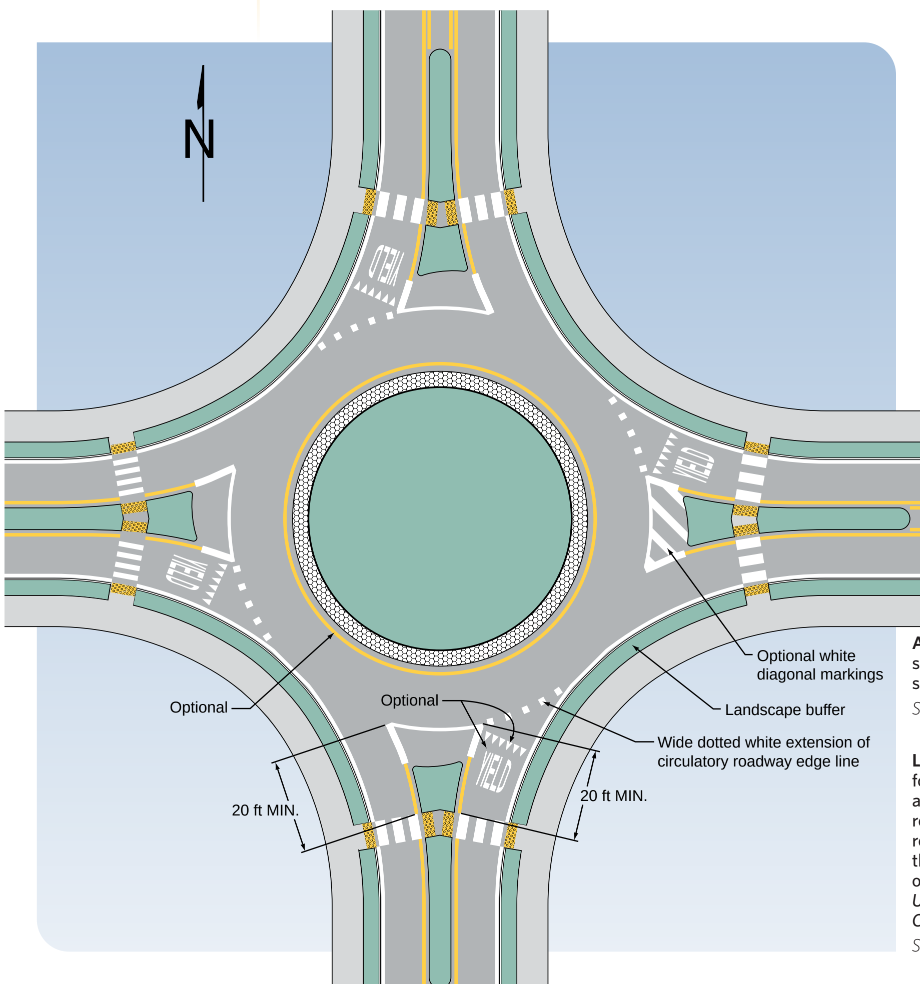
The *2025 Florida Department of Transportation Design Manual* includes a chapter on speed management containing national noteworthy practices for achieving desired operating speeds that are allowable on arterials and collectors. The revised manual was released on November 1, 2024, and includes an expanded discussion on the relationship between target speed, design speed, context classification, and guidance for achieving the desired target speed. The Florida Department of Transportation (DOT) guidance recognizes that, when there is a large difference between the current design speed and desired target speed, achieving the target speed may need to occur incrementally through a series of projects and speed management strategies. The manual provides guidance on strategies based on context classification, design speed, and target speed, allowing a determination to be made on the amount of speed management that is achievable.

The Massachusetts Department of Transportation (MassDOT) developed a toolkit for agencies that links target speed to specific design features that support safe speeds. The "Safe Speeds: Roadway Treatment Technical Toolkit" contains basic information about roadway treatment strategies that have been effectively implemented in the State.

Practitioners using the toolkit can select from physical and engineering-related roadway treatments such as vertical deflection countermeasures, horizontal countermeasures, mini-roundabouts and neighborhood traffic circles, and pavement marking measures, and speed transition zones, advisory and feedback signage. Once a type of treatment is selected, practitioners can learn more about the features, costs, and considerations of the countermeasure.

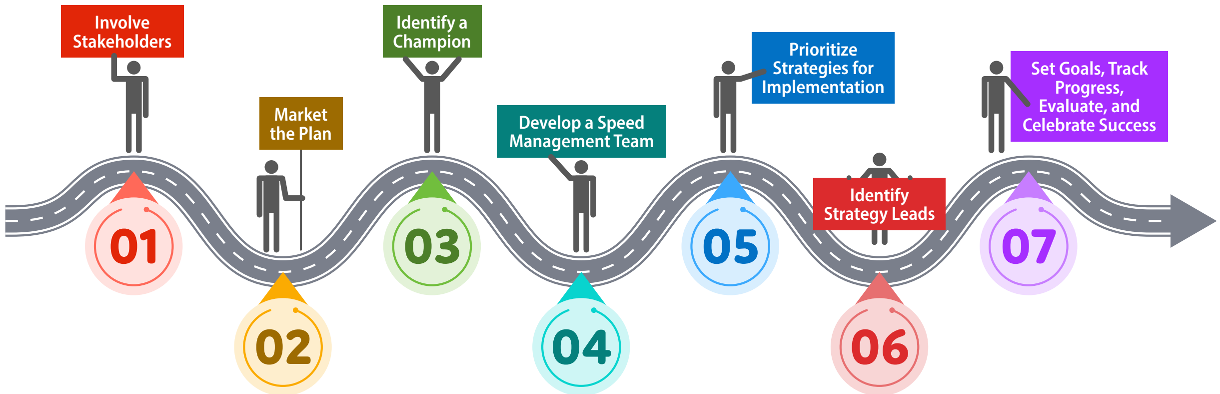
A Road Map to Safe Speeds

A Speed Management Action Plan (SMAP) is a shared plan developed between transportation agencies and their partners to identify strategies to improve their specific speed management challenges. SMAPs are an effective tool to facilitate collaboration among stakeholders to implement



ABOVE: WSDOT's steps to achieving safer speeds. *Source: FHWA.*

LEFT: Markings for approach and circulatory roadways at a roundabout from the 11th edition of the *Manual on Uniform Traffic Control Devices.* *Source: FHWA.*



FHWA's road map to safe speeds.
Source: FHWA.

speed management strategies and realize the vision of zero traffic deaths.

The Oglala Sioux Tribe (OST) Pine Ridge Reservation is located in the southwestern portion of South Dakota and encompasses more than 2 million acres (3,469 square miles; 5,582 square km). The OST Transportation Department is responsible for maintaining nearly 520 miles (836 km) of Bureau of Indian Affairs roadways and more than 1,450 miles (2,333 km) of Tribal roadways.

From 2018 to June 2023, 62 of the 199 (24 percent) crashes recorded along OST roadways were attributed to speed. Of the fatal or severe injury crashes, 11 of the 21 (34 percent) were speed related. The OST 2021 Tribal Transportation Plan identified speeding as a roadway safety concern.

OST developed a SMAP to identify crash types and roadways at high risk of speeding-related crashes. A systemic approach using roadway typologies classified the speeding-related crashes into three categories based on speed limit, roadway context, and pavement type, either paved or unpaved. Typology A represents 45–65 mph (72–104 km per hour), two-lane, rural highway, paved roads; typology B represents rural, unpaved roads; and typology C represents 25–35 mph (40–56 km per hour), rural town, paved roads. The speed-related safety concerns were then identified within each typology.

Speed management strategies are provided for each typology to address the specific crash types and are prioritized based on risk and severity. Strategies include behavioral speed management strategies that apply across all typologies; general speed management strategies that address driver education, enforcement, and setting appropriate speed limits; and targeted engineering speed management strategies, such as treatments on horizontal curves, posted nighttime speed limits, and transition zone treatments. Each strategy names an agency champion (i.e., an individual or agency that has a vested interest or motivation for seeing the strategy implemented), funding opportunities, and resources to assist with implementation of the strategy.

ROAD TYPOLOGIES AND CRASHES

Typology A: 45–65 mph, Two-Lane, Rural Highway, Paved:

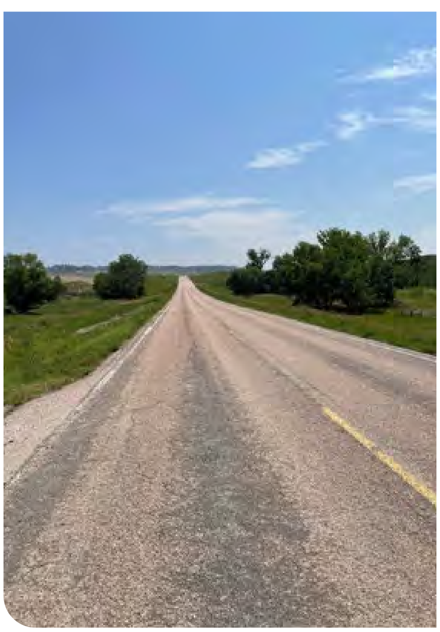
- Horizontal curves are present, specifically on the 55-mph roadways.
- First horizontal curves appear after a significantly straight section.

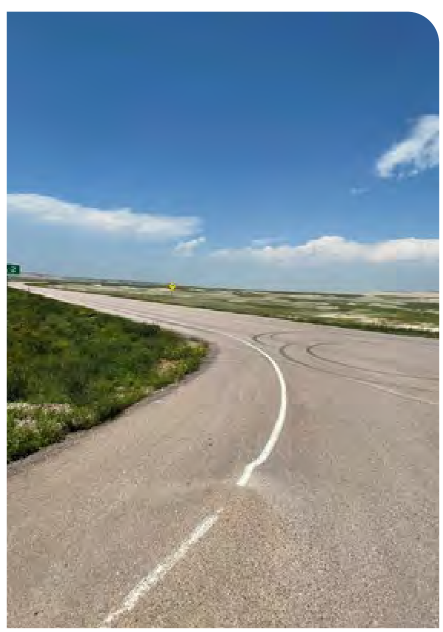
Typology B: Rural, Unpaved:

- At nighttime, the roadway is not lighted.
- Horizontal curves are present.
- First horizontal curves appear after a significantly straight section.

Typology C: 25–35 mph, Rural, Paved:

- Transition zones are present.
- Wet, icy, snowy, and slushy road conditions occur.

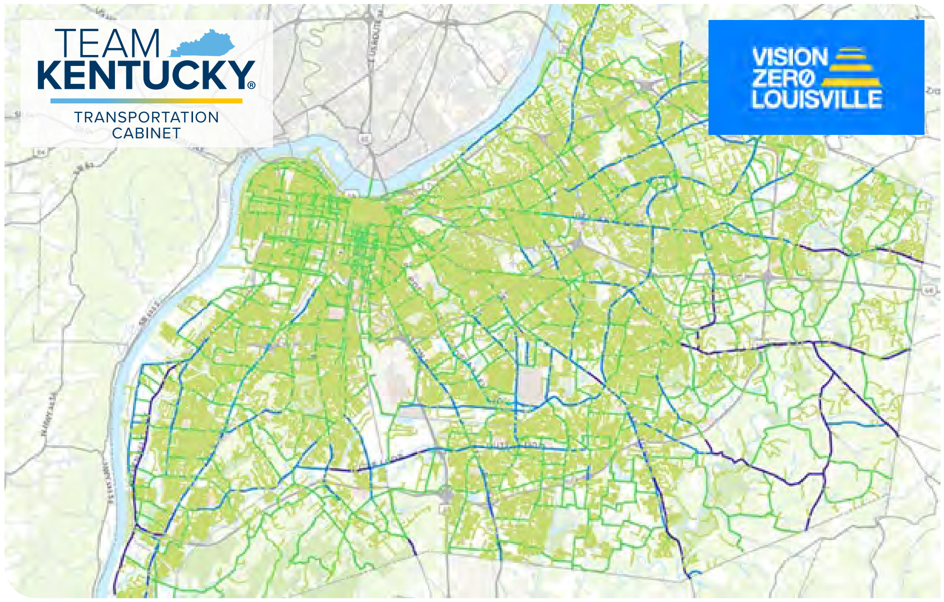




A long, straight rural road and a curved road on the Oglala Sioux Pine Ridge Reservation in South Dakota.
Source: FHWA.

This SMAP is the first to be completed by a Tribal transportation agency. "To effectively address speed-related fatalities and serious injuries on OST transportation roadways, it is crucial to define the problem before applying strategies and countermeasures. The SMAP provides the OST with a structured framework to identify speed safety concerns, connect them to specific countermeasures, and prioritize their implementation based on data. Additionally, the plan equips the Tribe to apply for funding to implement these countermeasures, ensuring resources are available to support their efforts. This is a significant success for the Tribe, marking a proactive step toward safer roadways," says Virginia O'Connor, a roadway safety engineer who led the SMAP development for the Tribe.

A Data-Driven Strategic Approach to Safer Speeds



Speed limit map of surface streets for Louisville, KY.
© 2024 Louisville/ Jefferson County Metro Government.
© 2024 Team Kentucky Transportation Cabinet.

The Louisville Metro Government owns and maintains more than 2,100 centerline miles (3,379 kilometers (km)) of roadways throughout Jefferson County, KY. In 2023, Louisville Metro Public Works conducted speed studies on metropolitan-owned roads with posted speed limits greater than 35 mph (56 km per hour) and found the operating speeds often greatly exceeded the posted speed limit. These data supported the need for a speed management plan that would complement other transportation safety efforts, including Louisville's High Injury Network.

As Louisville advances its process of examining how, and for whom, its transportation infrastructure is designed, the Louisville Metro Public Works and the Kentucky Transportation Cabinet have partnered together to develop the Louisville Speed Management Plan. The Speed Management Plan will guide the Louisville Safer Speeds strategic approach over the next 5 to 10 years, complementing other transportation safety efforts with the goal of reaching zero fatalities by 2050.

Louisville has planned a multifaceted and balanced effort to develop the Speed Management Plan, which could modernize how speed limits are set. One task included in the study was to define the relationship between speed, speeding, and safety in Louisville. Current driver trends are being reviewed to compare actual operating speeds to posted speed limits. Where speeding most frequently occurs, the posted speed limits and roadway designs will be evaluated, and the corridors with the highest need or potential for improvement will be identified. Community members are also being engaged and invited to provide their ideas and recommendations for achieving safer speeds in Louisville.

The Louisville Speed Management Plan, expected to be completed in spring 2025, will include recommendations for policy changes, programs, and projects to help make progress toward Louisville's vision of zero roadway deaths. Ultimately, the Speed Management Plan will provide a safer speeds framework, identifying needs and recommendations in a data-supported manner. The plan will also be used to seek funding for recommended speed management programs and roadway improvements.

Claire Yates, Louisville program manager, has been involved with the development of the plan since 2023. Yates says, "Data collected on Jefferson County roadways shows speeds are a significant contributor to traffic deaths, and particularly dangerous to pedestrians. Louisville follows the Safe System Approach. This Speed Management Plan will provide a safer speeds framework, identifying needs and recommendations in a data-supported manner to help realize our vision of zero fatalities by 2050."

Traffic Signal Timing Is Making Waves at MassDOT

Safety and achieving safe speeds should not be thought of as a compromise to efficiently moving vehicles. While other speed management strategies include physical measures that eliminate conflicts and separate users, a new approach to traffic signal timing developed by Northeastern University researchers and tested by MassDOT—the Safe Waves approach—shows traffic signals can be used to effectively manage speed on multilane arterials while still providing "reasonably good arterial progression."

With conventional coordinated signal timing, a large proportion of vehicles arrive at signals on a "stale green," meaning no vehicle is ahead of the arriving vehicle for 5 seconds. This situation can present speeding opportunities, especially on multilane arterials that lack other traffic-calming features (or are not amenable to such features) and create an unsafe roadway condition for users.

The Safe Waves approach uses techniques such as short cycles, short coordination zones, low progression speed, and fully actuated signal control to move vehicles at safe speeds without sacrificing progression along the corridor.

Working with Northeastern University researchers, MassDOT tested the effectiveness of Safe Waves for managing speed in terms of reduced speeding, changes in vehicle delay, and changes in pedestrian delay with a field test in one corridor and a simulation test in another.

The field test was conducted on Route 114 in Danvers, MA, and included six signalized intersections. The result from collected data with radar counters showed a 74- to 79-percent reduction in the number of speeding vehicles as the number of speeding opportunities decreased an average of 57 percent when looking across multiple time periods. Travel time measurements using data collected from mobile phone apps in the segment between the first and the last intersections showed arterial delay increased, on average, by only 1.8 seconds per intersection. At the same time, pedestrian delay decreased by 18.5 seconds (33 percent).

Route 114 in Danvers, MA, shows potential for stale green time at upstream signals. *© Google® StreetView™.*

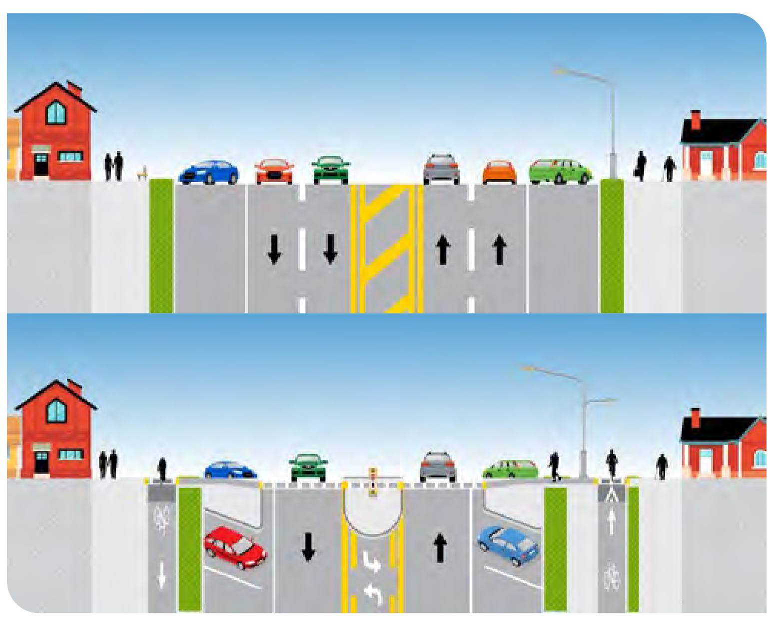
The simulation test was conducted on Route 16 in Everett and Chelsea, MA, and included nine signalized intersections. Safe Waves signal timing reduced the number of speeding opportunities by more than 50 percent in the morning and afternoon periods. Vehicle delay per intersection increased by 4.2 seconds in the morning and by 1.4 seconds in the afternoon. Past studies of the Safe Waves approach have identified the value of having pedestrian phases on recall when timing urban arterial signals with moderate or high pedestrian demand. For the setting with low pedestrian demand, this test evaluated the effectiveness of keeping pedestrian crossings on demand and using undersized phases, sometimes called the "oversized ped" technique, which allowed cycle lengths to be much shorter. The shorter cycles helped reduce speeding opportunities and also reduced pedestrian delay by an average of 28 seconds, not counting one intersection with a two-stage crossing where using left-turn overlaps to improve pedestrian progression decreased pedestrian delay by 93 seconds (from 140 to 47 seconds).

Detailed results of the field tests can be found in MassDOT's *Safe Waves: Signal Timing Guide, Analysis Tool, and Case Studies* report completed in February 2024. Overall, the results from field tests showed the cycle length could be substantially shorter with undersized phases, leading to fewer speeding opportunities and better coordination. The disruption caused by the pedestrian service created no significant deterioration in arterial performance. However, to validate the Safe Waves signal timing designs, more field tests are needed.

Bringing It All Together to Achieve Safe Speeds

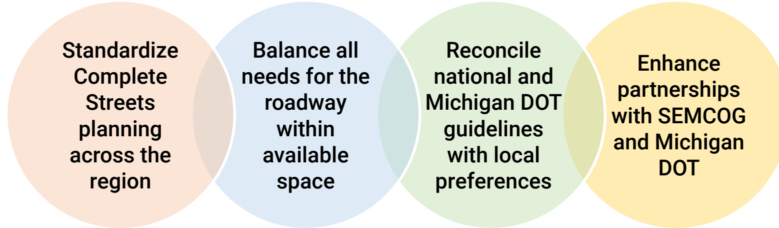
Bringing it all together involves addressing the Safe System elements of Safe Speeds and Safe Roads and advancing the proactive implementation of safety infrastructure by setting and designing for appropriate speeds; separating users in time and space; improving connectivity and access for pedestrians, bicyclists, and transit riders, including people with disabilities; and implementing proven safety countermeasures. FHWA's Proven Safety Countermeasures initiative is a collection of countermeasures and strategies effective in reducing roadway fatalities and serious injuries on our Nation's highways.

Accommodating all modes in a single street is not always possible due to competing demands for limited space within the right-of-way. The roadway design may vary based on surrounding land uses and the role the street needs to serve in the multimodal network. Communities in southeast Michigan, for example, experienced challenges prioritizing, approving, and implementing projects as they



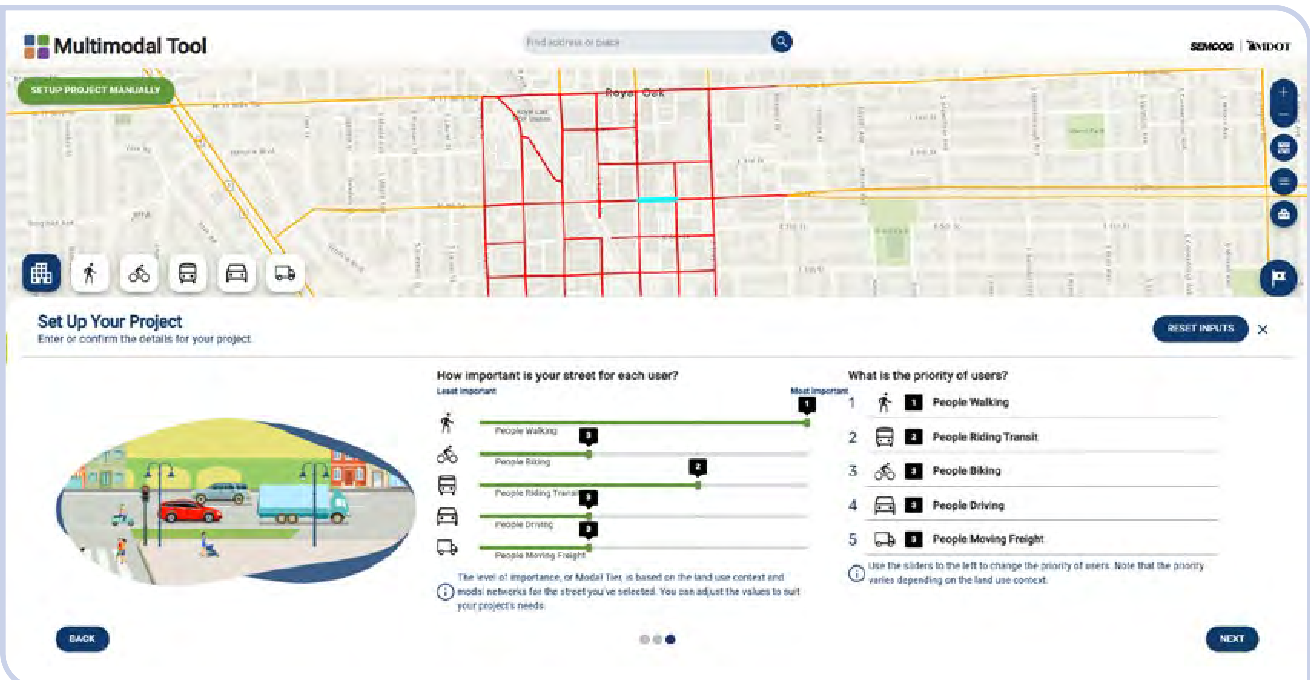
RIGHT: Complete Streets transform streets for pedestrian safety. *Source: FHWA.*

strived to develop transportation networks that are safe, convenient, and affordable for people of varying ages and abilities. This process can be especially challenging with the growing number of demands, choices for travel modes, and competition for limited space in the right-of-way. Even with the variety of supporting policies and initiatives in place at various levels of government, the Southeast Michigan Council of Governments (SEMCOG) and the Michigan Department of Transportation (MDOT) saw the need for a streamlined, data-driven decision-making process that would help local communities understand what is feasible for each project, and how a project serves the needs of different road users based on roadway characteristics and land use context.

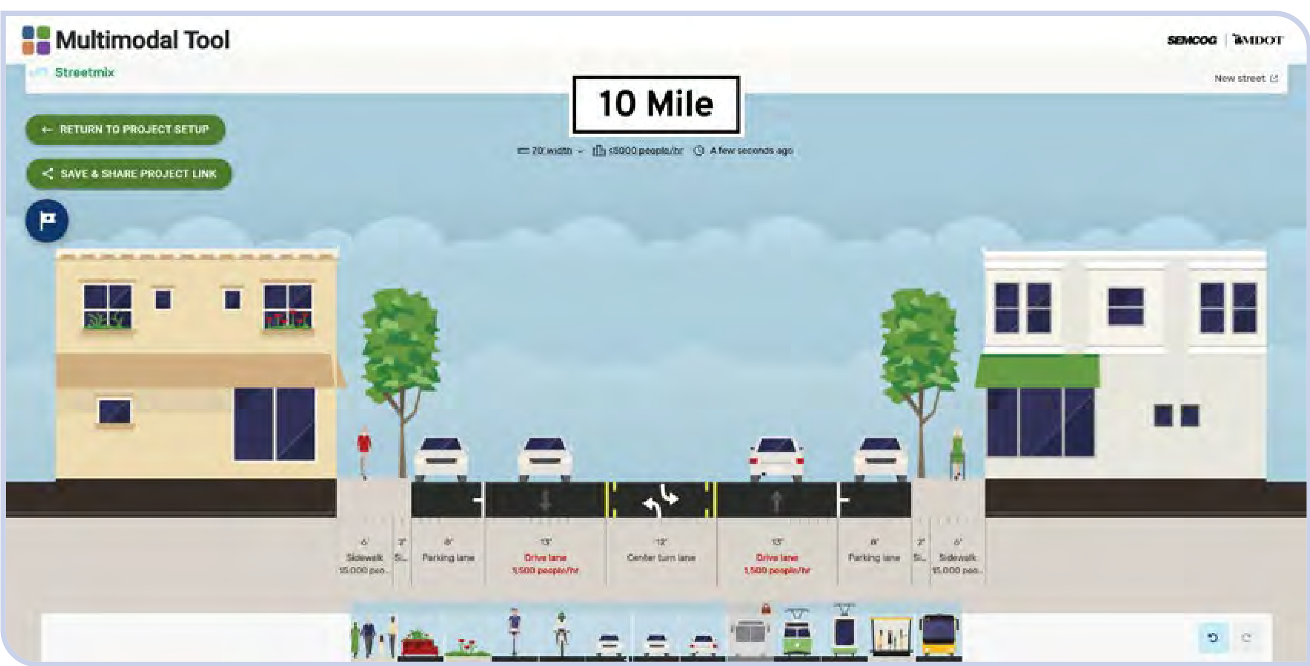


SEMCOG uses a streamlined process to standardize Complete Streets planning across the region.
© 2024 SEMCOG.

SEMCOG, working together with MDOT, developed a digital planning tool that lets transportation agencies plan, design, and evaluate cross sections for various road users, including people driving, moving freight, riding transit, biking and walking. The interactive web application has four components: The Modal Network Viewer lets the user view



The SEMCOG Multimodal Tool interactive web application allows users to view modal networks and land use contexts and identify project corridors.
© 2024 SEMCOG.



The Cross-Section Street Builder feature lets the user design cross sections to serve the prioritized modes in the given land use context. Project scoring evaluates how well the street cross-section serves users.
© 2024 SEMCOG.

modal networks and tiers and identify a project corridor. The Project Setup module lets the user set basic road characteristics, confirm modal priorities, and determine land use contexts. The Street Builder lets the user design cross sections to serve the prioritized modes in the given land use context. Project scoring evaluates how well the street cross section serves users.

The Multimodal Tool can be used for corridor planning, community and stakeholder engagement, and project evaluation. The tool can also be used for areas other than southeast Michigan by using the manual project setup option and entering information such as roadway characteristics, land use context, and modal priorities. Outputs from the tool include a shareable link to test alternative configurations and an exportable PDF summary of the project score, which includes a list of FHWA's Proven Safety Countermeasures implemented in the project. Every element in a street cross section is a choice, and each choice comes with consequences. For further information on a safety-first approach to allocating roadway space, the National Cooperative Highway Research Program Research Report 1036 provides a framework to assess the potential impacts of roadway space allocation and understand the potential tradeoffs.

> *"One instance where the Multimodal Tool has really helped One instance where the Multimodal Tool has really helped has been with our planning studies. The Multimodal Tool was used during the M-3 (Gratiot Avenue) Planning and Environmental Linkages study to assist with stakeholder and public engagement. Use of the tool allowed us to document the development and evaluation of illustrative and practical alternatives. We are still finding new applications for when and how to use the Multimodal Tool, but so far it has proven to be a very valuable resource in the engagement process."*
>
> —Matt Galbraith, metro region planning manager at MDOT.

Summary and Looking Ahead

Safer speeds are a cross-cutting issue that spans departments within USDOT, State DOTs, regional and local transportation agencies, and Tribal governments. The Safe System Approach can guide the safety actions agencies can take to achieve safer speeds for the traveling public. FHWA promotes safe mobility through the Safe System Approach and is developing resources for effective speed management practices. In addition, FHWA promotes several strategies and treatments known as Proven Safety Countermeasures, including methods and practices for setting appropriate speed limits. FHWA is committed to championing the Safe System Approach and continuing to work with stakeholders to achieve safe speeds and safe mobility.

BRANDY SOLAK is a former roadway safety and design engineer with the FHWA. She promoted implementation of the Safe System Approach as a framework for establishing safe speeds and safe roads and is a technical expert in the areas of safety and geometric design. She holds a bachelor's degree in civil engineering from Michigan Technological University.

GUAN XU, P.E., is a former highway engineer with FHWA's Office of Safety Technologies, where she worked on safety issues related to speed management. She holds a master of science degree in civil engineering from the University of Cincinnati.

For more information, see *https://highways.dot.gov/safety/speed-management*.

© sheilaf2002 / AdobeStock.com.

RESOURCES:

- Florida DOT's *2025 FDOT Design Manual* (*https://www.fdot.gov/roadway/fdm/default.shtm*).
- Florida DOT's Roadway Design Bulletin (*https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/roadway/bulletin/rdb-24-04.pdf?sfvrsn=b4a7f875_3*).
- Massachusetts' Safe Speeds: Roadway Treatment Technical Toolkit (*https://www.mass.gov/tool-kit/safe-speeds-roadway-treatment-technical-toolkit*).
- Massachusetts' *Safe Waves: Signal Timing Guide, Analysis Tool, and Case Studies* report (*https://www.mass.gov/doc/using-traffic-signals-to-reduce-speeding-and-speeding-opportunities-on-arterial-roads-final-report-0/download*).
- Proven Safety Countermeasures (*https://highways.dot.gov/safety/proven-safety-countermeasures*).
- Safe System Approach for Speed Management (*https://highways.dot.gov/sites/fhwa.dot.gov/files/Safe_System_Approach_for_Speed_Management.pdf*).
- SEMCOG (*https://www.semcog.org/mmtool*).
- *NCHRP Research Report 1036: Roadway Cross-Section Reallocation: A Guide* (*https://nap.nationalacademies.org/catalog/26788/roadway-cross-section-reallocation-a-guide*).
- Vision Zero Louisville (*https://louisvilleky.gov/government/vision-zero-louisville/safer-speeds*).
- *WSDOT Design Manual* (*https://wsdot.wa.gov/publications/manuals/fulltext/M22-01/M22-0123Revision.pdf*).

FHWA's Transportation Pooled Fund Program

TPF

Source: FHWA.

Leveraging Resources to Achieve Common Research Goals

© 2019 Colorado DOT.

The Transportation Pooled Fund (TPF) Program enables public and private entities to combine resources to conduct high priority research on a wide variety of shared, highway related problems. Over more than 45 years, the TPF Program has supported more than 750 successful multi-agency projects.

Participate in Diverse Research and Topic Areas

Investing in TPF studies helps partners stretch their research dollars to support a diverse array of topic areas.

Make an Impact Through a TPF Study!

Learn more about initiating a pooled fund study and browse the list of open solicitations on the TPF website at ***www.pooledfund.org***.

For more information, contact Tricia Sergeson, TPF Program Manager, at ***Patricia.Sergeson@dot.gov***.

© 2020 The Transtec Group, Inc.

TPF TRANSPORTATION POOLED FUND

Engineering Appropriate SPEED LIMITS

The appropriate speed limit is fundamental to achieve safe mobility.

by **GUAN XU**, **TIMOTHY TAYLOR**, and **BRANDY SOLAK**

Promoting safer speeds is one of the focal points of the U.S. Department of Transportation's comprehensive approach to eliminating fatalities and serious injuries on our Nation's roadways. The Department has adopted the Safe System Approach (SSA), which focuses on five key elements: safe people, safe roads, safe vehicles, safe speeds, and post-crash care. To have a significant impact on reducing or eliminating fatalities and serious injuries in the United States, the engineering study for setting and achieving safer speeds should be consistent with the SSA.

There are multiple factors that contribute to the speed people drive beyond the number posted on a speed limit sign. A 2017 safety study from the National Transportation Safety Board (NTSB), titled *Reducing Speeding-Related Crashes Involving Passenger Vehicles*, reports, "The relationship between speed and crash involvement is complex, and it is affected by factors such as road type, driver age, alcohol impairment, and roadway characteristics like curvature, grade, width, and adjacent land use."

The NTSB safety study report goes on to say, "In contrast, the relationship between speed and injury severity is consistent and direct. Higher vehicle speeds lead to larger changes in velocity in a crash, and these velocity changes are closely linked to injury severity. This relationship is especially critical for pedestrians involved in a motor vehicle crash, due to their lack of protection."

In the SSA, the elements of safe speeds and safe roads are intrinsically linked. Applying the SSA is about matching operating speeds to what is appropriate for the roadway conditions and road users. Achieving safer speeds also requires using thoughtful, context-appropriate roadway design, targeted education, outreach campaigns, and enforcement. Setting appropriate speed limits is fundamental to the SSA and to achieving safer speeds on our Nation's roadways.

This article focuses on speed limit setting by presenting the background on why and how speed limits are set and providing noteworthy examples of procedures and practices demonstrating how States and local agencies have set appropriate speed limits.

ABOVE: Speed impacts safety of the traveling public, especially those who walk and bike.
© ako-photography / Thomas Pajot / AdobeStock.com.

Why Speed Limits Are Set

Speed limits are set and posted for public safety. Federal, State, and local governments all have the shared responsibility to guard and promote travel safety for road users. Despite these

engineer and subject matter expert on speed management safety with a transportation engineering and planning consulting firm. "It also involves numerous stakeholders, such as residents, businesses, school districts, elected officials, law enforcement, the judiciary system, and other government agencies that may all be part of the process to assure that the speed limits address the needs and safety of all roadway users," Schroeder notes.

Understanding the process and learning from noteworthy practices on how to conduct an engineering study to determine appropriate speed limits sets the tone for successful implementation to improve travel safety.

How Speed Limits Are Set

The 11th edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) (issued in December 2023) requires that speed limits for speed zones (other than statutory speed limits) "shall only be established on the basis of an engineering study that has been performed in accordance with traffic engineering practices. The engineering study shall consider the roadway context." The MUTCD guidance in section 2B.21 paragraph 7 provides six basic groups of factors that should be considered when conducting an engineering study for establishing or reevaluating speed limits within speed zones as the following:

> *"A. **Roadway environment** (such as roadside development, number and frequency of driveways and access points, and land use), functional classification, public transit volume and location or frequency of stops, parking practices, and pedestrian and bicycle facilities and activity;*
>
> *B. **Roadway characteristics** (such as lane widths, shoulder condition, grade, alignment, median type, and sight distance);*
>
> *C. **Geographic context** (such as an urban district, rural town center, non-urbanized rural area, or suburban area), and multi-modal trip generation;*
>
> *D. **Reported crash** experience for at least a 12-month period;*
>
> *E. **Speed distribution** of free-flowing vehicles including the pace, median (50th-percentile), and 85th-percentile speeds; and*
>
> *F. **A review of past speed studies** to identify any trends in operating speeds."*

These recommended study factors contribute to a context-centered study methodology derived from the application of the SSA.

The engineering study for setting speed limits required by MUTCD section 2B.21 paragraph 6 typically involves establishing and documenting the need and basis for the study, followed by collecting and analyzing the six factors described.

After the necessary data has been collected, the next steps in the engineering study are to use the evaluation results and engineering judgment to arrive at a recommendation for a safe and appropriate speed limit. This process can involve, among other things:

- Evaluating the six factors identified in the MUTCD (plus other factors as applicable, such as weather and seasonality) to identify an initial safe and appropriate speed limit for the study area's conditions.
- Incorporating speed limit setting engineering study tools such as USLIMITS2 (***https://highways.dot.gov/safety/speed-management/uslimits2***), and the Speed Limit Setting Tool, National Cooperative Highway Research Program (NCHRP) Research Report 966: *Posted Speed Limit Setting Procedure and Tool*, partner agency outreach,

best efforts, human behavior largely determines the safety of streets and roads across the Nation. The primary factor is risk perception—where a user of the transportation system makes a judgment of the present visual cues and operational conditions and then decides to drive at a speed perceived to be safe. When the road user accepts and acts at a heightened level of risk, such as driving over the speed limit or driving too fast for conditions, the likelihood of a severe injury or death increases. According to the authors of *Underestimated Risk Perception Characteristics of Drivers Based on Extended Theory of Planned Behavior*, "aggressive driving behaviors due to drivers' underestimation of risks are one of the major causes of traffic crashes." Risk perception is inseparable from the task of driving, bicycling, or walking and the basic speed law assigns this responsibility to the user who must determine when and where the user's choice of speed is too fast for conditions, which is defined by the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS) as one of the components for speeding. This responsibility involves assessing roadside activity, context, and geometric elements and other factors that influence choice of speed.

"Addressing setting and achieving safe and appropriate speeds limits is a complex issue involving engineering, geometric design, roadway context, driving behavior, education, and enforcement," says Dr. Bastian Schroeder, a senior principal or both, on the initial speed limit recommendation (optional).

- Examining target speed policy to assess the need for speed management countermeasures as listed in *Engineering Speed Management Countermeasures: A Desktop Reference of Potential Effectiveness in Reducing Crashes November 2023* to achieve desired speed and safety outcomes.

State of Practice for Engineering Appropriate Speed Limits

State and local jurisdictions are responsible for setting and enforcing speed limits on their roadways following the State and local laws and regulations. State transportation agencies, e.g., departments of transportation (DOTs), or local authorities may change the speed limit for any road in their respective jurisdictions, based on the required engineering study noted previously, if the State agency or local authority determines that the speed limit established by law is greater than or less than what is reasonable or safe for road users given road or traffic conditions.

Noteworthy practices, such as State speed limit setting procedures, demonstrate how an engineering study is carried out.

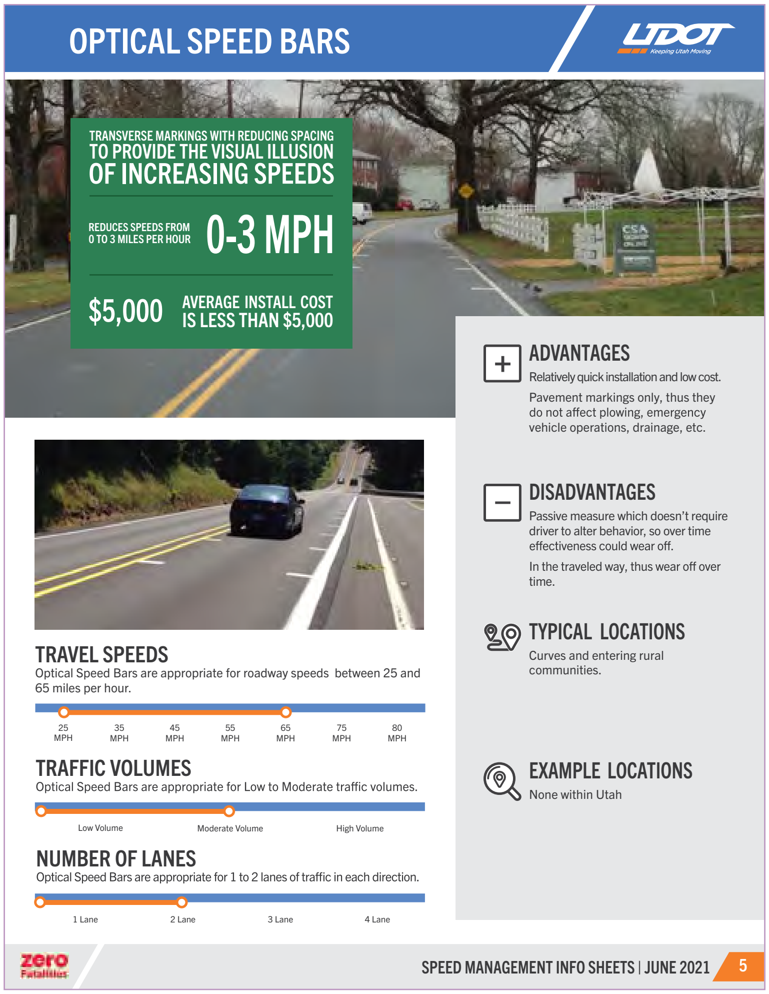
State Speed Limit Setting Procedures

Many State and local authorities develop speed zoning manuals or procedures that include a detailed process and approaches for conducting an engineering study that consider the related provisions provided in the MUTCD. Many States have updated their States' speed limit setting manuals and procedures to incorporate concepts and state of practices that are context sensitive. For example, the Utah Department of Transportation (UDOT) updated the guidelines on the establishment of speed limits on its State highways in 2023. The UDOT speed limit setting process uses roadway access to determine if using 85th-percentile speeds is appropriate. For many access types, the appropriate speed is determined from within a given context—appropriate target speed range for the access type using the roadway environment, culture, and characteristics to determine where to set a speed limit within the range. Access type used is "a classification assigned to a segment of highway that determines the degree to which access to a State highway is managed," as defined in Utah's Administrative Code.

For implementing and achieving appropriate speed limits, UDOT's speed limit setting procedures also include identification of speed management techniques when the recommended speed limit is more than 10 mph below the 85th-percentile speed. Speed management techniques consist of horizontal, vertical, lane narrowing, roadside, and other features that use physical or psycho-perception means—the process of becoming aware of objects or events, for example—to produce desired effects such as reducing speeds. UDOT recognizes speed management is also appropriate when the 85th-percentile speed is 5–10 mph above the recommended speed limit, and in some cases when the 85th-percentile speed is less than 5 mph above the recommended speed limit. "Setting appropriate speed limits is part of a holistic approach to dealing with speed safety issues. Research has shown that artificially lowering speed limits generally does not lead to lower vehicle speeds. Speed limits should be lowered in conjunction with the implementation of speed management measures," says Adam Lough of UDOT who oversaw the development of the Guidelines and the Speed Management Studies report," and "these techniques, used in isolation or combination, modify the roadway environment with a goal of reducing driver's comfortable traveling speeds."

The UDOT's Speed Management Studies guideline includes speed management techniques such as roadway geometric design, landscaping, pavement markings, roundabouts, vehicle speed feedback signs, and wider striping. These techniques raise the risk perception, which cause motorists to slow down. The document provides facts on each of these countermeasure ranges in cost as well as in the travel speeds, volumes, and number of lanes over which they provide impact.

Incorporating new safety and operation concepts has been helping practitioners to set safe and appropriate speed limits. New concepts such as injury minimization, context, target speed, and kinetic energy have been applied to engineering studies. The Washington State Department of Transportation (WSDOT) convened a workgroup to develop speed management guidelines focused on injury minimization. The recommended guidelines were summarized in a document released in October 2020. The WSDOT workgroup encourages all agencies in the State of Washington to adopt injury minimization and speed management strategies based on the elements outlined in the document.



RIGHT: Fact sheet for optical speed bar, one of the speed management countermeasures provided in UDOT Speed Management Study. *© 2021 UDOT.*

Speed study segment of Route 1 with three distinctly different sections.

© 2024 Google®. Modifications made by FHWA to illustrate overlays as the corridor boundaries.

"Studies show a direct link between driver speed and injury outcomes for those involved in a traffic crash. One of the key elements of the Safe System Approach is safe speed. Applying injury minimization concepts for setting speeds means designing and operating a roadway in which impacts on the human body are kept at tolerable levels to minimize fatalities and injury severity should a crash occur," says John Milton, State safety engineer, WSDOT.

WSDOT recognizes that target speed is a proactive approach to establishing a speed consistent with the context characteristics. WSDOT defines that target speed is the design operating speed, which aligns design, posted and operating speed as the same value.

A unique aspect of WSDOT's engineering study process recommended by the workgroup document involves a phased, step-down approach for applying the target speed concept to set speed limit for minimizing fatalities and injuries. The recommended process includes establishing target speeds based on road and land use context, road users, crash risk, the impact forces that result from a crash, and the human body's injury tolerance. For example, if the operating speed is within 5 mph of the target speed, adopt the target speed. However, if the operating speed exceeds the target speed by 5 mph, planners and engineers should use an engineering study to determine incremental speed limits and implement speed management approaches and make incremental adjustments of 5 mph or more as motorists respond to speed management techniques until the target speed is achieved.

Corridor Speed Limit Study

Conducting an engineering study typically involves developing an initial speed limit recommendation based on the relevant factors, implementing the use of an expert system as a "second opinion" on the recommendation, or starting the study process using the expert system and then comparing the outcome against application of target speed policy. In addition, some States may also require outreach to partner agency staff (e.g., law enforcement) and various decision-making bodies before a speed limit recommendation can be finalized.

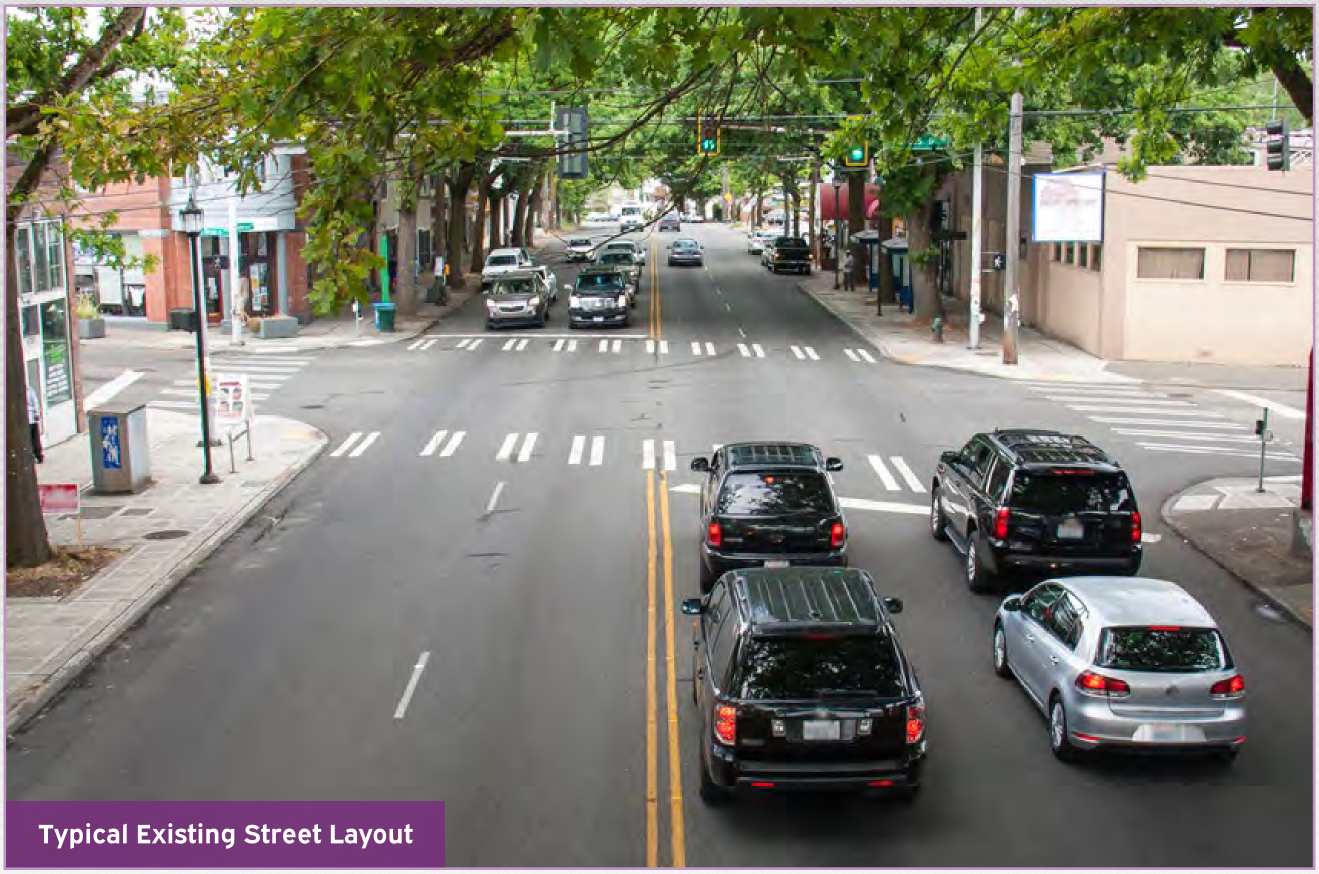
The Richmond Highway (Route 1) Speed Limit Study, conducted by the Virginia Department of Transportation (VDOT) from 2021 to 2023, demonstrates how the engineering study and engineering judgment process was carried out to reach the final decision on setting appropriate speed limits for the segment of Route 1.

The segment of Route 1 is an urban principal arterial that functions as a multimodal corridor serving commuters, through traffic, and freight traffic in Fairfax County, VA. The segment is approximately 8 miles from I-495 to the intersection of Richmond Highway and Belvoir Road and Meade Road. The roadway carries about 47,000 vehicles per day and has significant pedestrian activity due to the dense concentration of transit bus stops and commercial developments along the corridor.

Based on the analysis of roadway and roadside context characteristics, the segment of Route 1 was divided into three distinctly different sections for the study:

- I-495 to the northern Buckman Road intersection;
- Northern Buckman Road intersection to the intersection with Jeff Todd Way; and
- Intersection with Jeff Todd Way to the intersection with Belvoir Road and Meade Road.

The study evaluated the full set of reported crashes within the corridor for each of the sections. As part of the crash analysis, additional scrutiny was given to crashes involving speeding and pedestrians and bicyclists. The study also collected and analyzed speed data at several locations to identify existing speed conditions. The speed data revealed that the average



RIGHT and **NEXT PAGE:** Seattle Department of Transportation employed various street design changes to help improve speed limit compliance and road user safety along Rainier Avenue South. *© Seattle DOT.*

operating speeds on Richmond Highway are near 35 mph during much of the day.

The results of the multimodal accessibility and safety of nonmotorized road users' assessment, which was part of the study parameters, identified that there was significant pedestrian activity due to the dense concentration of transit bus stops and access points for apartments, businesses, and shops, along the middle and northern-most portions of the corridor, and this was a key factor in the final decision to lower the speed limit.

After completing the study, VDOT recommended that the current speed limit of 45 mph on Richmond Highway should be lowered to 35 mph in the middle and northern sections between Jeff Todd Way and I-495. The southern section, south of Jeff Todd Way, would remain at 45 mph.

Stakeholder collaboration and communication and community outreach were also a key part of the speed limit study process. A stakeholder meeting was held with representatives from VDOT and Fairfax County's Department of Transportation, transit services, fire and rescue department, and police department. The stakeholders concurred with the recommendation to reduce the speed limit. Public involvement meetings were also held to inform the public on the proposed speed limit change. Public comments indicated an overall consensus in favor of the lower speed limit.

The roadway environment, such as the high number of driveways and traffic signals, lack of turn lanes and raised median in certain areas, and frequent bus stops, as well as high pedestrian activity, create situations where drivers may need to react to several conflicts within a short period of time. By reducing driver speeds on Richmond Highway, drivers will be more readily able to identify conflicts and have more time to react. In addition, when a collision does happen, the chances for an injury or fatality are greatly reduced compared to situations with higher speeds.

Implementation

The principal objective of speed limits is to improve safety, but in some situations, simply posting a speed limit does not guarantee the desired change in driver behavior or result in a reduction in crashes or crash severity. Identifying and implementing speed management strategies and countermeasures for set speed limits should be considered part of the decision-making process based on engineering judgment. There are situations where after assessing the factors of the engineering study, practitioners may decide that the appropriate speed limit is lower than the current operating speeds, especially when the SSA—injury minimization principles—is incorporated for minimizing fatalities and injuries of nonmotorized road users such as pedestrians and bicyclists.

The city of Seattle, WA, speed limit policy and practices serve as an example of the application of the SSA principles and elements for setting and achieving safer speeds for all users. Since 2015, Seattle has prioritized the safety of people by lowering speed limits across the city from 25 mph to 20 mph for residential streets and from 30 mph to 25 mph on arterial streets, unless otherwise signed. To achieve the desired outcomes through the lowered speed limits, Seattle implemented speed management strategies along with the lowered speed limits, including increased frequency of speed limit signs, lane narrowing, more durable and visible pavement markings, speed cushions which are a type of speed hump, and removing the center line. The context appropriate speed limits along with these improvements contributed to a 26 percent fatality decrease between 2017 and 2018.

Typical Future Street Layout

Resources

- NTSB Safety Study: *https://www.ntsb.gov/safety/safety-studies/Documents/SS1701.pdf*
- MUTCD, 11th edition: *https://mutcd.fhwa.dot.gov/kno_11th_Edition.htm*
- WSDOT policy practices: *https://wsdot.wa.gov/sites/default/files/2021-10/InjuryMinimization-SpeedManagement-PolicyElements-Recommendations.pdf*
- FHWA Proven Countermeasures: *https://highways.dot.gov/sites/fhwa.dot.gov/files/App%20Speed%20Limits_508.pdf*
- NHTSA's Fatality Analysis Reporting System: *https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars*
- UDOT Speed Management Info Sheets: *https://drive.google.com/file/d/1JjXqTppAeVMTd580v5TrVONnUP_vPtdu/view*
- UDOT Speed Study Guidelines: *https://drive.google.com/file/d/1O3uAjPaQeec0O1Uy647iLuXi0ZtFR0J0/view*

"As we all know, speed is the critical factor in the frequency and severity of crashes. A few miles per hour difference can make a big impact on a person's chance of survival, especially those who walk and bike. Managing vehicular speeds has been and will continue to be a key part of Seattle's Vision Zero efforts," says James Le of the Seattle Department of Transportation.

Looking Ahead

Safe speed is a critical element of a safe system. When mistakes happen, and all other elements of the system fail, driving at a safe speed can be the difference between a minor incident and a major or catastrophic one. Setting appropriate speed limits is fundamental to reduce injuries and fatalities.

The Federal Highway Administration has identified setting "Appropriate Speed Limits for All Road Users" as one of the Proven Safety Countermeasures and has been promoting the countermeasures by providing direct technical support to State, local, and Tribal agencies, as well as technical and informational guidance. In addition, FHWA has been working with the National Academies of Sciences, Engineering, and Medicine to develop the next generation of expert system speed limit setting tool called USLIMITS3. USLIMITS3, which is under development through NCHRP 03-139 (01), will enhance the existing USLIMTS2 tool by incorporating the state of research and state of practice into the expert system logical decision rules that will help practitioners conduct their engineering studies for setting appropriate speed limits.

"FHWA will continue its collaboration with all of its safety stakeholders for advancing safe speed strategy to achieve the ultimate safety goal of zero deaths on our Nation's roadway system," says Jessie Yung, director, FHWA's Office of Safety Technologies.

GUAN XU, P.E., is a former highway engineer and program manager with FHWA's Office of Safety Technologies working on safety issues related to speed management. Guan holds an M.S. in civil engineering from the University of Cincinnati.

TIMOTHY TAYLOR is a former roadway safety and design engineer with the FHWA. He has 42 years of experience at the State and Federal level. He is a graduate of the University of Alabama and a licensed professional engineer.

BRANDY SOLAK, P.E., is a former roadway safety and design engineer with the FHWA. She promotes implementation of SSA as a framework for establishing safe speeds and safe roads and is a technical expert for FHWA in geometric design. She holds a bachelor's degree in civil engineering from Michigan Technological University.

Along the Road features current and upcoming activities, developments, trends, and items of general interest to the transportation community.

Public Information and Information Exchange

SDDOT Wins at 2024 America's Transportation Awards

In July 2024, the South Dakota Department of Transportation's (SDDOT) diverging diamond interchange (DDI) was named a winner in the 2024 America's Transportation Awards competition within the Western Association of State Transportation Officials (WASHTO) region. In addition to South Dakota, this region includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. Selected from 106 nominations across all regions, the $17.5 million project was recognized in the "Best Use of Technology and Innovation, Medium Project" category in the annual contest.

With traffic expected to increase and cause congestion at the Interstate 90 (I–90)/LaCrosse Street junction by 2035, SDDOT implemented a DDI—an innovative interchange design also called a "double crossover diamond"—to help reduce future traffic incidents. The DDI has also increased traffic flow, improved pedestrian connections, and ensured compliance with the Americans with Disabilities Act in enhancing pedestrian access between stores and hotels on both sides of I–90. As a result, Rapid City, SD—where the DDI is located—has experienced an economic upswing.

ABOVE: SDDOT's DDI wins a 2024 regional competition for "Best Use of Technology & Innovation, Medium Project." *© Jacob / AdobeStock.com.*

RIGHT: *© South Dakota Department of Transportation.*

Novel Path for Holistic Alkali-silica Reaction Management

Alkali-silica reaction (ASR) is a ubiquitous deleterious mechanism of concrete transportation infrastructure that involves the reaction between certain siliceous mineral phases within the aggregates and alkalis from cement. Some ASR products absorb moisture, expand, and induce cracking in concrete. ASR-induced cracking can expedite the ingress of undesired elements into the concrete, accelerating other degradation mechanisms such as corrosion, freezing and thawing, and carbonation—ultimately reducing the service life of the concrete. The combined effect of these concrete deteriorations mechanisms results in high annual maintenance and reconstruction costs.

Prevention is the most effective strategy against ASR. Practitioners rely on accelerated physical expansion standards, mainly ASTM International's ASTM C1260 and C1293, to detect the alkali-silica reactivity of aggregates and decide on the best mitigation strategy. Unfortunately, factors such as low sensitivity to detect specific alkali-silica reactive phases in aggregates or the influence of cement and the type of the "nonreactive" counterpart aggregate used in the testing protocol affect the reliability of these standards.

The Chemistry Laboratory at the Federal Highway Administration's Turner-Fairbank Highway Research Center developed two novel American Association of State Highway and Transportation Officials (AASHTO) standards, AASHTO TP 144 (T-FAST) and T 416 (ATT), geared toward evaluating ASR potential in concrete with improved accuracy and efficiency. These tests enable concrete stakeholders to assess the ASR risk of aggregates with more confidence, which in turn increases the use of marginal and local materials. The tests will also reduce the use of ASR-susceptible aggregate mixtures and improve the life of concrete structures, introducing substantial cost savings to both the public and private sectors. Nearly 20 States are part of the efforts to implement these new tests in partnership with FHWA's Office of Preconstruction, Construction, and Pavements and the Resource Center. In addition, ASR management approaches utilizing both T-FAST and ATT can be tailored to match the ASR risk associated with a particular concrete mix and is being incorporated as an appendix into AASHTO R-80, the current standard practice for determining ASR reactivity in aggregates and selecting appropriate mitigation measures.

CTDOT Begins Repairs on 102-Year-Old Mystic River Drawbridge

In July 2024, the Connecticut Department of Transportation (CTDOT) began repairs to the Mystic River Highway Bridge. The State-funded maintenance, costing nearly $150,000, will extend the bridge's life and concentrate on structural issues discovered by CTDOT crews during routine inspections. For instance, repairs are scheduled for the component supporting the two 230 short ton (209 metric ton) concrete-filled counterweights that help the bridge lift up. Additional repairs, scheduled to begin in spring 2026, will focus on keeping the bridge in a state of good repair, improving load capacity and any structural, mechanical, electrical, architectural, fender system, and waterway deficiencies.

The historic bridge carries U.S. Route 1 over the Mystic River into the tourist town of Groton, delivering vehicle and foot traffic (via a pedestrian bridge) to and from retail shops, restaurants, and other downtown sites. Its drawbridge, spanning 218 feet (66 meters), is raised several times daily, typically for 5 minutes and only during daylight hours. To learn more about the history of the Mystic River Drawbridge project, visit **https://historicbridges.org/bridges/browser/?bridgebrowser=connecticut/mysticriverbasculebridge/**.

The Mystic River drawbridge was built in 1922 and is still routinely raised for boat traffic.

© Connecticut Department of Transportation.

Policy, Regulations, and Grants

Tennessee's New Plan Includes a Vulnerable Road User Assessment

The Federal Highway Administration, Tennessee Department of Safety and Homeland Security, Tennessee Department of Transportation (TDOT), and other safety partners recently signed a new Strategic Highway Safety Plan (SHSP) for the State of Tennessee. SHSPs must be updated at least every 5 years (23 CFR 924.9(a)(3)(i)). Of notable addition to Tennessee's most recent edition is the inclusion of a Vulnerable Road User Safety Assessment, a requirement pursuant to 23 U.S.C. 148(l)(1) and (5). Pedestrians, bicyclists, and other nonmotorized vehicle transportation users are examples of Vulnerable Road User Safety Assessments, who are more vulnerable if subjected to a collision, requiring transportation agencies to focus on and address their unique safety needs. The Vulnerable Road User Safety Assessment is included as an appendix in Tennessee's 2025-2029 SHSP.

Over the past 5 years, strategies found within the SHSP have led TDOT to put more than 300 safety projects into effect for a cost of $241 million. Fifteen percent of these previously implemented safety projects focused on Vulnerable Road User Safety Assessments. To view the Tennessee Strategic Highway Safety Plan: 2025-2029, visit: *https://www.tn.gov/content/dam/tn/tdot/strategic/TN-SHSP-2025-2029-Update.pdf*.

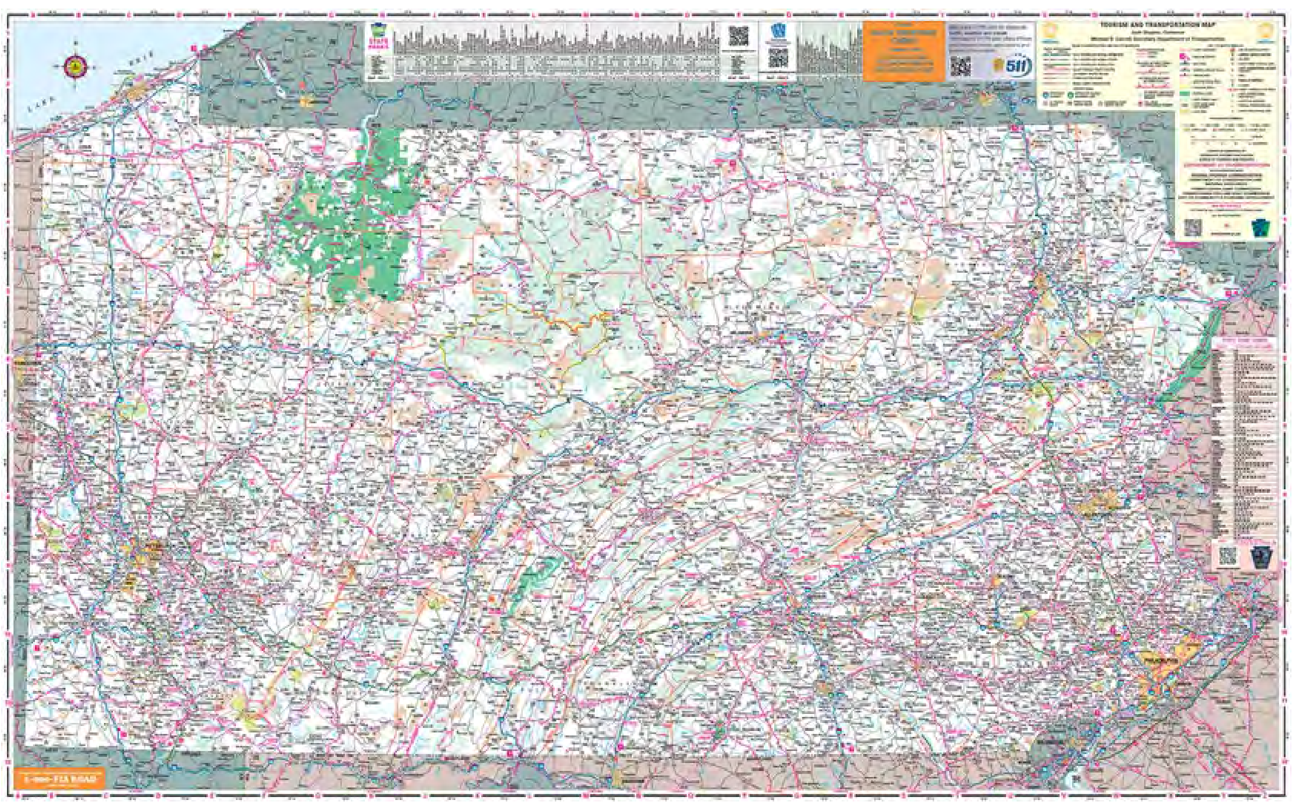
Internet Watch

All PennDOT Maps Are Available Online

Looking for a specific map of Pennsylvania? The Pennsylvania Department of Transportation's (PennDOT) digital library consists of both current and historical maps dating back to 1911. With a vast amount of information available, users can narrow their searches using the "Sort & Filter," which allows searches by specific map type, counties, and the year the map was created.

Maps can be searched by 11 categories: Tourism and Transportation Maps; Metropolitan Areas Maps; Statewide Maps; County Type 3 Maps; Historic Transportation Maps; Township, Borough, City Maps (Type 5); County (Type 3 Segment) Maps; County Type 10 Maps and County Type 10 Historic Maps; Traffic Volume Maps; Federal Functional Class Maps; and Federal Aid Primary and National Highway System Maps. The county maps show roads open to the public and those designated as expressways, toll roads, multi-lane highways, State-maintained roads and bridges, and more. Maps also indicate areas designated as State parks and game lands, State and Federal forests, Federal parks and reservations, drainage networks, airports, railroads, rest areas, and many more points of interest.

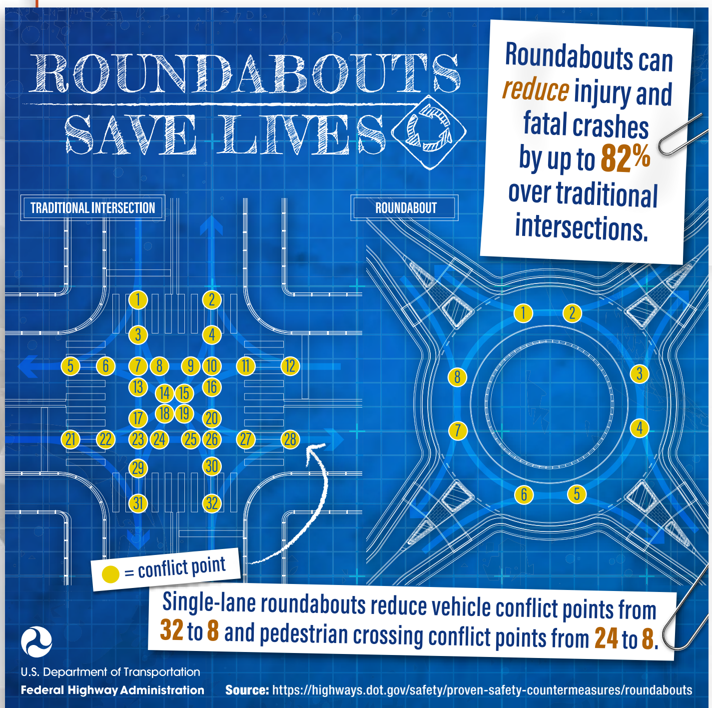
To access PennDOT's library of maps, visit: *https://www.pa.gov/agencies/penndot/maps.html#sortCriteria=%40copapwptitle%20ascending%2C%40title%20ascending*. For more information, contact *ra-penndotmaps@pa.gov*.

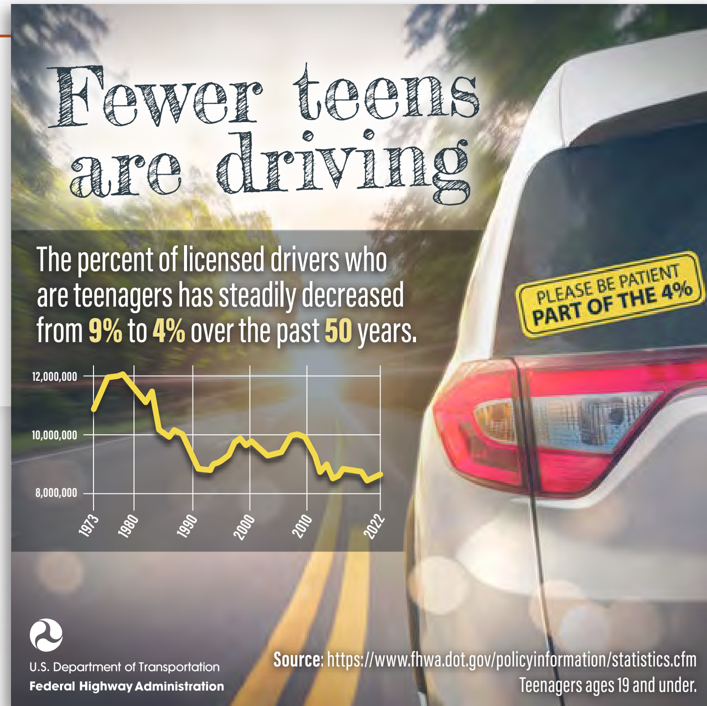


New Pennsylvania map library now available.

© Pennsylvania Department of Transportation.

Interesting Facts





For more interesting facts, visit the Federal Highway Administration on social media: *https://www.facebook.com/FederalHighwayAdmin*, *https://twitter.com/USDOTFHWA*, *https://www.linkedin.com/company/federal-highway-administration/posts/?feedView=all*, and *https://www.instagram.com/federalhighwayadmin/*.

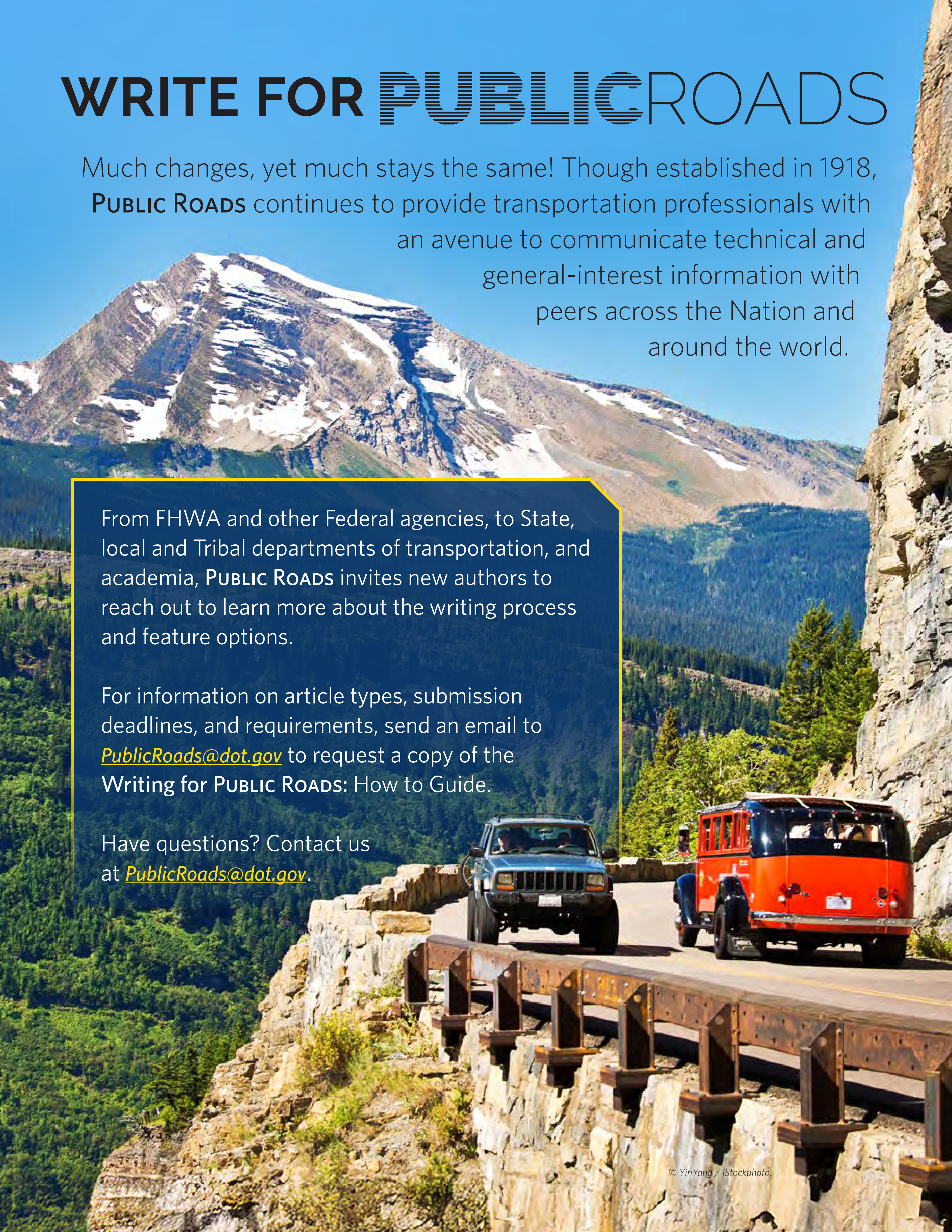
WRITE FOR PUBLIC ROADS

Much changes, yet much stays the same! Though established in 1918, **Public Roads** continues to provide transportation professionals with an avenue to communicate technical and general-interest information with peers across the Nation and around the world.

From FHWA and other Federal agencies, to State, local and Tribal departments of transportation, and academia, **Public Roads** invites new authors to reach out to learn more about the writing process and feature options.

For information on article types, submission deadlines, and requirements, send an email to *PublicRoads@dot.gov* to request a copy of the **Writing for Public Roads:** How to Guide.

Have questions? Contact us at *PublicRoads@dot.gov*.



© YinYang / iStockphoto.

Readers Want More Research, Data, and Innovation *– You Can Help!*

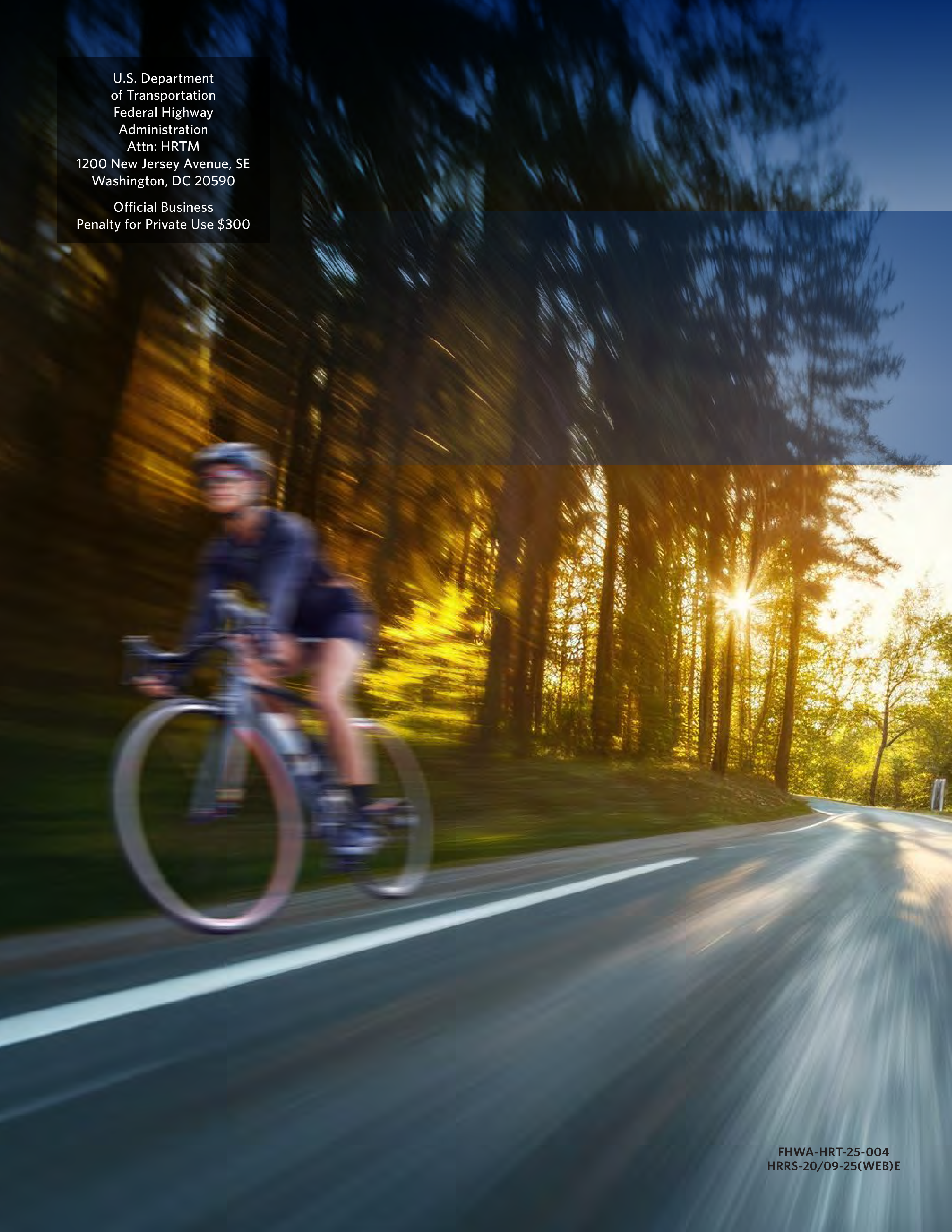
Academics, send us your story ideas.

You spoke and we listened.

The 2024 Reader Survey revealed what audiences want more of, and research, data, and innovation are just a few of those topics.

We encourage academics in the fields of engineering, materials, and other transportation-related areas to submit their story ideas to be considered for a feature article in a future issue of PUBLIC ROADS.

For more information on the process or to submit your story idea, email PublicRoads@dot.gov.



U.S. Department
of Transportation
Federal Highway
Administration
Attn: HRTM
1200 New Jersey Avenue, SE
Washington, DC 20590

Official Business
Penalty for Private Use $300

FHWA-HRT-25-004
HRRS-20/09-25(WEB)E