Salt-tolerant sod and seed mixes bring greener roadsides to Minnesota

For Minnesota’s roadside grasses, life isn’t easy. To survive, grass must be able to withstand extreme stresses including drought, heat, disease, soil compaction, poor quality soils, and high levels of road salt. Ideally, it could survive all that while still looking lush and green.

“Many roadsides, especially in metropolitan areas, need to look good,” says Eric Watkins, associate professor in the Department of Horticultural Science. “In addition to aesthetics, quality roadside vegetation is needed to prevent erosion and maintain water quality from roadside runoff.”

Timber bridge safety inspections improve with new techniques and equipment

Not all bridges in the United States are made of concrete and steel. Even today, timber bridges remain an important part of the U.S. roadway system, especially in rural areas: more than 50,000 bridges in the U.S. and more than 1,700 Minnesota bridges have wood or timber superstructures, while countless more have timber decking or substructure elements.

Because routine inspections have the potential to miss internal decay or deterioration using traditional techniques, the service life and load-carrying capacity of a timber bridge can be in question. In addition, the possibility of a timber bridge failure creates safety concerns. To improve
In 2012 the Minnesota legislature modified a law—often called the Dimler Amendment—that exempts certain speeding violations from a motorist’s driving record. The modifications increased the qualifying range for the exemption from 5 mph to 10 mph in 60-mph speed zones during a roughly two-year test period that ended in the summer of 2014.

The legislation also requested a joint report from the Minnesota Department of Transportation (MnDOT) and the Department of Public Safety to learn the impacts of the modifications in terms of safety, travel reliability and efficiency, and data privacy. The U of M’s State and Local Policy Program (SLPP) at the Humphrey School of Public Affairs provided policy and data analyses for this report.

The research team, led by SLPP associate director Frank Douma, found that the impacts of the 2012 modifications were small, or even negligible. There was no consistent increase or decrease in the proportion of drivers who exceeded the speed limit, and no significant change in speed-related crash rates. “More significantly, however, our findings led us to question the effectiveness of the Dimler amendment itself,” he says.

One concern relates to the Dimler amendment’s scope and coverage. Since its passage in 1986, the law has been amended to apply to a substantially limited portion of the state’s roads—9,000 total miles. “This limited scope can create confusion regarding how the law is applied and enforced, and therefore limit its effectiveness and perceived fairness,” Douma says.

In addition, the Dimler amendment offers negligible protection for drivers’ personal information. Data vendors are still allowed to access driving records for several reasons (including resale to insurance companies), and conviction records are publicly available through the State Courts record system.

One impact the Dimler amendment does have, however, is to allow habitual speeders to stay on the road. Minnesota law states that a person’s license can be suspended for 30 days if the person is convicted of four traffic offenses within a 12-month period or five traffic offenses in a 24-month period. “Since Dimler prevents some of these convictions from appearing on a driver’s record, certain drivers are able to violate repeatedly without risking suspension,” Douma says. “This loophole is detrimental to public safety.”

The amendment also allows habitual offenders to remain eligible to apply for a commercial driver’s license. If the statute remains in effect, Minnesota may become out of compliance with new federal regulations for commercial vehicle learner permits that take effect in July 2015, he says. This would place Minnesota at risk of having up to 5 percent of federal-aid highway funds withheld.

Also because of the amendment, Douma says, habitual offenders may avoid paying higher insurance premiums that accurately reflect the public impact of their behavior—costs that are instead passed on to all other drivers in the form of higher insurance rates.

“The analyses and corresponding report provided by Frank and his team were pivotal to fulfilling the legislative requirement,” says Katie Fleming, senior research analyst with MnDOT’s Office of Traffic, Safety and Technology.
Lighting rural intersections reduces nighttime crash rates

Nighttime crashes at rural intersections are a major roadway safety concern. Rural intersection collisions account for 16 percent of all fatalities nationwide, with almost 30 percent of those fatalities occurring at night.

While previous research has shown the connection between an increase in lighting and a reduction in rural road nighttime crashes, little has been known about how the quality or quantity of that lighting affects nighttime crash rates.

In a recent project, University of Minnesota research fellow Chris Edwards confirmed that adding lighting to unlit rural intersections can significantly reduce nighttime crash rates, even when lighting levels are below national recommendations. In addition, he found that increasing lighting levels at lighted intersections can provide additional crash-reduction benefits.

“Though headlights provide some illumination of the forward roadway on rural roads, drivers may be more likely to overdrive if the only source of light is the headlight beam,” says Edwards, the study’s principal investigator, from the HumanFIRST Laboratory in the Department of Mechanical Engineering. “Adding roadway lighting at rural road intersections gives drivers additional, and otherwise low-contrast, visual information.”

Edwards began his work by identifying 63 intersection locations in six Minnesota counties. Working with Brian Davis, a research fellow in the Intelligent Vehicles Laboratory, Edwards drove a vehicle equipped with an advanced lighting data-collection system through the intersections to record the average illuminance level at each location.

Following data collection, Edwards analyzed the data using a series of models to assess the lighting level in conjunction with the nighttime crash ratio, intersection configuration, and the proximity of an intersection to a curve in the roadway.

“Our models demonstrated that intersection lighting produces major safety benefits,” says Edwards. “The biggest impact comes from adding lighting to an unlit intersection, which can reduce the ratio of nighttime-to-daytime crashes by more than 90 percent.” In addition, the team found that across all intersections, a one-unit increase in average illuminance (1 lux/0.1 footcandle) can reduce nighttime crash rates by 9 percent, and that at lighted intersections, a one-unit increase from average illuminance (1-lux/0.1 fc) can reduce crashes by 20 percent.

The research also indicates that lighting at rural road intersections produced significant safety benefits despite the fact that only 5 of the 37 lighted intersections met the minimum lighting levels set by national organizations. (The project’s lighting measurement area for an intersection differed from that currently used for national recommendations, which likely contributed to the variance in research results.) “The bottom line is that some lighting is better than no lighting at rural intersections,” Edwards says.

The collaboration with the Minnesota Department of Transportation (MnDOT) and the Minnesota Local Road Research Board (LRRB), the project’s sponsors, will position Minnesota to be a leader in rural roadway lighting research, Edwards says. “We hope that we can continue to investigate the lighting levels needed to achieve maximum safety benefits in the most cost-effective way. Having the lighting measurement data-collection system and teaming with the innovative minds at MnDOT and LRRB, we will achieve these goals.”

“This study helps validate the safety impacts that lighting can have on an intersection,” says Sue Zarling, MnDOT traffic electrical systems engineer. “MnDOT will continue to look at intersection lighting as one method of improving safety on our roads.”
The road to smart cities and smart mobility depends on better data integration and modeling

The term “smart city” is invading our world, but what exactly does it mean? What makes a city smart? According to Jaume Barceló of the Technical University of Catalonia in Barcelona, “smartness” is not simply synonymous with technology. Rather, it depends on how a city uses its data and technology to influence and improve services and quality of life.

“A smart city is one that uses the huge amounts of quality data that are now available through the instrumentation of our urban areas to provide information and insights on how to better manage their city,” said Barceló during his presentation at the CTS Winter Luncheon on February 9.

According to Barceló, the availability and quantity of urban data have increased dramatically during the past 20 years, and the technology used to collect this data is now more interconnected than ever before. However, data alone does not make a city smart. “Data on its own does not provide information,” Barceló emphasized. “Data collection is just the starting point—if I want to generate information I must process this data with models, and if we have better data we can build better models and generate better information, which will in turn help us to provide better services.”

Through advanced data processing techniques, data can be filtered and filled in to make it more accurate and complete, then fused with other types of data to provide better information. “For example, traffic data and weather data are both very different types of data, but weather can have a big impact on traffic,” Barceló said. “We can combine these two types of data through data fusion and then use data modeling to support decision making.”

Barceló also stressed the need to make the information generated with data models available to both decision makers and the public through easy-to-use graphical interfaces. “One aspect of smart mobility is making real-time journey planning available through mobile devices. Using a simple interface, you could plan a route that allows you to drive by a car to a certain point, park, and take public transportation, and then walk to your destination. If I have the ability to plan a viable transportation option right when I need it, maybe I don’t even need my car.”

User-friendly technology such as a real-time journey-planning tool could also promote sustainability. For example, it could provide information on the environmental impacts of different mode choices for a journey, giving users the ability to choose more environmentally friendly travel modes.

Importantly, the emergence of smart cities and smart mobility has the potential to change not just how we move through and manage our cities today, but also how we plan for the future of our urban areas. “Through the use of data and models, we can better understand the relationship between land use, transportation, and mobility patterns,” Barceló says. “This allows us to determine which things are generating positive impacts and which are generating negative impacts, and make decisions that strengthen the positive links between land use and transport.”

READ CATALYST ONLINE for links to research reports and other resources.
Roadway safety, transit transformers, and the Panama Canal: all are highlighted topics at this year’s CTS Transportation Research Conference. The event will take place May 20 and 21 at the Saint Paul RiverCentre. The brochure and registration information will be available in late March at cts.umn.edu/events/conference. Highlights follow; details about the opening plenary session will be included in the April Catalyst.

The Panama Canal Expansion: Myths and Realities for the North American Economy—May 20

Large infrastructure projects are prone to misconceptions—in particular, their benefits and their costs. The Panama Canal expansion is no exception. In early 2016, the estimated $6.2 billion project will add a new set of locks that will enable the canal to handle larger ships. Such an increase in capacity has triggered many expectations about its potential impacts on global trade, especially for ports on the U.S. East Coast. What are the myths of the project, and what are the realities? Jean-Paul Rodrigue, a professor in Hofstra University’s Department of Global Studies and Geography, will address this question at the conference luncheon.

Roadway Safety Showcase—May 21

In this full-day showcase, transportation safety researchers from the Roadway Safety Institute (RSI) will share research results that address today’s most-pressing roadway safety challenges. Projects focusing on tribal nation road safety, technology and roadway innovations, safety policy, human factors, and rail-grade crossings will be showcased. RSI is the Region 5 University Transportation Center, led by the University of Minnesota.

Transit Transformers Workshop—May 21

This half-day workshop will focus on how new transit service concepts and design will transform the transit system in the Minneapolis–St. Paul metropolitan area. The first part of the workshop will highlight case studies and community partnerships; the concluding session will explore topics such as the economics of car sharing, transit access and equity, and improvements to regional transit service plans.

Minneapolis bike design showcased at U of M museum exhibit

An exhibit currently on display at the U of M’s Goldstein Museum of Design is showcasing the craftsmanship of Minnesota bike designers and exploring the state’s rich bicycling culture.

“Design Cycles: A Bike Show” features bikes, frames, tires, gear, and tools created by Minnesota companies and designers. It also includes a short history of early bicycles and early biking examples, such as a late-19th-century high-wheel bike.

To complement the exhibit, the museum is also convening local bike experts for a panel discussion, “Minnesota Bicycling: A Work in Progress,” on March 25 at Summit Brewery in St. Paul. The panel will feature CTS Scholar and Humphrey School of Public Affairs professor Greg Lindsey, who has conducted extensive research on bicycle traffic and infrastructure in Minnesota.

“The panel will cover topics that were difficult to get at in the exhibition, such as what it means to be a vehicular cyclist, challenges in planning bicycle facilities, the trajectory of cycling growth, and factors that prevent people interested in bicycling from being able to bicycle,” says exhibit curator Jean McElvain. “Even though Minnesota is highly regarded as a bicycle-friendly state, the work at integrating bicycles into a predominately vehicular landscape is ongoing.”

“Design Cycles: A Bike Show” is on display through May 10 at the Goldstein Museum on the St. Paul campus. For more information about the exhibit or the panel discussion, visit goldstein.design.umn.edu.
the quality of timber bridge safety inspections, a research project led by researchers at the University of Minnesota Duluth’s Natural Resources Research Institute (NRRI) identified new advanced inspection techniques and equipment and developed implementation strategies.

“Current bridge inspection procedures are mostly limited to visual inspection of the wood components, along with ‘sounding’ with a hammer and coring to confirm suspected damage areas,” says Brian Brashaw, director of the Wood Materials and Manufacturing Program at NRRI. “These techniques have generally been adequate for advanced decay detection, but they are not adequate when the damage is in the early stages or is located internally.”

The research team began by identifying advanced inspection technologies for timber bridges that could be used effectively in Minnesota. These technologies included moisture meters to identify areas susceptible to timber decay, stress wave timing to locate and define areas of decay non-invasively, and resistance micro-drilling to confirm and quantify bridge element decay.

“When used by experienced inspectors, this equipment offers the potential to locate and quantify the extent of decay that is present in bridge elements, often before it reaches an advanced stage,” Brashaw says.

The project also included several activities to put the research findings into practice. The team developed standard inspection protocols, integrated the results into MnDOT’s bridge data management software, developed a new timber bridge inspection manual, and held outreach training across Minnesota for more than 150 inspectors and engineers.

“Good inspections can catch potential problems early and possibly avoid emergency closures or load postings,” says Dave Conkel, MnDOT State Aid bridge engineer. “It enhances safety while also helping stretch available funding for local bridge repair and replacement.”

Finally, the research team completed an economic assessment on the use of advanced inspection technologies for timber bridges. “We quantified the possible extension of the timber bridge life cycle before replacing the bridge or posting weight restrictions, and we found that using these bridge inspection techniques and equipment does provide a positive return on investment,” Brashaw says.

“The project helped put advanced inspection tools in the hands of our inspectors,” adds Bruce Harbargen, county engineer in Beltrami County. “The tools are now available, and the inspectors have the knowledge on how to use them. Timber bridge inspection has been significantly improved.”

MnDOT has purchased three sets of the recommended inspection equipment for use by bridge owners to conduct timber bridge inspections. In this recently funded effort, NRRI will manage the equipment use and provide support to inspectors across Minnesota.

The Minnesota Local Road Research Board and the Iowa Highway Research Board provided financial support for the project. The research team included MnDOT’s Offices of Bridges and Structures and State Aid for Local Transportation, Iowa State University’s Bridge Engineering Center, the USDA Forest Products Laboratory, and HDR, Inc.

More than 1,700 MINNESOTA BRIDGES have WOOD OR TIMBER superstructures.

Photo: Brian Brashaw

The team identified advanced inspection technologies that could be used in Minnesota.
In 2010, the Minnesota Department of Transportation (MnDOT) noticed a number of its new sod and seed plantings were failing and asked U of M experts to take a look at its specification. “We saw the problem immediately,” Watkins says. “The specification was for a mix with a lot of Kentucky bluegrass, which needs a great deal of care and watering. There was clearly an opportunity for improvement.”

During the next several years, Watkins’ team, led by former graduate student Josh Friell, worked to identify the best seed and sod for use along Minnesota’s roadsides in research sponsored by the Minnesota Local Road Research Board and MnDOT. Findings are now available in a final report.

The study was completed in several stages. First, many different types of cool-season grasses were planted in the fall and assessed the following spring to determine their ability to establish and survive on roadsides in Minnesota. Next, researchers looked at the salt tolerance of those grasses.

“In cold-weather climates like Minnesota’s, salt tolerance is required because of the application of deicing salts in the winter,” Watkins explains. “To determine if a grass species could stand up to this stress, we applied different levels of salt solution to the different grass species in a greenhouse. We identified several types of fescue grass as the most salt tolerant.”

Based on the results of the first two stages, researchers developed and tested 50 different grass mixtures along Minnesota’s roadsides and evaluated the survival and performance of those plantings for two years. In addition, each mixture was planted under a movable rain-out shelter to determine drought tolerance. This phase of the study resulted in the identification of a mix of three types of fescue for planting on roadsides in Minnesota.

Finally, researchers needed to find out if the new grass mixture would work as sod (sod growers need to be able to harvest it properly from their sod fields). “Most sod currently grown in Minnesota is Kentucky bluegrass, which isn’t the best for winter survival when salt stress is a problem,” says Watkins. “We grew 51 different grass mixtures as sod for 22 months and found that contrary to popular belief, fine fescue mixtures produced sod of acceptable strength for harvest.”

MnDOT has applied the research to standard specifications for construction activities for salt-tolerant sod products, salt/shade/drought-tolerant turf seed mixtures, and a third-party certification program for ensuring performance standards are met based on past and current research results, says Dwayne Stenlund, MnDOT erosion control engineering specialist.

Researchers are also working with the state’s sod growers to produce sod grown from the new seed blends.

Moving forward, the researchers plan to continue their work to improve Minnesota’s roadside grass plantings. “The reality is that the success of sod or seed plantings depends on a number of factors, including time of year, amount of water, soil preparation, temperature, and sod harvest depth,” Watkins says. “In our next project, beginning this spring, we will identify the most important factors for the success of roadside plantings and sod cultivation, and then help MnDOT update the specifications for managing new installations.”

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Eric Watkins (third from left) leads a greenhouse tour of grass mixtures.
Salt-tolerant sod and seed mixes bring greener roadsides to Minnesota.

Timber bridge inspection tools service life, safety.

Adding lighting to rural intersections reduces nighttime crashes.

Study questions value of law that exempts speeding violations from driver records.

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