



Low-volume roads can be susceptible to damage during the spring thaw period.

# RESEARCH SOLUTIONS

## Taking the guesswork out of spring weight restrictions

Throughout most of the year, low-volume roads in rural areas are open to commercial and agricultural vehicles. During the spring season, however, fluctuating temperatures and cycles of freezing and thawing weaken road structures and make them vulnerable to damage from heavy vehicles. Many states impose temporary weight restrictions on these roads until the pavements completely thaw and regain their full strength and stiffness. A new research project developed tools that transportation agencies can use to help local engineers determine when these restrictions can safely be lifted.

### THE NEED

Low-volume roads provide important connections for rural and agricultural communities across the country. In cold-weather states, however, these roads can be susceptible to damage from heavy loads for months during the spring season, when the frozen ground is unable to absorb surface snowmelt and

water trapped between the road's foundational layers weakens its structure. Temporarily limiting the allowable load carried by vehicles during the spring season can reduce the potential for damage to the road, but timing is critical: Lifting the restrictions before the roads are strong enough could lead to costly

repairs, but waiting too long could impede the transportation of goods and impact local economies.

Traditionally, transportation agencies that impose seasonal weight restrictions have removed them based on on-site observations or on a specific calendar date —



**“Iowa’s low-volume roads provide valuable connectivity. By removing seasonal weight restrictions at the right time, local agencies can reduce the potential for damage without affecting Iowa’s agricultural economy.”**

**— TINA GREENFIELD,**  
Iowa DOT Road Weather Information System Coordinator

methods that are either subjective or unnecessarily cautious. Measuring the subsurface conditions directly can produce more accurate results, but requires specialized equipment that most smaller agencies don’t own and can be expensive and time-consuming to contract. As lead state of the Aurora transportation pooled fund study, Iowa DOT and the 18 other member states wanted an accurate, economical, and user-friendly tool that any transportation agency could use to determine the right time for removing seasonal weight restrictions in any location.

## RESEARCH APPROACH

Below-ground temperatures were central to this project. The researchers leveraged the system of subsurface temperature probes that the North Dakota Department of Transportation (DOT) had previously installed throughout the state to gather frost data in a variety of locations. To develop a standard methodology that all states could use to remove their seasonal weight restrictions, a wealth of data collected using specialized structural testing equipment at the low-volume road test sections of Minnesota DOT’s MnROAD research facility was analyzed. The methodology was validated on nine roads in four states.

## WHAT IOWA LEARNED

Drainage is key to a low-volume road’s stability. Results from this study

indicated that the type of subgrade and depth of the water table were the most significant factors affecting when a road can safely reopen to heavy loads in the spring. Roads built on coarse-grained subgrades, which drain better than subgrades built on fine-grained cohesive materials, are able to regain their strength earlier. Seasonal weight restrictions on these roads can be removed within a few days after the subsoil has thawed completely (frost out). However, restrictions on roads built on soils that don’t drain as well should stay in place for at least two weeks after frost out, and restrictions on roads without a free-draining base layer may need to remain in place even longer.

This methodology, as well as a new decision tool, can be used in any winter weather state to determine when seasonal weight restrictions can be safely removed. To use the decision tool effectively, transportation agencies need to be able to determine when the subsoil has thawed (using instrumentation such as subsurface temperature sensors, frost tubes, or perhaps even moisture sensors). They also need to know details about the road’s composition and groundwater and drainage conditions near the roadway.

## PUTTING IT TO WORK

Though Iowa’s state highways are constructed to withstand heavy loads

year-round and are not subject to seasonal weight restrictions, Iowa DOT helped to fund this research so that counties across the state would have better resources for managing the state’s low-volume roads. With a new methodology that’s accurate and easy to use, Iowa’s county engineers will be better equipped to protect their road networks and keep their communities connected.

## ABOUT THIS PROJECT

**PROJECT NAME:** [Evaluation of Spring Load Restriction Removal Protocols](#)  
[Final Report](#) | [Technical Brief](#)

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**PROJECT CHAMPION:**  
**Tina Greenfield**  
Road Weather Information System  
Coordinator  
Iowa DOT  
[tina.greenfield@iowadot.us](mailto:tina.greenfield@iowadot.us)  
515-357-0965

**PROJECT MANAGER:**  
**Khyle Clute, P.E.**  
SPR Research and Pooled Fund  
Programs Manager  
Iowa DOT  
[khyle.clute@iowadot.us](mailto:khyle.clute@iowadot.us)  
515-239-1646

**PRINCIPAL INVESTIGATOR:**  
**Heather Miller**  
Heather Miller & Associates  
[hjmillerconsulting@gmail.com](mailto:hjmillerconsulting@gmail.com)  
603-662-8205

**IOWA DOT RESEARCH:**  
[iowadot.gov/research](http://iowadot.gov/research)  
[ideas.iowadot.gov](http://ideas.iowadot.gov)