

The “Sweet Sixteen” state research projects highlighted on these pages were selected by the Research Advisory Committee of the American Association of State Highway and Transportation Officials. They comprise four high-value research projects from each of the four AASHTO regions, funded primarily through the programs below.

The State Planning and Research Program. As the nation’s cornerstone state research program, SPR provides federal aid funding to the states to address top concerns and identify solutions at the state level. States further address areas of common concern through the Transportation Pooled Fund Program.

The National Cooperative Highway Research Program. State DOTs commit SPR funding to support and oversee NCHRP, which pools the states’ research dollars to find solutions to transportation challenges identified as critical by the states.

The U.S. Department of Transportation. Research conducted through the Federal Highway Administration and other U.S. DOT channels allows the government to tackle high-priority needs and share new technologies and practices with the states.

“**T**here are innovations in every single aspect of what we do. It’s incredibly important that we stay ahead of that curve and keep pushing.”

Mike Hancock
Secretary, Kentucky
Transportation Cabinet, and
AASHTO President

RESEARCH

Makes the Difference 2014 INNOVATION ADVANCES TRANSPORTATION

PLANNING SMARTER, OPERATING BETTER

MANAGING RISKS AND SAVING MONEY IN WYOMING’S PROJECT PIPELINE

Research is affording Wyoming DOT a savings of \$90 million over a decade on its transportation project pipeline, where missing the mark on timing just a little can drive up risk and holding costs or hurry-up costs. WYDOT developed a research-based simulation tool to analyze its project pipeline and consider different funding scenarios, leading to process improvements and new techniques to reduce the risk of incurred holding costs. The techniques also shift revenue uncertainties from major projects to minor ones, helping keep critical, high-impact projects from sitting on the shelf. Bottom-line savings from the new methods were calculated at a representative 3 percent; that’s an average savings of \$9 million annually for a 10-year project pipeline of about \$3 billion.



NCHRP UPDATES AUTHORITATIVE GUIDANCE ON HIGHWAY CAPACITY



Extensive NCHRP research was the basis of a recent update to TRB’s *Highway Capacity Manual*, which addresses new topics like roundabouts, shared-use paths, and active traffic management. This fifth edition of the manual also includes a level-of-service grading system that explains projects in easy-to-interpret terms for policy makers and the public. By providing the latest methodologies for balancing the costs and benefits of new infrastructure, the manual helps transportation agencies evaluate the adequacy of existing and planned roadways to meet the public’s needs. The manual has an international impact, too: Agencies worldwide depend on it as an authoritative document on highway capacity, quality of service, and level of service.

HEAVY TRUCK DAMAGE PROMPTS INNOVATIVE SOLUTIONS IN INDIANA, SOUTH CAROLINA, AND SOUTH DAKOTA

Heavy trucks are a major source of damage to pavements and bridges, and states are targeting several different approaches to addressing this operations challenge.

- Indiana DOT examined whether truck permit revenues were covering costs of highway damage. Its sensitivity analysis of consumption costs for pavements and vehicles will inform decisions and subsequent legislation on overweight permitting policies. The study also examined costs and issues associated with overweight truck enforcement.
- South Carolina DOT similarly investigated the impact of different types of overweight trucks on bridges and pavements to update state policy. Recommendations included axle-based and flat-fee alternatives as well as guidelines for gaining stakeholder buy-in for such changes.
- Facing proposed legislation to allow wide-base tires to carry the same legal loads as dual-tire configurations, South Dakota DOT conducted high-priority research showing which pavement types would and wouldn’t see increased damage. The results led to a law allowing super-single tires only on main freight routes, protecting more vulnerable smaller highways.

BUILDING LONGER-LASTING ROADS AND BRIDGES



NEW HAMPSHIRE REALIZES MILLIONS IN SAVINGS BY SAFELY RAISING GUARDRAILS

Resurfacing a roadway section adjacent to a guardrail adds thickness to the pavement and lowers the height of the guardrail relative to the roadway. This can reduce the guardrail's safety benefits, especially for larger vehicles. However, replacing posts and guardrail sections during resurfacing can be costly. To save on these costs, New Hampshire DOT recently conducted a

field evaluation of raising the wooden offset blocks that attach guardrail sections to their posts. Researchers found that raising the guardrail by 3 inches, a method provisionally approved by FHWA and identified in two other states, is as safe and effective as replacement. Since 2009, the use of this method on 27 projects has saved NHDOT more than \$5.2 million.

IOWA DEVELOPS ASSESSMENT AND REPAIR PROTOCOLS FOR FLOOD DAMAGE



In 2011, flooding of the Missouri River caused \$63.5 million in damage to infrastructure in western Iowa, including levees, bridge abutments and foundations, roadway pavements and foundations, culverts, and embankment slopes. The extent of the damage was often directly observable, with pavement damage or whole segments of roadway washed away. However, much of the damage was hidden, since it occurred to road and bridge foundations. In the aftermath of the flooding, Iowa DOT sponsored the development of a mitigation decision matrix and technical toolbox to evaluate hidden flood damage and recommend specific repair and mitigation strategies (traditional and innovative alike). With Iowa experiencing severe flooding on a regular basis, these tools and strategies will help city, county, state, and federal agencies better determine damage and risk, and will enable more efficient response to future flood events at lower cost.

MISSOURI FINDS EFFICIENCIES IN LOAD RATING SYSTEM FOR BOX CULVERTS

The live loading effects of vehicles passing over a box culvert diminish with the thickness of the soil fill placed over the culvert, which helps distribute these loads. Missouri DOT recently conducted research to more precisely determine the live and dead loading effects of trucks on culverts with various fill thicknesses. They found that AASHTO design specifications may be overly conservative in predicting strains and displacements for fill depths of less than 8 feet. Moreover, the research results suggest that culverts with more than 6 feet of fill do not require a load rating. With about 700 such box culverts in the state, the research provided Missouri an immediate savings of \$350,000 on ratings. Extended future savings for Missouri—as well as other states that choose to adopt this approach—can be tremendous.



NEW SOFTWARE IMPROVES WEST VIRGINIA'S SLOPE STABILIZATION DESIGN

To stabilize slopes and prevent landslides and slope failures, especially on bridge embankments, West Virginia DOT often uses driven piles or micropiles. Recently the department developed an improved design procedure for slope stabilization that uses new methods to assess the stability of vulnerable slopes before and after deploying these piles. This includes new software, called PSSLOPE, which allows engineers to more realistically model loads transferred to piles from the soil. Designers can make a more accurate assessment of the effect of a sliding soil mass on bridge foundation performance and choose the best pile size for stabilizing the slope. The new design procedure is more accurate and less labor-intensive than the method it replaces, and will lower the risk of slope failure and associated costs in West Virginia.

“We can save money if we’re willing to put innovative technologies to work.”

Gregory Nadeau
Deputy Federal Highway Administrator

A GREENER TRANSPORTATION SYSTEM

NEW YORK STATE ZEROES IN ON LEAD-BASED PAINT HAZARDS ON BRIDGES



Residual lead-based paint is a health and environmental hazard that all states take very seriously. However, using excessively conservative methods for identifying lead hazards when repainting bridges can result in needless (and costly) disposal of nonhazardous waste in specially designated landfills. This led New York State DOT to seek better ways to classify paint waste from bridge painting projects. Researchers conducted field and lab tests on paint and paint waste from bridges across the state, including bridges where lead-based paint had previously been removed. This led to key insights on critical factors for predicting lead content, such as iron traces in waste paint and the specific blasting techniques used for paint removal. Based on this research, updates to NYSDOT's waste paint specifications are already in place, and the agency reports reductions in hazardous waste generation, decreased administrative and compliance costs, and lower waste and reporting fees.

WASHINGTON STATE AND MONTANA MAKE THE MOST OF RECLAIMED AND RECYCLED MATERIALS

DOTs embrace environmental stewardship through reuse and recycling across all areas of operation, from construction to maintenance.

Washington State DOT looked to use recycled concrete aggregate as a replacement for natural aggregate in new concrete pavements. After rigorous testing, the recycled aggregate proved to be a viable alternative: At a replacement rate of 45 percent of the natural aggregate, the recycled concrete aggregate showed no significant effects on the new hardened concrete. WSDOT is poised to enjoy significant savings in reduced landfill costs and virgin material requirements.



Montana, too, has uncovered potential cost savings—as high as 75 percent—by recycling traction sand applied to winter roadways. A Montana DOT study showed that collecting traction sand in the spring and reusing it in subsequent winters is a practical and cost-effective alternative to landfilling or roadside dumping. Just as important, this practice mitigates the environmental impacts of uncollected sand, such as sedimentation in streams and clogged culverts. Montana's research also points to opportunities to process the collected sand and mix it with gravel to produce recycled aggregate for new road construction.

SAFER HIGHWAYS AND WORK ZONES

REAL-TIME TRUCK PARKING DATA WILL ENHANCE SAFETY ON MARYLAND'S HIGHWAYS

Limited parking along highways leads to semitrucks parked on shoulders and ramps, which creates a safety hazard for other drivers. Maryland State Highway Administration looked to new technologies to develop real-time parking availability information for truckers, who must follow strict federal rules on rest breaks. Researchers developed a prototype parking monitoring system that uses magnetic sensors to detect vehicles in truck parking spots and has a customizable web-based user interface. The prototype proved to be accurate (within 4 percent, with opportunities for improvement) and featured other benefits over imagery-based methods, such as improved driver privacy. By pairing the collected data with information on historical facility use, the state can further optimize parking operations, ensuring a safe and efficient highway system for all motorists.



“Typically, state-sponsored research, including NCHRP, is highly applied ... often leading to new specifications and design guidelines.”

Robert Skinner
Executive Director,
Transportation Research Board

SAFER HIGHWAYS AND WORK ZONES, continued

STRATEGIES AND PARTNERSHIPS FOR AN AGING DRIVER POPULATION IN PENNSYLVANIA



The aging of Pennsylvania's driver population is a serious issue. Drivers age 65 or older now make up 17 percent of the state's licensed drivers, and the number continues to rise. Pennsylvania DOT undertook a comprehensive research study on improving mature driver safety and addressing the growing mobility challenge. The research approach considered older drivers' medical condition, crash history, and violations. Analysis yielded hard data that helped PennDOT develop mitigation strategies such as signage improvements and driver improvement programs. Another major accomplishment of this research was a symposium of more than 60 stakeholders representing diverse interests in the state. This partnership-building will speed implementation of recommendations and increase trust and understanding among PennDOT, state law enforcement, and the medical community.

LOUISIANA, MISSISSIPPI, AND KANSAS USE INNOVATIVE SAFETY TOOLS AND TREATMENTS

DOTs test and implement an array of techniques to make roads and work zones safer, with positive results nationwide.

- **Edge lines on rural highways.** A series of research and implementation studies in Louisiana showed that placing edge lines on rural two-lane highways improves how drivers position their vehicles in the lane and reduces crashes by more than 15 percent. The state calculates an impressive benefit-cost ratio of 19:1.
- **Roundabouts.** Mississippi DOT studied two signalized intersections converted to roundabouts and found a 38 percent reduction in total crashes and a 60 percent reduction in injury crashes. Benefits extended beyond safety, with reductions in delay, wasted fuel, and idling vehicle emissions. Combined annual user savings were estimated at \$806,000.
- **Portable plastic rumble strips.** Kansas DOT tested the effectiveness of portable plastic rumble strips as a short-term work zone traffic control device. The research showed that drivers reduced their speed as much as 11 mph, and researchers identified possible improvements to the strips and other promising work zone control tools.



“The SPR program affords states the opportunity and flexibility to address those research and technology needs that are most vital to maintaining and improving their transportation systems.”

John Halikowski

Director, Arizona Department of Transportation, and
Chair, AASHTO Standing Committee on Research

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DISCLAIMER: The opinions and conclusions expressed or implied in reports are those of the research agencies. They are not necessarily those of the Transportation Research Board, the National Research Council, or the program sponsors.

Project links are available in the online version of this document at research.transportation.org:

WYOMING'S PROJECT RISK MANAGEMENT

Research report

TRB'S HIGHWAY CAPACITY MANUAL NCHRP research summary

OVERWEIGHT TRUCKS

- Indiana's Joint Transportation Research Program [website](#)
- South Carolina's [research report](#)
- South Dakota's [research presentation](#)

NEW HAMPSHIRE'S GUARDRAIL RAISING

Research summary

IOWA'S FLOOD DAMAGE ASSESSMENT

Research report

MISSOURI'S CULVERT LOAD RATING SYSTEM

Research report

WEST VIRGINIA'S SLOPE STABILIZATION

Technical manual

NEW YORK STATE'S LEAD-BASED PAINT HAZARD ASSESSMENT

Research report

RECYCLED MATERIALS

- Washington State's [research report](#)
- Montana's [research project website](#)

MARYLAND'S TRUCK PARKING MONITORING

Research report

PENNSYLVANIA'S STRATEGIES FOR AGING DRIVERS

Research report

INNOVATIVE SAFETY TREATMENTS

- Louisiana's [research report](#)
- Mississippi's [research report](#)
- Kansas's [research report](#)

See AASHTO's research website, research.transportation.org, for additional high-value state DOT research projects.