



WINTER MAINTENANCE AT A GLANCE

2018-2019

Raising the Bar on Best Practices



Introduction

Snow and ice control is a critical element of operations on our state highway system. To meet level of service goals in this area, Wisconsin DOT contracts with the state's 72 county highway departments for winter maintenance on these highways, a unique and mutually beneficial partnership. WisDOT receives the services of a skilled, experienced work force, and supports the counties through training, research initiatives, and testing of products, equipment and methods.

This summary document highlights key aspects of the 2018-2019 winter, including weather, materials and equipment use, performance, and costs. The complete Annual Winter Maintenance Report, which provides further detail on these areas and others, will be available at:

<http://wisconsin.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/default.aspx>

Inside

Statewide Winter Summary	2-3
Materials and Costs	4-5
Measuring and Advancing Performance	6-7
Looking Ahead	Back cover

Statewide Winter Summary

Winter by the Numbers

In 2018-2019, Wisconsin experienced a more costly winter than the previous year, and winter was slightly more severe than in 2017-2018. Compared to last year's winter costs of \$97,831,087, this winter's costs totaled \$111,681,476; an increase of 14 percent. The state experienced an average of 37 winter storms this winter, resulting in an average of 92.9 total inches of snowfall. This average represents a 19 percent increase from last year's statewide average of 77.8 inches of snow.

This year the statewide average Winter Severity Index was 105.7 which is four percent higher than the average of the previous ten winters (101.6). [Figure 1](#) on page 3 shows county 2018-2019 winter severity indices versus 5 year averages. Salt use was two percent lower than 2018-2019, at 553,443 tons.

[Table 1.](#) summarizes key facts and statistics from this winter in several core areas. The 2018-2019 Annual Winter Maintenance Report provides more detail on all topics in this table.

Table 1. Statewide Summary: This Winter by the Numbers

	Measure	Previous Winter	2018-2019
Infrastructure	Lane miles	34,678 miles	34,774 miles
	Patrol sections ⁴	754.0	756.0
	Average patrol section length ⁴	46.0 lane miles	48.0 lane miles
Weather	Average statewide Winter Severity Index	90.0	105.7
	Number of storms, statewide average and range across counties	Average: 33 Range: 20 to 61	Average: 37 Range: 23 to 57
	Snowfall, statewide average and range across counties	Average: 77.8 Range: 25.8 to 222.6	Average: 92.9 Range: 42.9 to 215.6
Materials ¹	Salt used	567,600 tons 16.40 tons per lane mile	553,443 tons 15.90 tons per lane mile
	Average cost of salt	\$67.60 per ton	\$73.51 per ton
	Total liquids used (prewet, anti-icing, direct liquid application)	6,561,404 gal.	9,393,029 gal.
	Sand used	19,955 cubic yd.	21,019 cubic yd.
Costs and Performance	Total winter costs ²	\$97,831,087	\$111,681,476
	Total winter costs per lane mile	\$2,821	\$3,212
	Average crew reaction time from start of storm	2.89 hours	2.45 hours
	Percentage of roads to bare/wet pavement (Within WisDOT target times)	66%	69%
	Road Weather Information System (RWIS) stations	68	70
	Underbody plows	753	753
	Counties that used anti-icing agents during the winter season	64 of 72 (89%)	63 of 72 (88%)
Labor and Services	Regular county winter labor hours ³	166,741 hrs.	195,223 hrs.
	Overtime county winter labor hours	140,471 hrs.	167,094 hrs.
	Public service announcements aired	9,954 total 8,385 radio; 1,569 TV	None
	Cost of public service announcements	\$36,000 (\$334,564 market value)	–

1. All material usage quantities are from the county storm reports except for salt. Salt quantities are from WisDOT's Salt Inventory Reporting System.

2. Costs refer to final costs billed to WisDOT for all winter activities, including activities such as installing snow fences and thawing culverts.

3. Labor hours come from county storm reports, and reflect salting, sanding, plowing and anti-icing efforts.

4. Patrol sections and average length include hybrid sections in some counties which may include a portion of county highway.

Up and Down

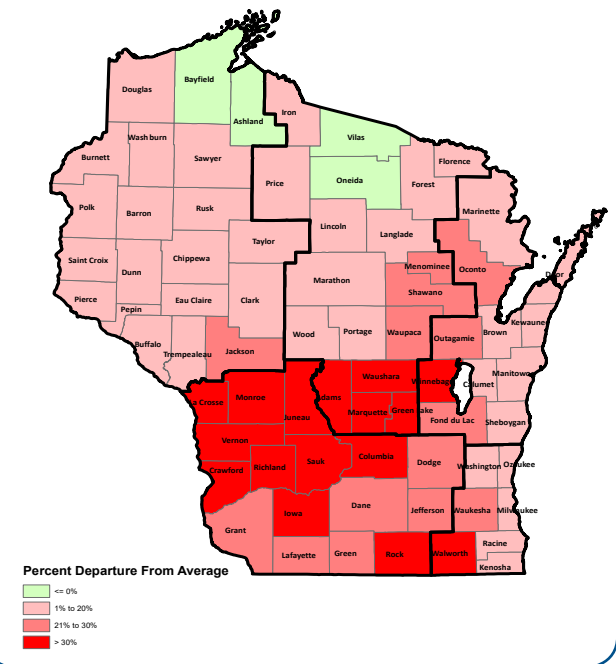
The winter season started off rather benign. Until the middle of January, severity was below average across most of the state. However, from that point until the end of February, winter hit with a vengeance. Frequent storms hit the state, and temperatures were well below normal. Lake Michigan and the Mississippi River both froze, causing delays in salt deliveries. More average conditions returned in March.

During the 2018-19 winter season, county highway departments responded to:

- A statewide average of 37 winter events per county, or 4 more than the previous winter. The high was 57 events in Iron County and the low was 23 events in Fond du Lac County.
- A statewide average of 4 frost events.
- A statewide average of 15 freezing rain events.

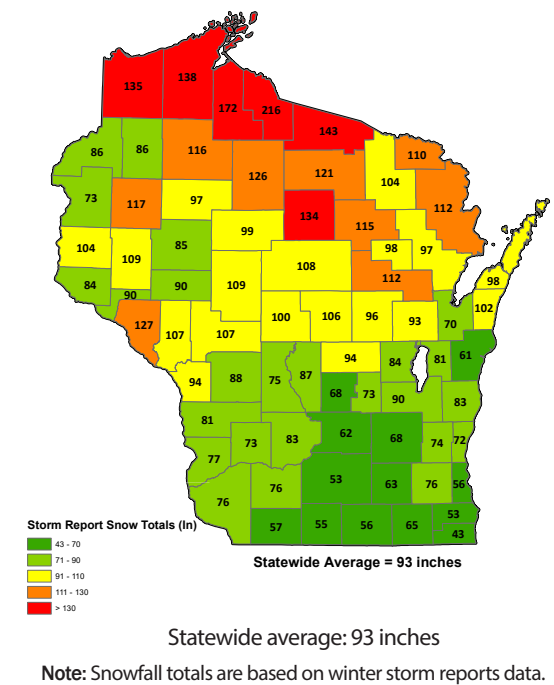
Figure 2 shows the total snowfall received in Wisconsin this winter based on storm report data. Snowfall varied significantly across the state; the highest snowfall recorded was in Iron County, at 216 inches; the lowest was in Kenosha County, at 43 inches. This winter's statewide average total snowfall was 92.9 inches.

Figure 1. 2018-2019 Winter Severity Index vs. 5-Year Average



Note: If you are looking at black-and-white versions of the maps in this report, you may download a color version of the report at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.

Figure 2. Statewide Snowfall, 2018-2019



Salt and Anti-icing Work Together

Salt use was two percent lower than the previous year, at 553,443 tons. Figure 3 shows county 2018-2019 salt usage per lane mile versus 5 year averages. Figure 4 shows statewide historical salt usage per lane mile overlaid with average severity index. WisDOT encourages counties to use salt efficiently by making use of best practices such as anti-icing and prewetting. Use of anti-icing materials was up 124 percent over last year, with counties using a record 2,848,384 gallons of anti-icing liquid. 63 counties made at least one anti-icing application. Use of prewetting materials was up approximately 66 percent over last year with counties using 6,377,338 gallons.

Direct Liquid Application (DLA) is a relatively new best practice in Wisconsin. During the winter of 2018-2019 four counties used this technique. Liquids applied directly to the pavement for deicing replace rock salt as the primary storm management tool. This reduces the amount of salt applied and has been found to be more effective than solid salt. WisDOT hopes to expand use of DLA in the future.

In contrast, WisDOT actively discourages counties from using sand on the state trunk highway system. Sand is not effective at high traffic speeds, negatively impacts the environment, and ultimately decreases the level of service provided. Counties used 21,019 cubic yards of sand on state highways this year, a 5 percent increase from the previous year.

Wisconsin counties applied a statewide average of 15.9 tons of salt per lane mile, a decrease of three percent compared with the 2017-2018 winter. When compared with nearby states, which differ by winter severity and level of service standards, Wisconsin salt use is relatively high.

Figure 3. 2018-2019 Salt Use per Lane Mile vs. 5-Year Average

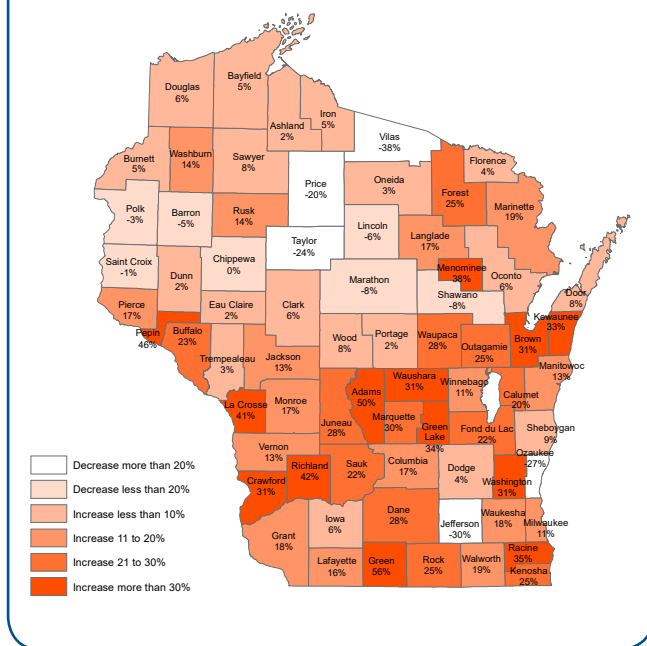
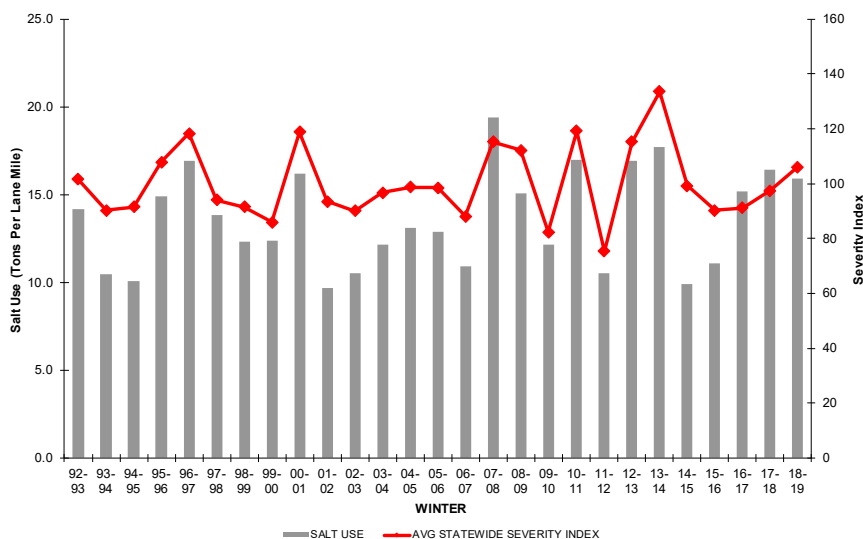


Figure 4. Salt Use per Lane Mile and Average Severity Index From Salt Inventory Reporting System, 1992-2019



Higher Labor and Equipment Costs

The total cost of statewide winter operations this winter was \$111.7 million, making it 14 percent more costly than 2017-2018. The winter was more severe in 2018-2019 which likely accounts for some of the increase in cost. **Figure 5** also demonstrates a 25 percent increase in winter costs from the average of the previous five years. This winter's statewide average cost per lane mile of \$3,212 was 14 percent higher than last year's cost of \$2,821 per lane mile.

WisDOT spent \$40.6 million on salt, \$36.3 million on equipment-related expenses, \$31.3 million on labor, and \$3.5 million on materials other than salt, such as sand. Similar to previous winters, anti-icing activities only make up only about 1 percent of total expenditures.

As is to be expected, winter costs per lane mile tend to increase as statewide average winter severity increases. Annual increases in labor rates and salt pricing also affect overall winter maintenance cost, even in less severe winters. This winter was more severe than last year and costs were slightly higher this year. Total salt expenditures increased by six percent compared to the prior year. The cost for materials other than salt increased by one percent. Labor and equipment costs increased by 16 percent and 24 percent, respectively. Salt continues to be the largest expenditure, accounting for six percent of all costs (see **Figure 6**).

Each of the previous two winters WisDOT has renewed its existing salt contracts at lower prices in lieu of rebidding. In 2018-2019, salt prices finally increased. The average of \$73.51 per ton is an increase of nine percent from last year. **Figure 7** shows historical salt prices for Wisconsin and for 14+ states nationwide.

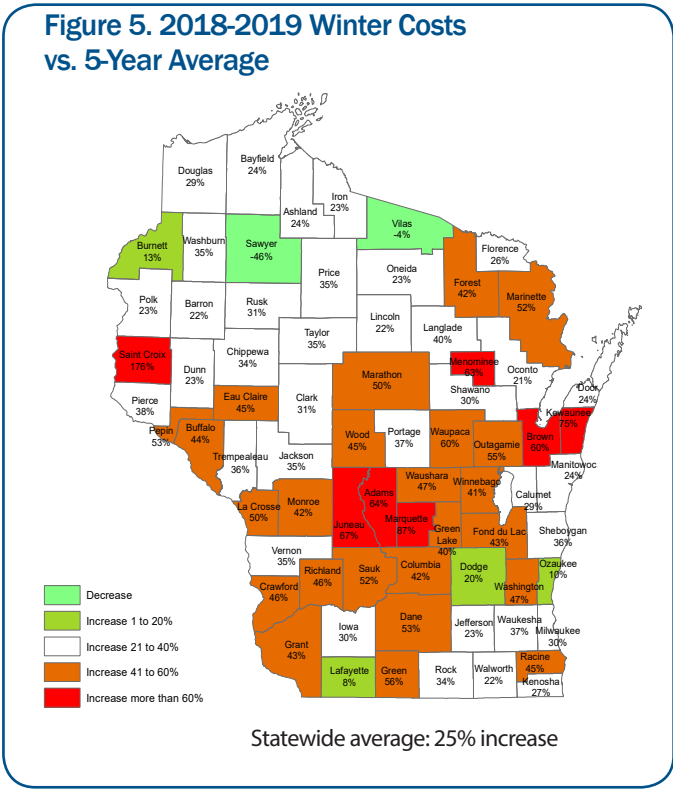


Figure 6. Expenditures by Category, 2018-2019

Statewide Winter Costs
2018-19 Total Cost: \$111,681,476

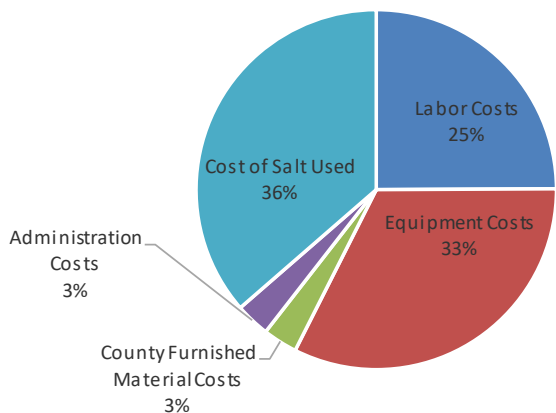
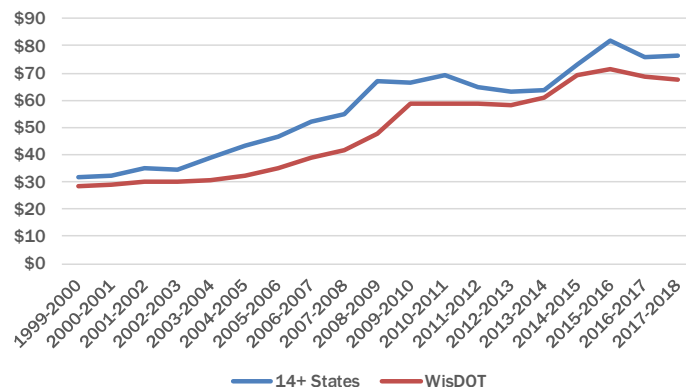


Figure 7. Salt Prices Over Time (through 2017-2018)

Historical data supplied by Clear Roads. From 1999 to present, the number of states reporting data has increased from 14 to 35 states.

Note: Updated data for 2018-2019 has not yet been released.



Coordinating Counties' Response

This winter WisDOT continued its emphasis on close communication between the counties and WisDOT regional staff. Before each event, regional staff worked with the counties to coordinate available materials, staffing and equipment, and regional staff assisted the counties in managing shifts for long events.

This winter WisDOT also continued to implement its Adverse Conditions Communication/Coordination Plan to provide improved coordination during severe weather or other emergencies. The regions worked closely with the Wisconsin State Patrol in advance of storm events to ensure readiness across the affected areas. WisDOT staff helped man the state Emergency Operations Center in Madison, increasing the department's level of engagement during winter events and its ability to respond to severe incidents on the highway system.

Tracking the Winter

Each week during winter, representatives from the 72 county highway departments complete winter storm reports. These reports give WisDOT the tools to manage statewide materials use and maintenance expenses as the winter progresses. Winter storm reports are also used to create the "Winter Severity Index" and other statewide performance measures.

Response Time

The counties continue to work on becoming more proactive in responding to winter storm events. Average response time this winter was 2 hours and 27 minutes. This is 26 minutes faster than 2017-2018. See Table 2.

"Time to bare/wet pavement" is measured from a storm's reported end time. Heavily traveled urban highways tend to be returned to a bare/wet condition sooner than rural roads. WisDOT expects 24-hour roads to be clear within four hours of the end of the storm and 18-hour roads to be clear within six hours. This year, on average statewide, 69 percent of roads were to bare/wet pavement within the targeted time frame (see Table 3 on page 7).

Table 2. Maintenance Crew Reaction Time

Winter Service Group	Avg. Reaction Time (hours)		10-year Average	Percent change
	2017-2018	2018-2019	2008-2009 to 2017-2018	2018-2019 vs. 10-year Average
A	0.52	0.48	0.88	-54%
B	1.34	1.16	1.82	-36%
C	2.61	2.16	2.91	-26%
D	2.70	2.61	3.50	-25%
E	5.04	4.40	4.72	-7%
F	5.13	3.91	6.07	-36%
Statewide average (unweighted)	2.89	2.45	3.25	-25%

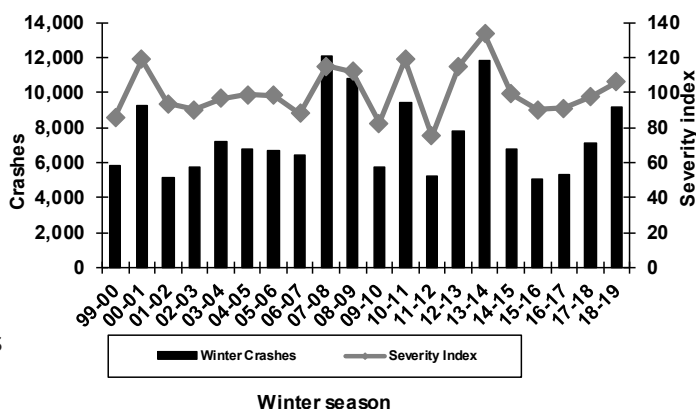
Analyzing Travel and Crashes

By keeping roads as clear as possible within their expected level of service (18- or 24-hour coverage), maintenance crews have an opportunity to help prevent crashes. This year, there were 9,182 winter weather crashes (those that occurred on pavements covered with snow, slush or ice).

The statewide average crash rate (number of crashes per 100 million vehicle miles traveled) increased from 24 to 30, a 25 percent increase over the previous winter. Last year, 7,137 winter crashes were reported.

Crash rates tend to correlate with winter severity. Compared with recent years that had similar severity indices, this winter's crash rate was similar. Figure 8 shows the trends in total crashes statewide over the last 20 years overlaid with the Winter Severity Index.

Figure 8. Crashes and Winter Severity Index



Using Performance Measures

Developed in 2001, Compass is WisDOT's quality assurance and asset management program for highway operations. As indicated in Table 3, this winter was more costly than the previous four winters when adjusted for winter severity. This winter, the success rate of getting bare/wet pavement within 4 or 6 hours (depends on road level of service) of the end of the storm increased from last year as did the total number of winter weather crashes.

Table 3. Statewide Compass Measures for Winter

	2014-15	2015-16	2016-17	2017-18	2018-19
Percentage of roads to bare/wet pavement (Within WisDOT target times)	70%	74%	70%	66%	69%
Cost per lane mile	\$2,155	\$2,087	\$2,537	\$2,821	\$3,212
Winter Severity Index	99.3	90.4	91.1	97.5	105.7
Cost per lane mile per Winter Severity Index point	\$21.71	\$23.09	\$27.85	\$28.93	\$30.39
Winter weather crashes	25 per 100 million VMT	18 per 100 million VMT	18 per 100 million VMT	24 per 100 million VMT	30 per 100 million VMT

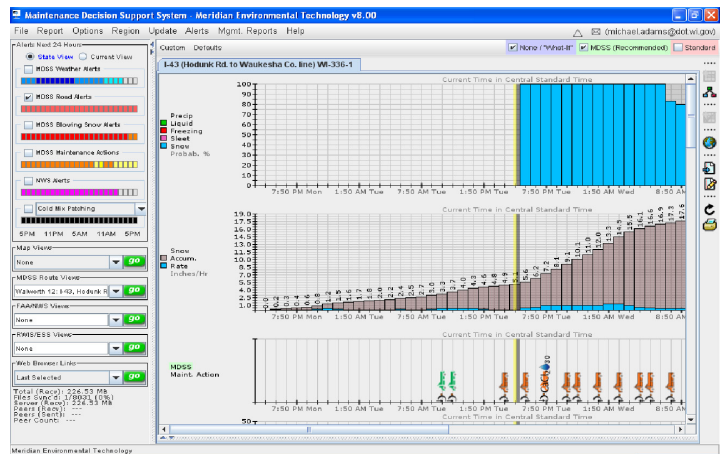
MDSS and AVL-GPS Initiative

MDSS is a major project undertaken by WisDOT since 2009. Highlights from 2018-2019 include:

MANAGEMENT TOOLS. WisDOT continued to collaborate with the MDSS Pooled Fund Technical Panel to develop new management tools for WebMDSS. Some new tools have already been implemented, but huge gaps remain between what was available in the desktop version and what is currently available in the web version. The pooled fund plans to have this completed by the end of summer 2019.

MONITORING. WisDOT began using new Google Analytics data to monitor usage. There are questions about whether all user data is being collected.

COORDINATION. WisDOT attended three MDSS Pooled Fund Study Technical Panel meetings in Sioux Falls, SD. We interacted with other pooled fund members to elicit ideas that would help WisDOT. We provided two presentations on WisDOT's experience in implementing MDSS and its winter operations. We worked with Iteris on a continuing basis to resolve any issues that arose and to better understand the workings of the system.



When integrated with AVL/GPS equipment, the MDSS system can show past applications and future treatments as well as actual precipitation amounts and predicted snowfall, with probabilities. The vertical line shows actual time with the past being to the left and the future to the right.

Looking Ahead

The Wisconsin Department of Transportation (WisDOT) Bureau of Highway Maintenance continues to look toward efficiencies that reduce winter maintenance costs. Using brine during winter storm events helps reduce salt use and can result in a significant reduction of material costs. Additionally, the reduction in salt can reduce impacts to roadside vegetation and the state's water resources.

WisDOT hired the University of Wisconsin – Madison Traffic Operations and Safety (TOPS) Laboratory in 2018 to collect data from these DLA routes and to research the effectiveness of different brine mixtures in varying weather conditions. The department will continue this effort with the UW TOPS Lab during the winter of 2019-20 with the goal to collect more data relating to these liquid routes. These results are expected to promote statewide use of liquids, as equipment is upgraded and personnel adapt to changes in winter maintenance practices. As part of similar research being performed by a Clear Roads Technical Advisory Committee led by WisDOT, the UW TOPS Lab has also been contracted to perform a nationwide analysis of this technique. This will allow for synergy between WisDOT's efforts and those occurring on a national level.

WisDOT will continue to explore other methods of reducing rock salt usage on the state highway system. Through our partnership with the counties, we will continue to implement route optimization, which has proven to enhance efficiency. The Maintenance Decision Support System (MDSS) continues to be refined, including the option of having treatment recommendations sent directly to plow drivers. This winter, MDSS will also include recommendations for DLA routes. Through the Wisconsin County Highway Association, winter maintenance training at all levels will be implemented using materials and methods created by Clear Roads and other expert sources.

All these efforts are aimed at providing users of Wisconsin's highways the safest possible experience despite harsh winter weather while WisDOT safeguards the state's natural environment by implementing sustainable practices.

Winter Operations Staff

Cody Churchill, P.E.
Winter Maintenance Engineer
cody.churchill@dot.wi.gov
(608) 266-0464

Michael J. Adams, Meteorologist
RWIS Program Manager
michael.adams@dot.wi.gov
(608) 266-5004



Wisconsin Department of Transportation
Division of Transportation System Development
Bureau of Highway Operations
4802 Sheboygan Ave., Room 501
P.O. Box 7986
Madison, WI 53707-7986