



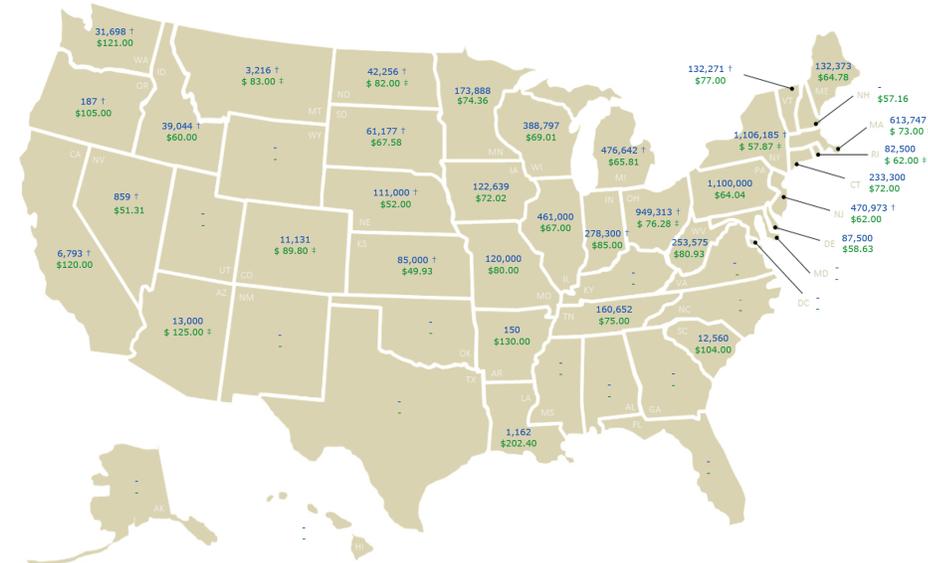
# ACCELERATOR

Putting your ideas in motion



State Winter Maintenance Data and Statistics

**2014-2015**  
**DRY MATERIALS: Salt applied (tons)**  
**COSTS: Average salt price mid-winter (Jan. 1) (\$/ton)**



**1. Select Winter**

2014-2015

**2. Select First Metric to Map**

- SYSTEM: Total lane miles
- HUMAN RESOURCES: State workers (full-time)
- HUMAN RESOURCES: State workers (part-time and seasonal)
- VEHICLE RESOURCES: Plow trucks (owned and contracted units)
- VEHICLE RESOURCES: Road graders (owned and contracted units)
- VEHICLE RESOURCES: Blowers (owned and contracted units)
- FACILITY RESOURCES: Salt storage facilities (count)
- FACILITY RESOURCES: Salt storage capacity (tons)
- FACILITY RESOURCES: Liquid storage facilities (count)
- FACILITY RESOURCES: Liquid storage capacity (gallons)
- DRY MATERIALS: Total chemicals applied (tons)
- DRY MATERIALS: Abrasives (non-chemical) applied (tons)
- LIQUID MATERIALS: Salt brine applied (gallons)
- LIQUID MATERIALS: Total liquid applied (gallons)
- COST: Total labor cost (\$ million)
- COST: Total equipment cost (\$ million)
- COST: Total materials cost (\$ million)
- COSTS: Snow and ice total expenditure (\$ million)
- COSTS: Average salt price mid-winter (Jan. 1) (\$/ton)
- COSTS: Salt price change to next Jan. 1 (%)

**3. Select Second Metric to Map**

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- (Do not display a second parameter)

This interactive map feature of the Clear Roads winter maintenance database, available at [clearroads.org/winter-maintenance-survey](http://clearroads.org/winter-maintenance-survey), helps reveal regional trends for different metrics.

## Winter Decision-Making Crosses State Lines

Winter weather events have a regional and often national impact. “Storms never stop at the state line,” said Tom Peters, research and training engineer, MnDOT Maintenance Operations. “That’s why it’s so important for us to know about winter maintenance efforts around the country, and particularly at neighboring states with similar climates.”

MnDOT leads the Clear Roads Transportation Pooled Fund Project ([clearroads.org](http://clearroads.org)), a national winter maintenance research consortium. In 2015, Clear Roads launched a national survey to collect and report the annual winter maintenance operations of

state DOTs. The effort included nearly 50 data points related to equipment, materials and costs.

The results, which are available at [clearroads.org/winter-maintenance-survey](http://clearroads.org/winter-maintenance-survey) as a Microsoft Excel-based spreadsheet, are available at no cost for users to examine, analyze and parse as needed. Beyond the raw data, the spreadsheet includes calculated statistics and an interactive map for plotting key metrics.

The results quantified much of what was known only anecdotally and provided useful, actionable data. “Data trends by geographic region and over time let us make more informed

operations decisions,” Peters said. “We can also draw on this information to communicate with management, elected officials and the public about how MnDOT’s winter operations fit in a national context.”

As the lead state, MnDOT commits significant administrative time and attention across the agency to Clear Roads. “It’s rewarding and satisfying to see such a useful product as one of the payoffs for all this effort,” Peters said.

*Additional data collection for the 2015-2016 winter season is already complete. Look for an update to the online database later this year.*

## What is Clear Roads?

Clear Roads is a 33-member pooled fund program dedicated to winter road maintenance research. Led by MnDOT, Clear Roads projects evaluate winter maintenance materials, equipment and methods; develop specifications and recommendations; study and promote innovative techniques and technologies; and develop field guides and training curricula. Learn more at [clearroads.org](http://clearroads.org).

## Research in Progress

Clear Roads has nearly a dozen research projects in progress, including:

- An investigation of equipment factors that cause fatigue in plow operators.
- A survey of state of practice for contracting for snow and ice control by state DOTs.
- A synthesis of best practices for plow route optimization and facility placement.
- Development of a decision support tool to quantify the impact of capital improvements on the cost of winter maintenance operations.

See all of Clear Roads' current research projects at [clearroads.org/research-in-progress](http://clearroads.org/research-in-progress).

## What's Next?

At its September meeting in Omaha, Nebraska, the Clear Roads Technical Advisory Committee funded five new projects:

- Utilization of GPS/AVL Technology: Case Studies
- Standards and Guidance for Using Sensor Technology to Assess Winter Road Conditions
- Emergency Operations Methodology for Extreme Winter Storm Events
- Weather Event Reconstruction and Analysis Tool
- Training Video for the Implementation of Liquid-Only Plow Routes



Conveyor systems that fill a salt storage facility from its highest point maximize facility capacity and improve safety.

## Best Management Practices Guide Reveals 20 Ways to Save on Salt

**Maintenance & Operations** — The 2013-2014 winter was particularly severe and caused a nationwide road salt shortage. This shortage affected winter operations and led to spikes in salt prices the next year. In collaboration with the Federal Highway Administration, Clear Roads developed a guide to 20 best management practices (BMPs) for procuring, storing and applying road salt to help agencies meet their performance goals at the lowest possible cost. Offering vendors flexibility in delivery times and maintaining enough salt storage capacity to avoid the need for last-minute orders are among these BMPs. The guide describes each practice on a single page, front and back, which can be separated from the manual and shared with relevant personnel.

### Clear Roads Project 14-10

## GPS/AVL Options for Winter Maintenance Vehicles

**Maintenance & Operations** — Global Positioning System and automatic vehicle location (GPS/AVL) technology turns winter maintenance vehicles into mobile data collection systems that can save big dollars. However, putting it in place can be complicated. Agencies need to evaluate a range of hardware and communications options for transferring information collected to a data management system, and decide which data to collect and how to use it most effectively.

In this project, researchers developed a guide that describes currently available GPS/AVL options and their capabil-



Many agencies use GPS/AVL systems to generate maps and reports of winter maintenance activities.

ities, as well as positive and negative experiences agencies have had with them. The guide also reviews key issues to consider when implementing GPS/AVL equipment and developing policies for data access and storage.

### Clear Roads Project 14-01

## Implementing Efficient, Effective Safety Measures

“One additional advantage of the sinusoidal rumble is that pavement markings installed on the rumbles stay below the pavement surface, which should protect them against plow damage and extend their life.”

— Ken Johnson, MnDOT State Work Zone, Pavement Marking and Traffic Devices Engineer

### State Closer to Friendlier Rumble Strip Design

**Traffic & Safety** — Previous MnDOT research showed that rumble strips with a sine-wave shape produced sounds that were quieter to bystanders than Minnesota's current design, while still loud enough within the vehicle to alert the driver. Building on this research, investigators tested several sinusoidal designs with careful measurement of noise levels inside and outside vehicles as they passed over the strips.

All of the tested rumble strips performed better than MnDOT's current design, providing a less intrusive pitch. The design featuring one 14-inch-wide strip with rumbles 1/16 inch to 1/2 inch deep was most



Popular in Europe, the wave-like patterns of the sinusoidal rumble strip give off less stray noise.

effective in alerting drivers. Using the results of this project and from additional testing at MnROAD, MnDOT will decide whether to deploy the sinusoidal rumble strip only in noise-sensitive areas, on all centerlines, or on all centerlines and edge lines. The agency must also choose between a single- or split-rumble design.

[Technical Summary 2016-23](#)

### New Risk Factors Identified for Upgrading Railroad Crossings

**Traffic & Safety** — Upgrading a passive railroad crossing marked only by signage to an active crossing with flashing lights and lowered gates can cost up to \$500,000. MnDOT aims to target limited upgrade funds to the most dangerous of the state's 2,500-plus passive crossings but needed a more effective model for ranking risk.

Investigators identified 10 key risk factors for crashes based on a study of crashes that occurred at railroad crossings from 2004 through 2013.

They found that 8 percent of the crossings exhibited seven or more of the factors, providing a rationale for MnDOT and its partners to prioritize safety improvements and consolidate redundant crossings, with a goal of zero deaths at railroad crossings in Minnesota.



[Technical Summary 2016-25](#)

## Maintaining Our Bridges

### Steele Bridge Design Analysis Helps Prioritize Inspections

**Bridges & Structures** — MnDOT's 20,000 bridges require inspections every two years. Special attention, however, needs to be paid to those bridges considered fracture-critical, where the failure of a single steel element that is in tension could cause the bridge to collapse. These bridges require yearly and more intensive inspections by the department's 600 busy inspectors. By applying new

national guidelines to conduct a more precise analysis of bridge designs, MnDOT can safely remove some bridges from the fracture-critical list, allowing inspectors to focus attention where it is really needed. The new design analysis can identify existing redundancies or encourage simple, inexpensive retrofitting in place of more extensive repairs.

[Technical Summary 2016-22](#)



Hammerhead piers attach broad columns to the underside of a bridge deck and may offer sufficient redundancies or potential for retrofitting to remove a bridge from the fracture-critical list.

### New Tools for Ensuring the Accuracy of Prestressed Concrete Girder Bridge Load Ratings

**Bridges & Structures** — In conducting load ratings and evaluating shear on bridges in Minnesota, MnDOT generally relies on specifications produced by the American Association of State Highway and Transportation Officials (AASHTO). However, these requirements have changed over the years, and some concrete bridges designed according to earlier specifications rate poorly for

shear by newer standards, despite showing no signs of distress.

Upon investigation, MnDOT found that shear forces for some bridges are not as high as predicted by current AASHTO standards. Researchers recommended more refined methods for rating bridges that are currently rated low for shear, and developed a screening tool to identify them.

MnDOT will use these recommendations to re-evaluate such bridges and is reviewing results for inclusion in its load rating manual. These measures will help the agency ensure the safety of Minnesota bridges, make cost-effective maintenance decisions and accurately process overload vehicles for heavy trucks.

[Technical Summary 2016-32](#)



RESEARCH SERVICES & LIBRARY

# ACCELERATOR

*Putting your ideas in motion*

## Calendar

- 12/7 Mn Asphalt Pavement Association annual conference, St. Louis Park
- 12/7-8 Local Road Research Board (LRRB), research proposal presentation and selection, Minneapolis
- 1/17-20 Minnesota County Engineers Association Annual Conference, Brainerd
- 1/25-27 City Engineers Association of Minnesota Annual Conference, Brooklyn Center

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GPS/AVL Options for Winter Maintenance Vehicles

Sinusoidal Centerline Rumble Strips Perform Better Than Current Design

