WINTER MAINTENANCE AT A GLANCE

2013-2014

Keeping Wisconsin Moving During the Polar Vortex

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 equipment, training, research initiatives, and testing of methods.

This summary document highlights key aspects of the 2013-14 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://www.dot.wisconsin.gov/travel/road/docs/2013-2014annualreport.pdf

Inside

Winter by the Numbers

For the second year in a row, Wisconsin experienced its most costly winter on record, breaking the previous record of $94,982,937 by nearly $10 million – the Department spent $113,473,270 in 2013-14 for winter maintenance. The state experienced an average of 43 winter storms this winter, resulting in an average of 101.5 total inches of snowfall. This average represented a 9 percent increase from last year's statewide average of 93.2 inches of snow.

This year the formula for the Winter Severity Index (WSI) was modified to make the number more easily understood – the result was a WSI of 133.64 for the winter of 2013-14, which was 16 percent higher than 2012-13 and 33 percent higher than the average of the previous five winters. Salt use was nearly 8 percent higher than 2012-13, at 669,807 tons. With the WSI now scaled to 100 being an average winter, it is easier at a glance to determine if the winter was above or below average in severity.

Table 1 summarizes key facts and statistics from this winter in several core areas. The 2013-14 Annual Winter Maintenance Report provides more detail on all topics addressed in this table.

Table 1. Statewide Summary: This Winter by the Numbers

	Measure	Previous Winter	2013-14
Infrastructure	Lane miles	34,192 miles	34,339 miles
	Patrol sections	769	753.5
	Average patrol section length	44.46 lane miles	45.57 lane miles
Weather	Average statewide Winter Severity Index	115.13	133.64
	Number of storms, statewide average and range across counties	Average: 36 Range: 23 to 65	Average: 43 Range: 30 to 69
	Snowfall, statewide average and range across counties	Average: 93.2 inches Range: 43 to 249 inches	Average: 101.5 inches Range: 56 to 233 inches
Materials[1]	Salt used	621,207 tons 18.2 tons per lane mile	669,807 tons 19.5 tons per lane mile
	Average cost of salt	$58.34 per ton	$60.40 per ton
	Prewetting liquid used	2,124,834 gal.	2,970,166 gal.
	Anti-icing agents used	1,110,886 gal.	887,415 gal.
	Sand used	18,589 cubic yd.	58,870 cubic yd.
Costs and Performance	Total winter costs[2]	$94,982,937	$113,473,270
	Total winter costs per lane mile	$2,778	$3,304
	Average crew reaction time from start of storm	2.42 hours	7.03 hours
	Percentage of roads to bare/wet pavement (Within WisDOT target times)	73%	63%
	Road Weather Information System (RWIS) stations	60	58
	Counties equipped to use anti-icing agents	66 of 72 (92%)	66 of 72 (92%)
	Counties that used anti-icing agents during the winter season	65 of 72 (90%)	63 of 72 (88%)
Labor and Services	Regular county winter labor hours[3]	212,090 hrs.	244,602 hrs.
	Overtime county winter labor hours	137,225 hrs.	182,311 hrs.

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.

Another Record-Breaking Winter

The 2013-14 winter season was one for the record books for Wisconsin, with the incursions of the polar vortex bringing extremely low temperatures to the Upper Midwest, combined with higher than average snowfall. Numerous fairly light snow events impacted the state almost non-stop from December into early April.

After a relatively benign November, winter weather arrived in earnest in early December. Numerous winter weather events impacted the entire state, with the most severe of them hitting northwest Wisconsin. Many locations across the state set daily snowfall records in December.

January brought a continuation of snowy conditions, as well as bitterly cold temperatures, with average daily low temperatures below zero across all but far southeastern Wisconsin. Snowfall was well above average, with two significant snow events each bringing over 6 inches of snow to many locations during last week of January.

February brought little change, with two more major snow events striking the state. On February 4, southern Wisconsin was hit, then on February 20 an even heavier snow event blanketed the northwest with as much as 18 inches. Adding to the challenge of keeping the roads open were below average temperatures.

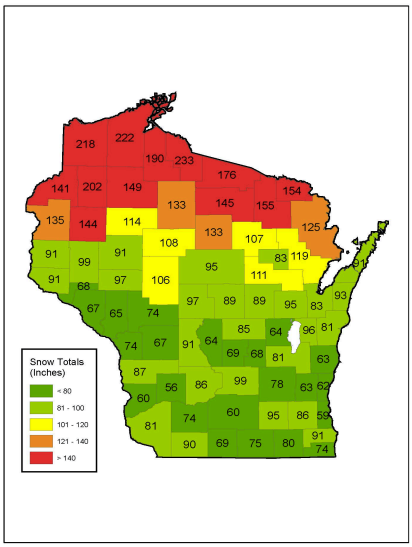
Well-below-average temperatures lingered into March. Several snow events also occurred, especially across northern Wisconsin. These trends continued even into April, as several additional snow events impacted the northern areas.

During the 2013-14 winter season, county highway departments responded to:

- A statewide average of 43 winter storm events per county, with a high of 69 snow events in Iron County and a low of 30 in Kewaunee County.
- A statewide average of 4 frost events.
- A statewide average of 6 freezing rain events.

Figure1 shows the total snowfall received in Wisconsin this winter based on storm report data. Snowfall varied quite a bit across the state; the highest snowfall recorded was in Iron County at 233 inches; the lowest was in Richland County at 56 inches. Statewide, this winter's total snowfall was well above average.

Figure 1. Statewide Snowfall, 2013-14

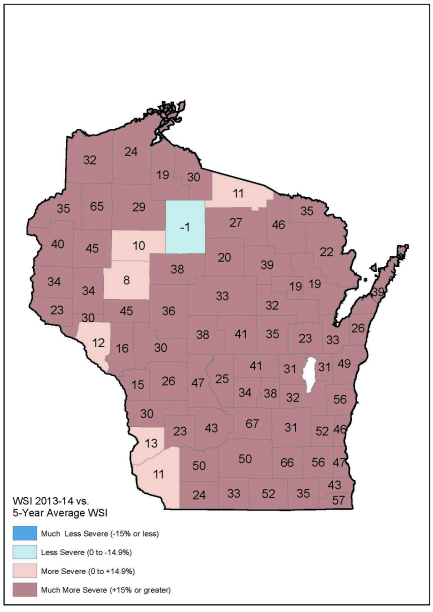


Statewide average: 101 inches

Note: Snowfall totals are based on winter storm reports data.

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. 2013-14 Winter Severity Index vs. 5-Year Average

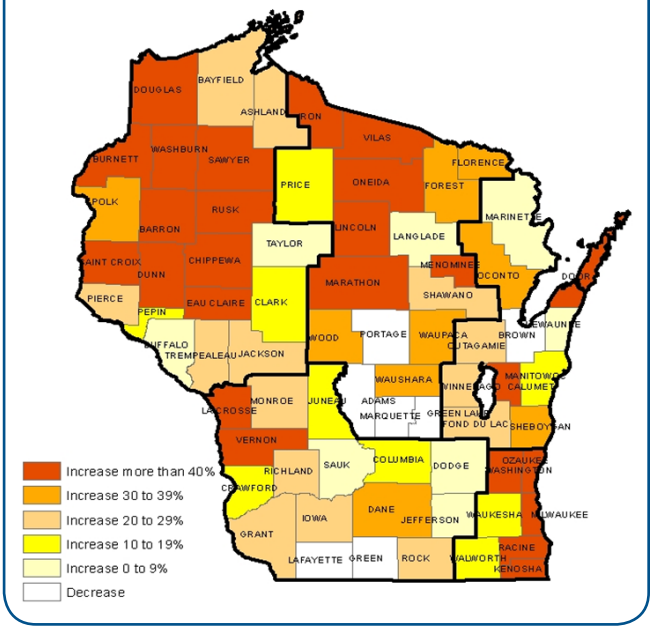


Salt and Anti-icing Work Together

Salt use last winter was about 8 percent higher than in 2012-13, at 669,807 tons. WisDOT encourages counties to use salt more efficiently by making use of best practices, such as anti-icing and prewetting. Both practices are used not only across the country, but throughout the world. The amount of anti-icing materials used statewide declined 20 percent from 2012-13, to 887,145 gallons. The 2,970,166 gallons of prewetting materials used last winter represented a 40 percent increase from the amount used in 2012-13.

WisDOT actively discourages counties from using sand on the state trunk highway system since sand is not effective at high traffic speeds, negatively impacts the environment, and ultimately decreases the level of service provided. However, counties used 58,870 cubic yards of sand on state highways in 2013,14, which was 172 percent higher the previous 5-year average sand usage. For more information on the disadvantages of sand use, see a report prepared for WisDOT through the Clear Roads pooled fund project at: http://www.clearroads.org/synthesis-reports.html.

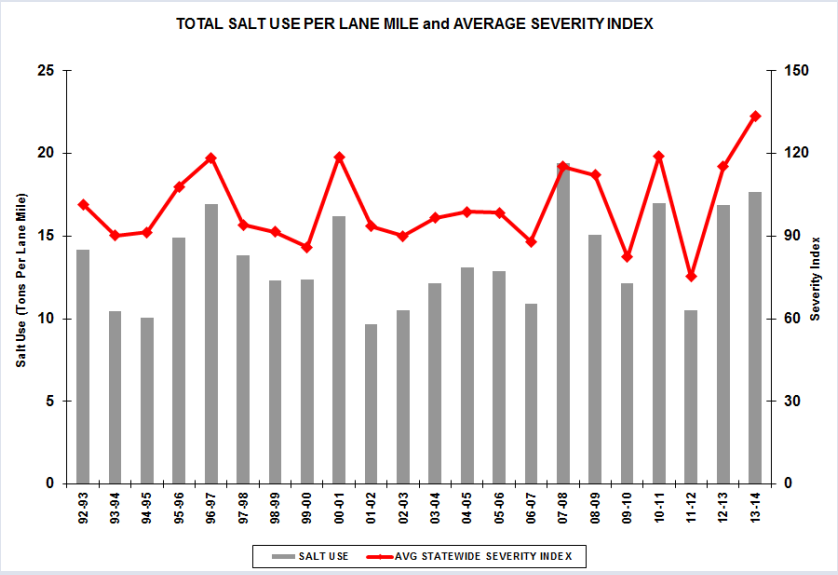
Figure 3. 2013-14 Salt Use per Lane Mile vs. 5-Year Average



Wisconsin counties applied a statewide average of 19.5 tons of salt per lane mile on state highways, an increase of 7 percent from 2012-13. When compared with nearby states, which differ by winter severity, availability of affordable salt, and level of winter service standards (such as prescribing less salt and more sand), Wisconsin salt use is relatively high. In 2009-10, the last year for which comparable data was available, Wisconsin used 12.2 tons of salt per lane mile on state highways. In that same year, Minnesota (5.9 tons per lane mile), Iowa (9.8) and Indiana (11.8) used less, while Illinois (12.3) and Michigan (12.6) used more.

Figure 4. Salt Use per Lane Mile and Average Severity Index

From Salt Inventory Reporting System, 1992–2014



Higher Labor and Equipment Costs

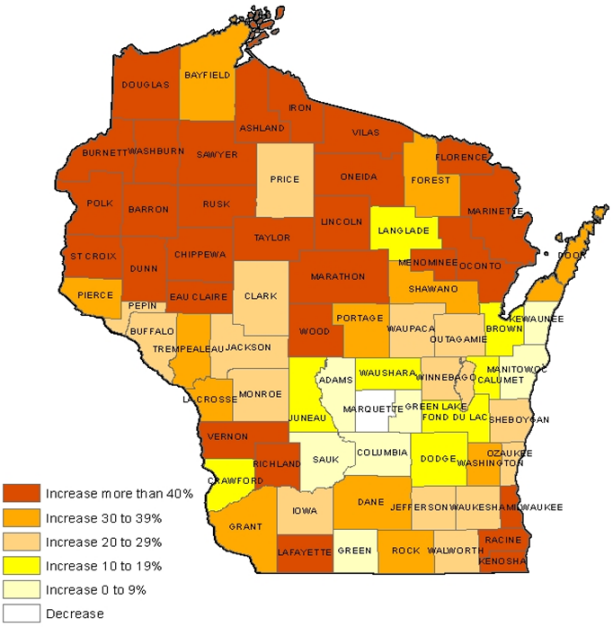
The total cost of statewide winter operations this winter was $113 million, making it 19 percent more costly than 2012-13 and 43 percent more costly than the average of the previous five winters (2008-09 thru 2012-13).

This winter's statewide average cost per lane mile of $3,304 was 19 percent higher than last year's cost of $2,778 per lane mile and was double the per lane mile cost of $1,656 in 2011-12.

In 2013-14, WisDOT spent $40.5 million on salt, $38.2 million on equipment-related expenses, $28.8 million on labor, and $2.8 million on materials other than salt, such as sand. Administrative costs added $3.3 million to the total. Anti-icing activities continue to represent a very small part of total winter maintenance expenditures – this year only about 0.5 percent.

In general, winter costs per lane mile tend to increase as the statewide average winter severity increases. Increases in labor rates and salt pricing also affect overall winter maintenance costs, even in less severe winters. Since 2013-14 was an extremely severe winter, unsuprisingly, maintenance costs were very high. Total salt expenditures increased by 7.3 percent compared to 2012-13, despite only a 3.5 percent increase in the cost per ton. Expenditures for materials other than salt nearly doubled, inreasing by 95 percent. Labor and equipment costs increased by 22 percent and 30 percent, respectively. Salt continues to be the single largest expenditure, accounting for nearly 36 percent of all winter maintenance costs (see Figure 7).

Figure 5. 2013-14 Winter Costs vs. 5-Year Average



Salt prices remain high nationwide, due in part to higher fuel prices and increased demand: The 2013-14 average of $60.40 per ton was 71 percent higher than the average price of $35.22 per ton just eight winters ago. Figure 6 shows the upward trend in salt prices for Wisconsin and for 14+ states nationwide.

Figure 6. Salt Prices Over Time

Average cost per ton of salt for 14+ states

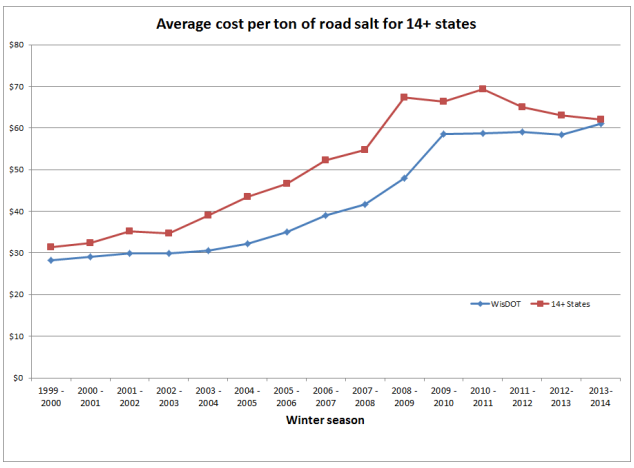
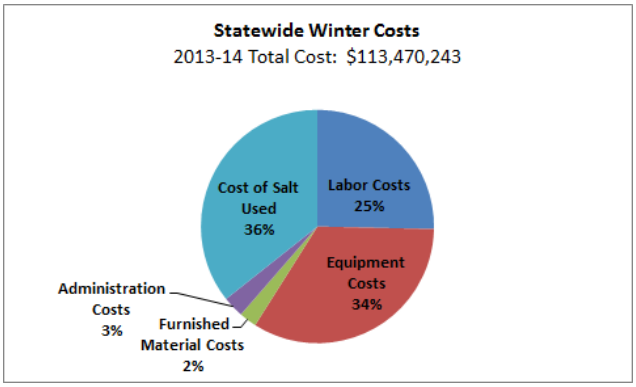


Figure 7. Expenditures by Category, 2013-14



Coordinating Counties' Response

During the 2013-14 winter, WisDOT continued its emphasis on close communication between the counties and WisDOT regional staff. Before each winter storm 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. WisDOT regions worked closely with the Wisconsin State Patrol in advance of storm events to ensure readiness across the affected areas. WisDOT personnel helped staff 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. Post-storm analysis of the crews' response remains a challenge that the department plans to address in future winters.

Tracking the Winter

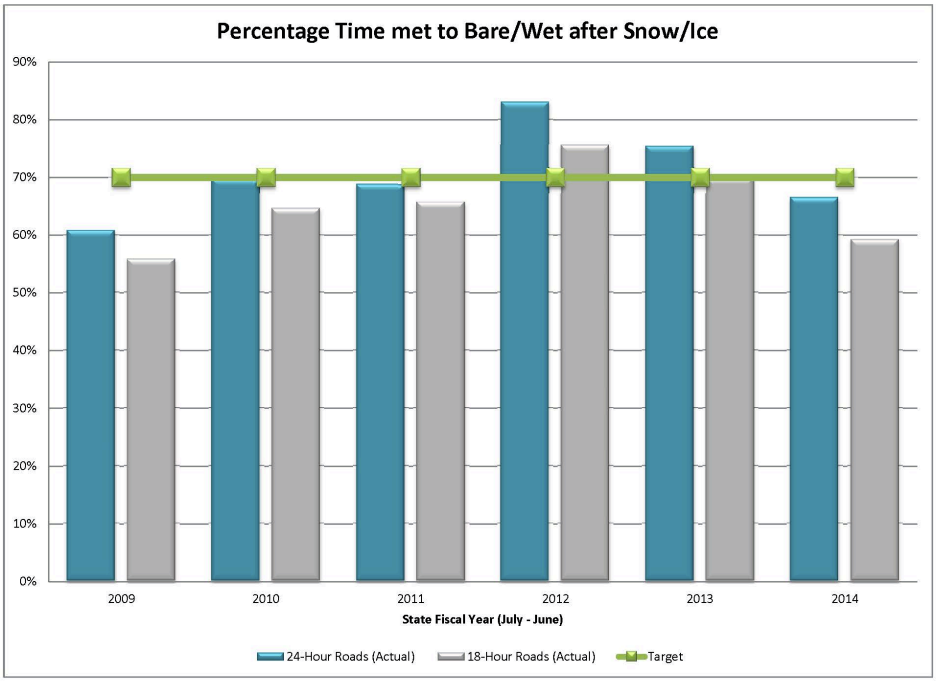
Each week during winter, representatives from the 72 county highway departments complete winter storm reports. These reports give WisDOT the ability to manage statewide materials use and maintenance expenses as the winter progresses. Winter storm reports are also used to create the "Winter Severity Index"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

Response Time

The counties continue to strive to be more proactive in responding to winter storm events, but in 2013-14, the average crew response time increased in every Service Group, for a statewide average of 7 hours, which was 4 hours and 36 minutes slower than 2012-13. As expected, average response times in the more urban counties, which provide the highest level of service (24-hour coverage), were better than in those counties that are directed to provide 18-hour coverage.

"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 4 hours of the end of the storm and 18-hour roads to be clear within 6 hours at least 70 percent of the time. This year, on average statewide, 63 percent of roads were to bare/wet pavement within the targeted time frame (see Figure 8).

Figure 8. Mobility Performance Measure, 2009-10 thru 2013-14



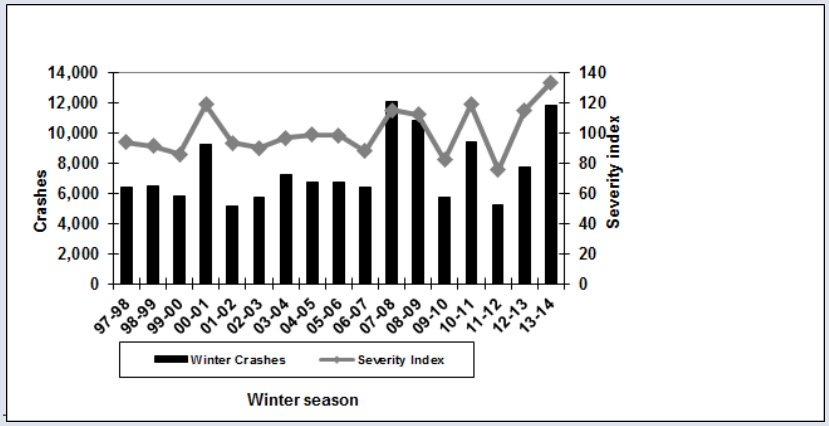
Analyzing Travel and Crashes

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 11,837 winter weather crashes (those that occurred on pavements covered with snow, slush or ice), which was a 53 increase from 2012-13.

The crash rate (number of crashes per 100 million vehicle miles traveled) also increased this year, to a statewide average of 44, which was up from the 2012-13 crash rate of 29.

Crash rates tend to correlate with winter severity, increasing when the severity index increases. This pattern was repeated in 2013-14, with both the severity index and the crash rate increasing. Figure 8 shows the trends in total crashes statewide over the last 16 years overlaid with the Winter Severity Index.

Figure 9. Winter Crashes & Severity Index since 1997-98



Using Performance Measures

Developed in 2001, Compass is WisDOT's quality assurance and asset management program for highway operations. Measures for winter operations were first established in 2003. As indicated in Table 2, on a per lane mile basis, 2013-14 was the most costly winter on record, but was actually less costly than 2009-10 when adjusted for winter severity. The success rate in getting to bare/wet pavement within 4 or 6 hours (depending on road level of service) of the end of the storm was the poorest in five years, and the winter weather crash rate increased dramatically.

Table 2. Statewide Compass Measures for Winter

	2009-10	2010-11	2011-12	2012-13	2013-14
Percentage of roads to bare/wet pavement (Within WisDOT target times)	67%	79%	79%	73%	63%
Cost per lane mile	$2,222	$2,696	$1,656	$2,778	$3,304
Winter Severity Index	82.4	119.2	75.4	115.2	1336
Cost per lane mile per Winter Severity Index point	$26.97	$22.62	$21.96	$24.11	$24.73
Winter weather crashes	22 per 100 million VMT	35 per 100 million VMT	20 per 100 million VMT	29 per 100 million VMT	44 per 100 million VMT

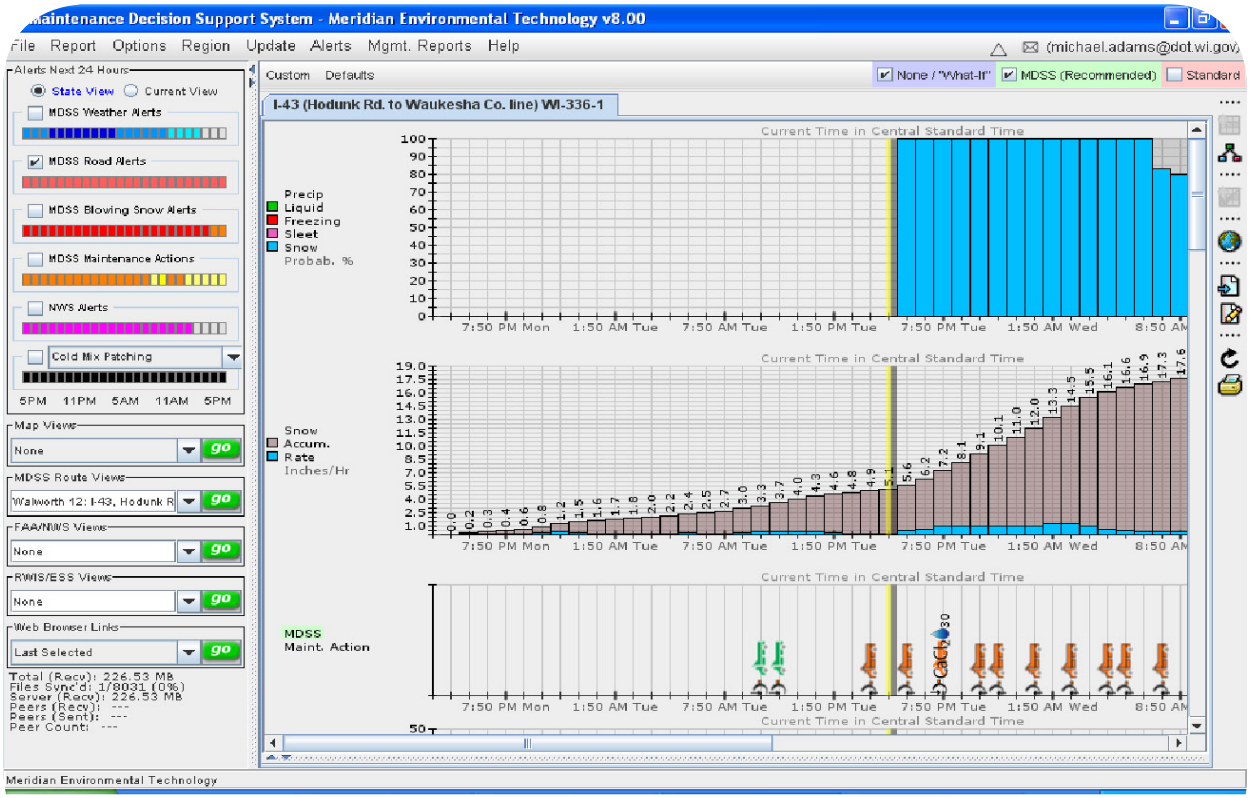
MDSS and AVL-GPS Initiative

The Maintenance Decision Support System (MDSS) was initially deployed in Wisconsin in 2009, and became fully operational in 2011. The MDSS combines state-of-the-art weather forecasting with WisDOT's rules of practice to generate treatment recommendations for plow routes statewide. Ideally, the system would include real-time information from plow trucks that is gathered via the Automatic Vehicle Location/Global Positioning System (AVL/GPS), but sharp increases in licensing fees forced the Department to eliminate this live data feed. AVL/GPS data is still being gathereed, but just not in real-time.

Most county highway departments are using MDSS to aid in handling winter storms. The accuracy of the weather forecasts generated by the system has been very good.

WisDOT continues to participate in the MDSS Pooled Fund Study, an efrfort that now includes 12 other Snow Belt states. This group continues to push MDSS technology forward. For example, in the past couple years, a browser-based version of the software, as well as mobile applications for both Android and Apple operating systems have been developed and deployed – making MDSS access easier than ever for all users.

Forty-eight of Wisconsin's 72 county highway departments have implemented AVL/GPS in full or in part in their fleet of plow trucks. This effort was funded by Intelligent Transportation System (ITS) grants from WisDOT. Some ITS funding still remains available if additional counties wish to deploy the system in their vehicles.



When integrated with AVL/GPS equipment, theMDSS 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 thepast being to the left and the future to the right.

Where do we go from here?

The winter of 2013-14 was the most expensive winter in history. It had the highest severity index and highest salt use. It seemed as if winter would never end.

In 2014-15, WisDOT will continue to work on implementing and expanding the best practices. However, focus over the next year will move towards identifying service providers who are efficient and cost effective as the department will explore full implementation of the best management practices.

Areas of focus for the 2014-15 winter:

1. AVL/GPS (Automatic Vehicle Location/Global Positioning System) has become standard equipment and is now being utilized in 49 counties. The effort to implement the technology statewide is proceeding with a higher emphasis on service providers with Interstates and Expressways and with counties that are actively using the MDSS forecasting-treatment recommendation program. The goal is to expand to 60 counties.
2. WisDOT is going to partner with Dane County Highway Department to conduct a route optimizing study on Dane County's highways. Software called 'Route Smart' is being jointly purchased for the study.
3. WisDOT will focus MDSS user training on the transition to the web-based version, as well as the mobile version. WiSOT will continue implementing the improved reporting capabilities of MDSS and will continue to study the use of MDSS data to develop an objective winter severity index.
4. Mixing liquid deicers is becoming more popular nationwide, as is the technique of getting more liquids on the roadway during plowing operations. We will work with counties to begin investigating and testing these techniques.
5. Snowplow operator training modules for operators and supervisors will continue to be developed by Clear Roads in 2014-15 and will be implemented in 2016.

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