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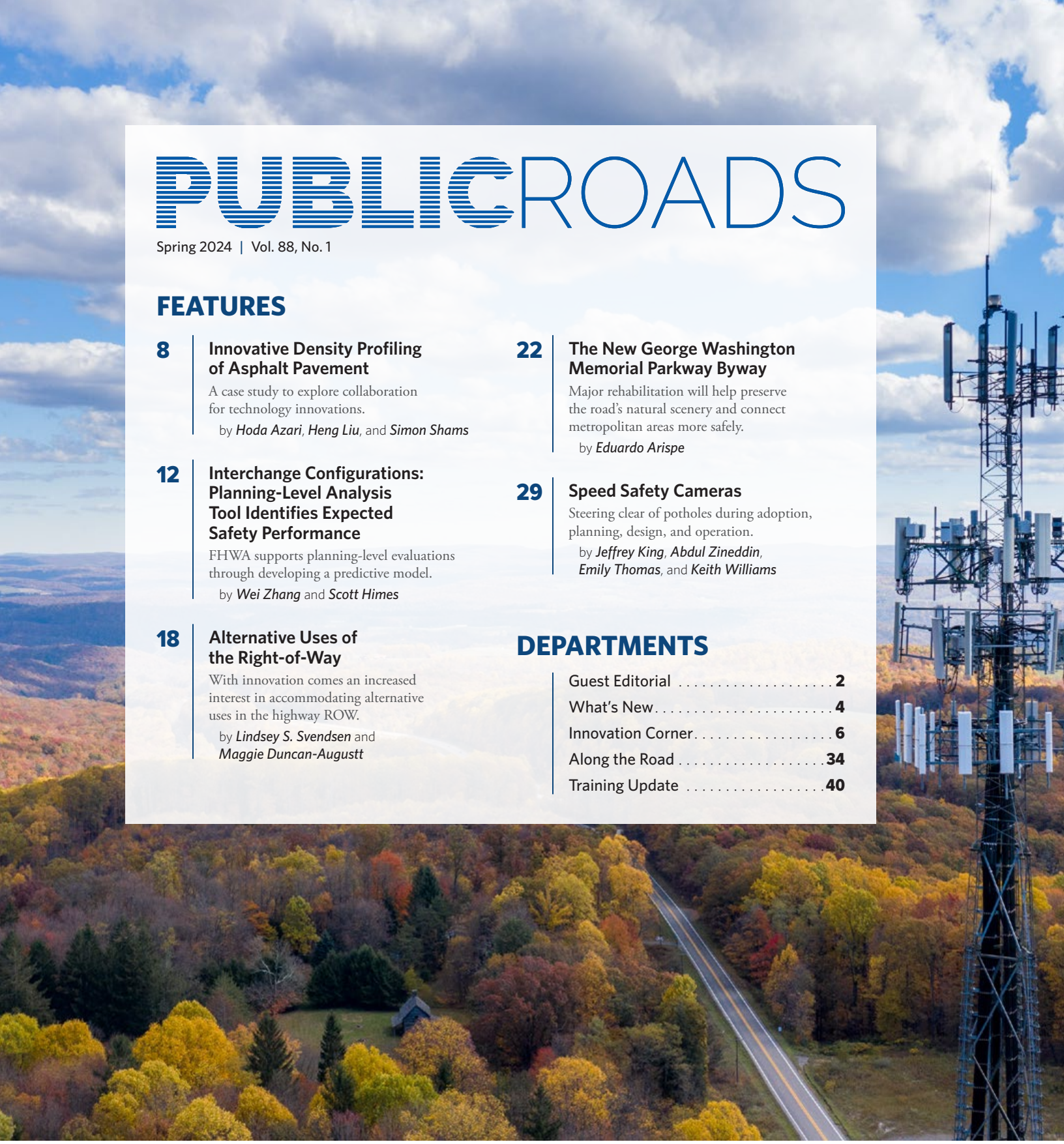

PUBLIC ROADS

Spring 2024 | Vol. 88, No. 1

FEATURES

DEPARTMENTS

ABOVE: State DOTs can use right-of-way to accommodate utilities like broadband towers.

COVERS: Implementing the use of speed safety cameras supports the reduction of speed-related crashes and fatalities on our Nation's roadways.

Recommended citation: Federal Highway Administration, Public Roads, Spring 2024 (Washington, DC: 2024) https://doi.org/10.21949/1521747

U.S. Department of Transportation
Federal Highway Administration

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Are you a longtime transportation professional conducting new research on a particular topic? Or an industry freshman looking to expand your knowledge base?

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Source: FHWA.

Embracing Innovation Leads to a Better World

The products of Federal research and development (R&D) investments have a profound impact on the safety, security, and quality of life of American citizens. These products include investments in advancing medical science such as new cancer treatments and vaccines, maintaining an advanced military to serve as a bulwark against threats with innovations such as the global positioning system, or finding new ways of sharing information such as the creation of the World Wide Web.

Federal R&D can also serve as a source of national pride—from putting a man on the moon, to harnessing the power of nuclear energy, or adding to our fundamental understanding of the universe—all leading to a deep sense of achievement and creating new opportunities for innovation in the future.

As Americans, our identity is tied to our willingness to take chances, explore frontiers, and contribute to the greater good. This ethos continues to drive progress, foster economic growth, and enhance global competitiveness. In part, it accomplishes this by laying the groundwork for private-sector innovation, leading to new applications that advance society here and around the world.

At the Federal Highway Administration, we are presented with an opportunity to further contribute to the national tradition of innovation and progress. The National Highway System (NHS) is already a point of national pride. The NHS, formed in 1995 and born from the creation of the Interstate System in 1956 by President Dwight D. Eisenhower, is the backbone of this Nation's economy, defense, and mobility. Building off this existing infrastructure, FHWA can leverage new tools and technologies—many of which are rooted in Federally funded R&D—to reimagine surface transportation for the future. For example, cooperative driving automation offers a real opportunity to move toward zero deaths on our Nation's roads. Digital infrastructure and building information modeling offer opportunities to improve the safety and efficiency of how we design, construct, maintain, and operate roads. New sensor technologies can help us identify and predict maintenance requirements, optimize traffic flow, and improve vulnerable road user safety. Further, implementation of advanced tools such as artificial intelligence, machine learning, and edge computing opens new doors for transportation researchers to explore as we try to solve complex, but important problems.

At FHWA, we strive to be strong, effective leaders in transportation research. We understand the opportunities that exist and that our partners and stakeholders look to us for guidance. At a time when it feels like everything is evolving quickly, the Federal Government can provide direction and set the stage for transformative change. The R&D that FHWA conducts will inform the direction of surface transportation for future generations and will provide avenues for industry to implement and deploy new innovations that address our most pressing challenges.

Working with our stakeholders and partners, we can improve lives and increase global competitiveness by being open to the opportunities that come along with transformative technologies and new ways of thinking. The present is one of the most exciting times in the history of transportation, but it will require vision and a willingness to take technological risks in order to achieve the future we imagine. This is how we achieved success in the space program and leveraged nuclear energy: we can do the same for highway transportation.

By embracing innovation, FHWA will lead the country toward a better transportation future and will support both national and global change. FHWA has an opportunity to put itself at the top of the list of the great drivers of societal change by leading through research and forward-thinking strategies. Investments in Federal R&D can change the world, and I am excited to be part of an organization that has the occasion to push innovation toward transformative solutions.

Craig Thor
Chief Scientist
Federal Highway Administration

ABOVE: Technology and automation lead the way in improving safety for all road users. *Source: FHWA.*

ABOVE RIGHT: *Source: FHWA.*

RIGHT: Virtual simulations are paving the way for transportation innovation. *Source: FHWA.*

FHWA's Transportation Pooled Fund Program

TPF

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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.

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

TPF TRANSPORTATION POOLED FUND

FHWA Celebrates the Traffic Noise Model's 25th Anniversary

FHWA marks 25 years of TNM, helping transportation stakeholders comply with regulatory requirements.

by **AILEEN VARELA-MARGOLLES**, **ANTHONY NORMAN**, **KELLY JOY**, and **LILAH MORRISSEY**

The Federal Highway Administration is celebrating 25 years of the Traffic Noise Model (TNM) with the release of an anniversary web page (*https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/tnm_25th_anniv/index.cfm*). TNM assists policymakers, planners, engineers, and traffic noise analysts in fulfilling the requirements of the highway traffic and construction noise rules in 23 Code of Federal Regulations, Part 772 (*https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-772*). To best assist stakeholders and users, TNM was developed cooperatively with States, academia, and consultants with a focus on providing the necessary acoustic outputs to make decisions and provide the necessary public information as required by the rule. TNM calculates noise levels from a highway project so analysts can identify potential noise impacts to areas near highways. TNM also calculates the reduction in traffic noise to those areas from noise abatement measures, like noise walls or berms.

The noise rule provides the process and requires using TNM for conducting a noise analysis on applicable Federal aid-funded or FHWA-approved projects. Typically, a validated project-level TNM setup is used first to predict the existing and anticipated noise levels on the roadway. The noise analyst then reviews TNM outputs to determine whether there are impacts. If there are impacts, TNM is used to evaluate noise abatement options and to determine whether they meet the criteria for feasibility and reasonableness from the noise rule, as implemented in the State's policy.

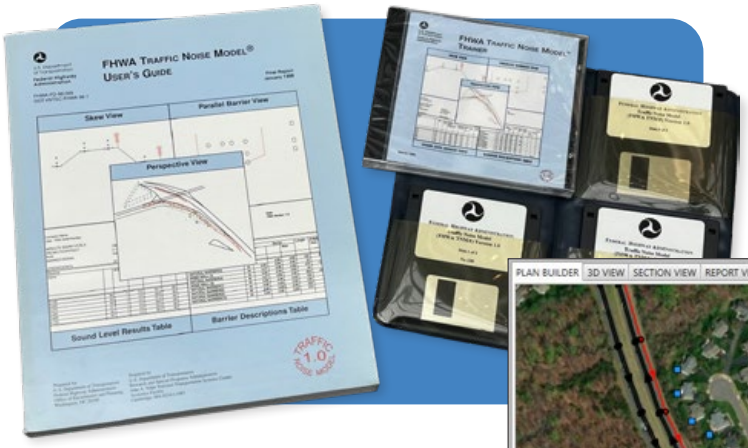
To meet the criteria, the noise abatement options must be constructable, provide the necessary acoustic reductions, and remain below the maximum cost. If the abatement measure meets these criteria, it is deemed feasible and reasonable and proposed for inclusion in the project. Engineering review is important to the determination of constructability, and further public involvement is necessary to determine if there is public support for the abatement measure. TNM is central to the analysis process because it assists with the determination of whether the abatement measure provides the requisite noise reductions and meets the cost criteria.

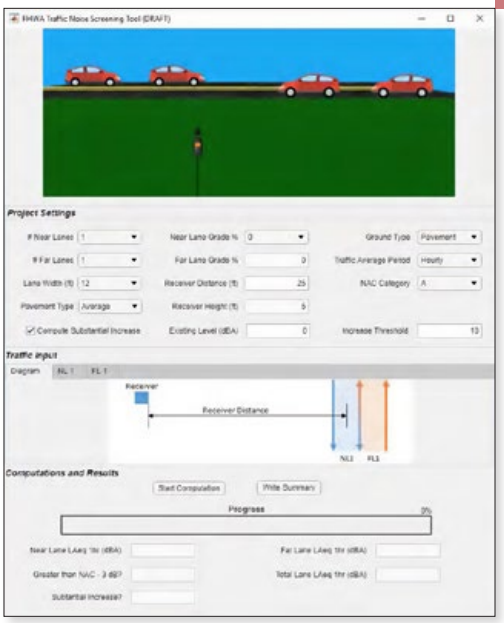
"TNM is a state-of-the-art computerized model used to predict noise impacts of highways. The evolving functionality of TNM allows for ease-of-use highway traffic noise modeling, leading to the design of efficient, cost-effective highway noise barriers," says FHWA Associate Administrator for the Office of Planning, Environment, and Realty (HEP) Emily Biondi.

Before TNM, noise analysts used numerical methods and charts to hand calculate noise impacts on highway projects. From there, the noise modeling technology was used with

ABOVE: Noise wall along a highway. *© carroteater / AdobeStock.com.*

RIGHT: Three dimensional model of a noise barrier along a street for a project in the TNM. *Map image © Mapquest Open Street Map. Modeling software © Cesium. TNM added a 3D noise barrier.*





punch card computers. Finally, in 1978, a program for noise impacts was developed for personal computers. This program was the Standard Method In Noise Analysis (STAMINA) and its associated barrier optimization system called OPTIMA. STAMINA was used for two decades, but as research and technology advanced, FHWA and its partners saw the need to design a new noise model.

FHWA worked with the John A. Volpe National Transportation Systems Center (Volpe), researchers in academia, and the private sector to develop TNM 1.0, which was released in 1998. TNM used a new acoustic database containing reference energy mean emissions levels (REMELs) for different vehicle types and operating conditions. This new REMEL database was developed in cooperation with multiple State departments of transportation (DOTs), based on thousands of field measurements and validated by acoustic experts. TNM has been updated over the past 25 years to add new capabilities and functions, incorporate the latest acoustic science, address different bugs, and improve usability. Each update has relied on the feedback and cooperation of the user community.

TNM 2.5, the version currently required by FHWA's noise rule, included an updated REMELs database, and relied on State DOT participation and assistance. The next version, TNM 3.0, also started with the prioritization of State DOT needs and cooperative funding agreements. TNM 3.0 updated the acoustics and separated the graphical user interface (GUI) from the acoustics database. This separation of the GUI from the database was an improvement that has allowed for increased responsiveness to user needs and more frequent software releases. The latest version, TNM 3.2, integrates the Roadway Construction Noise Model (RCNM). The combined program of TNM and RCNM now enables the prediction of construction noise levels via the application of the empirical data collected under the National Cooperative Highway Research Program (NCHRP 25-49)(*https://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-49/nchrp_25-49RCNM2.0finalreport.pdf*).

In response to user feedback and national trends, FHWA developed three new tools associated with TNM: the Traffic Noise Screening Tool (TNST), the TNMAide spreadsheet tool, and the Automated Consistency Test Suite (ACTS). The TNST improves and replaces the Low Volume Road Tool and helps analysts determine whether a more detailed study is needed. The TNMAide spreadsheet tool works with the Database for Air Quality and Noise Analysis, known as DANA, to identify the worst noise hour for a given segment of roadway. ACTS speeds up consistency tests by automating the comparison of other noise models to TNM.

FHWA has responded to TNM stakeholders by including novel elements in each TNM version, such as the user interface, bug fixes, and in acoustic updates. FHWA responds to stakeholders by providing funding opportunities or participating in national research though the NCHRP program, via pooled funds, or by collecting input on beta tests, and group meetings. The future of TNM will continue to involve cooperative research and development. FHWA and Volpe are currently participating in NCHRP 25-66 to update the acoustic database in TNM in response to changing vehicle fleet characteristics. FHWA invites users to continue to share feedback and needs as we look toward the future together.

AILEEN VARELA-MARGOLLES is the lead noise specialist for FHWA's Office of Natural Environment (HEPN). She has a decade of experience in highway traffic noise policy and requirements, and a master's in environmental studies from Florida International University.

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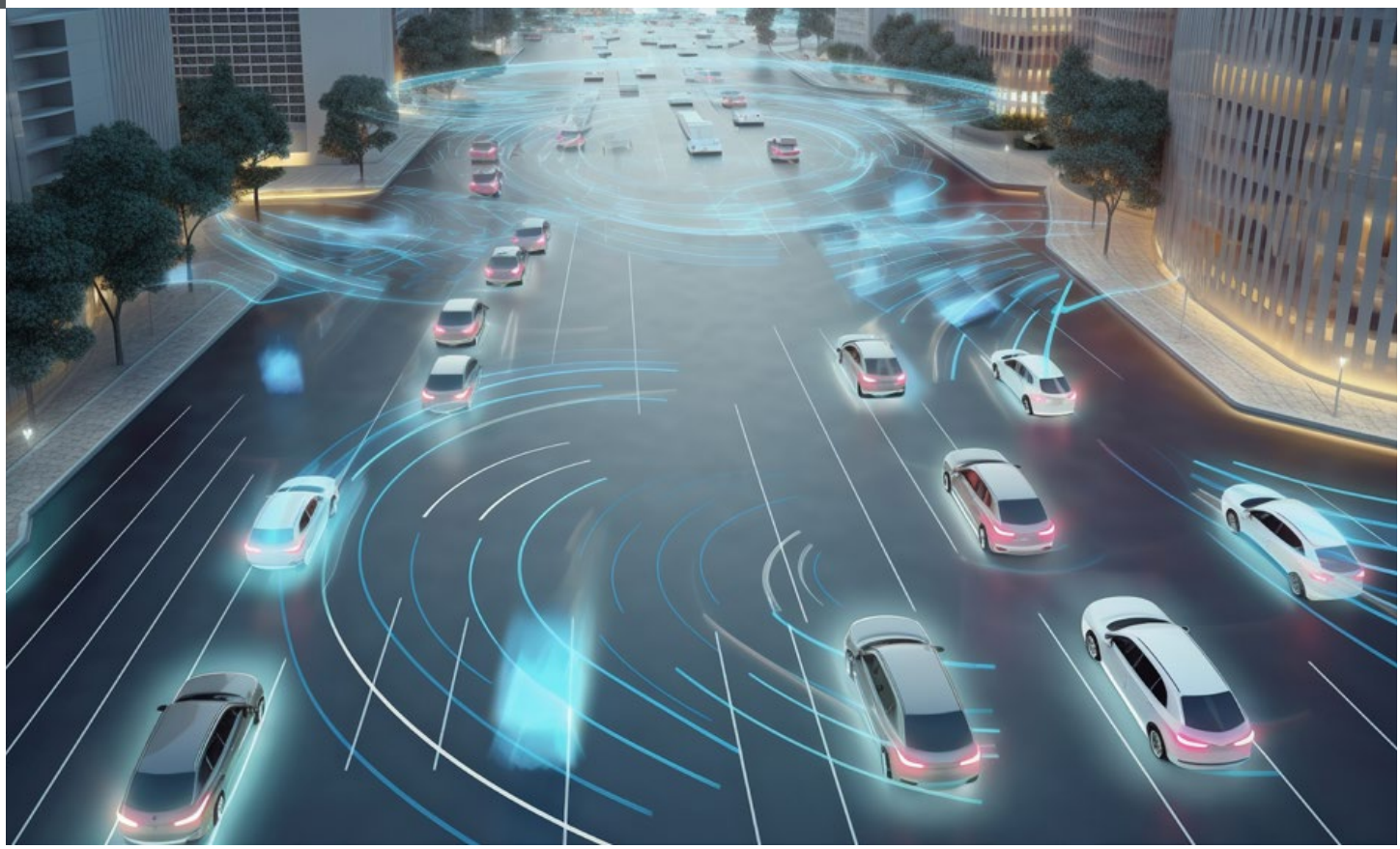
For more information about TNM, visit *https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/* or contact *TNMHelp@dot.gov*.

The different versions of TNM are archived online at: *https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/*.

ABOVE LEFT: FHWA Traffic Noise Model Guide 1998, training compact disc and installation floppy disks. *Source: FHWA.*

ABOVE CENTER: Traffic Noise Model version 3.2. *Map image © ESRI. Modifications made by TNM to show noise barrier and receivers along roadway.*

ABOVE RIGHT: Traffic Noise Screening Tool. *Source: FHWA.*



Navigating Smart Roads: Safeguarding Vulnerable Road Users Through Technology

by **JON STRAUSS**

The number of roadway-related deaths and injuries among vulnerable road users is unacceptable. In 2021, there was a 12.5% increase in fatalities among people walking- the highest recorded in decades. The Federal Highway Administration is working toward zero deaths through the application of the Safe System Approach.

The U.S. Department of Transportation's National Roadway Safety Strategy specifies that zero is the only acceptable number of deaths and serious injuries on our roadways. USDOT is committed to taking substantial, comprehensive action to achieve this goal. USDOT and FHWA encourage roadway owners and operators to use data-driven approaches to identify and address safety challenges affecting vulnerable road users (*https://highways.dot.gov/safety/hsip/vru-safety-assessment-guidance*).

The Bipartisan Infrastructure Law (BIL) provides unprecedented funding to address roadway safety issues, including issues specific to vulnerable road users.

Existing and evolving technology provides opportunities for addressing the crisis of vulnerable road user deaths. Transportation agencies such as the Tampa Hillsborough Expressway Authority (THEA) worked with USDOT at a connected vehicle (CV) pilot site to address road user safety.

THEA's Executive Director, Greg Slater, comments: "…as part of the THEA CV Pilot, we deployed a pedestrian collision warning application that we are now using to tackle an issue where drivers exiting an expressway into a dense urban area, need to slow down as they enter a completely new system."

The application uses cameras to detect pedestrian movements while they are in the crosswalks and sends a message to vehicles capable of receiving the message in the vicinity. Those vehicles then provide the driver with an alert that a vulnerable road user is in the crosswalk ahead.

FHWA funded the CV pilot program to test the ability of CV technology to prevent traffic crashes. The pilot program's success is measured by averted potential crashes and collisions and the number of advisories issued to the CV system.

CV technology, also known as Vehicle-to-everything (V2X) technology enables the rapid transmission of situational information providing safety warnings of imminent collisions. The communication of situational information takes place between equipped motor vehicles, pedestrians, cyclists, and non-motorized travelers. For example, V2X technology—like units carried by cyclists, scooters, and pedestrians—sends signals to corresponding equipment in vehicles, which then alerts drivers through visual and auditory cues to the presence of vulnerable road users.

Slater noted that this technology "… can provide auto and vulnerable road users with valuable information when making decisions while navigating busy roadways and intersections."

THEA continues to test V2X and other technologies in a controlled real-world environment on the authority's reversible lanes. To have real-world benefits, V2X capabilities need widespread application of interoperable technology on vehicles, devices carried by vulnerable road users, and infrastructure.

ABOVE: V2X technologies will connect drivers and infrastructure across the roadscape.
© Sawitree / AdobeStock.com.

Field applications such as the ones tested by THEA indicate the promise of this technology to save lives in all conditions, especially instances of low visibility like nighttime or weather-related scenarios.

FHWA's Every Day Counts 7 Nighttime Visibility for Safety initiative focuses on the broad application of visibility treatments to protect vulnerable road users. Low visibility conditions make intersections hot spots for crashes.

FHWA's analysis of Lighting for Pedestrian Safety concludes that 90 percent of traffic fatalities happen in four types of places: intersections, pedestrian roadway crossings, curves, and ramps, and 76 percent of pedestrian fatalities occur at night. Improving visibility for pedestrians at these location types can help transportation agencies curb preventable crashes, injuries, and deaths.

The integration of new technology into the current infrastructure, along with partnerships with agencies and businesses, could lower the risk of crashes involving vulnerable road users and vehicles in low-visibility situations. Infrastructure owners and operators are testing new technology and interactions between road users. These tests are happening at pilot sites across the Nation. They require cooperation from partners, such as the Federal Government, State and local governments, stakeholder agencies, and numerous interested parties, including the auto industry, advocacy groups, higher learning institutions, and the public. Partnerships enable the testing of technologies such as V2X.

As vehicles become more connected, so will vulnerable road users with personal alert systems such as V2X technologies, facilitating awareness between users and vehicles. This advancement enhances visibility and prompts behavioral changes, reducing the risk of crashes. From smart infrastructure to wearable devices, partnerships, and testing solutions, embracing these innovations and collaborations will propel our Nation to safer and more accessible roads for everyone regardless of their mode of transport.

JON STRAUSS is a communications specialist and project manager contractor with FHWA.

For More Information

- https://www.transportation.gov/nrss/usdot-national-roadway-safety-strategy
- https://theacvpilot.com
- https://www.fhwa.dot.gov/innovation/everydaycounts/edc_7/nighttime_visibility.cfm
- https://safety.fhwa.dot.gov/roadway_dept/night_visib/docs/Lighting_for_Pedestrian_Safety_2pager.pdf
- https://www.transportation.gov/NRSS/SafetyProblem

ABOVE: The pilot program's success is measured by averted potential crashes and collisions and the number of advisories issued to the CV system.

© Laszlo / AdobeStock.com; Graphic source: FHWA.

LEFT: New technologies support the safety of all road users.

© Volodymyr / AdobeStock.com.

Innovative Density Profiling of Asphalt Pavement

A case study to explore collaboration for technology innovations.

by **HODA AZARI**, **HENG LIU**, and **SIMON SHAMS**

The Nation's pavement network consists of more than 8.8 million lane-miles. The integrity of this network is critical to support the mobility of more than 282 million registered motor vehicles, with each vehicle traveling at an annual distance of, on average, about 11,000 miles. Under such a travel demand, numerous technologies and innovations have emerged to ensure the safety, resiliency, and sustainability of our transportation infrastructure. Among these innovations, density profiling technologies have gained considerable attention from highway agencies.

The density of asphalt pavement is a measurement reflecting the pavement compaction, a critical element in asphalt pavement construction. Adequately compacted asphalt pavement can meet the desired strength and reduce the risk of water penetration through excessive air voids. Adequate and uniform compaction can increase the pavement's long-term performance and durability, maximizing the return on investment in pavement construction.

ABOVE: Pavement compaction is critical to ensure road infrastructure is safe and resilient.
© Volodymyr / sevector / AdobeStock.com.

Challenges in Pavement Density

The current state of practice for density measurement relies on drilling cores in the field. The drilling process is labor intensive and only feasible for a few random locations. Scattered measurements from random locations introduce the risk of failing to detect improperly compacted areas. Furthermore, core drilling is a destructive process, which brings added risks that may compromise the integrity of pavement structure. In some cases, highway agencies use nuclear gauges for density measurement. While nuclear gauges offer advantages in terms of nondestructiveness, they come with their own set of complexities. Specifically, the requirement of special licenses for handling nuclear gauges can add layers of regulation and potential liabilities.

All these risks translate into additional costs that asset owners need to consider, including expenses related to unnecessary pavement preservation and/or rehabilitation. The costs associated with traffic control and addressing public complaints should also be considered and not underestimated.

"Within our extensive highway infrastructure, the need for better density profiling is driven by the pursuit of safer, more resilient, and sustainable transportation networks," says Dr. Dai Shongtao with the Office of Materials and Road Research at the Minnesota Department of Transportation. "This, in turn, contributes to pavement integrity, cost effectiveness, and a dedicated commitment to enhancing the commute of millions of travelers," says Dr. Shongtao.

Nondestructive Innovation

A promising solution for density measurement is to use ground penetrating radar (GPR). GPR can measure the dielectric constant, a material property of asphalt material, which correlates to the pavement's density. GPR emits short pulses

of electromagnetic (EM) waves that can penetrate pavement surfaces and interact with underneath paving materials. The reflecting signals contain rich information about scanning of the asphalt pavement, and with proper correlation, the information can reflect its density. The use of GPR is nondestructive and safe for the operator's health. The emitting energy of GPR is approximately equivalent to 1 percent of the outcoming energy from a cellular phone. One of the most prominent advantages of using GPR for density profiling is its capacity to provide continuous, real-time, or near-real-time density data across expansive pavement areas. Commercially available equipment can scan a 6-foot-wide paving area at a walking speed.

The innovative use of GPR for density profiling of asphalt pavements has interested several highway agencies. With a shared interest in advancing pavement compaction assessment, 14 State DOTs and FHWA formed a pooled fund collaboration in early 2020. The collaboration formed a working group to test, evaluate, improve, and standardize the new technology, aiming to transfer the research findings into best practices.

"Innovations in density profiling technologies hold the promise of revolutionizing how we assess and optimize pavement compaction, providing a more efficient, cost effective, and nondestructive approach to ensuring the longevity and performance of our vital transportation infrastructure," says Dr. Jean Nehme, director of FHWA's Office of Infrastructure Research and Development, located at the Turner-Fairbank Highway Research Center (TFHRC) in McLean, VA.

Nondestructive Evaluation (NDE) Laboratory Collaboration with Federal, State Partners

The mission of the FHWA NDE Laboratory is to conduct state-of-the-art research, development, and implementation of nondestructive testing systems and technologies to improve the Nation's highway infrastructure assets. The NDE Laboratory

Density profiling using GPR shows advantages in obtaining continuous density measurements for large paving areas at near-real time.
Source: FHWA.

ABOVE: The NDE Laboratory uses a temperature-controlled chamber (left) to assess the robustness of the density profiling equipment (right). *Source: FHWA.*

is committed to strengthening partnerships between Federal and State entities by leveraging its extensive knowledge and expertise in the research and development of NDE technologies. The NDE Laboratory is equipped with state-of-the-art technologies and has a research team with diverse expertise to support the laboratory's mission and commitment.

As a participant in the pooled fund collaboration, the FHWA NDE Laboratory shares a common interest with its partners in testing, evaluating, and researching new technologies for better pavement construction. Since 2020, the NDE Laboratory has conducted a series of studies to investigate and evaluate GPR. The investigation starts with an equipment survey to review the state of practice in density profiling using GPR. The investigation also involves laboratory testing and field trials to understand the physical principle of the technology.

By conducting research, the NDE Laboratory aspires to generate practical guidelines that can help stakeholders use, evaluate, and test the technology. For example, the research team assesses the robustness and resiliency of GPR operating under harsh climatic conditions by using a temperature-controlled chamber to simulate high temperatures during pavement construction. Another example is the study of the edge effect in dielectric measurements of cylindrical samples. Obtaining density information requires conducting tests to correlate the dielectric and the pavement's density. The correlation could be done using field cores. An alternative approach to avoid field coring is to test gyratory samples compacted in the lab. These samples are cylindrical with limited sizes. The cylinder height is about 4.5 inches (114.3 mm), and the diameter is up to 6 inches (152.4 mm). The small size of these specimens compared to the wavelength of GPR signals can lead to signal interferences from edges, potentially affecting the accuracy of dielectric measurements. The research team investigated this issue by performing a set of numerical simulations and experimental tests. The results confirmed the presence of the edge effect. It is worth noting, however, that this effect remains within practical acceptability when conducting tests on cylindrical samples with a 6-inch (152.4 mm) diameter and a height exceeding 4.5 inches (114.3 mm).

One more noteworthy example of the study is the discovery of the scanning boundary during density profiling. Past research has shown the technology's sensitivity to a thin layer underneath the pavement surface; however, the precise extent of this sensitivity remained unknown. The research team performed state-of-the-art numerical simulations to understand how EM propagates in asphalt pavements. The numerical model can simulate the asphalt binder, aggregates, and air voids in the asphalt mixture. This model, as shown in the figure at the top of the next page, can better capture the EM wave propagation (plotted in the black solid line) inside asphalt material, especially the wave scattering, compared to a simplified approach by modeling asphalt as a simple homogeneous material (plotted in the red dotted line). By using a classical theory of Rayleigh scattering, the research team uncovered the scanning boundary of this technology. The Rayleigh scattering describes how EM waves interact with particles that have sizes similar to the EM wavelength. The scanning region reveals the sensitivity of the technology to the density change below the pavement surface. For example, a numerical scenario with a big hollow void below the scanning region (plotted in the blue dashed line) shares similar wave characteristics to the case without the hollow void (plotted in the black solid line).

Roadmap for Next Steps

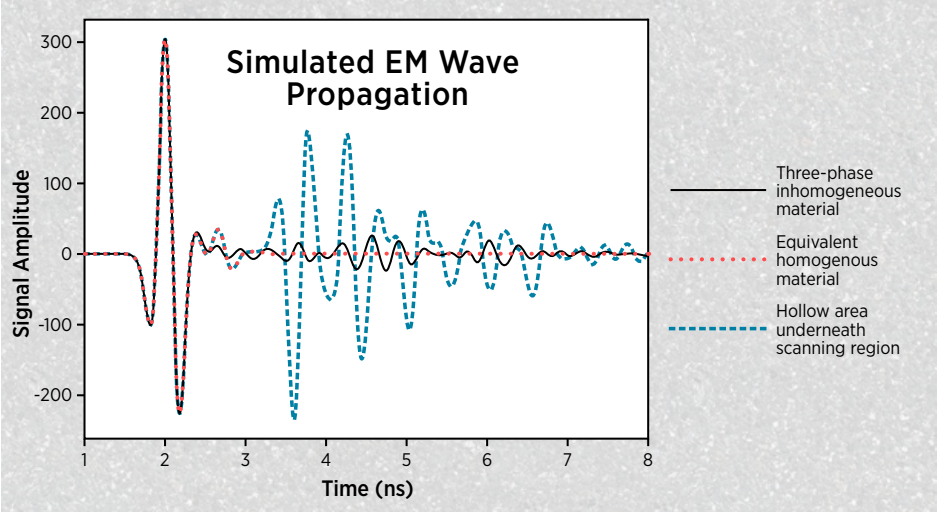
The NDE Laboratory has developed a roadmap for the next steps. One study will investigate how different asphalt mixes could potentially influence the density measurements. The study will involve a comprehensive set of numerical simulations and experimental validations. The numerical simulations may provide valuable insights to optimize the experimental tests. Another study will integrate the surface macrotexture of asphalt pavement into density profiling. Some users have expressed concerns about how the pavement surface might impact density

measurements, but no studies have been done on this topic. These two studies aim to find scientific insights into how asphalt mix design and surface macrotexture may influence the density measurement and, if identified, develop practical adjustments to enhance GPR's performance.

As the NDE Laboratory follows its research roadmap, it places a significant emphasis on the value of collaborative research. The NDE Laboratory research team believes that collaboration not only amplifies the collective research effort but also introduces a diverse range of ideas that can spark new innovations. In 2021, the NDE Laboratory participated in a round-robin program with the Minnesota DOT and the National Center for Asphalt Technology at Auburn University. The round-robin program involved testing the same sets of asphalt samples with the same set of equipment and using the same testing method but by different research groups. The collaboration tested and evaluated the consistency, precision, and bias when implementing the new density profiling technology.

In 2023, the NDE Laboratory established a collaborative partnership with the Asphalt Binder and Mixtures Laboratory, the Mobile Asphalt Technology Center, and the long-term infrastructure team at TFHRC. This collaboration is specifically aimed at driving technological innovation and knowledge transfer through the framework of the newly revamped third-generation Pavement Testing Facility. The NDE Laboratory envisions that this collaborative endeavor will give stakeholders an improved understanding of and heightened confidence in using GPR for density profiling, among other significant objectives.

For more on the Pavement Testing Facility and the Mobile Asphalt Technology Center, see the Guest Editorial and What's New in the Summer 2023 issue of *Public Roads* (*https://highways.dot.gov/public-roads/summer-2023/editorsnotes* and *https://highways.dot.gov/public-roads/summer-2023/whatsnew*).



The NDE Laboratory uses the state-of-the-art numerical modeling technique to study electromagnetic wave propagation in density profiling using GPR. The technique identifies the scanning region by comparing three simulation cases.
Source: FHWA.

HODA AZARI is the manager of the NDE research program and NDE Laboratory. She holds a Ph.D. in civil engineering from the University of Texas at El Paso.

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For more information, see *https://highways.dot.gov/research/laboratories/nondestructive-evaluation-laboratory/ongoing-projects*, or contact Hoda Azari, 202–493–3064, *hoda.azari@dot.gov*.

For more information about the pooled fund collaboration for continuous asphalt mixture compaction assessment, see *https://www.dot.state.mn.us/materials/dps/index.html*.

Rehabilitation and reconstruction of pavement surfaces supports the safe transportation of people and goods across the Nation.
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INTERCHANGE CONFIGURATIONS: Planning-Level Analysis Tool Identifies Expected Safety Performance

FHWA supports planning-level evaluations through developing a predictive model.

by **WEI ZHANG** and **SCOTT HIMES**

Since President Dwight D. Eisenhower signed the *Federal-Aid Highway Act of 1956*, the national Interstate System has served an essential role in America's prosperity and way of life. It, among other influences, connects diverse geographical areas, provides access to employment, and decreases driving distances and travel times. Thus, it is of national interest to continually preserve and enhance the system by assuring it provides the highest level of service in terms of safety and mobility for all users. The Interstate System also influences the mobility and safety of people and goods by providing access to local highways and networks of public streets. Complete control of access along the Interstate mainline and ramps and control of access on the crossroad at interchanges is critical to providing the highest level of service.

The Federal Highway Administration provides the requirements for the justification and documentation necessary to substantiate any proposed changes in access to the Interstate System. Changes in access to the Interstate System may involve proposing a new interchange or proposing modifications to an existing interchange. FHWA's decision to approve new or revised access points to the Interstate System—under Title 23, United States Code, Section 111—-is made after considering an analysis of expected operational and safety performance impacts.

Typically, substantiated information comes by way of Interchange Justification Reports (IJRs). IJRs are written early in the project planning process, with details generally consistent with conceptual design and descriptions of potential safety performance impacts.

Historic crash data shows that high traffic facilities such as freeway interchanges—like the one at Interstate 75 (I–75) and University Parkway in Sarasota, FL—exhibit stable annual traffic crash patterns over time; therefore, their annual safety performance should be predictable. "When an existing interchange or intersection exhibits a history of safety and/or operational problems and is being proposed for conversion into a new interchange or configuration, it helps to know the expected safety performance," says Brian Cronin, former director of the FHWA Office of Safety and Operations Research and Development. "Although analysts can identify many causal factors leading to traffic crashes, so far, no simple and reliable predictive methodology has been developed that can accurately predict an interchange's safety performance in terms of total annual crashes and severity distribution," Cronin continues.

ISAT and ISATe: The Initial Predictive Tools

In 2007, FHWA completed the Interchange Safety Assessment Tool (ISAT), a spreadsheet-based tool for performing safety assessments of interchanges and adjacent roadway segments and intersections. This original tool used a building block approach and focused on traffic volumes, the number of lanes on each

interchange roadway segment, ramp configurations, and ramp terminal control. ISAT also provided limited opportunity to consider design features and the differences in interchange configurations. ISAT was developed as an intermediate tool to meet immediate needs, providing crash estimates of only three typical interchange configurations—diamond, partial cloverleaf, and full cloverleaf.

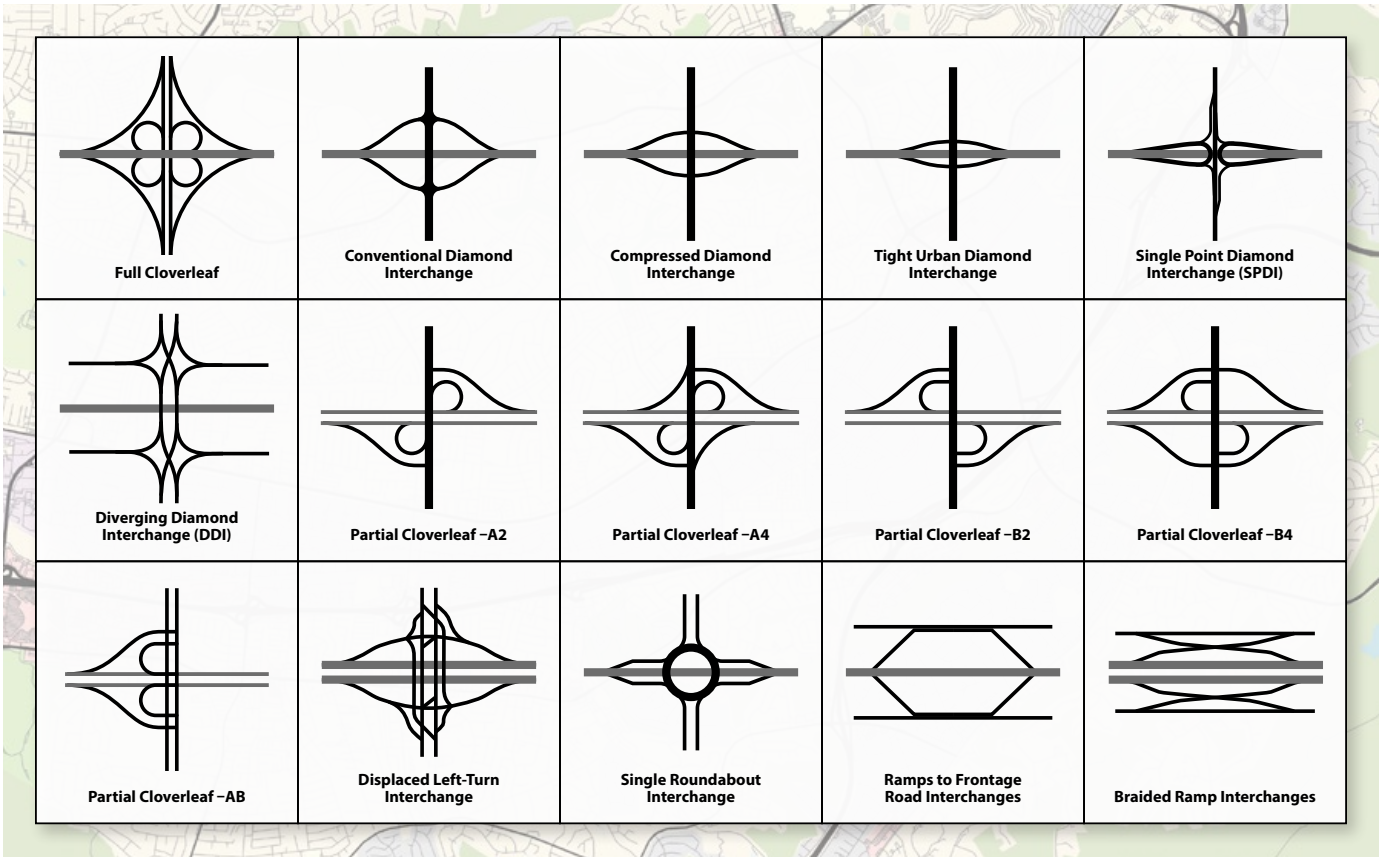
In 2009, FHWA began collaborating with the Transportation Research Board to develop the Enhanced Interchange Safety Analysis Tool (ISATe), an improved prediction methodology and safety analysis tool for corridor and site-specific analysis. ISATe also provides information about the relationship between roadway geometric design features and safety. This version of the tool automates a safety prediction method consisting of algorithms and equations. The lead researchers of ISAT and ISATe worked as the lead researchers in the development of the *Highway Safety Manual* (HSM). Hence, many of the methodologies used in the interchange safety tools are adopted in HSM.

Eventually, in 2014, ISATe became a supplemental component of HSM, which provides detailed descriptions of the underlying data needs and predictive models implemented in ISATe and serves as the primary means for evaluating safety performance for freeway segments, ramp segments, and ramp terminals. To predict crashes for these facilities, the ISATe and HSM predictive models require detailed sets of inputs—down to specific design characteristics—for features such as lane width and shoulder width as well as specific locations and design of barriers and curves for freeway facilities. Ramp connection locations and ramp terminal design details (e.g., channelization and turn-phasing) are also required. These details are not commonly known during the planning phase, leaving agencies unable to use the HSM models for purposes of safety performance assessment. In addition, even for instances where the model inputs are available during the planning phase, aggregating component-by-component predictions (e.g., individual ramp and freeway segment) may only partially capture the safety performance impacts when considering a project location. Finally, some interchange configurations, such as diverging diamond interchanges, cannot yet be evaluated using HSM predictive models.

As an alternative approach to using ISATe during the planning phase, particularly for interchange configurations not considered in the existing tool, analysts can use a single crash modification factor (CMF) to assess the difference in expected safety performance from one interchange configuration to another. Unlike HSM models, a single CMF fails to capture complex interactions taking place and cannot be used to evaluate factors within an interchange configuration that may impact safety performance. However, this is a reasonable approach given what is known at the planning stage of a project.

ABOVE: The I-75 and University Parkway interchange in Sarasota before (top) and after revisions (bottom). In this innovative interchange design, long and protected passes are provided to non-motorized road users. There are also designs that enhance movement of non-motorized users compatible with motorized traffic, among other features.

Photos: FHWA. All underlying maps: © Sam / AdobeStock.com



Interchange configurations included in survey.
Source: FHWA.

Developing the Next Best Tool

While ISATe filled a critical need, analysts identified several difficulties in utilizing the tool. When funding became available in fiscal year 2020 to support the need for substantive safety performance assessments for IJRs, FHWA began developing planning-level models and tools to predict crash frequency and severity for an existing or proposed interchange. Published in early 2023, these planning-level models now allow analysts to compare the potential safety performance effects of freeway access and interchange design decisions earlier in the project development process without knowing the geometric details.

To maximize the applicability of a planning-level interchange configuration safety comparison tool, FHWA began identifying interchange types in the top 75 percent of those considered by State transportation agencies. "Although numerous IJRs are submitted to FHWA for review, the types of interchange configurations evaluated in those IJRs concentrate into mainly just a few categories. If we have a tool that can assess the safety performance of these more commonly studied types of interchanges, it will be a huge relief to practitioners involved in evaluating safety on IJRs," says Mark Doctor, senior safety and design engineer at FHWA Resource Center.

The research team surveyed FHWA division representatives for all 50 States, plus Washington, D.C., and Puerto Rico, to identify how commonly each interchange configuration is considered or constructed in each State, city, or territory annually. The survey included a graphical representation of potential interchange configurations to choose from, in order of importance or value to the State.

FHWA representatives from 47 divisions responded to the electronic survey, providing detailed descriptions of practices and information on access proposals received over the past few years in their respective locations. The results of the survey indicated the following configurations should be included in the next improved version of the predictive tool for interchanges (in order of most to least responses):

- Standard diamond interchange.
- Diverging diamond interchange.
- Single-point diamond interchange.
- Compressed diamond interchange.
- Tight diamond interchange.
- Partial cloverleaf (Parclo) type A.
- Parclo type B.
- Parclo type AB.

Additionally, this survey revealed the need to differentiate single roundabout interchanges from diamond interchanges with roundabout ramp terminals, otherwise referred to as roundabout diamond interchanges. The development of the new Interchange Configuration Safety Comparison Tool included roundabout diamond interchanges.

Identifying the Scale and Scope of the New Predictive Model

The primary consideration for evaluating interchange safety performance was identifying the analysis area scope for the new predictive model. Due to the variability of an interchange's influence area (or area of study), a planning-level predictive method based on influence area was impractical. This level of analysis would have included the freeway sections outside of the interchange area—all the way to adjacent interchanges and crossroad sections—to at least the nearest intersections. Therefore, the predictive method focused on the interchange area. The interchange area consists of the freeway mainline, crossroad, and ramp terminals. The freeway mainline includes 457 meters (1,500 feet) upstream and downstream of the entrance and exit ramp gores and 30 meters (100 feet) beyond the curb return on the crossroad, which is consistent with other planning-level safety analysis tools. Additionally, this distance

provides consistency with ISATe's research, which shows a decreasing influence from ramp entrances and exits, with no influence beyond 805 meters (2,640 feet), when there is not an adjacent interchange nearby. Analysts included all crashes observed in the interchange area in the scope for this tool; however, the tool does not predict crash frequency by location within the interchange area, only for the interchange area as a whole.

The method underlying this tool separately predicts fatal, injury, and property damage-only crash frequency. When combined, the tool predicts the total crash frequency for each interchange configuration considered. Moreover, the tool includes inputs to evaluate the relationship between geometric and operational features on the predicted severity level of injury crashes. Analysts can use the tool to evaluate the predicted crash frequency for varying interchange configurations, considering a standard diamond interchange or compressed diamond interchange as the baseline.

The predictive models underlying this tool identify that the relative safety performance among interchange configurations differs as the freeway volume per lane, crossroad volume per lane, or interaction of freeway volume to ramp volume changes. This means that for a given set of conditions, the relative safety performance among interchange configurations is different than an alternate set of conditions (i.e., a single CMF would provide misleading results of relative safety performance).

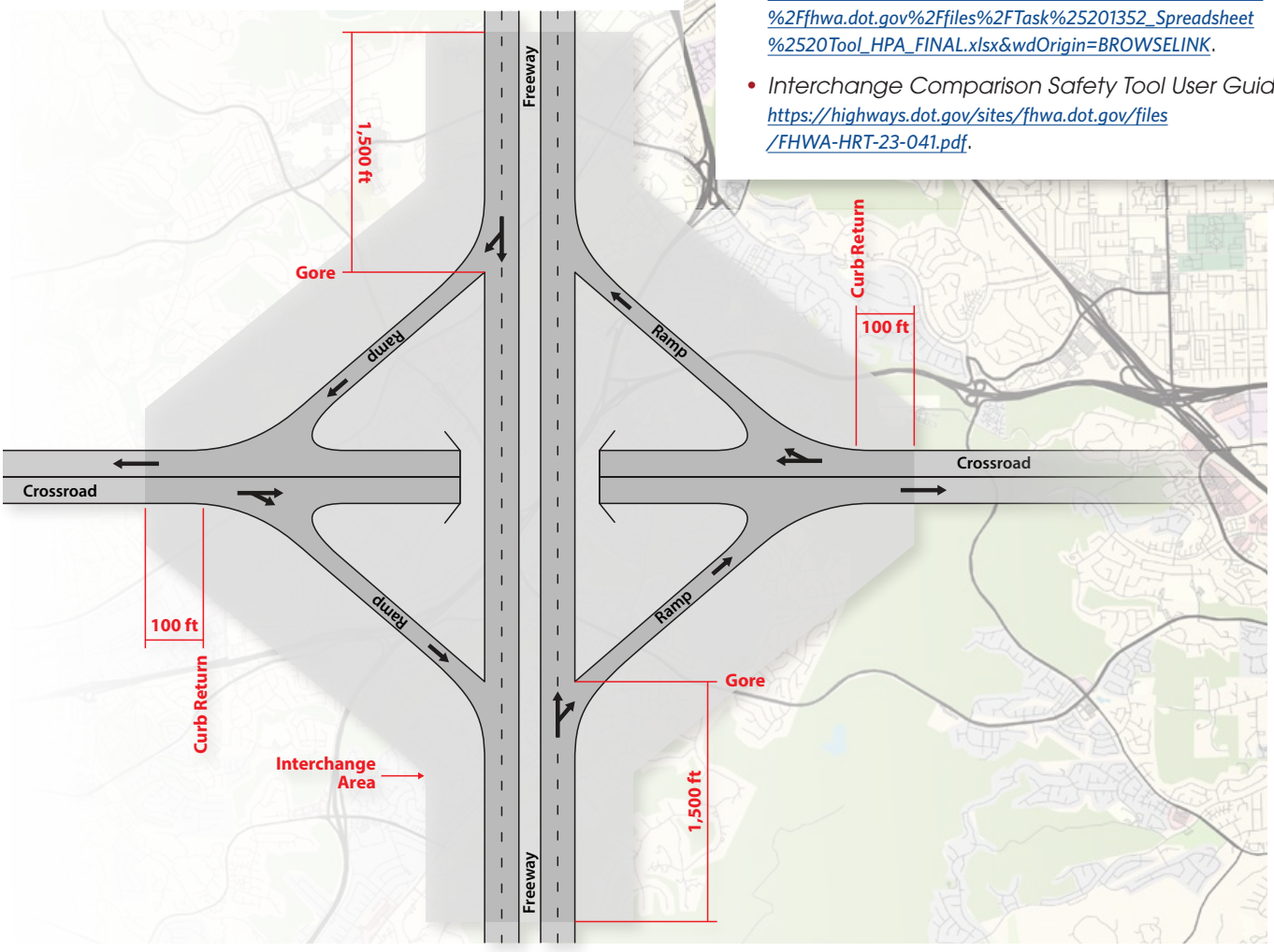
In addition to traffic volumes, this tool includes crash frequency adjustment factors (like the HSM predictive method) for planning-level geometric and operational considerations, including:

- The number of through lanes on the freeway and crossroad.
- The interchange location (within an urban, suburban, or rural area).
- Closely spaced adjacent interchanges on the freeway mainline.
- The presence of one or more managed lanes on the freeway mainline.
- Skew between the freeway mainline and crossroad.
- The number of left-turn lanes present on the crossroad.
- Consistency in traffic volumes among interchange ramps.

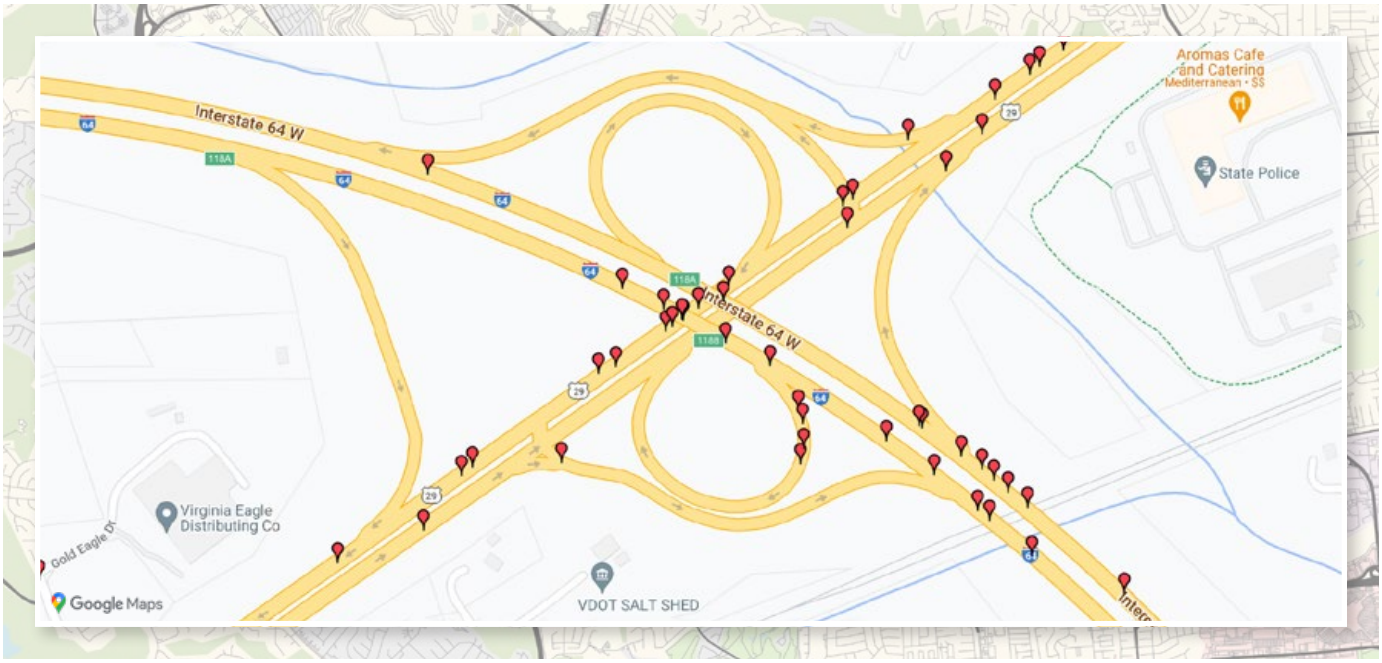
Where to Find the Tool

The Interchange Configuration Safety Comparison Tool includes the 2023 final report, companion implementation tool, and user guide:

- *Safety Comparisons Between Interchange Types* (final report): https://highways.dot.gov/sites/fhwa.dot.gov/files/FHWA-HRT-23-049.pdf.
- FHWA Interchange Configuration Safety Comparison Tool spreadsheet (companion implementation tool): https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fhighways.dot.gov%2Fsites%2Ffhwa.dot.gov%2Ffiles%2FTask%25201352_Spreadsheet%2520Tool_HPA_FINAL.xlsx&wdOrigin=BROWSELINK.
- *Interchange Comparison Safety Tool User Guide*: https://highways.dot.gov/sites/fhwa.dot.gov/files/FHWA-HRT-23-041.pdf.



Interchange area definition. *Source: FHWA.*



Example of applicable crashes mapped to interchange area.

Original map © Google Maps. Modifications made by FHWA.

Additionally, this tool includes adjustment factors for planning-level geometric and operational characteristics that will impact injury severity, given that a crash has occurred. Considerations impacting crash severity include:

- Traffic volume on the freeway mainline or crossroad.
- Closely spaced adjacent interchanges on the freeway mainline.
- An adjacent intersection in close proximity to the ramp terminal on the crossroad.
- The posted speed limit on the freeway mainline or crossroad.
- The number of through lanes on the freeway mainline or crossroad.
- The number of pedestrian crossings conflicting with right turns at ramp terminals.

These inputs—both for crash frequency and severity—provide analysts the flexibility to understand the impacts of geometric design decisions on interchange-level safety without needing detailed design information for each freeway mainline, ramps, and ramp terminals. Further, these planning-level models incorporate the interactions among interchange elements by considering features together rather than independently.

How to Apply the Predictive Model

The FHWA research team developed an implementation spreadsheet based on the predictive model. The implementation spreadsheet allows users to enter data for any or all applicable interchange configurations for simultaneous analysis. Users can enter the exact data for each alternative or enter specific features as needed.

The implementation spreadsheet provides the predicted property damage only, fatal and injury, total crash frequency, and a 95 percent confidence interval for each interchange configuration entered. Additionally, the implementation spreadsheet provides a graphic representation of the outputs for visual analysis. As a companion document, the *Interchange Comparison Safety Tool User Guide* gives practitioners details on input data requirements and examples of data elements required for applying the predictive model.

Further, analysts can use the implementation spreadsheet to compare the predicted safety performance for alternative interchange configurations, focusing on the planning-level inputs required to use the model. In addition to configuration, analysts can evaluate the impacts of interchange spacing, proximity to adjacent intersections, number of through lanes on the freeway or crossroad, presence of managed lanes, posted speed limits, and number of right turns conflicting with pedestrian crossing movements. The results of the analyses can be used along with other considerations—ones typically considered in a particular region but not explicitly considered in the tool—to evaluate alternatives early in the planning and conceptual design phases as well as provide supporting documentation for decisions made. This tool can be used directly to support interchange access proposals or to support decisionmaking on other freeway interchange projects, on or off the Interstate System.

What's Next

The development of the Interchange Configuration Safety Comparison Tool bridged a gap, attempting to strike a balance between the need to assess the safety implications of design-level details and those details that are generally known during project concepts and preliminary engineering. Further, this tool focused on considering the interactions between individual project elements, rather than using a building-block approach; however, the safety effects of some interchange components (e.g., ramp terminal control) were difficult to isolate.

This new tool focused on the service interchange configurations most considered in access modification requests and cannot be applied to unique interchange configurations or system interchanges. Future efforts should build on the foundations of this tool to incorporate more locations (to support identifying the safety effects of ramp terminal configuration and traffic control) and to incorporate more interchange configurations considered by agencies as viable alternatives during project planning.

Service interchanges are facilities primarily designed to facilitate vehicular traffic movements, and this tool is developed based on this reality. Although design elements

User Input

Input Characteristic	Diamond/ Compressed	Roundabout Diamond	DDI	Parclo B, AB	Parclo A	SPDI	TDI
Urban area type *(1 = yes, 0 = no)*	0	0	0	0	0	0	0
Intersection skew angle >30 degrees *(1 = yes, 0 = no)*	0	0	0	0	0	0	0
Nearest interchange gore distance within 0.5 mi *(1 = yes, 0 = no)*	0	0	0	0	0	0	0
Managed lanes on freeway *(1 = yes, 0 = no)*	0	0	0	0	0	0	0
Freeway AADT *(value in vehicles/day)*	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Freeway no. of through lanes (bidirectional total) *(no.)*	4	4	4	4	4	4	4
XR AADT *(value in vehicles/day)*	5,000	5,000	5,000	5,000	5,000	5,000	5,000
XR no. of through lanes (bidirectional total) *(no.)*	4	4	4	4	4	4	4
Total ramp AADT *(value in vehicles/day)*	20,000	20,000	20,000	20,000	20,000	20,000	20,000
COV of ramp volumes (see below) *(decimal #; calculation)*	0	0	0	0	0	0	0
Number of LT lanes on the XR at intersections *(no.)*	0	0	0	0	0	0	0

NOTE: Changes to the table above will be reflected on the KABC worksheet.

This is the base condition. Analysts must fill out the entire column even if this interchange type is not under consideration.

Coefficient of Variation (COV) of Ramp Calculation Tool

Ramp 1 AADT =	500			
Ramp 2 AADT =	500	Std. Deviation	0.00	
Ramp 3 AADT =	500	Mean	500	NOTE: range of acceptable COV values is 0 to 1.15.
Ramp 4 AADT =	500	COV	0.00	*Use this value for COV inputs in table*
Ramp 5 AADT =				
Ramp 6 AADT =				

NOTE: leave input cells blank for any ramps not included in analysis.

Model Output (Do Not Edit)

Predicted Crash Frequency	Diamond/ Compressed	Roundabout Diamond	DDI	Parclo B, AB	Parclo A	SPDI	TDI
95 percent CI LB *(crashes/year)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Expected PDO crash frequency *(crashes/year)*	19.74	15.52	15.74	20.95	17.11	16.38	17.17
95 percent CI UB *(crashes/year)*	41.28	32.83	33.27	43.71	36.02	34.55	36.14
95 percent CI LB *(crashes/year)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Expected KABC crash frequency (from KABC sheet) *(crashes/year)*	6.47	4.95	5.96	7.58	7.12	4.77	3.98
95 percent CI UB *(crashes/year)*	14.46	11.42	13.43	16.67	15.75	11.05	9.47
95 percent CI LB *(crashes/year)*	3.23	1.99	2.63	4.02	3.44	1.91	1.41
Expected total crash frequency (KABC + PDO) *(crashes/year)*	26.21	20.47	21.69	28.53	24.23	21.14	21.15
95 percent CI UB *(crashes/year)*	49.18	38.95	40.75	53.04	45.02	40.37	40.90

can be implemented at such facilities to better integrate non-motorized traffic, the design thresholds, such as roadway grades, curvatures, and design sight-distances, already adopted for decades at such facilities, imply that there are limits of what can be done to accommodate non-motorized users. At high vehicular traffic facilities like service interchanges, it is better to completely separate non-motorized traffic from motorized traffic using micro tunnels, separated bridge decks, or light-weight overpasses as conduits for moving non-motorized users.

There are two ways of providing better access and safety to non-motorized road users:

1. Mandate safe and equal access for all modes of users at all types of roadway facilities, and
2. Provide safe and equal access for all modes of users at low to moderate speed facilities but plan and design separate facilities for non-motorized users in a way to minimize direct connection with high-speed facilities.

The latter approach requires less change to the current roadway design standard and can also deliver network-wide connectivity to all modes of road users.

Currently, the concepts of Complete Streets, Safe System approach, or safe roads for all users (different ways of providing better safety for non-motorized road users) are getting more attention from top-level decisionmakers. As the Vision Zero policy gets implemented broadly and into real projects, facilities for non-motorized road users will be systemically planned, designed, and built out, and the mix between motorized and non-motorized traffic will gradually shift to a new (more stable and livable) balance. As a result, traffic crashes will also change to new patterns with stable outcomes for all modes of road users. During the transition period, the safe performance prediction models for different types of facilities should be updated periodically to reflect the new paradigm.

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For more information, visit: *https://highways.dot.gov/research/publications/safety/FHWA-Interchange-Safety-Comparison-Tool*, or contact Wei Zhang, (202)493-3317, *wei.zhang@dot.gov*.

ABOVE: Interchange Configuration Safety Analysis Tool inputs and outputs. *Source: FHWA.*

Alternative Uses of the Right-of-Way

With innovation comes an increased interest in accommodating alternative uses in the highway ROW.

by **LINDSEY S. SVENDSEN** and **MAGGIE DUNCAN-AUGUSTT**

Sometimes real property interests must be acquired to construct a transportation project. This property is generally referred to as the right-of-way (ROW), or real property interests. Real property, or real property interest, is any interest in land and any improvements on the land, such as temporary and permanent easements, air or access rights, and other contractual rights to acquire or preserve the ROW for a transportation facility. Government agencies that acquire real property for Federal-aid highway projects are required to manage the acquired property after the project is completed.

Part of this responsibility includes inventorying their existing Federal-aid ROW. If ROW is no longer needed for the operation or maintenance of a project, or needed for a foreseeable future project use, an agency may determine that there is excess real property outside the final developed ROW that may be disposed of or made available for an alternative use. The ROW is intended for highway purposes (e.g., construction, operations, maintenance, and safety), and the temporary or permanent occupancy or use of ROW, including air space, for nonhighway purposes may only be approved if such occupancy, use, or reservation is in the public interest and will not impair the highway or interfere with the free and safe flow of

ROW are maintained by transportation facilities after the road project is completed. *© EdVal / AdobeStock.com.*

traffic thereon. Individual State departments of transportation (DOTs) are responsible for their State's ROW use, which, in certain circumstances, also needs Federal Highway Administration approval. These circumstances include, but are not limited to, nonhighway or alternative uses of the interstate ROW and requests for approval of less than fair market value determinations. State DOTs are responsible, by Federal regulation, for maintaining the acquired ROW and for clearing away any unauthorized uses (encroachments) that may interfere with the safety of motorists. The 23 Code of Federal Regulations (CFR) § 1.23, "Rights-of-way," states, "all real property acquired for highway purposes within the boundaries of a federally-assisted highway project shall be devoted exclusively to public highway purposes."

In certain situations, ROWs may be used for alternative, nonhighway purposes. Alternative use of the ROW must be in the public interest and cannot interfere with the free and safe flow of traffic. Private and public entities (e.g., State DOTs, local highway departments, and municipalities), due to a variety of factors, including availability and proximity to resources, have always been interested in available ROW for alternative uses. This interest has increased in recent years as State DOTs look for new ways to generate revenue and funds that can be used for Title 23 activities.

To provide clarification on ROW usage, FHWA released a memo in April 2021 titled "State DOTs Leveraging Alternative Uses of the Highway Right-of-Way Guidance." Nic Thornton, director of FHWA's Office of Real Estate Services, noted that the memo was intended to "provide information to the States as owners of the ROW, ensure the consistent application of the regulations across the country,

and describe where flexibilities exist within the current regulatory framework to support the safe accommodation of certain alternative uses." The memo discusses ROW's use in supporting renewable energy and developing technologies, such as solar panels, electric vehicle charging stations, and wind turbines. Transportation is one of the largest contributors to greenhouse gas emissions, and renewable energy and developing technologies can aid in their reduction by providing electricity and power without burning any fuel or polluting the air. ROW can play a part in generating renewable energy for State DOTs and local agencies for the potential of lowering their bills—as some States have Power Purchase agreements that provide discounts on their energy bills—and, at the same time, create clean energy and/or reduce greenhouse gas emissions.

ABOVE: ROW can be used for renewable energy facilities like solar panels, wind turbines, and electric power lines.
© Janne / AdobeStock.com.

LEFT: ROW can be used for alternative, nonhighway purposes such as fueling facilities.
© Sepla100 / AdobeStock.com.

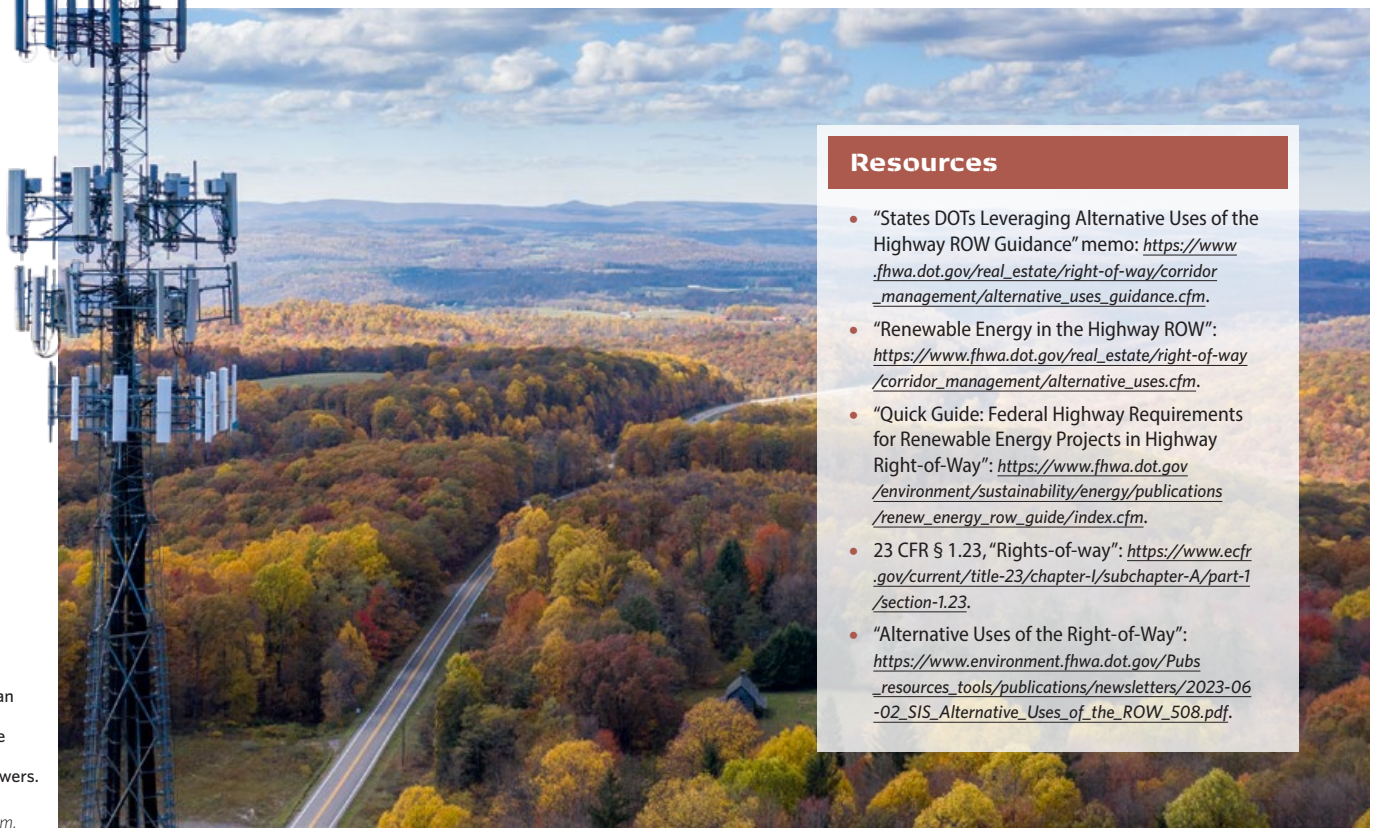
Guidance Summary

The April 2021 memo guidance encourages collaboration between FHWA and State DOTs to keep their Utility Accommodation Policies (UAPs) updated and to develop practices that further broadband deployment initiatives. State DOTs work with their respective FHWA Division Offices on the adequacy of their UAPs and procedures. States must decide if they want utilities on highway right-of-way, including freeways, and if so to what extent and under what conditions. Whatever they decide must be documented in an FHWA-approved utility accommodation policy. For States that regulate broadband as a utility, the UAP authorizes the State DOT to comply within the UAP confines. This compliance allows for a streamlined approach for broadband deployment. The guidance also explains the process for addressing renewable energy, alternative fueling, electrical transmission and distribution, and broadband projects and introduces clean energy and connectivity (CEC) projects. CEC is an umbrella term meant to capture all of the various uses mentioned in the memo.

There are several key takeaways from the guidance, such as State DOTs are encouraged to address projects through utility accommodation, if possible. Meaning, if the State law considers things like renewable energy, alternative fueling facilities, or broadband to be utilities, then the ROW use can be accommodated as a utility, but if the State law does not consider them to be utilities, then the State may accommodate them as an alternative use of the ROW under the Federal regulation. The guidance also explains that even if the UAP does not include a certain activity as a utility, if the State law says a particular use is a utility, then it can be accommodated as a utility. The regulation, 23 CFR 645.209(m), states, "In determining whether a proposed installation is a utility or not, the most important consideration is how the [State transportation department] views it under its own State laws and/or regulations." "Every State has different State laws and its own UAP, so it's important to familiarize yourself with the content of both if you're looking to pursue an alternative use or accommodation as a utility," says Thornton. An example of this can be found in Arizona where the Arizona DOT worked with the Arizona FHWA Division Office by providing a determination letter for the consideration of broadband as a utility while also working to make legislative changes for broadband accommodation.

The guidance also served as a reminder to States that fees charged for utility accommodation are at the discretion of the State, that each State should have a process for approving their State UAP, and that projects accommodated as a utility facility on the interstate ROW serving the public are not a prohibited commercial activity under 23 U.S. Code (U.S.C.) 111, unless the project also qualifies as an automotive service station or other commercial establishment under 23 U.S.C. 111. For example, while electric vehicle charging stations may be considered a utility, they also qualify as an automotive service station under 23 U.S.C. 111, so they may be installed in the interstate ROW, but fees may not be charged for their use.

The memo guidance made specific determinations in a few areas. For instance, FHWA determined that CEC projects and broadband are in the public interest and considers CEC projects to be acceptable alternative uses if they comply with



State DOTs can use ROW to accommodate utilities like broadband towers.
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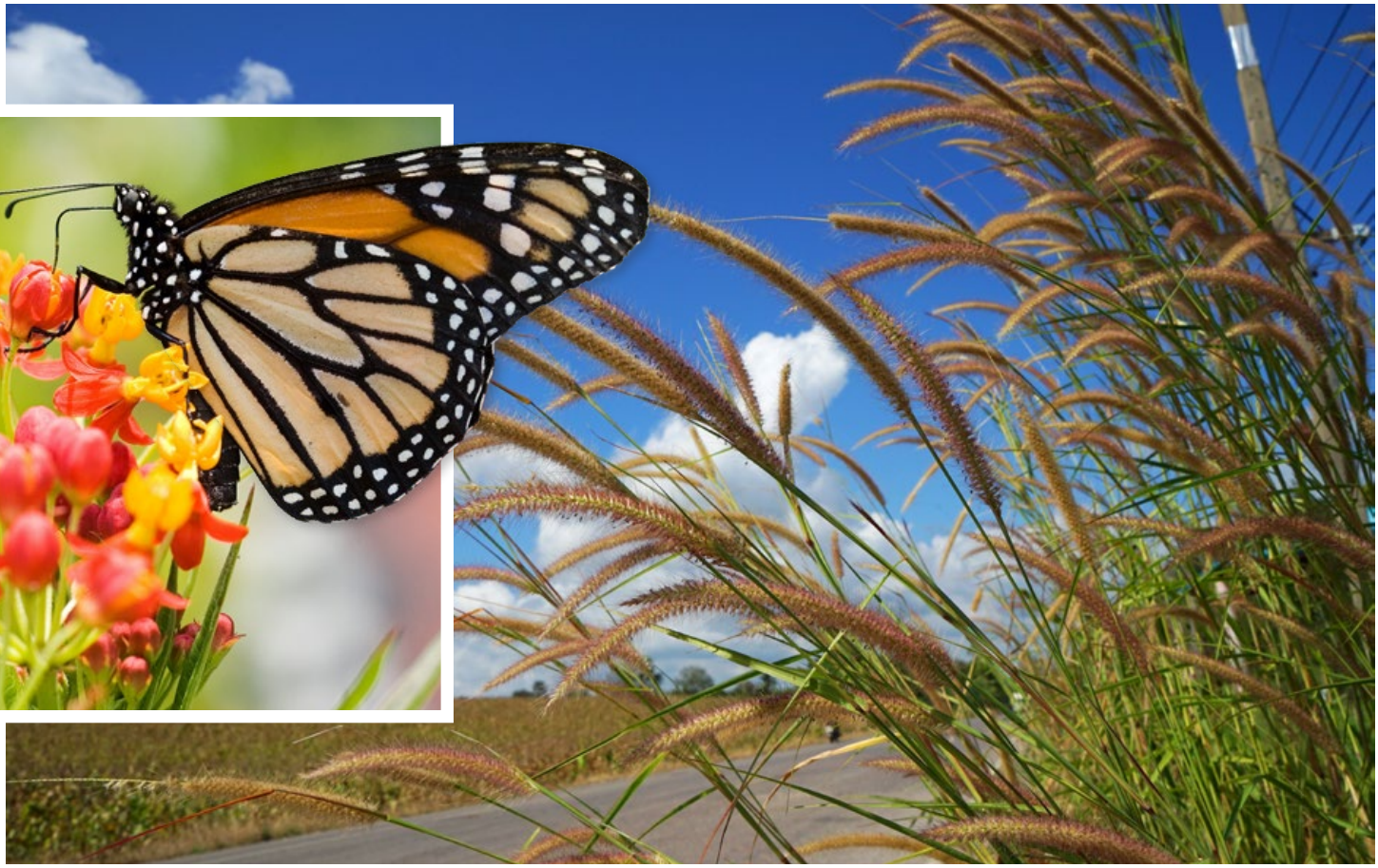
Resources

- "States DOTs Leveraging Alternative Uses of the Highway ROW Guidance" memo: *https://www.fhwa.dot.gov/real_estate/right-of-way/corridor_management/alternative_uses_guidance.cfm*.
- "Renewable Energy in the Highway ROW": *https://www.fhwa.dot.gov/real_estate/right-of-way/corridor_management/alternative_uses.cfm*.
- "Quick Guide: Federal Highway Requirements for Renewable Energy Projects in Highway Right-of-Way": *https://www.fhwa.dot.gov/environment/sustainability/energy/publications/renew_energy_row_guide/index.cfm*.
- 23 CFR § 1.23, "Rights-of-way": *https://www.ecfr.gov/current/title-23/chapter-I/subchapter-A/part-1/section-1.23*.
- "Alternative Uses of the Right-of-Way": *https://www.environment.fhwa.dot.gov/Pubs_resources_tools/publications/newsletters/2023-06-02_SIS_Alternative_Uses_of_the_ROW_508.pdf*.



relevant regulations and statutes. As stated in a separate part of the memo, FHWA determined that CEC projects qualify for an exception to charging fair market value because "CEC projects provide an opportunity to reduce carbon emissions and are an important tool to address climate change. FHWA has also determined that broadband installation can assist with equitable communications access [to underserved communities and rural areas]. These nonhighway alternative uses of highway ROW are in the public interest."

The other two topics covered by the April 2021 guidance memo include encouragement for States to consider approving ROW use for alternative fuel facilities near travel centers and to employ carbon sequestration practices on their ROW. Carbon sequestration is the process of removing carbon dioxide from the atmosphere. Certain actions can aid in the carbon removal process, such as vegetation management practices, which can affect the amount of carbon taken from the atmosphere. Increasing mowing heights and planting native grasses can increase the amount of carbon absorbed from the atmosphere. These practices are consistent with maintenance and safety considerations and may be carried out by agreements for an alternative use of the ROW. All States must follow the National Environmental Policy Act (NEPA) guidelines for all alternative uses of ROW, including projects such as carbon sequestration.

FHWA also encourages State DOTs to use ROW to develop habitat and forage for Monarch butterflies and other native pollinators. Tennessee DOT, for example, implemented Project Milkweed, which aims to restore and preserve the habitats of pollinating species like the Monarch butterfly by encouraging Tennesseans to plant milkweed (see the blurb in "Along the Road" in this issue of *Public Roads*).

Guidance Impact

As a result of this guidance, FHWA has seen the most interest in projects related to the memo for broadband use. The goal of the guidance is to provide State DOTs and other public agencies consistent information that will allow them to leverage their ROW, support developing technologies, and support and encourage renewable energy development. Supporting the uses described in the guidance can help reduce greenhouse gas, promote energy security by diversifying energy generation and delivery methods, foster the creation of a local green job market that enhances the viability of the Nation's renewable energy industry, and reduce or eliminate ongoing maintenance expenses for State DOTs.

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Disclaimer: Except for any statutes or regulations cited, the contents of this article do not have the force and effect of law and are not meant to bind the public in any way. This article is intended only to provide information to the public regarding existing requirements under the law or agency policies.

For more information, see *https://www.fhwa.dot.gov/real_estate/* or contact Lindsey Svendsen, 202-366-2035, *Lindsey.S.Svendsen@dot.gov*, or Maggie Duncan-Augustt, 202-366-9901, *Maggie.Duncan-Augustt@dot.gov*.

ABOVE: Native grasses planted in ROW absorb carbon from the atmosphere.
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ABOVE LEFT: ROW can provide habitats for Monarch butterflies.
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The New

Major rehabilitation will help preserve the road's natural scenery and connect metropolitan areas more safely.

Construction on the G.W. Parkway is scheduled for completion in late 2025.
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by **EDUARDO ARISPE**

In April 2023, commuters on the George Washington Memorial Parkway (GWMP)—also known as the G.W. Parkway—might have wondered what the construction was about. During that time—in the Washington, D.C., metropolitan area—the National Park Service (NPS) began implementing changes and slowing traffic on the northern portion of the parkway. NPS and the Federal Highway Administration have collaborated since 1926 through interagency agreements and now through the Federal Lands Transportation Program to provide road design and construction assistance. The NPS Federal Lands Transportation Program uses transportation industry standards and performance-based, data-driven decisions to maintain and modernize its transportation system.

Part of this construction project, scheduled for completion in late 2025, is sponsored by NPS along with FHWA's Eastern Federal Lands Highway Division (EFLHD), with the aid of the Turner-Fairbank Highway Research Center's

ABOVE: The existing GWMP masonry stone-faced barrier. *Source: FHWA.*

Office of Safety and Operations Research and Development, and the Federal Outdoor Impact Laboratory. The goal is to improve the safety performance of the parkway's park road and roadside hardware without sacrificing its aesthetic effect.

"It is vital for us and our NPS partners to preserve the historic look and feel of the parkway while implementing safety measures that will protect the traveling public now and for years to come," says Monique Evans, director of EFLHD. "The safety provisions used on the GWMP project are an example of balancing these very important priorities."

Missions and Visions

The NPS missions for the park road include:

- Providing access to scenic or historic areas in a manner that complements its environment by preserving the natural or scenic character of its roads.
- Accommodating larger volumes of traffic at higher speeds than conceived when it opened in 1962, as many NPS roads have become important links in growing metropolitan areas.
- Meeting safety and aesthetic goals through enhanced designs for roadside safety hardware.

To achieve these missions, traffic barriers—beyond those commonly used on most public roads (e.g., the standard galvanized steel W-beam or concrete safety shape barrier)—are required. Park roads use aesthetic barriers such as stone-faced walls and steel-backed timber guardrails. Aesthetic barriers, however, have not all been developed or tested to the latest industry crash testing guidelines of the American Association of State Highway and Transportation Officials *Manual for Assessing Safety Hardware* (MASH). GWMP's construction project offers the opportunity to ensure these types of aesthetic barriers, widely used on roads under the jurisdiction of NPS, meet the MASH industry crash test criteria. MASH is an industry standard and not required by Federal law.

The mission of FHWA is to deliver a world-class system that advances safe, efficient, equitable, and sustainable mobility choices for all while strengthening the Nation's economy. Safety is the cumulative result of efforts in many different sectors, with roadside safety hardware representing a key aspect. Roadside safety hardware is part of the highway infrastructure that functions to reduce run-off-the-road crash severity and includes signs, guardrails, and other types of safety devices. For example, traffic barriers play a key role by containing and redirecting vehicles, keeping vehicles from leaving the traveled way, and preventing vehicles from encroaching on objects on the roadside. With NPS's aesthetic objective and mission to provide access in a manner that preserves the natural or scenic character of its roads, standard traffic barriers may be inconsistent for projects like GWMP. "FHWA has and continues to promote standards for designing, deploying, operating, and maintaining the many roadside safety hardware elements," says Brian Cronin, program director of the U.S. Department of Transportation's Intelligent Transportation Systems Joint

Program Office. "The George Washington Memorial Parkway project is an excellent example of transportation agency partners working together to create safer, more resilient roadway systems."

Designing Roadside Hardware Through the Use of Crash Simulation

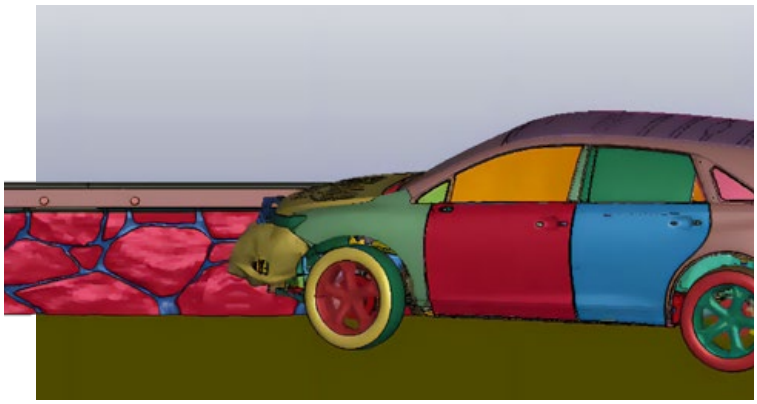
Over time, State and Federal transportation agencies have identified effective alternatives to traditional traffic barriers and developed both safety standards and protocols to assess them. The means to evaluate these alternatives, physically and analytically, have also evolved significantly. The process used in this project involves the development and use of finite-element (FE) computer models of vehicles and barriers to simulate the impacts of a vehicle with the barrier. Computer crash simulation—a numerical technique for solving mathematical problems that represent a destructive crash test of a car or a barrier system—analyzes the response of both the vehicle and barrier when an impact occurs and investigates factors such as stresses, deformations, fractures, and other effects on each part of the vehicle and barrier resulting from the impact. These analyses subdivide each part into smaller sections called elements, which might best be thought of as many small cubes characterizing the item. The impact forces are distributed across all the cubes, and the forces are distributed by the properties of each cube and those adjacent to it. These simulations have been shown to be extremely accurate representations of the effects of a collision. For the GWMP project, following proper research and simulation techniques ensures roadside hardware design practices are used to develop, upgrade, or modify its barrier systems.

Crash simulation and modeling have evolved and proven to be a powerful means to analyze safety issues and develop new and improved highway barriers and other roadside hardware concepts, which can lead to MASH-compliant roadside hardware, confirmed by crash testing. FHWA believes its initiatives to develop the fundamental tools necessary for roadside hardware crash simulations have led to safer roads. The initiative includes the development of detailed FE models of vehicles and barriers, as well as funding efforts to use FE tools to address emerging safety issues from changes in the vehicle fleet (such as higher weights and physical dimensions) to changes in safety hardware. Considerable knowledge is gained from crash simulation in a faster time, and at a lower cost, providing a sound basis for enhancing the safety performance of vehicles and roadside hardware.

The Impact of Crash Simulation on GWMP

Crash simulation technology was developed more than 40 years ago and has often become the first aspect in efforts to design and analyze the safety of new barrier concepts. Validations of the process over the years have shown a high degree of reliability in tracing crash effects as well as replicating the overall result by comparing them to full-scale crash testing.

ABOVE: Roadside safety hardware, like steel-backed timber guardrail, functions to reduce crash severity.
Source: FHWA.



TOP: A stone-faced barrier from simulations (left) and test (right). *Source: FHWA.*

Simulation rapidly allows designs to be varied, and a range of impact angles, speeds, barrier designs, and vehicles to be considered. Crash simulation helps transportation researchers and designers to revisit older roadside hardware designs, such as the ones used by NPS, and update them to meet the new industry crash test guidelines.

The computer simulation analyses performed in the GWMP project started with the original designs of these safety hardware systems, which were then modified and reanalyzed as needed to predict whether the final design would meet the appropriate MASH crash test level requirement. Roadside hardware is designed and examined for different test levels according to the road on which it will be generally used. For example, a Test Level 3 (TL-3) design would typically be used on a high-speed or high-volume roadway or both, such as a freeway. In the GWMP effort, once simulations were completed, full-scale MASH crash tests of each design proposed for use on the GWMP were conducted using a pickup truck and a small car, as indicated by the MASH industry crash test criteria. These final tests confirmed that the developed designs meet all MASH criteria for TL-3 crash tests.

EDUARDO ARISPE, as a member of the Roadway Safety Team within FHWA's Office of Safety and Operations Research and Development, works on finite element modeling and crash testing of roadside hardware to improve safety. He earned an M.S. degree in transportation safety engineering from The George Washington University and a B.S. in chemical engineering with a specialization in systems and controls from the University of Maryland.

For more information, see *https://highways.dot.gov/research/laboratories/federal-outdoor-impact-laboratory/federal-outdoor-impact-laboratory-overview*, or contact Eduardo Arispe, 202-493-3291, *eduardo.arispe@dot.gov*.

ABOVE: A vehicle right before it collides into a stone-faced barrier in a simulated version (left) as well as in a live test (right). *Source: FHWA.*

RIGHT: Crash simulations have played an increasing role in the analysis of highway crashes and roadside hardware effectiveness. *Source: FHWA.*

SCRC

SMART COMMUNITY RESOURCE CENTER

Source: USDOT.

The Smart Community Resource Center

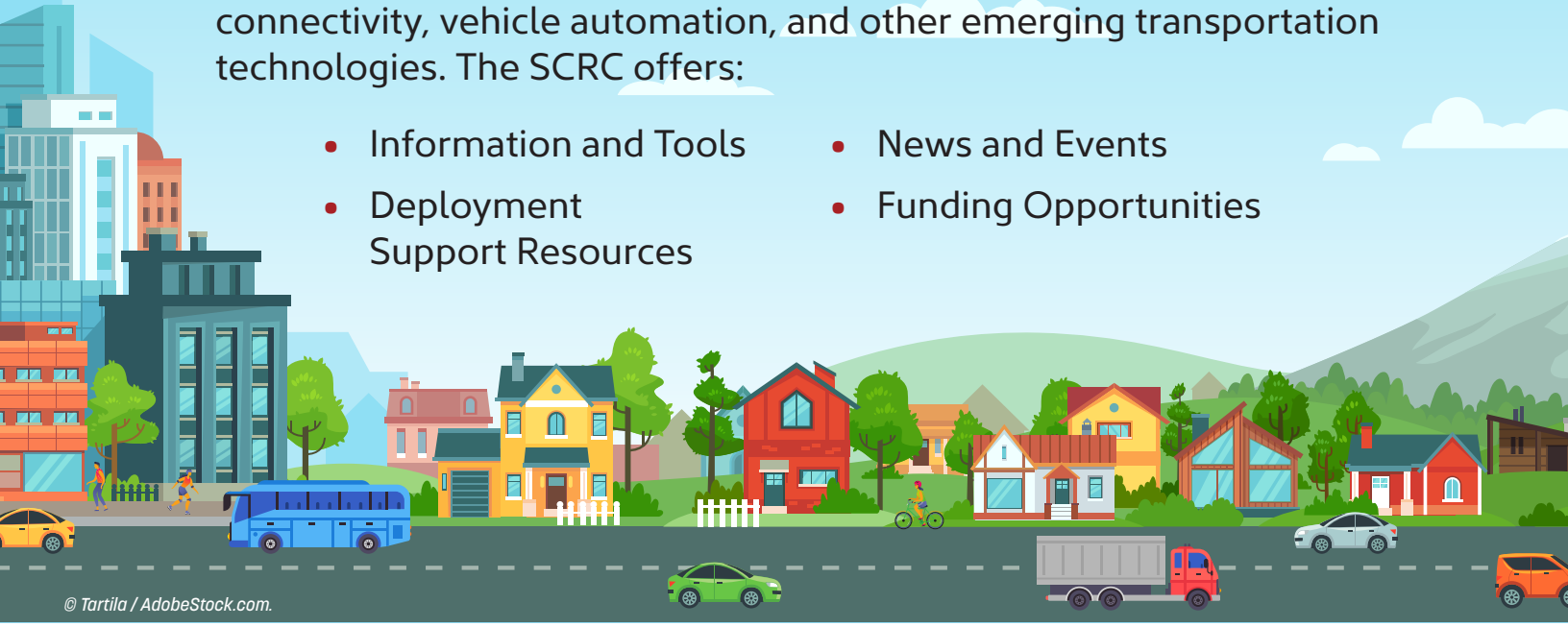
What You Need When You Need It

USDOT IS MAKING RESOURCES READILY AVAILABLE TO ITS DEPLOYERS.

Created by the U.S. Department of Transportation's Intelligent Transportation Systems (ITS) Joint Program Office (JPO), the Smart Community Resource Center (SCRC) helps connect States, Tribal governments, and local communities with the knowledge and expertise they need to advance their ITS and smart community transportation projects and programs.

The SCRC includes USDOT resources related to interoperable connectivity, vehicle automation, and other emerging transportation technologies. The SCRC offers:

- Information and Tools
- Deployment Support Resources
- News and Events
- Funding Opportunities



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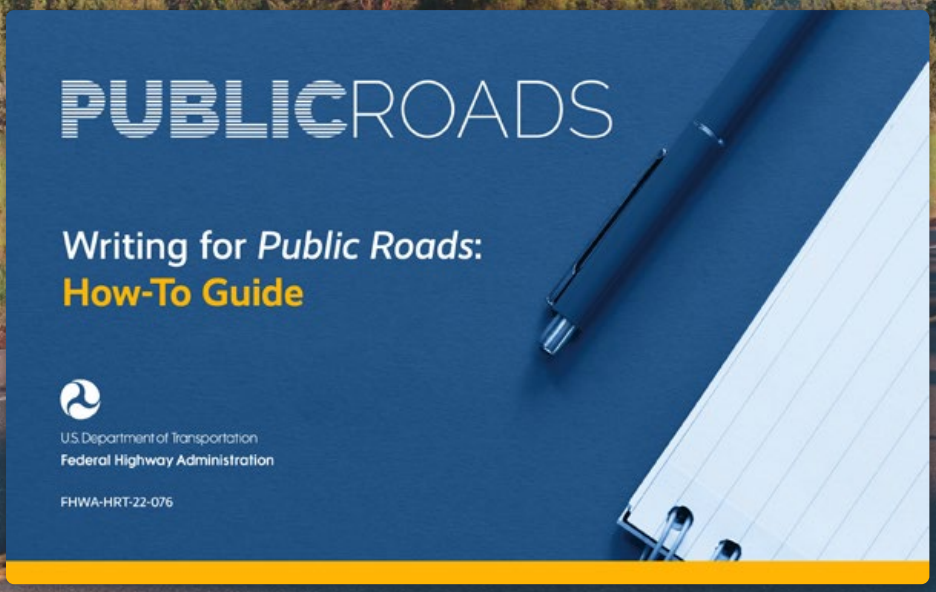


SPEED SAFETY CAMERAS

Steering clear of potholes during adoption, planning, design, and operation.

by **JEFFREY KING**, **ABDUL ZINEDDIN**, **EMILY THOMAS**, and **KEITH WILLIAMS**

A crash is defined as speeding-related if the investigating officer indicates the driver involved in the crash was driving greater than the posted speed limit, driving too fast for conditions, or racing. Speeding can contribute to both the severity and frequency of motor vehicle crashes and has been a leading contributing factor in fatal and serious injury crashes for several decades in the United States—and continues to be a growing problem. This problem is especially grievous when vulnerable road users (VRUs), such as pedestrians and bicyclists, are involved.

While much can be done to address speeding through non-enforcement strategies, speed enforcement as a traffic safety countermeasure has been proven effective when deployed appropriately. Traditionally, speed enforcement has been conducted by law enforcement officers, through roadside traffic stops. However, with the increased focus on social justice involving traffic stops and a growing shortage of traditional law enforcement resources, traffic safety practitioners are increasingly looking to automated solutions, such as speed safety cameras (SSCs). SSCs are one of the 28 Federal Highway Administration's Proven Safety Countermeasures and is identified as a five-star countermeasure that works by the National Highway Traffic Safety Administration (NHTSA). In January 2023, to assist practitioners considering the use of SSCs, FHWA and NHTSA jointly published the *Speed Safety Camera Program Planning and Operations Guide* (Guide).

Why is Speeding a Concern?

In 2021, 42,939 fatalities occurred on the Nation's roadways, of which 12,330 were speeding related—a 7.9 percent-increase in speeding-related crashes over 2020. That increase followed a 17 percent increase in speeding-related crashes from 9,592 in 2019 to 11,258 in 2020. Speeding has played a role in more than a quarter of traffic deaths, killing nearly 100,000 people over the past decade.

Speeding can be dangerous on all types of roads, but particularly on non-interstate rural and urban roadways. In 2021, 35 percent of speed-related fatalities occurred on non-interstate rural roadways, 52 percent on non-interstate urban roadways, 9 percent on interstate urban roadways, and 5 percent on interstate rural roadways.

Drivers speed for a variety of reasons. A 2019 telephone survey conducted by the American Automobile Association (widely known as AAA) Foundation for Traffic Safety revealed that nearly half of drivers said they had exceeded the speed limit on a freeway by at least 15 miles per hour (mph, 24 kilometers per hour (kph)) in the past month; over 40 percent of drivers reported exceeding the speed limit by at least 10 mph (16 kph) on residential streets. Of those surveyed, only 55 percent perceived speeding 15 mph (24 kph) over the speed limit on freeways as extremely or very dangerous. Additionally, 63.5 percent of respondents perceived speeding 10 mph (16 kph) over the speed limit on residential streets as extremely

ABOVE: Over the past two decades, speeding has been a contributing factor in nearly 30 percent of all motor vehicle crashes.

or very dangerous. In contrast, 92 percent indicated that in general, switching lanes or following too closely was extremely or very dangerous.

Speeding behavior can be categorized as intentional or unintentional. When speeding behavior results from an intentional decision, the behavior is often rationalized based on perceptions of peer behavior, time-saving convenience, or an unrealistic perception of driving ability. Speeding can also be unintentional and influenced by prevailing traffic conditions and cues from the built environment.

Filling the Compliance Gap

In an ideal transportation environment, compliance with speed limits and adapting to changing roadway conditions would occur voluntarily based on a driver's perception and understanding of the risks involved. However, that is not always the case as drivers may choose to accept the risks of speeding based on their personal beliefs and driving abilities. Other drivers may not realize they are speeding due to distraction or inattention, and some may not consider the risks and abilities of those with whom they are sharing the road. "Safety is our top priority at the U.S. Department of Transportation, and we know that safer roads and safer speeds have a significant impact on reducing fatalities and serious injuries on our Nation's roadways, especially for children in school zones, roadway construction workers, and other vulnerable road users who are outside vehicles," says Federal Highway Administrator Shailen Bhatt. "Speed safety cameras are a proven safety countermeasure supported by FHWA that have shown significant benefits in reducing crashes and improving safety on our roads." Failure to recognize the risk to themselves or the presence and risks to others, including VRUs, requires intervention to mitigate those risks and improve safety for all road users.

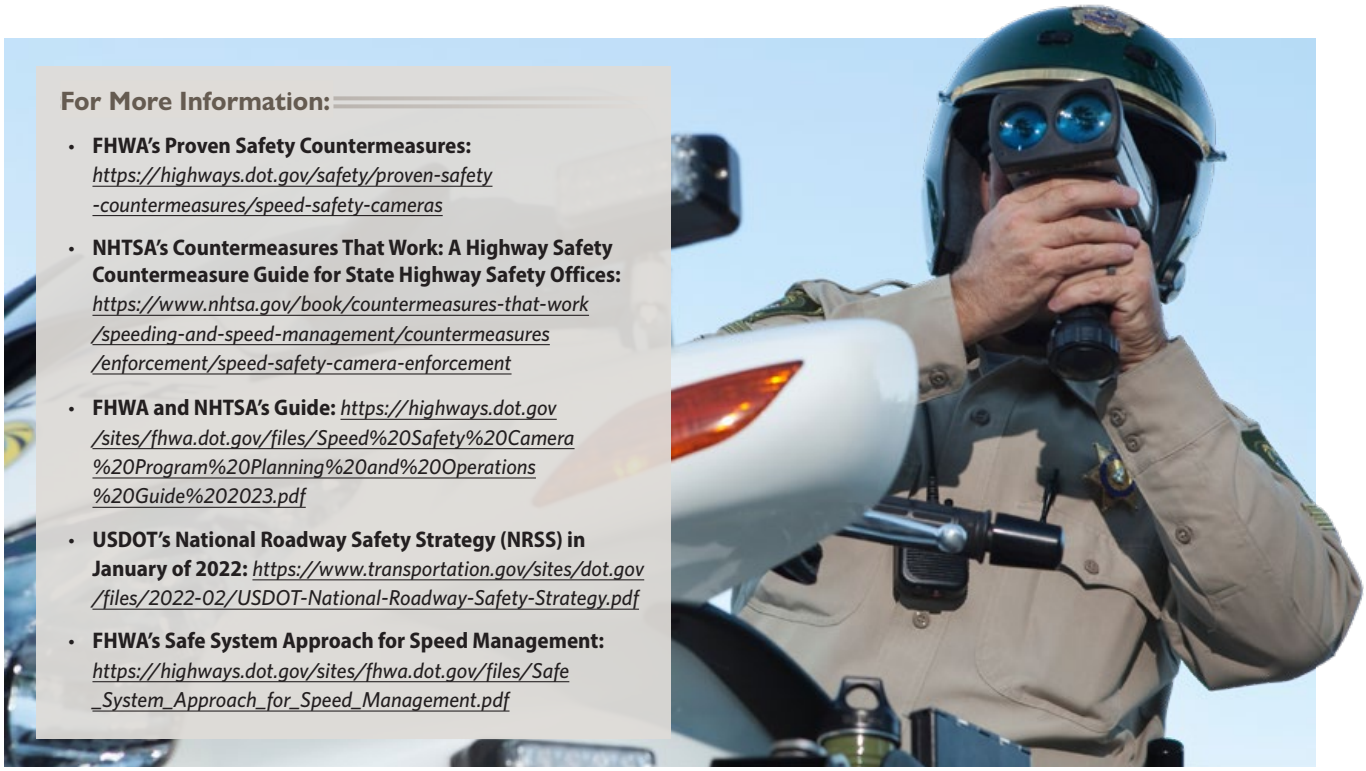
To address this gap in compliance, traffic safety practitioners often use traditional speed enforcement methods. Traditional speed enforcement is accomplished by law enforcement officers conducting roadside traffic stops on drivers who violate speeding-related statutes. Traffic enforcement can be deployed much quicker than infrastructure-related solutions, and when deployed appropriately with safety and equity in mind, it is a proven, effective strategy. Law enforcement officers use a variety of methods to determine vehicle speeds. Evidence of speeding has most commonly been measured based on the officer pacing the vehicle or using technology such as radar, light detection and ranging (widely known as LiDAR), and various other equipment to measure the time and distance of the vehicles to calculate their speed. This evidence is then recorded and presented by the officers for use in adjudicating speeding violation cases.

The Introduction of SSCs

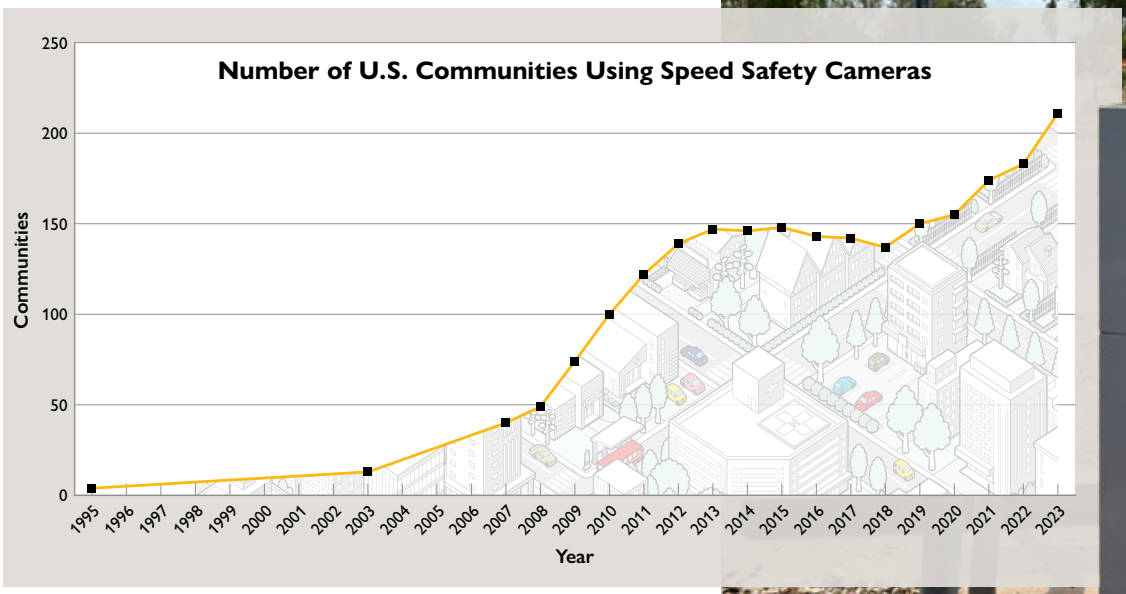
As technology evolved over time, it was combined with photography and automation to build SSC systems. SSC systems collect evidence of speeding violations remotely, eliminating the need for officers to make personal contact with drivers on the roadside, and increasing officer safety by reducing the risk of struck-by crashes. To capture evidentiary proof of a speeding violation, SSCs utilize technology similar to that of traditional enforcement, and when a violation is detected, evidence is recorded that includes the speed of the vehicle and an image of the vehicle at the time and location of the violation. This photographic evidence is used by officers or other personnel authorized to issue enforcement action to identify the person to be held responsible for the violation. Responsibility varies among communities using SSCs: some legislation holds the owner of the vehicle responsible, while others hold the driver at the time of violation responsible. "Speed enforcement is among the most common traffic enforcement strategies conducted by law enforcement. When implemented properly, SSCs can be a safer and more equitable strategy to change speeding behaviors," states Nanda Srinivasan, NHTSA's associate administrator for Research and Program Development.

For More Information:

- **FHWA's Proven Safety Countermeasures:** *https://highways.dot.gov/safety/proven-safety-countermeasures/speed-safety-cameras*
- **NHTSA's Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices:** *https://www.nhtsa.gov/book/countermeasures-that-work/speeding-and-speed-management/countermeasures/enforcement/speed-safety-camera-enforcement*
- **FHWA and NHTSA's Guide:** *https://highways.dot.gov/sites/fhwa.dot.gov/files/Speed%20Safety%20Camera%20Program%20Planning%20and%20Operations%20Guide%202023.pdf*
- **USDOT's National Roadway Safety Strategy (NRSS) in January of 2022:** *https://www.transportation.gov/sites/dot.gov/files/2022-02/USDOT-National-Roadway-Safety-Strategy.pdf*
- **FHWA's Safe System Approach for Speed Management:** *https://highways.dot.gov/sites/fhwa.dot.gov/files/Safe_System_Approach_for_Speed_Management.pdf*



Evidence of speeding has most commonly been measured based on an officer pacing a vehicle or using LiDAR.



In 1987, the Paradise Valley Police Department in Arizona became the first agency in the Nation to utilize SSCs. At that time, the town council authorized the use of SSCs (then referred to as photo enforcement) in direct response to a steady increase of traffic crashes in town. That year, over 400 reported collisions occurred. After SSCs were deployed, the town realized a 42 percent decrease in collisions. Traffic safety has always been one of the top concerns expressed by residents. Therefore, in 2013, the Public Safety Task Force—a committee composed of 50 residents—requested an expansion to the town's SSC program. That expansion was completed, and in 2017, only 208 collisions were reported. This decrease, a 50 percent overall reduction of traffic collisions from the numbers reported 30 years ago, was a staggering accomplishment, especially considering the growing population, corresponding traffic volumes, and increasing driver distractions.

As chief of the Paradise Valley Police Department, "my top priority is ensuring the safety of every individual within our community," states Freeman Carney. "A significant aspect of this commitment lies in prioritizing traffic safety. In response to the expressed needs and desires of the community we serve, implementing photo enforcement is a vital tool in safeguarding lives. Photo radar is a proactive measure designed to induce positive behavioral changes among our residents and visitors. It serves as a powerful deterrent, encouraging adherence to speed limits and traffic regulations, ultimately contributing to the overall well-being of our community."

"It's important to emphasize that photo radar is not imposed upon our residents but implemented for their benefit," adds Chief Carney. "By prioritizing safety through technology, we are actively working towards creating a secure environment where everyone can thrive. Our commitment to utilizing photo enforcement shows our dedication to the welfare of those who call our community home and those who choose to visit. Photo radar reflects our responsibility to support a culture of safety, respect, and responsible driving habits."

Nationwide, the use of SSCs is not new. From that early deployment by one community in 1987, the deployment of photo enforcement has continued to rise through 2008, when there were 49 communities using SSCs. This increase coincided with the year FHWA and NHTSA published the *Speed Enforcement Camera Systems Operational Guidelines* in 2008. These guidelines were developed based on lessons learned in programs that went well and many that did not go so well, it also provided a high-level overview of the technologies available at that time. In recent years, an increase in speeding-related crashes has been noted, along with a reduction in traditional law enforcement resources and an increased number of communities deploying SSC programs. Currently, 209 communities across the Nation use SSC programs, an increase of 39 percent since 2019. Although the use of SSCs has accelerated, the number of communities using them remains very small as the problem associated with speeding spans the Nation. The U.S. Census Bureau estimated that as of 2022, the Nation was composed of 19,493 incorporated communities.

Tested, Tried, and Proven

In 2021, SSCs were added to FHWA's list of Proven Safety Countermeasures. This list of 28 countermeasures—including "appropriate speed limits for all road users," "speed safety cameras," and "variable speed limits"—have been proven to work through extensive research yet remain underutilized by traffic safety practitioners across the Nation. Many studies support the addition of SSCs; a few of those study results are highlighted on the Speed Safety Camera Proven Safety Countermeasure fact sheet, including a 54 percent reduction in overall crashes and 48 percent reduction in injury crashes using fixed cameras in Scottsdale, AZ; a 37 percent reduction in fatal and injury crashes using point to point cameras in Italy; and a 20 percent reduction in fatal and injury crashes using mobile cameras in Edmonton, Canada.

ABOVE LEFT: Currently, 209 communities across the Nation use SSC programs.
Data © Insurance Institute for Highway Safety. Graphical representation source: FHWA.

ABOVE RIGHT: SSCs are not biased based on race, ethnicity, or the type of vehicle someone drives.
© Paradise Valley Police Department.

USDOT issued its *National Roadway Safety Strategy* (NRSS) in January of 2022; the NRSS adopts the Safe System Approach as the manner by which to achieve zero deaths on the U.S. roadway network. Safe speeds is a core principle of the Safe System Approach since humans are less likely to survive high-speed crashes. For additional information on applying this approach to speed management, review the recently released FHWA publication, *Safe System Approach for Speed Management*. Key actions called out in the NRSS to enable safer speeds included updating guidance documents, promoting SSCs as a Proven Safety Countermeasure, and studying and piloting automated or other enforcement strategies focused on speeding that are designed to ensure their equitable application.

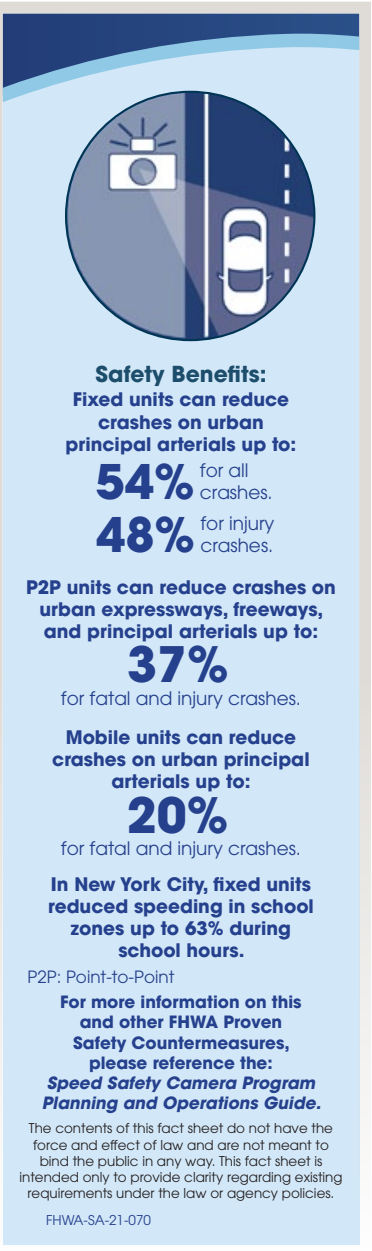
As part of implementing the NRSS, the Guide provides an update to the former 2008 *Speed Enforcement Camera Systems Operational Guidelines*. The Guide incorporates updated research and practices from the United States and international jurisdictions. The Guide emphasizes the need to consider SSCs as one component of a comprehensive speed management program and includes new case studies to describe how five different jurisdictions in the Nation have implemented or taken steps to implement SSC programs.

The purpose of the Guide is to provide information on the planning, implementation, operation, and evaluation of SSC programs. The update also adds new information on SSC technologies which are referred to as "section," "speed-over-distance," or "point-to-point," enforcement. This type of system utilizes two camera sensors at each end of a corridor, capturing a vehicle's average speed through the length of that corridor.

"We feel this new guide will provide communities interested in adopting speed safety cameras with the tools to avoid the pitfalls of the past and successfully achieve desired results while maintaining equity and transparency," says Robert Ritter, PE, associate administrator of FHWA's Office of Safety.

The Guide reiterates ideas from the 2008 guidelines while drawing on additional program experiences, evidence-based information on safety effectiveness, and other research published from 2009 to 2022.

The chapters in the new Guide were also restructured to address all parts of developing a program to include planning, policy, communications, administration, operations, and issues related to the deployment of SSCs. They contain instances of community involvement, transparency, and addressing equity concerns. Throughout the Guide, especially in Chapter 8, there are many examples that share lessons learned and noteworthy practices from current programs in a variety of different situations like school and work zones.



RIGHT: Safety benefits of SSCs.
Source: FHWA.

Reducing Speeding and Inequities

SSCs are not biased based on race, ethnicity, or the type of vehicle someone drives. However, camera placement and the program penalty structure can create inequities if demographics are not considered. Engaging stakeholders to include public health professionals, racial and social justice organizations and advocates, and the public—particularly members of underserved communities—is necessary to build and maintain support for SSC programs. Not unlike traditional enforcement programs, SSCs can generate revenue in the form of fines. The deterrent effects of enforcement will diminish if these fines are viewed as a "revenue generator." To mitigate this issue, many programs put revenue from penalties back into other safety and education programs and longer-term infrastructure projects that can ultimately reduce the need for SSCs.

"We encourage cities that adopt speed cameras to engage with their communities, especially communities of color, to ensure these cameras are used fairly and not punitively. The goal must be safety, deployed equitably across all roadways in areas that have speeding problems," explains Sophie Shulman, NHTSA's deputy administrator.

Crash data have shown that underserved communities can experience increased fatal and serious injury crashes, including those involving VRUs, which could call for additional speed management activities in those areas. This disparity and possible burden from increased enforcement should be acknowledged when deployment of SSCs is considered by speed management practitioners. Many times, these locations could be prioritized for longer-term engineering solutions to address deficiencies in infrastructure as part of the broader comprehensive speed management program.

The goal of any speed enforcement program should be to reduce speeding and lessen the risk of crashes and severity. The penalty should be structured to accomplish that goal regardless of the age, race, gender, or socioeconomic status of the violator. However, the same penalties imposed on one demographic can have a more burdensome consequence to a person of a different demographic. For example, paying a $100 fine would likely not impact a middle- or high-income person's ability to pay for primary living expenses. However, for a low-income wage earner, with little to no disposable income, this amount may mean choosing between paying the fine or putting food on the table or paying for their commute to work the next day. Not paying the fine could further result in a suspended driver's license, and if the driver is caught again, additional fines and the possibility of arrest can ensue, depending on the laws in that jurisdiction.

Penalty structure should consider the impact to the individual while still achieving the goal of deterrence and future compliance. Innovative penalty structures such as progressive fines based on income, amounts lower than traditional fines, or allowing for alternatives to monetary penalties such as community service or attending road safety courses may be more equitable. Some programs discourage punitive measures related to driver's license sanctions such as points, which can result in loss of license and a spiral into the cycle of poverty. Additional research is encouraged to find alternative penalty structures for underserved and impoverished communities, keeping the focus on safety without posing inequitable outcomes. An ideal speed management program would look to gain voluntary speed compliance without the need for ticketing, such as longer-term engineering and education programs to reduce the need for enforcement strategies.

Despite numerous surveys on driving behavior, it is evident that many drivers do not perceive speeding as a traffic safety concern comparable to impaired driving or distracted driving. Paradoxically, data reveal that fatal crashes related to speeding contribute as much, if not more, to traffic-related injuries and deaths over recent decades. To mitigate the escalating number of fatal and serious injury crashes, it is imperative to educate drivers about the perils of speeding and explore innovative approaches to encourage safer speeds. Traditional speed enforcement, when employed in isolation, has proven insufficient in addressing this issue. Achieving safer speeds, as outlined in the NRSS and the Safe System Approach, necessitates a collective responsibility involving a blend of strategies. These include educating drivers about the dangers of speeding and enhancing road engineering for better voluntary compliance. Until this comprehensive approach is realized, establishing appropriate speed limits for all road users, and ensuring compliance through enforcement will demand additional resources, with speed safety cameras emerging as a valuable tool in this regard.

For more on this topic, and be on the lookout for the *Public Roads* special issue on "Safer Speeds and Speed Management," coming in 2025.

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KEITH WILLIAMS serves as chief of NHTSA's Enforcement and Justice Services Division and previously served as a highway safety specialist with FHWA's Office of Safety. Prior to joining USDOT, he retired from the Anne Arundel County Maryland Police Department after 25 years of service. He holds a bachelor of science degree from the University of Baltimore.

For more information, see *https://highways.dot.gov/safety/speed-management*, *https://www.nhtsa.gov/risky-driving/speeding*, or contact Jeffrey A. King, 602-382-8991, *Jeffrey.king@dot.gov*.

The Guide is organized into eight chapters:

- **Chapter 1** introduces the rationale and benefits of using SSCs.
- **Chapter 2** outlines initial steps stakeholders should take to assess safety needs, the legal framework, and community and stakeholder engagement.
- **Chapter 3** guides SSC program developers through steps to implement SSC enforcement in a jurisdiction.
- **Chapter 4** details aspects of enforcement planning, including site selection and the strengths and uses of different SSC enforcement strategies and technologies.
- **Chapter 5** describes steps and potential issues for timely, reliable, and equitable processing of violations.
- **Chapter 6** details the final steps to implement the enforcement and violation processing plans.
- **Chapter 7** outlines program monitoring and evaluation, including data and methods that may be used in evaluations.
- **Chapter 8** presents four new case studies that describe implementation of SSCs in five different areas and jurisdictions.

ABOVE LEFT: The 2023 *Speed Safety Camera Program Planning and Operations Guide* published by FHWA in collaboration with NHTSA. *Source: FHWA.*

LEFT: Speeding can be dangerous on all types of roads, but particularly on non-interstate rural and urban roadways. *© VERTEX SPACE / AdobeStock.com.*

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

ABOVE: Truck parking is an important factor in drivers attaining adequate rest to continue to safely operate on the Nation's roadways.
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Public Information and Information Exchange

Trucking Industry, USDOT Celebrate Parking Milestone

In September 2023, members of the American Trucking Associations, industry leaders, truck drivers, and government officials—including U.S. Department of Transportation Secretary Pete Buttigieg—gathered in South Dakota to celebrate the creation of new truck parking spaces. The 11 new parking spots, along the State's Interstate 90, highlight the progress that's being made to resolve the Nation's truck parking shortage.

As mentioned in the Winter 2023 issue of *Public Roads* (*https://highways.dot.gov/public-roads/winter-2023/05*), the lack of safe truck parking is a consistent concern expressed by commercial motor vehicle operators. A USDOT report found 98 percent of drivers regularly experience problems finding safe parking and many States have identified parking capacity deficiencies as a major issue. The issue stems partly from an active economy, which places pressure on the trucking industry to move larger quantities of goods.

Under the Biden Administration, USDOT has increased funding allocated to trucking and freight. South Dakota was awarded a $61.1 million grant to improve its freight corridor, including expansions to truck parking accommodations. A truck travel plaza in Texas was awarded $23 million from USDOT's Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program; the truck plaza in Texas will be between Austin and San Antonio, and encompass approximately 20 short-term and 100 long-term truck parking spaces in addition to an entry/exit gate control, lighting, fencing, a rest stop with restrooms and showers, and 24-hour monitored security.

Likewise, a truck parking facility in northeast Louisiana was recently awarded a $10.5 million RAISE grant. The Louisiana facility will be able to accommodate 50 trucks for overnight parking as well as 100 cars and be equipped with electric vehicle chargers for semitractors and passenger vehicles. Similar truck parking expansion grants through USDOT's Infrastructure for Rebuilding America program were awarded to Florida and Tennessee, totaling $37.6 million. "We are evaluating the I-40 Smith County Rest Area to accommodate an additional 125 truck parking spaces," says Dan Pallme, assistant bureau chief of Freight and Logistics at the Tennessee Department of Transportation. "For additional safety purposes, we will increase the length of the on and off ramps to accommodate the acceleration and deceleration of commercial motor vehicles when they are merging in and out of traffic. In addition, we will reconstruct a new bridge and increase the height restriction to ensure safety for years to come. We are currently designing some concept plans," he continues.

Secretary Buttigieg has spoken publicly on several occasions about the need for safe truck parking and USDOT's support for parking investment. At the September event, Buttigieg announced the availability of additional funding, more than $80 million in grants, for highway safety programs, including parking projects. To review Secretary Buttigieg's full remarks on truck parking at the South Dakota event, visit *https://www.transportation.gov/briefing-room/secretary-pete-buttigieg-delivers-remarks-truck-parking-salem-south-dakota*.

CTC Allocates $3.7 Billion for Projects, Local Roads Benefit

In October 2023, to enhance safety and create more convenient options for travelers, the California Transportation Commission (CTC) allotted nearly $3.7 billion for transportation projects across the State of California. The bulk of the funding, $2.3 billion, is from the Infrastructure Investment and Jobs Act (IIJA) of 2021, which will be distributed to more than 600 cities, counties, and regional agencies within the State to improve transportation infrastructure (e.g., bridges), reduce traffic delays, and reduce climate impact—among other benefits.

The projects that CTC approved for funding focus on local roadways that help connect counties and cities together. For example, approximately $1.3 million is allocated toward roadway and other repairs on U.S. Route 101, from the Humboldt County line to the Klamath River Bridge in Del Norte County. An additional $1.3 million was allocated to U.S. Route 101—at two different locations from south of Hamilton Road to northbound Sixth Street in Crescent City—toward the removal and replacement of culverts. Additionally, on State Route 1 near Westport south of Hillcrest Terrance in Mendocino County, nearly $38 million was allocated toward roadway repairs (i.e., extending a retaining wall and constructing a dewatering system).

Another portion of the funding, $169 million, was provided via Senate Bill (SB) 1, the Road Repair and Accountability Act of 2017. For more information on projects funded by SB1 and IIJA in California, visit *https://rebuildingca.ca.gov/*.

TFHRC Restarts Division Research Coordinator In-Person Meetings

In August 2023, staff with the Federal Highway Administration's Office of Corporate Research, Technology, and Innovation Management (HRTM) hosted a full- and half-day long business meeting with FHWA division research coordinators. The August 2023 meeting commenced the first of several in-person meetings scheduled in 2024, 2025, and 2026.

Prior to the COVID-19 pandemic, over the course of 4 years, HRTM staff traveled to each of the 52 FHWA division offices (one in each State, the District of Columbia, and Puerto Rico). During the pandemic, HRTM increased its efforts to collaborate with division research coordinators at State Planning and Research-Subpart B Program forums, division research coordinator regional network meetings, and webinars on pooled fund updates, some of which were accessed online. HRTM staff wanted to continue building the relationship between TFHRC and the division research coordinators in the field and restarted the in-person meetings.

For the next 4 years (2023-2026), HRTM will provide travel funds to 12–13 FHWA division research staff per year to visit the Turner-Fairbank Highway Research Center (TFHRC) in McLean, VA. The goal is to ensure that each of the 52 designated FHWA division research coordinators can attend an in-person meeting.

In 2023, division research coordinators from 12 States visited and participated in discussions with TFHRC's office directors as well as key research partners from FHWA's Office of Federal Lands, the National Cooperative Research Program, and the American Association of State Highway and Transportation Officials Research Advisory Committee. The August 2023 meeting wrapped up with a three-hour tour of five TFHRC laboratories: the J. Sterling Jones Hydraulics Research Laboratory, Saxton Transportation Operations Laboratory, Structures Laboratory, Concrete Laboratory, and Human Factors Laboratory. Participants also met afterward for a dinner business meeting, continuing their discussions and strengthening their camaraderie.

The next FHWA division research coordinator meeting, scheduled for summer 2024 at TFHRC, will likely follow the format of the August 2023 assembly, with a different group of division research coordinators.

For more information on these meetings, contact Jill Stark, Research and Technology Program Development and partnership team member, at *jill.stark@dot.gov*.

FHWA division staff stand in front of a CARMA truck at the conclusion of the 2023 in-person TFHRC Division Research Coordinator Meeting.
Source: FHWA.

Two Winners Named in Coveted 2023 America's Transportation Awards

Sponsored by the American Association of State Highway and Transportation Officials, American Automobile Association, and the U.S. Chamber of Commerce, the America's Transportation Awards honors State departments of transportation (DOTs) and highlights the positive impacts their projects bring to communities. For the 2023 awards, 81 nominations were submitted by 36 State DOTs.

The categories for the 2023 competition were: Operations Excellence (recognizes the ability to operate and maintain the existing transportation system as safely and efficiently as possible); Best Use of Technology & Innovation (recognizes the use of new technology and/or creative, innovative solutions as part of a transportation project); and Quality of Life/Community Development (recognizes community involvement and interaction, and the public benefit for customers/users). Nominated projects first compete on a regional level against projects of similar size (i.e., small, medium, and large); after which, the three highest scoring projects compete for the Grand Prize and the People's Choice Award.

The Grand Prize-winning "Teamed Up for Transit" project, led by the Utah Department of Transportation and Utah Transit Authority, built the new Frontrunner train station, expanding the community's active transportation network and benefiting pedestrians, cyclists, and transit users. The Vermont Agency of Transportation's "Lamoille Valley Rail Trail" project—a 93-mile multimodal recreational path in northern Vermont that connects 18 town centers and links to other trails in Vermont and Canada—earned the People's Choice Award. The trail is open year-round for walking, biking, horseback riding, snowmobiling, and cross-country skiing, all against Vermont's natural landscape.

For more information, or to nominate a transportation project, visit *https://americastransportationawards.org/about-the-competition/*.

INSET: The 2023 People's Choice Award-winning project, "Lamoille Valley Rail Trail," was led by the Vermont Agency of Transportation.

© Vermont Agency of Transportation.

RIGHT: The 2023 Grand Prize-winning project, "Teamed Up for Transit," was led by the Utah Department of Transportation and Utah Transit Authority.

© Utah Department of Transportation.

New U-Md. Center for Greener Transportation

The University of Maryland (U-Md.) received $10 million from funds in the 2021 Infrastructure Investment and Jobs Act to launch the U-Md. Center for Multi-Modal Mobility in Urban, Rural, and Tribal Areas, based at the A. James Clark School of Engineering. In partnership with teams at four other higher learning institutions, the center's research into the future of the Nation's transportation system will focus on building fairer, greener transportation networks.

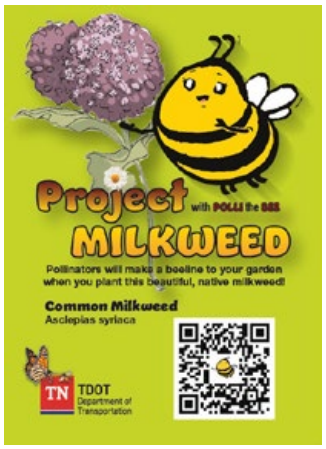
The center has a wide-ranging mission and will explore a variety of transportation concepts, designs, and policies, looking deeper into the effects and benefits of, for example, fare-free transit, Complete Streets, and the role of autonomous vehicles in low-income communities. Researchers also will consider ways to improve connections between rural and Tribal communities with nearby cities as well as how to better invest time and funds into transit, active transportation, and multimodal transportation.

Project Milkweed Returns in June 2024

Milkweed is a flowering plant that serves a critical role in the survival and growth of monarch butterflies. The plant serves as a food source; monarch caterpillars feed exclusively on milkweed, and milkweed provides a space for monarch butterflies to lay their eggs. Given their role, the Tennessee Department of Transportation (TDOT) carries out Project Milkweed, a subset of their Pollinator Habitat Program—a partnership between multiple State agencies and nonprofits to conserve native pollinators and habitats.

In October 2023, due to overwhelming demand, TDOT halted online orders for free milkweed seeds, which was a part of Project Milkweed's effort to restore and preserve the habitats of monarch butterflies and other pollinator species. Since June 2023, TDOT has taken nearly 131,000 individual orders from Tennesseans willing to plant milkweed to support monarch butterflies. After the number of migrating monarch butterflies sank to the lowest recorded population in 2013 and 2014, State departments of transportation, transportation associations, transportation planners, and roadside managers have been encouraged—via a 2014 presidential memorandum—to maximize insect pollinator habitats along roadways to curb pollinator losses.

TDOT's online offering of free milkweed seed will return in June 2024 during National Pollinator Week. For more information on Project Milkweed, visit https://tnpollinators.org/milkweed/.



Teller and USDOT Create Firsts, Make History

In May 2023, Arlando Teller received an historic appointment by becoming the first U.S. Department of Transportation Assistant Secretary for Tribal Government Affairs, a role established through the Federal Infrastructure Investment and Jobs Act (IIJA) of 2021. The position was created to address critical infrastructure impacts on Native American communities throughout the United States.

Previously, Teller—a member of the Navajo Nation—served as USDOT's deputy assistant secretary for Tribal Affairs; deputy director of the Navajo Department of Transportation; a former member of the Arizona State Transportation Board; and as an elected State representative for District 7 in the Arizona House of Representatives. In California, he worked on multimodal transportation projects as a transportation planner and as a Tribal liaison for the California Department of Transportation, served as a senior transportation planner for the Navajo Nation's Division of Transportation, and served as the vice chair for the Indigenous Peoples Caucus.

Teller is no stranger to firsts. He entered the aviation industry as the first Native American graduate from Embry-Riddle Aeronautical University. In his current role, Teller looks forward to building the foundation of the Office of Tribal Government Affairs, increasing capacity, improving engagement, and streamlining policy opportunities for Tribal transportation connectivity.

ADOT Approves 25-Year Transportation Plan

In October 2023, after a robust, year-long planning and public involvement process, the Arizona Department of Transportation (ADOT) approved the State's *2050 Long-Range Transportation Plan* (LRTP). The LRTP covers the next 25 years of transportation planning for the State, providing a roadmap for how the growing demands on Arizona's transportation system will be addressed to support Arizonans' quality of life; nearly 10,000 Arizonans contributed to the plan by completing surveys, attending public meetings, and submitting comments to ADOT.

The LRTP also provides direction to the State, residents, metropolitan planning organizations, and councils of government on transportation needs, available revenue, and system performance. More specifically, the LRTP defines how ADOT intends to allocate future resources across three major transportation investment types: preservation (i.e., activities to maintain the current highway system), modernization (i.e., activities to improve safety and operations of the existing highway system), and expansion (i.e., activities to add new highways). Arizona transportation investments are paid for with a combination of Federal, State, and local funding.

To support implementation of the 25-year plan, eight reports were referenced as supporting documents, including the *Resilience Improvement Plan Primer*, *Maricopa Association of Governments (MAG) and Pima Association of Governments (PAG) Current Conditions Report*, *Infrastructure Investment Act (IIJA) and Bipartisan Infrastructure Law (BIL) Funding Analysis*, *Vision Report*, *Gap Analysis Report*, *Public Involvement Summary Report*, and *2050 Multimodal Needs Analysis*. The *2050 Multimodal Needs Analysis* identifies the projected transportation needs in Arizona for the years 2026–2050.

To review the LRTP, visit https://adot2050plan.com/pdfs/ADOT-LRTP-2050-Update-Final-Document.pdf.

TOP: Since June 2023, TDOT has taken nearly 131,000 individual orders from Tennesseans willing to plant milkweed to support monarch butterflies.
© Tennessee Department of Transportation.

CENTER: In 2003, Teller received an historic appointment to a position created to address infrastructure impacts on Native American communities throughout the United States.
Source: USDOT.

BOTTOM: Arizona's LRTP covers the next 25 years of transportation planning.
© Arizona Department of Transportation.

First PBL Now Open in Anchorage, AK

In September 2023, Anchorage's first protected bike lane (PBL) opened as a pilot study that was funded entirely through the Bipartisan Infrastructure Law in partnership with the Federal Highway Administration. A PBL is a special bike lane with a vertical element physically separating it from vehicular travel lanes, which helps calm traffic and provides an added layer of safety for cyclists, pedestrians, and people with disabilities. For the month-long pilot study, temporary PBLs were installed along Pine Street and McCarrey Street, and multiple promising PBL treatments were tested. Through this pilot study, a research team consisting of the Municipality of Anchorage, Alaska Department of Transportation and Public Facilities, engineering consultants, local elected leaders, and a local advocacy bike organization aimed to learn how PBLs can be implemented in Alaska to improve transportation access equity and multimodal safety.

The project garnered substantial public feedback that provided valuable insights both into elements that worked well and those that did not. One clear positive outcome was that during the pilot, speed data showed a 40 percent increase in drivers obeying the 30 miles per hour (mph, 48 kilometers per hour (kph) speed limit, and drivers speeding 20 mph or above

(32 kph or above) the limit was decreased from 1.8 percent to less than 0.1 percent of drivers. This community-led research project will further inform Complete Streets policy development at both the city and State level. Anchorage is now planning a second PBL pilot in their downtown area for summer 2024 that will build upon the lessons learned.

For more information, visit: *https://dot.alaska.gov/comm/pressbox/arch2023/PR23-0028.shtml*.

Technical News

GDOT Celebrates Next Step in C-V2X Integration

In August 2023, the Georgia Department of Transportation (GDOT) received cellular vehicle-to-everything (C-V2X) waivers granted by the Federal Communications Commission, the organization that regulates interstate and international communications across the Nation. Securing the waivers places GDOT once step closer to fully integrating C-V2X technology across the State. Georgia already has more than 700 intersections and interstate installations ready to deploy C-V2X technology in addition to over 1,200 signalized intersections already deployed with connected vehicle technology.

GDOT hopes to enhance the safety of Georgia's driving public. For example, C-V2X technology will help to ensure first responders have priority on the roadway (improving response times through congested corridors); reduce idling at intersections (reducing emissions by 20 percent); and provide motorists with critical real-time information (e.g., work zone alerts and green light optimal speed advisories) to prevent accidents and reduce fatalities.

The Infrastructure Investment and Jobs Act allows for technology funding in transportation, and the Federal Highway Administration supported GDOT as it secured the FCC waivers and implemented the C-V2X technology on Georgia roadways. For more information, visit *https://www.dot.ga.gov/GDOT/Pages/ExtraMileBlogDetails.aspx?postID=1259*.

Accelerating Vehicle-to-Everything (V2X) Deployments

In 2022, there were an estimated 42,795 fatal vehicle crashes in the United States. The U.S. Department of Transportation is actively pursuing an approach to reduce the number of roadway fatalities to the only acceptable number of crashes: zero. Vehicle-to-everything (V2X) technology, which enables communication between vehicles, roadside infrastructure, and other road users such as pedestrians and cyclists, is a powerful tool in achieving USDOT's goal for Vision Zero.

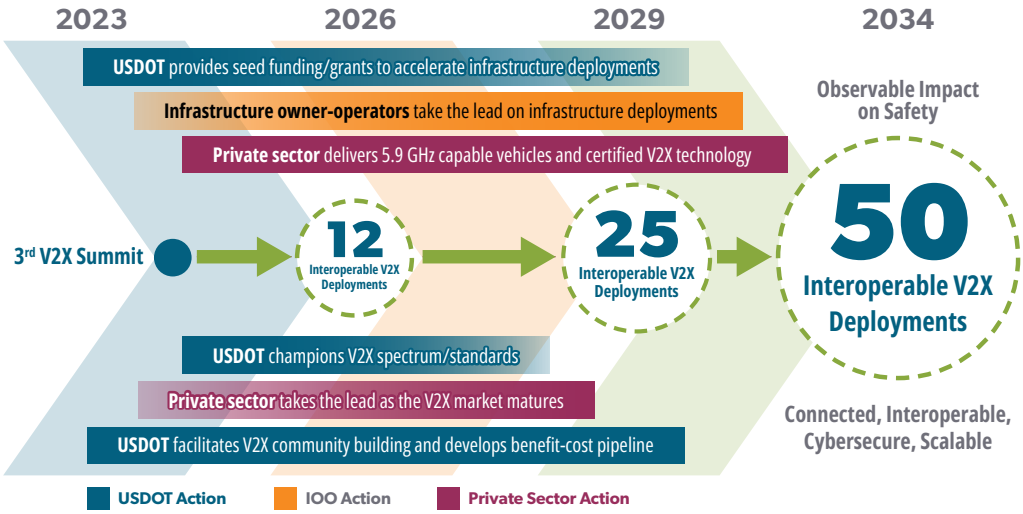
The wireless connectivity for V2X technologies must be interoperable (able to exchange and make use of information), ensuring that safety applications and other services dependent on seamless communications can be trusted to operate reliably and effectively across all the Nation's surface transportation system. Under interoperable connectivity, a diverse range of devices can communicate ubiquitously, efficiently, and securely in using multiple wireless communications technologies. V2X connectivity is a critical transformational technology that not only advances safety but also enhances mobility, bolsters efficiency, and reduces negative environmental impacts.

Accelerating V2X deployment now is a crucial step toward saving lives. USDOT has been working to roll out a series of products to assist the Intelligent Transportation Systems community in moving forward toward interoperable connectivity. Notable actions over the past year include:

- USDOT worked with the National Telecommunications and Information Administration and Federal Communications Commission to expedite the granting of waivers to permit the immediate deployment of V2X technology in the 5.9 GHz band. As of December 2023, a total of 39 waiver requests have been granted to organizations, including State departments of transportation.

ABOVE: Following the success of a September 2023 pilot study, Anchorage is planning another for summer 2024.
© Bike Anchorage.

- On October 26, 2023, USDOT held the 3rd V2X Summit on Saving Lives with Connectivity in Ann Arbor, MI, with nearly 800 public and private sector stakeholders, and where a draft *National V2X Deployment Plan* was unveiled (*https://www.its.dot.gov/research_areas/emerging_tech/pdf/Accelerate_V2X_Deployment.pdf*). This Plan outlines strategic goals and targets to creating a path toward achieving national interoperable connectivity. A companion document (*V2X Deployer Resources*) is being developed to provide more detailed technical guidance for deployers, is scheduled for release in early 2024.
- To coincide with the 3rd V2X Summit, USDOT announced the Saving Lives with Connectivity: Accelerating V2X Deployment Initiative. This $40 million funding opportunity will enable entities to deploy, operate, and showcase roadway deployments featuring applications enabled by V2X technologies.



- USDOT established the Interoperable Connectivity Cohort to allow private sector, public sector, and academia to share insights and best practices.

For more information on how USDOT is accelerating the deployment of V2X technology, visit: *https://www.its.dot.gov/research_areas/emerging_tech/htm/Next_landing.htm*.

Policy, Regulations, and Grants

USDOT SMART and ATTAIN Programs Emerge

In October 2023, the U.S. Department of Transportation began accepting applications for two new programs made possible by the Infrastructure Investment and Jobs Act of 2021 to award funding based on the use of technology to improve safety and transportation infrastructure.

The Strengthening Mobility and Revolutionizing Transportation (SMART) Grants Program will offer up to $100 million in grants to fund projects by public sector entities that address key transportation priorities like vehicle technology (e.g., automation and connectivity), systems innovation (e.g., smart grid and data integration), and new ways to monitor and manage infrastructure (e.g., sensors and unmanned aerial systems).

The Federal Highway Administration's $60 million Advanced Transportation Technology and Innovation (ATTAIN) Program will fund projects that utilize advanced technologies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment. ATTAIN-eligible projects will also be evaluated on how they consider climate change and environmental justice impacts—including the disproportionate impacts on disadvantaged communities. For more information, *https://www.transportation.gov/grants/SMART* and *https://ops.fhwa.dot.gov/bipartisan-infrastructure-law/index.htm*.

Delaware's New Motorcycle Helmet Law

On September 1, 2023, a new endorsement motorcycle helmet law went into effect in Delaware. The new State law requires everyone who obtains a new motorcycle endorsement (license) on or after the September 2023 date, or anyone riding with that person, to wear a helmet and eye protection for two years after they receive their endorsement.

In 2022, 22 motorcyclists were killed on Delaware roadways; as of August 31, 2023, 12 motorcyclists were killed in roadway incidents. With the new regulation, the Delaware Department of Transportation and Delaware Division of Motor Vehicles hope to reduce the number of motorcycle fatalities within the State, as over the last 5 years 25 percent of the crashes involving a Delaware-licensed motorcycle rider resulted in fatal and serious injury and involved a rider in their first 2 years of having a motorcycle endorsement.

A civil penalty will be assessed to those found to be in violation. Along with the provisions in the new law, all motorists are encouraged to always exercise caution: look twice at intersections, do not tailgate, and eliminate all distractions. For more information, visit *https://news.delaware.gov/2023/08/31/new-motorcycle-helmet-law-aims-to-reduce-fatalities/*.

TOP: Strategic, coordinated actions of key stakeholders create momentum towards interoperable V2X deployments.
Source: USDOT.

LEFT: Helmet use reduces the number of motorcycle fatalities.
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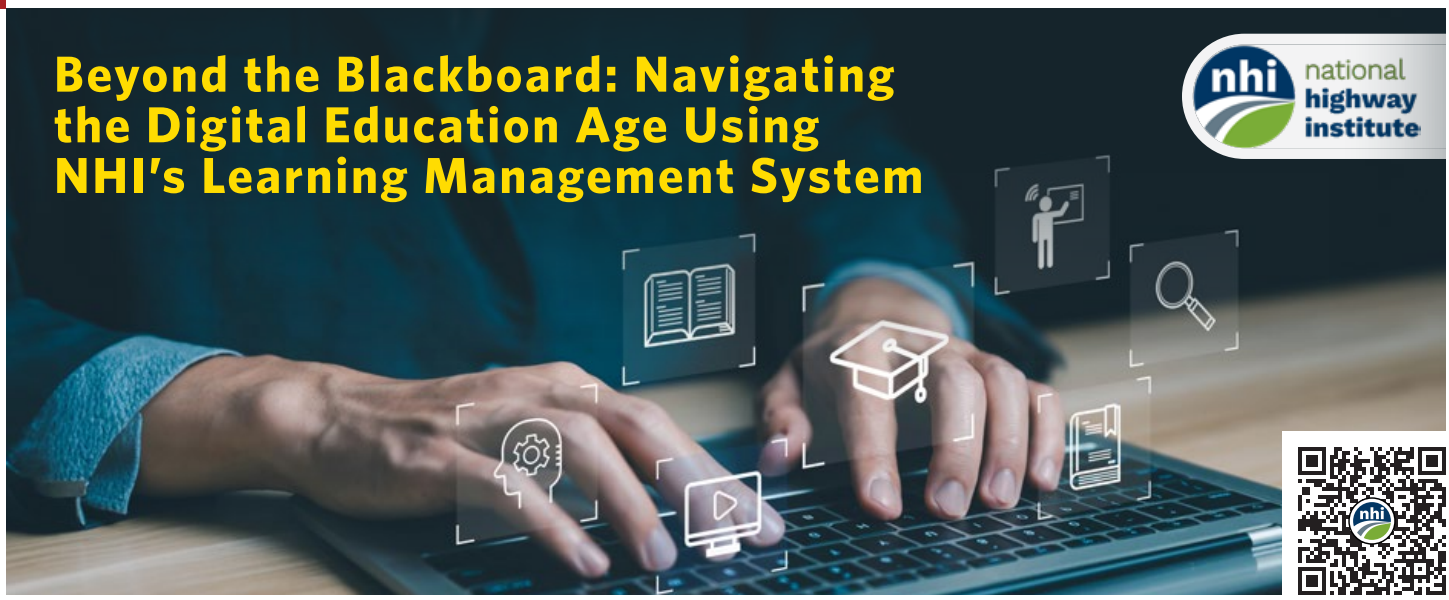
Beyond the Blackboard: Navigating the Digital Education Age Using NHI's Learning Management System



by **JON STRAUSS**

The Federal Highway Administration's National Highway Institute (NHI) launched its learning management system (LMS) on Blackboard®. This learning system delivers leading-edge subject matter expertise in the digital education age. The LMS redesign establishes practices to provide participants and course instructors with an engaging learning environment. The modifications align with NHI's efforts in 18 program areas, categorizing courses to inspire participants to improve the Nation's highway transportation system.

The new LMS offers an effective and interactive experience found on a user-friendly platform. The interface offers easy access to course information, simplifies the course registration process, provides comprehensive transcripts, and gives participants the ability to manage their profiles. LMS search functionality pulls from a diverse catalog of courses. The catalog describes courses and program areas where they have cross-appeal, providing a clear representation of the new learning environment.

Before the modifications, the delivery methods were Instructor-led Training, Web-based Training, and Web-conference Training. The three updated course delivery methods are unambiguous about what participants should expect. Course delivery method titles include In-Person Training, Self-Directed Training (SDT), and Virtual Instructor-Led Training. To learn more about these training formats and course materials, visit NHI's website to explore the types of training, *https://www.nhi.fhwa.dot.gov/training/*.

As of December 2023, the course catalog features SDTs. SDTs include an entire series of courses, as well as single standalone or introductory courses. The introductory Basics of Transportation Planning, Hydraulic Toolbox, and a whole series of courses on engineering and design in coastal environments are only a handful of the SDTs offered in the NHI course catalog.

Basics of Transportation Planning SDT (151052) is a comprehensive introductory course for participants who are involved with State, metropolitan, and rural transportation planning requirements, planning processes, and key stakeholders. Course completion infers that a participant understands the transportation planning process, can navigate the requirements of transportation planning, and can work with others involved in that process.

Hydraulic Toolbox SDT (135093) teaches participants about the software-supported suite of calculations that routine hydrologic and hydraulic analyses and designs of transportation infrastructure need. Participants completing the course can identify, recognize, and apply the hydraulic toolbox's uses in transportation hydraulic engineering.

The series of coastal environment SDTs (135082A - D) explores engineering and design principles of building and maintaining infrastructure in coastal environments subject to adverse climate events. Completion of this series affirms participants' understanding of the engineering and design of infrastructure and that they can differentiate, calculate, explain, and classify structures in and around coastal environments where infrastructure is adversely affected by bodies of water.

With the catalogue transitioning between the old platform and the new LMS, NHI continues to update and add courses. To get started on the new Blackboard LMS, participants need to create an account. Scan the QR code above to access the new Blackboard system and follow NHI's Account Creation Instruction Guide *https://www.nhi.fhwa.dot.gov/resources/docs/NHIGeniusAccountSetup.pdf* for detailed instructions.

Blackboard also offers a dedicated support helpdesk located on its homepage. If you have any questions regarding course content, email the NHI customer service center at *nhicustomerservice@dot.gov*.

To continue improving the learning experience that NHI makes possible, along with other services they offer, NHI wants to hear from you. Recently, NHI implemented course evaluations following every training. Your feedback about the training experience, new features, issues with course materials or content, and your opinion about the change to Blackboard are all encouraged. NHI will implement face-to-face focus groups to collect direct feedback from participants in courses and delivery methods in the future. Sign up for the NHI Newsletter to stay up to date on opportunities at *https://www.nhi.fhwa.dot.gov/*.

ABOVE: NHI offers a variety of tools for students to manage, track, and succeed in their courses. *© VRVIRUS / AdobeStock.com.*

ABOVE INSET: *Source: NHI.*

JON STRAUSS is a communications specialist and project manager contractor with NHI.

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