# Research Digest

**Research and Technology Implementation Division**

JANUARY 2026

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## Selected State DOT Reports

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## Item 1. Cascade Gateway Advanced Border Information System (ABIS) Design Project

*WHATCOM COUNCIL OF GOVERNMENTS*
*2025*

In 2023, the Whatcom Council of Governments (WCOG) was awarded project funding for the Cascade Gateway Advanced Border Information System (ABIS) Design Project through the U.S. Department of Transportation's (USDOT) Strengthening Mobility and Revolutionizing Transportation (SMART) Grants Program. This program funds purpose-driven innovation to build data and technology capacity and expertise for State, local, and Tribal governments, with the goal of using new technologies and approaches to target real-world challenges and create benefits. The Stage 1 ABIS Design Project is evaluating technologies to replace and improve aging wait time systems at the Cascade Gateway system of border crossings between the Lower Mainland of British Columbia and Whatcom County, Washington State.

The Texas A&M Transportation Institute participated in authoring this report.

This report is available for free download (66 pages, 2.3 MB):
https://rosap.ntl.bts.gov/view/dot/86028

More information about this publication available in the TxDOT Research Library Catalog.

## Item 2. Extending the Wisconsin Work Zone Data Exchange (WZDx) to Local Roads Using Smart Work Zone ITS Devices

*WISONSIN. DEPARTMENT OF TRANSPORTATION*
*2025*

"The project will expand the existing Wisconsin WZDx data model to incorporate local road work zone characteristics and prototype the capability on a select set of rural and urban projects in Wisconsin using smart work zone devices purchased through the project. The project will also evaluate the ability to scale the proposed solution to all WisDOT improvement projects statewide with local road work zone components. Lastly, this project will provide a model to incorporate other work zones along the local road network into the Wisconsin WZDx using smart work zone technology."

This report is available for free download (40 pages, 4.2 MB):
https://rosap.ntl.bts.gov/view/dot/84432

More information about this publication available in the TxDOT Research Library Catalog.

## Item 3. Unmanned Aerial Systems for Determining Vegetative Establishment on ALDOT Construction Sites

*AUBURN UNIVERSITY. DEPARTMENT OF CIVIL ENGINEERING*
*2025*

Roadside vegetation composition assessment is essential to maintain ecological stability, control invasive species, and to ensure the adoption of environmental regulations around construction zones. Traditional monitoring methods involving visual inspections are time-consuming, labor-intensive, and not scalable. Remote sensing offers a valuable alternative in automating large-scale vegetation assessment tasks efficiently. Our study compares the performance of proximal RGB imagery processed using deep learning (DL) techniques against the Vegetation Indices (VIs) extracted at higher altitudes, establishing a foundation to use the prior in performing vegetation analysis using unmanned aerial vehicles (UAVs) for a broader scalability. A pixel-wise annotated dataset for eight roadside vegetation species was curated to evaluate the performance of multiple semantic segmentation models in this context. The best-performing MAnet DL achieved a mean intersection over union of 0.90, highlighting models' capability in composition assessment tasks. Additionally, in predicting the vegetation cover – the DL model achieved a R2 of 0.99, RMSE of 1.761 and outperformed the top VI method of SAVI which achieved a R2 of 0.49, RMSE of 23.473. The strong performance of DL models on proximal RGB imagery under-scores the potential of UAV-mounted high resolution RGB sensors for automated roadside vegetation monitoring and management tasks at construction sites. The NDVI ortho mosaic image of the Prattville construction site.

This report is available for free download (78 pages, 11.0 MB):
https://rosap.ntl.bts.gov/view/dot/85648

More information about this publication available in the TxDOT Research Library Catalog.

## Item 4. Countermeasures for High-Risk Locations for Wildlife Related Crashes in Tennessee

*TENNESSEE. DEPARTMENT OF TRANSPORTATION*
*2025*

A study funded by the Tennessee Department of Transportation (TDOT) and the Federal Highway Administration under RES2024-003 was conducted to assess the occurrence of wildlife-vehicle crashes (WVCs) along TDOT maintained routes in Tennessee and to explore potential mitigation strategies. WVC hotspots were identified by analyzing wildlife incident data from 2019 to 2023, with route segmentation defined by intersections. Many incidents involved deer. An extensive literature review informed the analysis of WVC causality and mitigation methods. Key factors influencing WVCs included time of day, weather, seasonality, and traffic density, with deer-related behaviors driving most incident patterns. Environmental conditions and traffic density were not found to be significant predictors. Various mitigation strategies were considered, including signage, auditory cues, odor deterrents, wildlife rerouting, and fencing. Fencing was identified as an effective mitigation strategy, yet its effectiveness was limited due to frequent intersections on most high-WVC routes, which restricted the possibility of installing continuous fence segments. A targeted field review of the highest WVC segments revealed infrastructure features such as underpasses, culverts, and stream crossings that could support mitigation, but implementation was constrained by road layout and ingress/egress points. Ultimately, the study recommended deploying flashing warning signage during peak WVC periods, especially in November, to alert drivers and promote behavior changes—such as reducing speed and increasing vigilance—that may reduce collision risks.

This report is available for free download (110 pages, 6.2 MB):
https://rosap.ntl.bts.gov/view/dot/85818

More information available in the TxDOT Research Library Catalog.

## Item 5. Audible Alert and TMA Lighting

*MISSOURI. DEPARTMENT OF TRANSPORTATION*
*CMR 25-007 | 2025*

Truck Mounted Attenuators (TMAs) are designed to mitigate crash severity. Currently, TMA drivers rely on visual checks via driving mirrors to manually trigger warnings thus placing the duty on drivers. To address this limitation, the Automated TMA Warning System (AutoTMA) replaces or augments manual driver interventions with an artificial intelligence (AI)-enabled, sensor-fused platform. By integrating high-definition cameras, LiDAR, and radar with GPU-accelerated multi-

task learning, AutoTMA continuously detects and classifies oncoming vehicles, segments lane and drivable areas, and calculates dynamic distance thresholds—safe, warning, and danger—in real time. Validation of the AutoTMA included comprehensive trials within a Unity 3D simulation environment and test-track deployments on Missouri Department of Transportation (MoDOT) TMAs. Through iterative refinements, the system's response latency has been reduced from three seconds to 0.25 seconds, substantially improving both visual and audible alert accuracy. AutoTMA's modular architecture and robust sensor calibration mechanisms ensure rapid component replacement and resilience in variable operational conditions. Drawing on insights from prior research, including National Cooperative Highway Research Program (NCHRP) 05-24, the system optimizes lighting and audio cues while integrating adaptive safety zone parameters to overcome the limitations of fixed configurations. Preliminary findings confirm AutoTMA's ability to detect imminent collisions and deliver timely, context-sensitive warnings—significantly enhancing driver awareness and reducing the probability of TMA-involved crashes. AutoTMA marks a transformative shift in work zone safety protocols, offering a viable pathway for nationwide adoption. Future work will focus on expanding sensor modalities, further refining AI models to boost accuracy, and broadening field trials across diverse environments. By bridging the gap between manual vigilance and automated safety, the AutoTMA system not only improves operational workflows but also holds the promise of shaping policy and accelerating the integration of proactive safety technologies in transportation.

This report is available for free download (203 pages, 5.7 MB):
https://rosap.ntl.bts.gov/view/dot/85413

More information available in the TxDOT Research Library Catalog.

## Item 6. Testing Survey Methods for Detecting Bats Roosting in Bridges

*MISSOURI. DEPARTMENT OF TRANSPORTATION*
*CMR 25-008 | 2025*

Bats are a critical component of our natural world, and many species are at risk. Protecting roosting habitat is one way we can help conserve a variety of species. Although many bats use natural roosts, a growing number are adapting to anthropogenic structures due to habitat encroachment. In this study, we tested methods for detecting bats using bridges as roosts. We visited 20 bridges four times each to test six daytime methods (human visual and hearing, use of an acoustic detector, use of an agitator to induce bat vocalization, visual search with a spotlight, use of a thermal camera, and a borescope) and three evening emergence methods (human visual, thermal camera, and acoustic detector). Occupancy modeling revealed that the most effective way to document bat use

at bridges is with an acoustic detector during evening emergence. This was followed by the use of thermal cameras during evening emergence, and the third best model was use of thermal cameras during the day. Surveying longer did not increase detectability in any of the top models. Based on our findings and suggestions in guidance documents for detecting bats in bridges, the first step is to survey a bridge with a spotlight, listening for bat vocalizations, and noting smell. If bats are not detected during the day, using acoustic detectors and thermal cameras during emergence will determine if bats are using bridges and can provide additional data if they are documented using them during the day.

This report is available for free download (68 pages, 9.9 MB):
https://rosap.ntl.bts.gov/view/dot/85311

More information available in the TxDOT Research Library Catalog.

## Item 7. Feasibility Assessment of Alternative Power Options for Roundabout Lighting in Georgia

*GEORGIA. DEPARTMENT OF TRANSPORTATION*
*FHWA-GA-25-2415 | 2025*

This report presents a comprehensive assessment of the technical and economic feasibility of deploying renewable energy - powered lighting systems at roundabouts across Georgia. Driven by the dual goals of enhancing nighttime traffic safety and advancing sustainable infrastructure, the study integrates high-resolution meteorological data, renewable energy generation simulations, and benefit-cost analyses within a multicriteria decision-making framework. Three energy supply scenarios were examined statewide. To support practical implementation, machine learning models were developed to recommend optimal energy solutions based on location-specific weather patterns. Additionally, a safety performance function was established using roundabout crash data in Georgia to estimate potential safety benefits from lighting improvements. Results indicate that solar power is the most broadly applicable solution, particularly in the north-central and western regions, and wind and hybrid systems are more suitable for the southern and southeastern parts of the state. The findings offer geospatially targeted guidance for the Georgia Department of Transportation to prioritize lighting installations at existing roundabouts, inform planning for future roundabout sites, maximize return on investment, and advance renewable energy integration in transportation infrastructure.

This report is available for free download (74 pages, 2.1 MB):
https://rosap.ntl.bts.gov/view/dot/85458

More information available in the TxDOT Research Library Catalog.

## Item 8. Avoiding and Minimizing Impacts to Aquatic Resources through Construction Design Standards

*ILLINOIS. DEPARTMENT OF TRANSPORTATION*
*FHWA-ICT-25-001 | 2025*

The primary objective was to summarize best management practices that avoid and minimize impacts on aquatic resources through construction design standards. The study involved a literature review and discussions with experts to identify knowledge gaps regarding the effects of road and bridge construction on aquatic resources. We examined how other states responded to similar challenges and the standard specifications they used. These recommendations were based on findings from different states and best practices accepted by regulatory agencies. The research reviewed each state's processes and guidelines for stream-road crossings, focusing on culvert and bridge designs that affect aquatic resources. We identified that impacts on aquatic resources were commonly framed from the context of aquatic organism passage. Our report emphasizes the importance of bridges and culvert design specifics for maintaining ecological connectivity and the long-term health of aquatic ecosystems while also considering road crossings' structural integrity and safety. Information on the design specifics of culverts and bridges is described within our report. We provided a foundation for future studies and improvements to construction standards, aiming to reduce adverse effects on aquatic resources while meeting public safety and use demands.

This report is available for free download (52 pages, 4.7 MB):
https://doi.org/10.36501/0197-9191/25-001

More information available in the TxDOT Research Library Catalog.

## Item 9. Investigation of Commercial Motor Vehicle (CMV)-Related Crashes in Ohio Work Zones

*OHIO. DEPARTMENT OF TRANSPORTATION*
*FHWA/OH-2025/11 | 2025*

This research project was conducted to identify causation trends and factors that contribute to commercial motor vehicle (CMV)-involved work zone crashes in Ohio. In addition, the research project examined how workspace access points contribute to the CMV crash risk in work zones. In Phase 1, the research team reviewed previous research findings, conducted a preliminary crash analysis, and identified potential projects and novel data sources. In Phase 2, the research team reviewed the characteristics, narratives, and diagrams of fatal, serious injury suspected, and minor injury suspected CMV-involved work zone crashes to determine the factor that primarily influenced the crash, whether a CMV was fault, and whether a work-related CMV was involved. In addition, the research team used two statistical modeling techniques to identify the association between critical factors. The research team also conducted field studies in Phase 2 to observe the operational and safety impact of workspace access points. Based on the crash analysis and field study findings, the research team made 10 recommendations for improving CMV safety in work zones.

Researchers at the Texas A&M Transportation Institute authored this report.

This report is available for free download (139 pages, 6.5 MB):
https://ohiomemory.org/digital/collection/p267401ccp2/id/22724/rec/1

More information available in the TxDOT Research Library Catalog.

## Item 10. Roundabout Construction Using Precast Concrete in Virginia

*VIRGINIA TRANSPORTATION RESEARCH COUNCIL*
*FHWA/VTRC 26-R07 | 2025*

Roundabouts are a special type of intersection that ensures continuous vehicle movement while maintaining slow and safe speeds. Many state departments of transportation are converting existing intersections into roundabouts, but roundabout construction can create significant traffic closures and disruptions. Thus, accelerated construction can be very beneficial in places where extended traffic closure is not practical or possible. Using precast concrete panels in roundabout construction can shorten closure times and create less disruption for the traveling public. The Virginia Department of Transportation has constructed two precast roundabouts in the Richmond District—a mini roundabout on the I-195 South ramp at the Laburnum Avenue exit in December 2020 and

a regular, full-sized roundabout with an unpaved central island at the intersection of Hopkins and Kingsland Roads in July 2022. The panels were cast in New York and delivered to the jobsite for installation. The Laburnum Avenue roundabout was the first of its kind in the United States to be successfully completed and has performed satisfactorily since. The contractor was unfamiliar with this type of application but was able to complete both projects with weekend closures, thus minimizing weekday traffic disruptions. For comparison, the research team investigated five other roundabouts—four cast-in-place concrete and one asphalt truck apron with concrete curb containing rapid-setting cement. The roundabouts are constructed successfully using either precast panels or cast-in-place concretes and performing satisfactorily after at least a year of traffic exposure. The precast roundabout construction needs special attention to the base preparation, panel installation, and grouting. It is recommended that precast roundabouts be considered when short traffic disruptions are needed such that only weekend closures are permitted or when the supply of fresh concrete is of concern. Roundabouts with precast panels are expected to be more durable than the cast-in-place alternatives because the precast panels are cast in a controlled environment.

This report is available for free download (44 pages, 3.6 MB):
https://rosap.ntl.bts.gov/view/dot/85676

More information available in the TxDOT Research Library Catalog.

## Item 11. Evaluation of Wrong-Way Driving Countermeasures at Kansas Urban and Rural Interstate Ramps

*KANSAS. DEPARTMENT OF TRANSPORTATION*
*K-TRAN: KSU-19-2 | 2025*

Wrong-way driving (WWD) incidents and crashes are a serious concern for communities throughout the United States. WWD events typically occur at high travel speeds during low light conditions on roadways with limited horizontal maneuverability. These variables reduce driver reaction times and, in conjunction with other human factor variables that cannot be quantified, they significantly contribute to the increased rates of fatalities and serious injuries for wrong-way crashes. Previous WWD research has included statistical analyses of crash data, multiple countermeasure comparisons, investigations of driver characteristics, and proposed rewording of the MUTCD.

This report is available for free download (156 pages, 10.0 MB):

https://rosap.ntl.bts.gov/view/dot/83599

More information about this publication available in the TxDOT Research Library Catalog.

## Item 12. Development of a Geotechnical Asset Management System

*KANSAS. DEPARTMENT OF TRANSPORTATION*
*K-TRAN: KU-22-3 | 2025*

Geotechnical asset management (GAM) systems are a critical element of Transportation Asset Management (TAM) plans. Geotechnical assets include walls, slopes, embankments, and subgrades within the right of way. Although the Kansas Department of Transportation (KDOT) has a TAM, it does not currently have a GAM. A fully developed GAM would allow retrievable access to asset data via a computer-based system, including tracking of the asset life cycle either individually or based on asset type, construction method, contractor, material supplier, or other criteria. The asset data could then be used to evaluate the relative benefits of a wide range of engineering options. A GAM could also facilitate decision-making processes based on investment returns and a risk performance measure, potentially leading to systematic approaches for selecting appropriate corrective action for assets not demonstrating optimal performance. The objectives of this research were to develop the framework of a GAM tool for mechanically stabilized earth (MSE) walls in consultation with KDOT and to begin populating the tool with existing retaining wall data. This study developed an inspection sheet for KDOT MSE walls that included an electrical resistivity measurement developed in previous K-TRAN research. KDOT selected 18 walls to survey using the new inspection sheet. The inspection tool provides an overall rating on a 1–4 scale using a weighting system developed from experts in various industries related to MSE walls throughout the United States. The overall rating accounts for safety/mobility risks. This report summarizes the GAM tool for MSE walls in Kansas and includes recommendations for implementation.

This report is available for free download (82 pages, 4.9 MB):
https://rosap.ntl.bts.gov/view/dot/86780

More information available in the TxDOT Research Library Catalog.

## Item 13. Improving Safety of People Walking and Biking at Roundabouts

*MINNESOTA. DEPARTMENT OF TRANSPORTATION*
*MN 2025-27| 2025*

Roundabouts have been shown to enhance safety by lowering travel speeds as compared to other intersection designs. However, pedestrian and bicyclist crossings at roundabouts present unique challenges. Low yielding rates can heighten the risk of crashes, especially at entry and exit points. This study examines driver yielding behavior toward pedestrians and bicyclists at roundabout entry and exit points. Additional analyses compare vehicle speeds on the entry approach in the presence and absence of pedestrians and bicyclists at the roundabout crossing. Crossing events were staged at 16 roundabouts in Minnesota, with driver yielding behavior toward vulnerable road users recorded using video cameras. At nine of these locations, vehicle speed profiles at roundabout entries were also measured using lidar guns. Mixed-effects logistic regression and multiple linear regression models were developed to examine factors influencing yielding behavior and speed selection across different scenarios. The results showed differences in yielding behavior at the roundabout entry and exit, as well as differences based on crossing direction, roundabout geometry, and the presence of rectangular rapid flashing beacons. Additionally, speed selection varied depending on whether vulnerable road users were waiting to cross at the roundabout entry and how drivers responded to their presence.

This report is available for free download (77 pages, 10.1 MB):
https://rosap.ntl.bts.gov/view/dot/85626

More information available in the TxDOT Research Library Catalog.

## Item 14. Optimizing Work Zone Conditions to Maximize Safety and Mobility

*MICHIGAN. DEPARTMENT OF TRANSPORTATION*
*SPR-1752 | 2025*

Despite the fact that highway work zones represent a required element of maintaining and improving the transportation network, the resulting changes in traffic patterns, narrowed right-of-way, and other construction activities can lead to an increased risk for traffic crashes and related injuries or fatalities. This research sought to identify the critical work zone attributes that are related to improved (or degraded) work zone safety and/or mobility, and ultimately identify cost effective treatments that can achieve high levels of both safety and mobility. The outcomes of the

research include a synthesis of prior research and best practices used by other agencies, a benchmark of statewide work zone safety performance, new tools and resources to conduct safety analyses specific to freeway work zones, and recommendations to improve the department's work zone program. This research began with a review of the literature as well as the identification and review of relevant MDOT policies and guidance. Next, a statewide analysis of historical work zone crash data was conducted to quantify recent trends with respect to work zone safety within Michigan along with a comparison to nationwide work zone crash data. Historical models were developed for 25 recent freeway work zones across the state of Michigan to evaluate the safety and mobility impacts associated with implementation of temporary traffic control for long-term construction projects. The work zone projects were selected to provide a distribution of common work zone types, temporary traffic control configurations, types of work, area types, traffic volumes, work durations, and lengths among other factors. These models were used to quantify the safety performance impacts associated with each of the selected freeway construction projects via the Empirical Bayes (EB) method, including the estimated change in crashes at the project-level as well as the estimated change in crashes for each area within the work zone (e.g., advance warning, transition, and activity). Findings from these tasks were aggregated to support the development of recommendations to optimize safety and mobility within Michigan work zones, including recommendations for MDOT's Work Zone Safety and Mobility Manual, a revised Safety & Mobility Decision Tree, and a Microsoft Excel tool.

This report is available for free download (242 pages, 72.7 MB):
https://rosap.ntl.bts.gov/view/dot/86945

More information about this publication available in the TxDOT Research Library Catalog.

## Item 15. Bond vs. Pay-Go

*MICHIGAN. DEPARTMENT OF TRANSPORTATION*
*SPR-1754 | 2025*

This research examines the value of financing infrastructure improvements through bonding versus a program of pay-go improvements. Postponed construction becomes more costly in nominal terms because inflation raises the cost of construction over a longer period before construction begins. However, postponements can also create a variety of other situations. For example, postponements add to the level of damage that must be repaired when projects are subsequently let to contract. Both methods of finance encounter factors such as availability of funds and fiscal stability, inflation, population growth, as well as congestion growth rates, to name a few. While there is no

one-size fits all answer, understanding how these factors influence the outcomes and when they may be applicable, allows policy makers to make more informed decisions for the future.

Researchers at the Texas A&M Transportation Institute authored this report.

This report is available for free download (51 pages, 2.0 MB):
https://rosap.ntl.bts.gov/view/dot/86968

More information about this publication available in the TxDOT Research Library Catalog.

## Item 16. Pedestrian Safety and Traffic Operations Near Transit Stops

*UTAH. DEPARTMENT OF TRANSPORTATION*
*UT-25.11| 2025*

This research project's objective was to investigate the impacts of transit stop location (near-side versus far-side) on pedestrian safety and traffic operations at intersections. Three different video-based behavioral observation data collections at signals in Utah were utilized and studied: (1) transit stop events (interactions between transit vehicles and other vehicles) and transit passenger crossing behaviors and vehicle conflicts; (2) pedestrian conflicts with right-turning vehicles (conflict severity, driver/pedestrian reactions); and (3) pedestrian crossing behaviors (crossing location, crossing behaviors). These outcomes were then statistically compared for near-side versus far-side transit stop locations. From the results, far-side transit stops are better for general traffic operations, but potentially worse for transit operations. Transit departure delays are more likely and impactful at far-side stops, although actions can be taken to improve transit operations there. On the other hand, the evidence pointed toward far-side transit stops being worse for pedestrian safety. Specifically, conflicts at far-side stops were more severe, and drivers were less likely to slow/stop for pedestrians. This finding corroborates prior Utah-based research results that there were more pedestrian crashes at intersections with more far-side transit stops. Reconciling these differing findings likely requires improving pedestrian safety at some far-side transit stops, and prioritizing safety over operational efficiency at other near-side transit stops.

This report is available for free download (61 pages, 1.4 MB):
https://rosap.ntl.bts.gov/view/dot/86004

More information about this publication available in the TxDOT Research Library Catalog.

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