ANNUAL WINTER MAINTENANCE REPORT

2009–2010

Meeting Challenges with Innovations

Wisconsin Department of Transportation
Division of Transportation System Development
Bureau of Highway Maintenance
Winter Operations Unit

November 2010

Acknowledgments

Many people at Wisconsin DOT contributed to the development of this report, including:

Mike Sproul, Bureau of Highway Maintenance
Mike Adams, Bureau of Highway Maintenance
Cathy Meinholz, Bureau of Highway Maintenance
Lisa Meinholz, Bureau of Highway Maintenance
Mary McFarlane, Bureau of Transportation Safety
Bruce Aunet, Bureau of State Highway Programs

We wish to thank these individuals for their contributions to and assistance with this report.

In addition, we extend our thanks to Monty Mills of Washington State DOT for the use of his map of nationwide salt costs (see page 52).

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1 Introduction

To our partners

Wisconsin endured the third most expensive winter in history in 2009–2010, on the heels of the record-setting 2007–2008 season.

The winter was not as severe as several past winters but with an above average winter in combination with rising labor and equipment costs, it is becoming increasingly difficult to manage winter operations within the current budget.

Again this year we commend the county maintenance crews for their dedicated response to a harsh winter, and we recognize the role of WisDOT regional staff in coordinating these efforts. We continually stress the importance of improving processes and procedures for snow removal and especially applaud the counties for working closely with us in partnership to give the taxpayers in Wisconsin an acceptable level of service for a reasonable cost. To capture these efforts, this report features:

- Five sections that correspond to the key components of winter and the counties' response, including Introduction, Winter Weather, Snow and Ice Control, Performance, and Looking Ahead.
- Two key tables that summarize important data at a glance: Winter by the Numbers (page 6) highlights statewide facts and figures, and has been expanded this year to include more data as well as information about the previous winter. Winter in Wisconsin (page 10) compiles key data for all 72 counties. These tables should be a first point of reference throughout the year whenever you need a winter statistic.
- Three maps that compare key data for this winter with the previous five years. These maps visually put each county's experience with winter severity (page 21), salt use (page 34) and total costs (page ???) in the context of what's normal for that county.
- Two graphs that put Wisconsin's experience with salt costs in the context of what other states pay (pages 34 and 35), and a map of salt cost data for all snowy states compiled by Washington State DOT (page 36).
- Best Practices sidebars throughout the report that highlight efficient practices.

Because this report has a wide and diverse audience, the text includes some explanations of winter maintenance technologies and best practices, such as anti-icing, prewetting, and use of Road Weather Information Systems. The State Highway Maintenance Manual is the first resource for more information on any of these items, and there are other resources available on WisDOT's extranet site. Links to these resources are provided throughout this report. For more information, contact your regional WisDOT representative or Mike Sproul, WisDOT's state winter operations engineer, at michael.sproul@dot.wi.gov.

Sincerely,

David Vieth, Director
Bureau of Highway Maintenance

Table 1.1. Statewide Summary: This Winter by the Numbers

		2008-2009 winter	2009–2010 winter
Infrastructure	Lane miles	33,531 miles	**33,532 miles**
	Patrol sections	762	**767**
	Average patrol section length	45.54 lane miles	**43.72 lane miles**
Weather	Average statewide Winter Severity Index	36.2	**26.6**
	Number of storms, statewide average and range across counties	Average: 36 Range: 25 to 71	**Average: 24** **Range: 16 to 45**
	Snowfall, statewide average and range across counties	Average: 90.2 inches Range: 58 to 215 inches	**Average: 60.8 inches** **Range: 23 to 204 inches**
Materials[1]	Salt used	569,985 tons 17.0 tons per lane mile	**408,523 tons** **12.2 tons per lane mile**
	Average cost of salt	$47.19 per ton	**$60.92 per ton**
	Prewetting liquid used	1,321,290 gal.	**1,099,971 gal.**
	Anti-icing agents used	500,673 gal.	**683,144 gal.**
	Sand used	44,179 cubic yd.	**19,081 cubic yd.**
Costs, Equipment and Performance	Total winter costs[2]	$79,313,896	**$74,506,207**
	Total winter costs per lane mile	$2,365	**$2,222**
	Average crew reaction time from start of storm	2.57 hours	**3.18 hours**
	Time to bare/wet pavement (measured from end of storm)	2.54 hours	**1.14 hours**
	Road Weather Information System (RWIS) stations	58	**58**
	Counties with salt spreaders equipped with on-board prewetting unit	55 of 72 (72%)	**55 of 72 (76%)**
	Counties with salt spreaders equipped with ground-speed controller unit	67 of 72 (93%)	**67 of 72 (93%)**
	Underbody plows	572	**572**
	Counties with underbody plows	55 of 72 (76%)	**55 of 72 (76%)**
	Counties equipped to use anti-icing agents	65 of 72 (90%)	**65 of 72 (90%)**
	Counties that used anti-icing agents during the winter season	54 of 72 (72%)	**62 of 72 (86%)**
Labor and Services	Regular county winter labor hours[3]	148,655 hrs.	**133,715 hrs.**
	Overtime county winter labor hours	176,636 hrs.	**106,578 hrs.**
	Public service announcements aired	5,948 total 5,340 radio; 608 TV	**6,754 total** **6,122 radio; 632 TV**
	Cost of public service announcements	$36,500 ($288,895 market value)	**$36,000** **($259,062 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.

About This Report

Every year, WisDOT gathers a multitude of data on winter weather and the state's response to it. Tracking and analyzing this data helps us become more efficient by identifying good performance as well as areas that need improvement. In this way we use our limited resources to achieve the greatest benefit.

Through this report, WisDOT's Bureau of Highway Maintenance shares data with the department's regional maintenance staff and with our partners in the county highway departments. This allows regional and county staff to compare resource use with that of their peers across the state. The report has also been shared with the WisDOT Secretary's Office, the state legislature, national organizations such as Clear Roads, and the general public.

Report Structure and Data Sources

Following this section, this report is divided into four main sections:

Section 2: Weather
Section 3: Snow and Ice Control
Section 4: Performance
Section 5: Looking Ahead

Each section has several subsections; refer to the Table of Contents for more detail. To improve readability, this year's report includes more statewide summary tables within the text, while county-by-county data appears at the end of each section.

Within many of the county-by-county tables in this report, the counties are grouped by region, in acknowledgement of the role that WisDOT's regional staff plays in coordinating winter maintenance in their counties. In some tables, counties are divided by Winter Service Group (Groups A, B, C and D), which reflect the difference in the level of service provided on roads in these counties and facilitate comparisons within these groups. See Tables 1.3 and 1.4 on page 9 for more information on Winter Service Groups.

In most tables, raw numbers (such as total salt used) are presented along with data that has been adjusted for differences between counties (such as salt used per lane mile per Winter Severity Index point). This allows more accurate comparisons between regions in different parts of the state.

This report presents data from several sources:

- The weekly winter storm reports completed by the county highway departments, which detail the counties' estimates of the weather they faced and the materials, equipment and labor they used in responding to it. (See Section 4 for more information about storm reports.)
- Final cost and materials data as billed to WisDOT.
- Data on weather, crashes, travel and other topics from other bureaus within WisDOT and other agencies.

The final billed amounts are considered the most accurate source of cost and materials data, and are presented wherever possible. The source of the data in each table is indicated in the table's heading.

When interpreting the data in this report, readers should remember that many factors affect a county's response to winter, including the local Winter Severity Index, local traffic generators, the mix of highway types and classifications in a county, the type of equipment being used, and the length of patrol sections. Some tables in this report give data that is adjusted for one or more of these factors (for example, salt use per lane mile per severity index point), while others provide raw data.

Working with County Highway Departments

WisDOT's Bureau of Highway Maintenance, in partnership with the five WisDOT regional offices, is responsible for the maintenance of the state trunk and Interstate highway system. This system includes 33,532 lane miles of highway and 4,511 bridges.

WisDOT contracts with the state's 72 county highway departments to plow and provide ice control on all state- and U.S.-owned highways in Wisconsin, including the Interstate system. This partnership was set up more than 90 years ago, and to our knowledge, it is unique in the nation.

This relationship benefits both WisDOT and the county highway departments. WisDOT receives the services of a skilled, experienced work force at fair labor rates, and the counties are able to purchase more pieces and types of equipment than they could otherwise afford. This equipment is then available for use on both county and state roads, an arrangement that allows WisDOT and the counties to avoid duplicating equipment purchases and having crews or equipment sitting idle.

Staff at WisDOT's five regional offices work closely with the county highway departments. Regional managers administer the contracts with the counties, and work with the counties to plan maintenance activities and set priorities. Regional staff oversee county highway departments' maintenance expenditures, and are responsible for ensuring that the counties use resources efficiently and adhere to state guidelines for materials use. Regional staff also serve as a resource for the counties on state and federal rules and regulations, and can provide training assistance.

Figure 1.1. WisDOT Regional Divisions

Snow Removal Strategy

In order to gain the most benefit from limited resources, counties provide different levels of service on highways according to the amount of daily traffic they receive. High-volume roads typically receive 24-hour coverage, while lower-volume roads receive 18-hour coverage. On lower-volume four-lane highways, the passing lanes may receive less attention than the driving lanes and ramps.

Table 1.2. Highway Categories for Winter Maintenance

Category	Definition	Lane miles	% of total
1	Major urban freeways and most highways with six lanes and greater	2,720	8%
2	High volume four-lane highways (Average Daily Traffic ≥ 25,000) and some four-lane highways (ADT < 25,000), and some 6-lane highways.	3,228	10%
3	All other four-lane highways (ADT < 25,000)	8,538	25%
4	Most high volume two-lane highways (ADT ≥ 5,000) and some 2-lanes (ADT <5000)	4,946	15%
5	All other two-lane highways	14,100	42%
Total		33,532	

Table 1.2 shows how WisDOT categorizes the state's highways for winter maintenance. For more detail on the categories and which category each highway is assigned to, see the 2009 map on page 110 in the Appendix.

To facilitate comparisons between counties that provide similar levels of service, WisDOT divides the 72 counties into four Winter Service Groups—A, B, C and D, with A being the most urban and D the most rural. Table 1.3 explains the divisions between the groups. In many tables throughout this report, the counties are arranged according to these groups. Group A contains the fewest counties, while Group D has the most.

Table 1.4 shows which service group each county is assigned to.

In addition, each county highway department divides its highways into winter patrol sections. One snowplow truck is generally assigned to each patrol section. This winter, there were 767 patrol sections on state-maintained highways, with an average of 43.72 lane miles per patrol section. Patrol section length is another factor that can affect performance; see Section 4 for a complete discussion of patrol sections.

Table 1.3. County Winter Service Groups

Winter Service Group	Definition	Number of Counties	% of Counties
A	Counties where all or most of the highways receive 24-hour coverage	12	17%
B	Counties with 18-hour and 24-hour coverage. More than 50% of highways receive 24-hour coverage.	17	24%
C	Counties with 18-hour and 24-hour coverage. Less than 50% of highways receive 24-hour coverage.	21	29%
D	Counties where no highways receive 24-hour coverage.	22	31%

Note: Percentage totals exceed 100% due to rounding.

Table 1.4. Winter Service Group Assignments

Winter Service Group	County Name
A	Brown, Dane, Eau Claire, Kenosha, La Crosse, Marathon, Milwaukee, Ozaukee, Portage, Racine, Waukesha, Winnebago
B	Chippewa, Columbia, Dodge, Dunn, Jefferson, Manitowoc, Marquette, Oneida, Outagamie, Rock, Sauk, Shawano, Sheboygan, St. Croix, Walworth, Washington, Waushara
C	Calumet, Clark, Crawford, Door, Douglas, Fond du Lac, Grant, Iowa, Jackson, Juneau, Kewaunee, Lafayette, Lincoln, Monroe, Oconto, Trempealeau, Vernon, Vilas, Washburn, Waupaca, Wood
D	Adams, Ashland, Barron, Bayfield, Buffalo, Burnett, Florence, Forest, Green, Green Lake, Iron, Langlade, Marinette, Menominee, Pepin, Pierce, Polk, Price, Richland, Rusk, Sawyer, Taylor

This Winter in Wisconsin

Table 1.5 on page 13 summarizes key data from this winter for all 72 counties, including total salt use and cost data. This table facilitates comparisons in these core areas across regions and counties, and serves as a quick reference for commonly used data. The table uses a similar format to the Storm Report Summary (Table A-1 on page 111 of the Appendix), but the cost data in Table 1.5 are actual billed costs as submitted to WisDOT by the counties, rather than estimates from the storm reports.

County-by-County
Quick Reference Winter Summary Table
for Section 1: Introduction

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Table 1.5. Winter in Wisconsin, 2009-2010												
	County	Lane miles	Severity Index	Snowfall (inches)	Total salt used (tons)	Salt used (tons) per lane mile	Salt used per lane mile per Severity Index	Total salt costs	Total salt costs per lane mile	Total winter costs	Total winter costs per lane mile	Total winter costs per lane mile per Severity Index
North Central Region												
	Adams	192.72	29.92	50.7	2,465	12.79	0.43	$165,722	$860	$428,900	$2,226	$74.38
	Florence	141.07	29.77	68.6	1,862	13.20	0.44	$119,168	$845	$335,462	$2,378	$79.88
	Forest	312.38	31.51	67.3	4,351	13.93	0.44	$278,029	$890	$679,360	$2,175	$69.02
	Green Lake	151.30	24.65	61.6	758	5.01	0.20	$48,906	$323	$209,067	$1,382	$56.06
	Iron	250.91	46.53	209.4	3,892	15.51	0.33	$259,441	$1,034	$764,734	$3,048	$65.50
	Langlade	292.69	23.42	46.0	2,451	8.37	0.36	$152,722	$522	$496,499	$1,696	$72.43
	Lincoln	418.33	32.30	65.0	3,439	8.22	0.25	$227,662	$544	$701,183	$1,676	$51.89
	Marathon	880.19	27.83	34.1	7,329	8.33	0.30	$485,180	$551	$1,492,605	$1,696	$60.93
	Marquette	244.53	18.39	55.0	3,420	13.99	0.76	$229,721	$939	$501,681	$2,052	$111.56
	Menominee	90.26	22.48	68.8	1,251	13.86	0.62	$75,848	$840	$85,167	$944	$41.97
	Oneida	396.79	36.32	77.7	3,726	9.39	0.26	$253,368	$639	$990,706	$2,497	$68.74
	Portage	547.20	26.31	38.6	5,278	9.65	0.37	$344,126	$629	$984,598	$1,799	$68.39
	Price	320.57	37.23	56.1	3,103	9.68	0.26	$208,149	$649	$666,044	$2,078	$55.81
	Shawano	515.09	29.42	61.6	5,454	10.59	0.36	$325,440	$632	$1,052,125	$2,043	$69.43
	Vilas	305.24	36.76	99.1	3,712	12.16	0.33	$248,518	$814	$890,599	$2,918	$79.37
	Waupaca	546.64	21.04	54.9	5,388	9.86	0.47	$318,323	$582	$968,700	$1,772	$84.23
	Waushara	345.71	17.25	40.9	2,393	6.92	0.40	$154,133	$446	$523,950	$1,516	$87.86
	Wood	372.22	25.31	42.3	3,357	9.02	0.36	$234,688	$631	$657,237	$1,766	$69.76
Region total		**6,323.84**			**63,629**			**$4,129,144**		**$12,428,617**		
Region average		**351.32**	**28.69**	**66.5**	**3535**	**10.06**	**0.35**	**$229,397**	**$653**	**$690,479**	**$1,965**	**$68.50**

Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.

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Northeast Region												
	Brown	711.91	20.33	43.2	9,577	13.45	0.66	$541,867	$761	$1,762,360	$2,476	$121.77
	Calumet	201.29	28.95	56.0	1,225	6.09	0.21	$72,336	$359	$401,635	$1,995	$68.92
	Door	268.55	23.64	43.9	3,073	11.44	0.48	$185,302	$690	$528,009	$1,966	$83.17
	Fond du Lac	599.20	23.23	55.9	6,251	10.43	0.45	$372,935	$622	$1,272,178	$2,123	$91.40
	Kewaunee	110.41	23.77	54.5	995	9.01	0.38	$58,506	$530	$237,764	$2,153	$90.60
	Manitowoc	417.99	23.64	70.1	6,089	14.57	0.62	$343,846	$823	$1,082,319	$2,589	$109.53
	Marinette	417.29	29.16	63.9	3,495	8.38	0.29	$204,038	$489	$682,711	$1,636	$56.11
	Oconto	471.83	28.95	73.1	4,403	9.33	0.32	$257,047	$545	$828,584	$1,756	$60.66
	Outagamie	523.98	24.09	51.5	6,298	12.02	0.50	$361,379	$690	$1,340,531	$2,558	$106.20
	Sheboygan	520.30	23.69	57.0	6,970	13.40	0.57	$411,927	$792	$1,206,340	$2,319	$97.87
	Winnebago	568.31	20.77	43.4	6,952	12.23	0.59	$413,992	$728	$1,405,535	$2,473	$119.07
Region total		**4,811.06**			**55,328**			**$3,223,174**		**$10,747,964**		
Region average		**437.37**	**24.57**	**55.7**	**5030**	**11.50**	**0.47**	**$293,016**	**$670**	**$977,088**	**$2,234**	**$90.94**

Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.

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Northwest Region												
	Ashland	247.57	43.38	190.3	2,417	9.76	0.23	$159,522	$644	$562,322	$2,271	$52.36
	Barron	423.09	31.23	58.0	1,596	3.77	0.12	$109,326	$258	$683,186	$1,615	$51.71
	Bayfield	316.90	42.88	127.4	3,170	10.00	0.23	$202,468	$639	$705,766	$2,227	$51.94
	Buffalo	316.05	24.47	43.4	1,768	5.59	0.23	$105,019	$332	$336,833	$1,066	$43.55
	Burnett	233.64	24.77	56.6	1,708	7.31	0.30	$107,689	$461	$363,177	$1,554	$62.75
	Chippewa	669.29	26.60	49.4	7,176	10.72	0.40	$503,755	$753	$1,236,245	$1,847	$69.44
	Clark	402.28	25.55	55.4	3,187	7.92	0.31	$227,871	$566	$674,143	$1,676	$65.59
	Douglas	439.23	30.33	125.2	3,591	8.18	0.27	$217,974	$496	$861,493	$1,961	$64.67
	Dunn	516.55	22.14	46.9	5,182	10.03	0.45	$343,878	$666	$989,512	$1,916	$86.52
	Eau Claire	537.26	21.82	45.1	5,382	10.02	0.46	$330,993	$616	$900,194	$1,676	$76.79
	Jackson	514.30	28.44	77.0	5,763	11.21	0.39	$391,538	$761	$956,631	$1,860	$65.40
	Pepin	111.05	21.72	39.5	730	6.57	0.30	$47,034	$424	$166,999	$1,504	$69.24
	Pierce	366.08	32.49	53.9	3,238	8.85	0.27	$206,455	$564	$650,933	$1,778	$54.73
	Polk	385.05	27.97	52.1	3,840	9.97	0.36	$238,042	$618	$644,645	$1,674	$59.86
	Rusk	213.47	29.65	70.4	1,740	8.15	0.27	$118,320	$554	$315,923	$1,480	$49.91
	St. Croix	618.98	26.43	53.4	6,051	9.78	0.37	$359,853	$581	$1,199,401	$1,938	$73.31
	Sawyer	367.44	26.51	77.1	2,292	6.24	0.24	$157,415	$428	$494,710	$1,346	$50.79
	Taylor	233.25	27.78	43.8	2,071	8.88	0.32	$153,461	$658	$420,879	$1,804	$64.95
	Trempealeau	434.99	21.99	22.7	4,288	9.86	0.45	$255,822	$588	$699,714	$1,609	$73.15
	Washburn	372.14	23.44	58.0	2,454	6.59	0.28	$164,418	$442	$624,121	$1,677	$71.55
Region total		**7,718.61**			**67,644**			**$4,400,852**		**$13,486,826**		
Region average		**385.93**	**27.98**	**67.3**	**3382**	**8.47**	**0.30**	**$220,043**	**$570**	**$674,341**	**$1,747**	**$62.45**

Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.

Table 1.5. Winter in Wisconsin, 2009-2010												
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Southeast Region												
	Kenosha	573.11	20.57	50.40	6,770	11.81	0.57	$379,120	$662	$1,344,344	$2,346	$114.03
	Milwaukee	1784.17	20.33	40.40	25,769	14.44	0.71	$1,391,526	$780	$6,302,224	$3,532	$173.75
	Ozaukee	304.03	21.21	55.90	5,282	17.37	0.82	$289,982	$954	$906,531	$2,982	$140.58
	Racine	704.86	29.38	72.40	8,517	12.08	0.41	$459,322	$652	$1,722,736	$2,444	$83.19
	Walworth	682.81	21.72	59.90	11,354	16.63	0.77	$644,907	$944	$1,711,532	$2,507	$115.41
	Washington	581.11	25.25	69.10	8,034	13.83	0.55	$483,647	$832	$1,447,765	$2,491	$98.67
	Waukesha	1070.09	17.68	29.20	17,426	16.28	0.92	$942,747	$881	$3,131,151	$2,926	$165.50
Region total		**5,700.18**			**83,152**			**$4,591,250**		**$16,566,282**		
Region average		**814.31**	**22.31**	**53.9**	**11879**	**14.59**	**0.65**	**$655,893**	**$805**	**$2,366,612**	**$2,906**	**$130.29**

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Southwest Region												
	Columbia	743.95	24.87	55.5	13,808	18.56	0.75	$891,997	$1,199	$2,839,447	$3,817	$153.47
	Crawford	385.21	30.05	43.6	3,082	8.00	0.27	$195,707	$508	$652,154	$1,693	$56.34
	Dane	1501.97	24.31	41.8	36,131	24.06	0.99	$2,240,122	$1,491	$5,007,712	$3,334	$137.15
	Dodge	606.62	21.15	54.6	9,823	16.19	0.77	$609,026	$1,004	$1,569,665	$2,588	$122.34
	Grant	624.14	29.85	56.1	7,175	11.50	0.39	$468,528	$751	$1,032,914	$1,655	$55.44
	Green	311.37	26.31	56.6	2,751	8.84	0.34	$184,400	$592	$508,217	$1,632	$62.04
	Iowa	451.03	26.64	55.1	5,946	13.18	0.49	$352,479	$781	$873,918	$1,938	$72.73
	Jefferson	458.21	18.09	45.1	9,095	19.85	1.10	$522,963	$1,141	$1,136,434	$2,480	$137.10
	Juneau	498.79	24.47	49.9	7,765	15.57	0.64	$521,342	$1,045	$927,017	$1,859	$75.95
	La Crosse	488.24	29.17	59.9	7,324	15.00	0.51	$439,220	$900	$937,531	$1,920	$65.83
	Lafayette	293.88	27.21	58.3	2,074	7.06	0.26	$124,253	$423	$519,182	$1,767	$64.93
	Monroe	646.13	27.38	56.0	5,996	9.28	0.34	$371,032	$574	$1,126,795	$1,744	$63.69
	Richland	328.72	28.61	49.1	3,155	9.60	0.34	$208,609	$635	$409,901	$1,247	$43.58
	Rock	598.50	23.46	47.4	10,397	17.37	0.74	$647,421	$1,082	$1,470,870	$2,458	$104.76
	Sauk	591.55	22.20	55.9	9,006	15.22	0.69	$630,240	$1,065	$1,623,037	$2,744	$123.59
	Vernon	450.00	27.72	58.4	5,242	11.65	0.42	$329,774	$733	$641,724	$1,426	$51.44
Region total		**8,978.31**			**138,770**			**$8,737,112**		**$21,276,518**		
Region average		**561.14**	**25.72**	**52.7**	**8673**	**15.46**	**0.60**	**$546,070**	**$973**	**$1,329,782**	**$2,370**	**$92.14**
Statewide total		**33,532.00**			**408,523**			**$25,081,533**		**$74,506,207**		
Statewide average		**465.7**	**26.6**	**60.8**	**5674**	**11.16**	**0.44**	**$348,355**	**$696**	**$1,034,808**	**$2,052**	**$80.73**

Sources: Cost data are final billed costs as billed to WisDOT by the counties. Salt data are taken from WisDOT's Salt Inventory Reporting System.

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2 Winter Weather

In this section...

Every winter is different—the number and type of storms, the range of temperatures, the amount of snow. These factors and more combine to create varying challenges for the county highway departments each year.

The winter season once again started off with a major storm. A record-breaking snow event affected most of the state on December 8th and 9th. Parts of southern Wisconsin recorded over 20 inches of snow, and most of the state received at least one foot of snow. In addition, winds of up to 50 mph caused blizzard conditions. A second major winter storm brought snow and freezing rain to the northwest part of the state over the Christmas holiday. As was the case the previous winter, however, the weather eased off after December with very little snow fall in March 2010. The statewide average snowfall was 61 inches, which is still slightly above the average of 52 inches. It was, however, well below the previous two winters, when 90 and 105 inches were recorded.

This section describes the weather Wisconsin experienced during the 2009–2010 winter, and the tools and methodologies WisDOT uses to analyze individual storms and the winter as a whole. The Winter Severity Index is one such tool—WisDOT uses it to facilitate comparisons from one winter to the next, and from county to county within the same season.

Winter Weather, 2009–2010

	Statewide average	Range across counties
Total snowfall[1]	**60.8 inches**	**23 – 209 inches**
Winter Severity Index	**26.6**	**17.3 – 46.5**
Winter storms	**24**	**16 – 45**
Frost events	**4**	**0 – 22**
Freezing rain events	**3**	**0-12**

1. All data in this table is from Winter Storm Reports, 2009–2010.

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. ***See page 111 for more information.***

Winter Weather Challenges

Each year, county highway departments face unique combinations of temperatures and storms, and draw on their experience in deciding what combination of snow and ice control strategies to employ. The number of storms has a more significant impact on resources expended than snowfall totals, since staff and equipment may be mobilized even if only 0.1 inches of snow or freezing rain falls. Weekend and evening storms are also more costly than weekday storms because of overtime pay.

Storms with low temperatures can be difficult for crews because deicing agents become less effective at lower temperatures. Storms with high winds also are a challenge, because snow blows back onto the roadway quickly after the plows pass.

Counties in the northern half of the state tend to face colder temperatures and heavier snowfall than those in the southern half. Wisconsin's average annual snowfall ranges from about 40 inches in the south to as much as 160 inches along the shores of Lake Superior. The statewide average annual snowfall is 52.4 inches (30-year normal as recorded by the Wisconsin State Climatology Office).

On average, about 35 to 40 winter weather events hit Wisconsin each winter. While only a couple of large freezing rain events normally strike the state each winter, the state experiences numerous freezing drizzle and freezing fog events that cause roads to ice over.

This Winter's Weather

The winter of 2009–2010 was somewhat similar to the previous winter. Much of the total snowfall for the season fell in December, and the winter turned fairly benign after that.

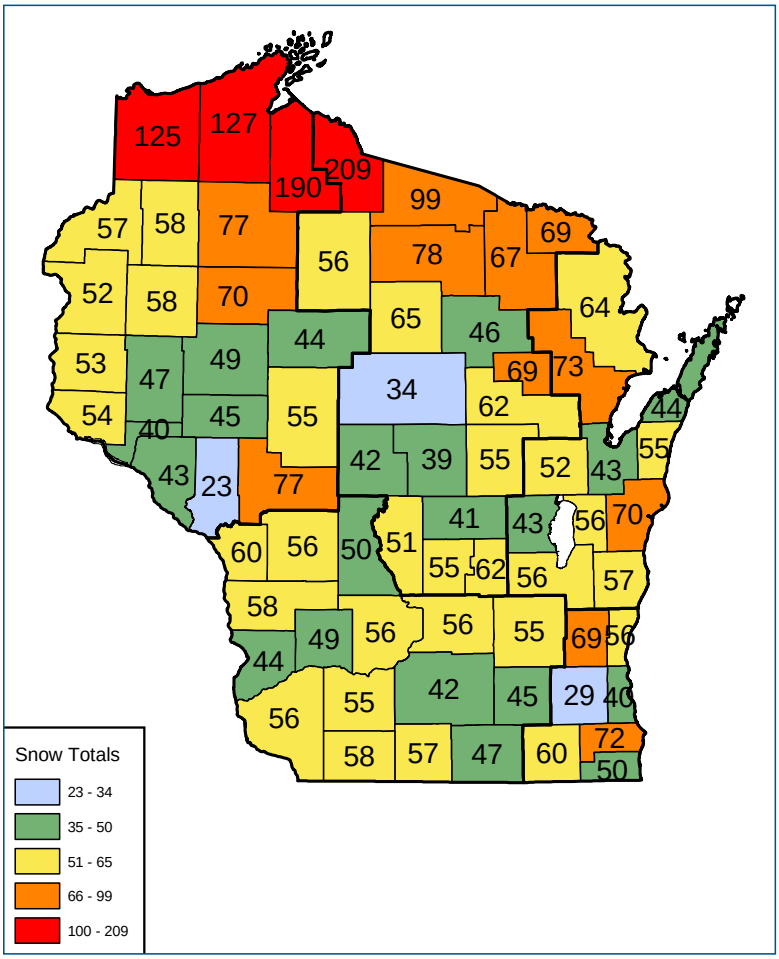
December 2009 was highlighted by two major winter storms that struck much of the state. The first, on December 8-9, dropped at least six inches of snow across the entire state. It set snowfall records across the south, where up to 17 inches were recorded near Madison. A second storm, over the Christmas holiday, brought heavy snow to the northwest part of the state, but a mix of weather to the rest of the state.

The weather settled down in January and February, with most of the state picking up less than 6 inches of snow. Only the typical lake-effect areas continued to receive heavy snow.

There was virtually no snow across the state in March, as many locations experienced their first snow-less March in recorded history.

Figure 2.1. Statewide Snowfall, 2009–2010

From Winter Storm Reports



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

During the 2009–2010 winter season, county highway departments responded to:

- A statewide average of 24 winter storm events per county, with a high of 45 in Vilas County and a low of 16 in Marquette and Kewaunee Counties.
- A statewide average of 4 frost events.
- A statewide average of 3 freezing rain events.

Figure 2.1 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 209 inches; the lowest was in Trempealeau County, at 23 inches. This range was wider than last year's range of 58 to 215 inches. Statewide, this winter's total snowfall was below average except in the far north. On average, temperatures were above normal statewide this winter.

Winter Severity Index

WisDOT's Winter Severity Index is a management tool that allows the department to maximize winter maintenance efficiency by evaluating the materials, labor and equipment used based on the severity of the winter in a given county or region.

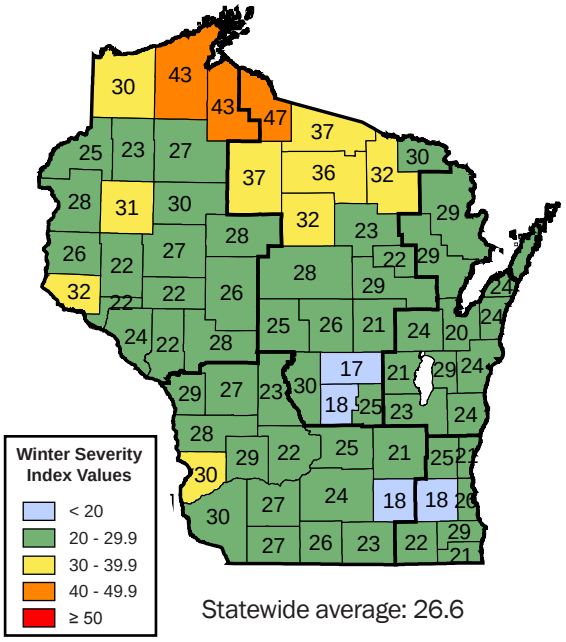
Developed in 1995, the severity index is calculated using a formula that includes:

- Number of snow events
- Number of freezing rain events
- Total snow amount
- Total storm duration
- Total number of incidents

Since all of these factors can affect materials use, the severity index gives the department a simple way to quantify severity that incorporates multiple factors into a single number. WisDOT uses the severity index in two ways:

1. Season-to-season comparisons. This lets the department compare apples to apples when evaluating materials use and costs over several seasons, and identify trends in winter weather that can be useful in planning materials purchases. In the case of cost trends, adjusting cost data for severity index ranking can help WisDOT separate cost increases due to more severe winters from those due to increased labor costs, equipment costs, lane miles and other factors.
2. Regional comparisons. Since snowfall, number of storms, and other factors vary widely across the state, the severity index also helps WisDOT compare resources use from one region or county to another within a single winter. This allows WisDOT to assess whether materials are being used consistently, whether counties have enough staff, and other factors that affect each region's response to winter.

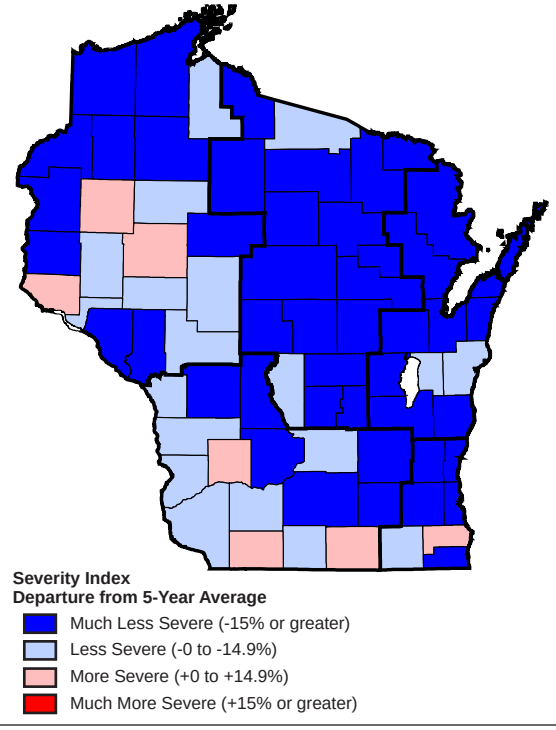
Figure 2.2. Winter Severity Index, 2009–2010



Statewide average: 26.6

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

Figure 2.3. 2009–2010 Winter Severity Index vs. 5-Year Average (2004–2005 to 2008–2009)



Data from weekly storm reports are used to calculate the Winter Severity Index for each county according to a weighted formula. The index expresses winter severity on a scale from 0 to 100. This winter:

- The statewide average Winter Severity Index was 26.6, which is 17 percent lower than the average of the previous ten winters (32.1)
- Iron, Ashland and Bayfield Counties had the highest severity index; all greater than 43
- Waushara, Marquette, Jefferson and Waukesha Counties had the lowest severity index; all less than 18

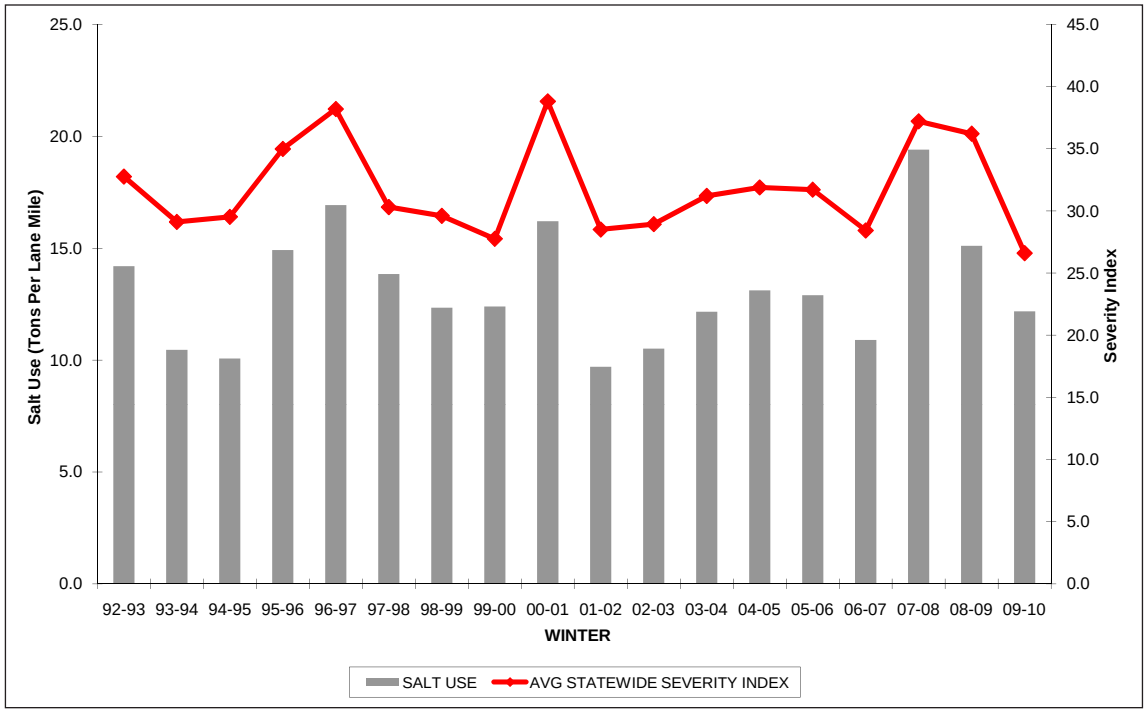
The high of 47 is lower than what is usually recorded as the state's highest severity index in the northern "snow belt" part of the state, and the low of 17 is higher than the state's typical lowest severity index as well. With few exceptions across the state, this winter was less severe than normal. Figure 2.2 on the previous page shows how severity index varied by county this winter, while Figure 2.3 shows how this winter's severity index for each county compares to the average of the previous five years in that county.

Figure 2.4 plots the average statewide salt use per lane mile versus the average statewide Winter Severity Index. Normally, salt use tends to increase as the severity index increases. This year's total salt use was about average relative to the severity index. Last year's salt use was higher than average relative to the severity index, which may have been partly due to the timing of storms (multiple storms in quick succession) as well as extended bouts of lower temperatures.

Since the Winter Severity Index is an important tool for comparing cost and materials data from year to year, this report includes several charts that compare trends in winter measures over time with changes in severity index. These include Figure 2.4, as well as Figure 3.2 (salt used per lane mile; page 35), Figure 4.2 (winter costs; page 71), and Figure 4.6 (winter crashes; page 76).

Figure 2.4. Salt Use per Lane Mile and Average Severity Index

From Salt Inventory Reporting System, 1992–2010



Because of concerns about consistency across all counties in reporting incidents, beginning with the 2005–2006 winter WisDOT adjusted the formula for computing the severity index to remove cleanup and bridge deck snow removal as components in the calculation. The effect of this change is slight, but readers should be aware of it when comparing severity index data from the last four winters against earlier data. The severity index for some counties may appear slightly lower using the new formula.

More information on the severity index is available by request from WisDOT:

- A report describing the process that was used to develop the severity index, including data on the five-year-average severity index for each county (March 1998).
- A table showing Winter Severity Index values for each county for the previous 10 winter seasons.

On page 27, Table 2.1 gives details about the types of storms and other incidents (such as frost, ice, and drifting or blowing snow) that each county experienced this winter, as reported by the counties in their winter storm reports.

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County-by-County Tables for Section 2 Winter Weather

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Table 2.1. Storms and Incidents

From Winter Storm Reports, 2009-2010

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
NC	ADAMS	50.7	192.72	2444	12.68	21	19	17	12	16	13	7	5	3	4	0	2	18
	FLORENCE	64.6	141.07	1780	12.62	30	8	24	6	0	13	2	5	0	1	2	9	5
	FOREST	65.3	312.38	3603	11.53	23	6	15	3	1	22	15	13	2	0	1	14	1
	GREEN LAKE	57.6	151.30	763	5.04	22	18	4	2	3	16	10	10	1	3	1	10	3
	IRON	203.9	250.91	3908	15.58	44	15	27	5	2	17	2	0	4	4	2	8	4
	LANGLADE	41.0	292.69	2488	8.50	19	11	13	2	3	22	16	9	1	8	1	9	6
	LINCOLN	59.0	418.33	3482	8.32	28	10	26	4	5	16	7	8	7	4	3	7	8
	MARATHON	34.1	880.19	7365	8.37	24	11	12	5	1	29	8	9	7	9	2	16	20
	MARQUETTE	55.0	244.53	2471	10.11	16	5	15	1	2	9	1	1	6	1	1	6	9
	MENOMINEE	62.8	90.26	1292	14.31	25	8	17	0	1	11	4	1	2	2	0	9	0
	ONEIDA	72.7	396.79	3376	8.51	28	10	14	5	2	19	2	0	14	4	3	4	9
	PORTAGE	38.5	547.20	5040	9.21	28	4	21	3	0	18	12	0	4	7	3	4	4
	PRICE	53.1	320.57	3103	9.68	30	14	20	7	7	21	10	1	3	12	4	11	10
	SHAWANO	54.6	515.09	4925	9.56	26	9	17	1	4	24	16	12	7	2	8	10	4
	VILAS	95.1	305.24	3660	11.99	45	24	23	4	6	7	0	0	2	4	1	2	4
	WAUPACA	49.9	546.64	5339	9.77	19	10	9	0	0	19	5	7	3	5	0	6	2
	WAUSHARA	40.9	345.71	2213	6.40	19	7	10	2	2	3	2	2	0	0	0	3	7
	WOOD	42.3	372.22	3675	9.87	25	16	20	7	3	10	8	8	12	2	1	6	16
Region Average		63.4	351.32	3385	10.11	26	11	17	4	3	16	7	5	4	4	2	8	7

Final totals as of Wednesday, September 15, 2010

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2009-2010

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
NE	BROWN	37.2	711.91	8462	11.89	20	12	7	2	6	3	0	0	18	2	0	0	17
	CALUMET	51.2	201.29	1476	7.33	28	7	25	1	2	22	14	1	2	4	0	12	12
	DOOR	39.4	268.55	2677	9.97	20	6	14	0	6	24	21	14	10	1	2	8	13
	FOND DU LAC	51.9	599.20	5527	9.22	24	9	25	1	3	10	4	0	3	1	1	6	14
	KEWAUNEE	50.5	110.41	972	8.80	16	4	13	1	1	22	17	8	0	8	0	15	1
	MANITOWOC	66.1	417.99	6190	14.81	21	17	4	0	5	14	10	11	0	10	12	14	2
	MARINETTE	58.9	417.29	3325	7.97	23	17	5	4	6	24	15	13	3	8	5	20	15
	OCONTO	63.1	471.83	3988	8.45	28	15	14	1	4	23	11	11	0	0	8	17	10
	OUTAGAMIE	46.5	523.98	5754	10.98	23	13	14	2	3	15	11	11	2	3	5	6	6
	SHEBOYGAN	57.0	520.30	6898	13.26	18	10	14	4	4	20	12	5	3	2	6	11	10
	WINNEBAGO	39.4	568.31	6680	11.75	22	3	19	0	1	17	4	5	1	0	7	14	6
Region Average		51.0	437.37	4723	10.40	22	10	14	1	4	18	11	7	4	4	4	11	10

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2009-2010

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
NW	ASHLAND	187.3	247.57	2420	9.78	34	16	18	3	7	16	6	0	17	5	5	8	14
	BARRON	58.0	423.09	1863	4.40	31	13	13	7	5	35	4	6	6	4	3	25	8
	BAYFIELD	124.4	316.90	3660	11.55	33	10	24	4	7	25	13	3	9	7	11	17	4
	BUFFALO	43.4	316.05	1709	5.41	21	10	12	2	2	16	13	0	4	3	0	9	6
	BURNETT	56.6	233.64	1718	7.35	18	16	7	3	8	20	15	13	7	18	12	19	6
	CHIPPEWA	49.4	669.29	5686	8.50	25	9	15	2	2	19	11	13	1	3	7	14	0
	CLARK	55.4	402.28	3590	8.92	25	7	15	4	2	13	9	2	4	2	1	5	6
	DOUGLAS	125.2	439.23	3616	8.23	25	18	11	2	3	26	13	4	4	14	21	12	9
	DUNN	46.9	516.55	5602	10.85	20	5	14	1	1	17	5	3	0	6	1	2	0
	EAU CLAIRE	45.1	537.26	4638	8.63	19	9	10	2	1	35	5	1	5	4	3	31	9
	JACKSON	77.0	514.30	5949	11.57	30	27	1	0	22	19	11	13	22	2	1	17	23
	PEPIN	39.5	111.05	738	6.65	21	4	16	3	2	12	3	4	2	6	2	2	0
	PIERCE	53.9	366.08	3312	9.05	27	8	18	7	8	22	15	8	8	7	10	18	7
	POLK	52.1	385.05	3842	9.98	18	7	11	0	1	34	20	13	2	27	4	9	0
	RUSK	70.4	213.47	1650	7.73	26	11	11	4	4	31	8	16	0	17	11	21	0
	SAINT CROIX	53.4	618.98	6210	10.03	27	20	4	4	4	13	4	3	4	7	7	8	1
	SAWYER	77.1	367.44	2555	6.95	36	19	12	4	1	10	0	2	0	1	2	5	0
	TAYLOR	43.8	233.25	2283	9.79	22	6	15	4	5	25	15	10	2	14	9	16	9
	TREMPEALEAU	22.7	434.99	3579	8.23	19	12	9	3	1	21	6	3	6	7	3	9	7
	WASHBURN	58.0	372.14	2409	6.47	23	9	11	3	1	18	1	3	1	4	2	10	8
Region Average		67.0	385.93	3351	8.50	25	12	12	3	4	21	9	6	5	8	6	13	6

Final totals as of Wednesday, September 15, 2010

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2009-2010

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
SE	KENOSHA	50.4	573.11	5880	10.26	22	7	13	3	1	5	2	1	0	0	0	5	10
	MILWAUKEE	40.4	1,784.17	29350	16.45	21	17	4	2	2	5	0	0	2	0	5	0	3
	OZAUKEE	55.9	304.03	5279	17.36	23	5	16	1	1	23	2	4	1	1	3	16	5
	RACINE	72.2	704.86	8445	11.98	26	9	21	1	1	16	13	12	0	1	3	8	20
	WALWORTH	59.9	682.81	11345	16.62	19	8	13	3	0	11	5	5	0	3	0	3	1
	WASHINGTON	67.1	581.11	7675	13.21	26	11	13	1	3	13	10	5	2	0	3	9	5
	WAUKESHA	29.2	1,070.09	16104	15.05	19	10	10	3	2	7	1	0	1	2	0	4	6
Region Average		53.6	814.31	12011	14.42	22	10	13	2	1	11	5	4	1	1	2	6	7

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2009-2010

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
SW	COLUMBIA	55.0	743.95	14200	19.09	25	12	12	1	0	22	12	6	0	1	5	18	26
	CRAWFORD	43.6	385.21	3357	8.71	21	3	16	6	4	25	16	11	3	6	1	17	6
	DANE	40.8	1,501.97	24973	16.63	21	6	12	3	0	3	1	0	3	0	0	0	1
	DODGE	52.6	606.62	10639	17.54	22	5	17	1	1	12	9	1	0	4	0	8	8
	GRANT	56.1	624.14	7395	11.85	25	8	12	4	2	35	5	14	5	4	1	16	5
	GREEN	56.6	311.37	2436	7.82	24	8	10	6	1	29	8	2	0	3	0	24	0
	IOWA	55.1	451.03	5796	12.85	24	12	9	4	1	14	5	7	2	2	0	8	0
	JEFFERSON	45.1	458.21	7929	17.30	22	13	7	1	2	5	4	1	1	1	0	0	0
	JUNEAU	49.9	498.79	7128	14.29	22	17	2	4	1	12	9	1	1	0	0	8	10
	LA CROSSE	59.9	488.24	4617	9.46	21	12	13	2	2	28	16	11	14	5	3	14	13
	LAFAYETTE	58.3	293.88	2232	7.59	21	6	11	4	1	12	8	1	2	1	0	0	3
	MONROE	56.0	646.13	6696	10.36	26	13	14	4	3	17	9	7	5	6	4	10	8
	RICHLAND	49.1	328.72	2296	6.98	23	10	7	7	2	13	6	3	0	9	4	11	4
	ROCK	47.2	598.50	10514	17.57	18	10	9	4	1	12	7	6	1	3	0	5	16
	SAUK	55.9	591.55	9199	15.55	21	14	11	4	1	15	3	0	2	4	0	14	26
	VERNON	58.4	450.00	3822	8.49	24	18	2	4	0	20	15	7	7	6	0	7	9
Region Average		52.5	561.14	7702	12.63	23	10	10	4	1	17	8	5	3	3	1	10	8

Final totals as of Wednesday, September 15, 2010

Table 2.1. Storms and Incidents

From Winter Storm Reports, 2009-2010

Region	County	Snow Depth	Lane Miles	Salt Used	Tons /LM	Number of Storms	Types of Storms				Number of Incidents	Types of Incidents						Anti-Icing applic.
							Wet Snow	Dry Snow	Freezing Rain	Sleet		Drifting	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
Statewide Averages		--	466	5378	10.69	24.0	10.9	13.3	3.1	3.0	17.6	8.2	5.5	3.8	4.6	3.1	10.0	7.5

3 Snow and Ice Control

In this section...

Wisconsin county highway departments use an array of strategies to combat winter storms. Materials, equipment and labor are three key pieces of the puzzle; county patrol superintendents use their skills and experience to combine these pieces in the most efficient way possible for each storm.

This section describes the counties' response to the 2009–2010 winter season, including materials use, best practices in equipment and technology, and training efforts. Many counties have added prewetting and anti-icing to their arsenal of best practices—strategies that help them use materials efficiently, save money and minimize environmental impacts.

Statewide Materials Use

	2009–2010
Total salt used[1]	**408,523 tons**
Total salt used per lane mile	**12.2 tons**
Total cost of salt used[2]	**$23,940,453**
Average cost per ton of salt	**$60.92**
Total prewetting agents used[3]	**1,099,991 gal.**
Counties prewetting salt	**66 of 72 (92%)**
Total abrasives used	**19,081 cubic yards**
Counties prewetting abrasives	**6 of 65 using sand (9%)**
Total anti-icing agents used	**682,514 gal.**
Counties equipped to use anti-icing	**65 of 72 (90%)**

There's More on the Web!

Looking for more information about winter maintenance in Wisconsin? WisDOT's extranet site features detailed reports on products, equipment, best practices and more.

See https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.

1. Salt use data is final data from WisDOT's Salt Inventory Reporting System.
2. Cost data is actual salt costs as billed to WisDOT by the counties.
3. Prewetting, abrasives and anti-icing data are estimates from Winter Storm Reports.

3A. Materials

After decades of use, salt and sand remain the primary materials used in winter maintenance. The advent of prewetting technology has improved the efficiency of materials use, and proactive anti-icing applications have reduced the amount of salt needed to keep roads clear.

Salt

Salt is a critical part of a highway crew's response to winter storms. When salt combines with ice or snow, it creates a brine solution with a lower freezing point than water. This solution then acts to break the bond between the ice or packed snow and the pavement, which allows the snow to be removed more easily through plowing.

Because of cost and environmental concerns, maintenance crews strive to use the smallest amount of salt necessary to provide an appropriate level of service for each roadway. Using anti-icing agents can help reduce overall materials use; see pages 40–41 for details on statewide anti-icing use.

Historically, counties have used more salt during more severe winters; see Figure 2.4 on page 22 for a detailed comparison. This winter 's statewide Winter Severity Index of 26.6 was 17 percent lower than the previous 10-year average of 32.1.

This winter's statewide average severity index was 27 percent lower than the previous winter, and salt use was 28 percent lower, at 408,523 tons. Salt use in 2007–2008 set a state record at 644,485 tons, beating out the previous record of 521,056 tons set in 2000–2001. See Table 1.5 on page 13 for county-by-county salt use data for this winter.

Wisconsin counties applied a statewide average of 12.2 tons of salt per lane mile on state highways, a decrease of 28 percent compared with the 2008–2009 winter and 18 percent lower than the average of the five previous winters. (See Figure 3.6 on page 51 for a county-by-county comparison.) This year, that rate was higher than the nearby states of Minnesota (5.9 tons per lane mile), Iowa (9.8 tons per lane mile), and Indiana (11.8 tons per lane mile), and slightly lower than Illinois (12.3 tons per lane mile) and Michigan (12.6 tons per lane mile). Several factors may contribute to other states' lower rates of salt used per lane mile, including salt shortages that prevented several states from obtaining the quantity of salt that they would normally use. In addition, some states provide a lower level of service that prescribes less salt and more sand use. And winter severity varied from state to state. Data on total salt use (not adjusted for lane miles) for most states is available on page 52 in a map of salt use and costs produced by Washington State DOT.

Figure 3.1. Salt Used per Lane Mile

From Salt Inventory Reporting System, 2009–2010

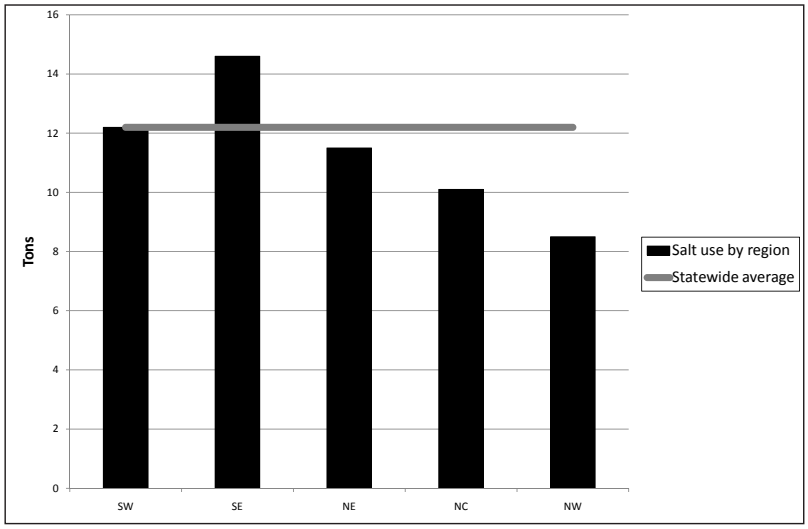


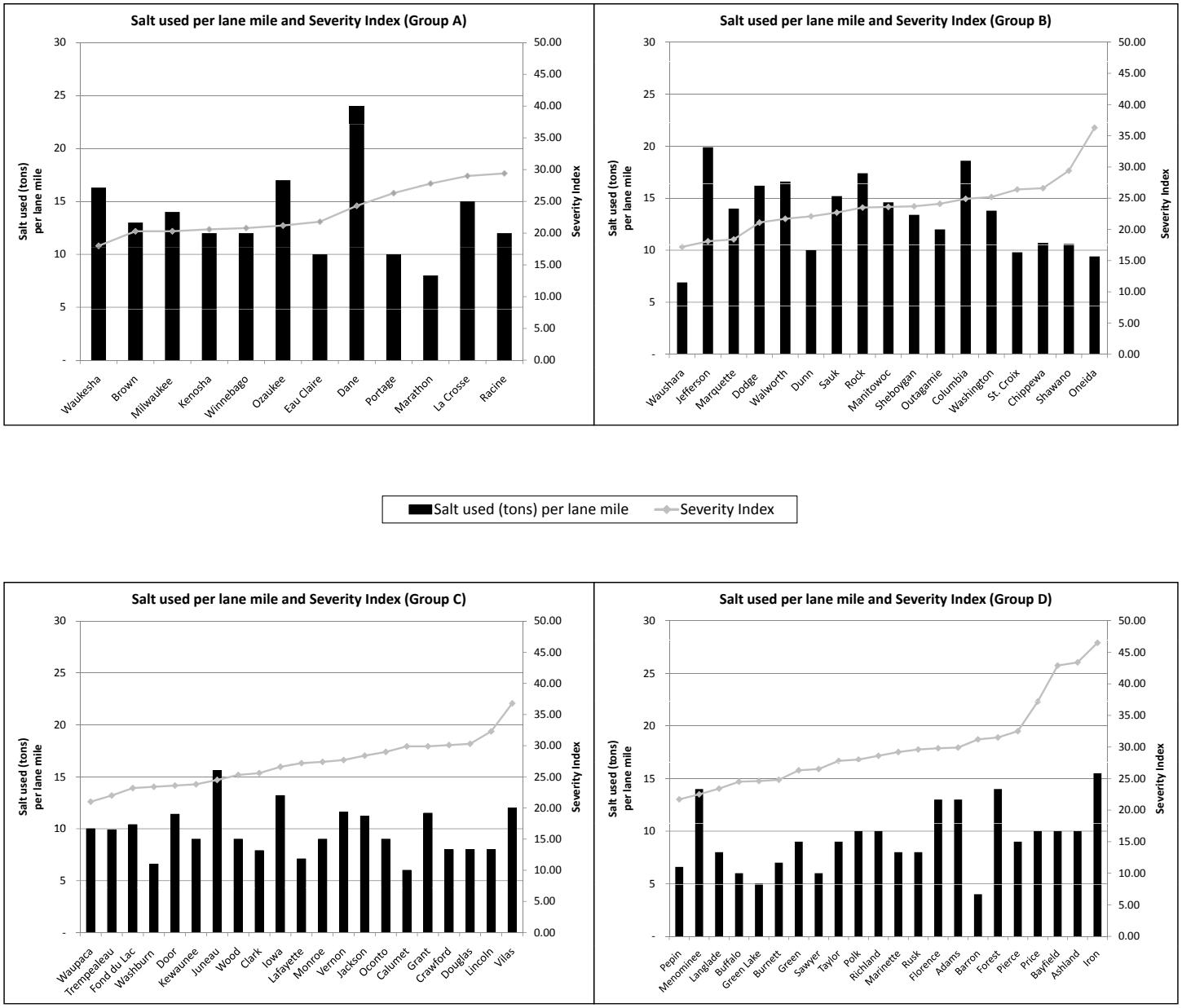
Figure 3.1 shows the regional levels of salt use per lane mile. Counties in the Southeast Region used an average of 14.6 tons of salt per lane mile, which reflects the greater number of highways in these counties receiving 24-hour service.

Figure 3.2 on page 35 shows salt use per lane mile in each county, overlaid with severity index to allow a further "apples to apples" comparison of salt use in each county. The counties in Winter Service Groups A and B have more urban highways and tend to use more salt per lane mile for a given level of severity.

For more detail on salt use in previous years, see Table A-9, "History of Salt Use on State Trunk Highways," on page 156 of the Appendix.

Figure 3.2. Salt Used per Lane Mile and Severity Index

From Salt Inventory Reporting System, 2009–2010



Cost of Salt

Salt prices continue to rise, which WisDOT's salt vendors attribute to multiyear supply and demand issues. This winter, WisDOT spent $23,940,453 on salt statewide, purchasing salt at an average of $60.92 per ton.

Higher fuel prices have contributed to higher salt transportation costs in recent years: The average of $60.92 per ton is an increase of 24 percent compared with prices paid under last winter's original salt contract, and an increase of 73 percent compared with the average price of $35.22 four winters ago.

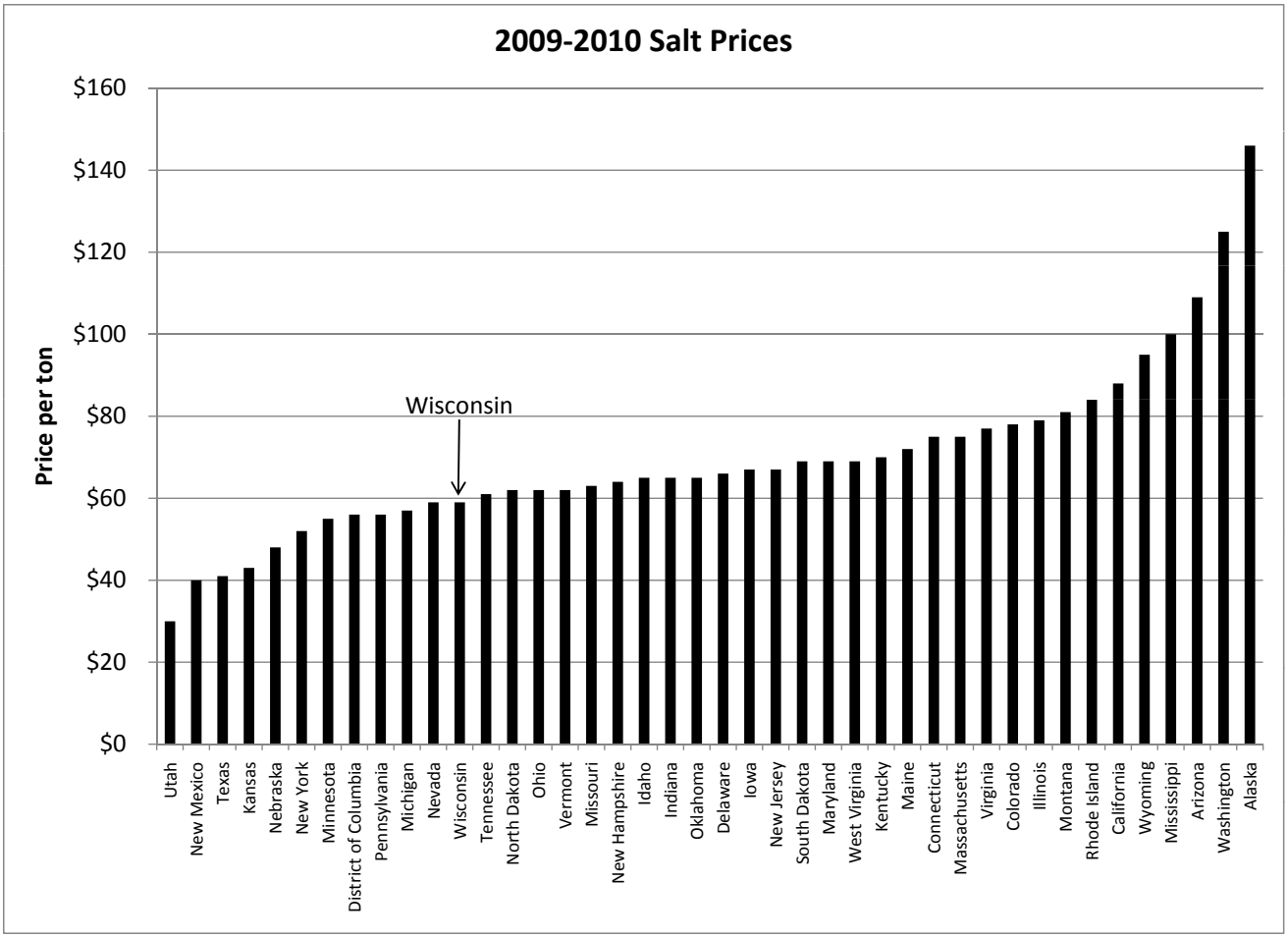
Despite this marked increase, WisDOT pays less per ton for salt than most other snowy states across the country, according to data compiled by Washington State DOT: Only ten states pay less on average per ton, one state (Tennessee) pays about the same, and 33 states pay more. (See Figure 3.3.) WisDOT created a map of per-ton salt costs and average salt use across the country, which we have reproduced on page 52. Per-ton costs for straight rock salt range from $30 in Utah (New Mexico pays from $33 to $56 per ton) to $125 in Washington state (Wyoming pays $95 per ton). Figure 3.4 shows that Wisconsin has historically paid less for salt than other states.

The department speculates that the flexibility of its contracting method may account for some of these cost savings. Wisconsin's contracts include a 100% provision, which means that the department guarantees that it will purchase 100 percent of the contracted amount of salt. Some other states' contracts include an 80/120 provision that requires the salt vendor to keep 120 percent of the contracted salt amount on reserve, and commits the state to purchasing only 80 percent of the contracted amount. This 40 percent spread could translate to higher costs for states under an 80/120 contract.

For more on costs, see Section 4 on page 70.

Figure 3.3. Salt Prices Across the United States

Source: Washington State DOT data



Note: Three states supplied a range of prices rather than an average. For these states, the midpoint of the range was used in this graph.

A Note About Materials Data

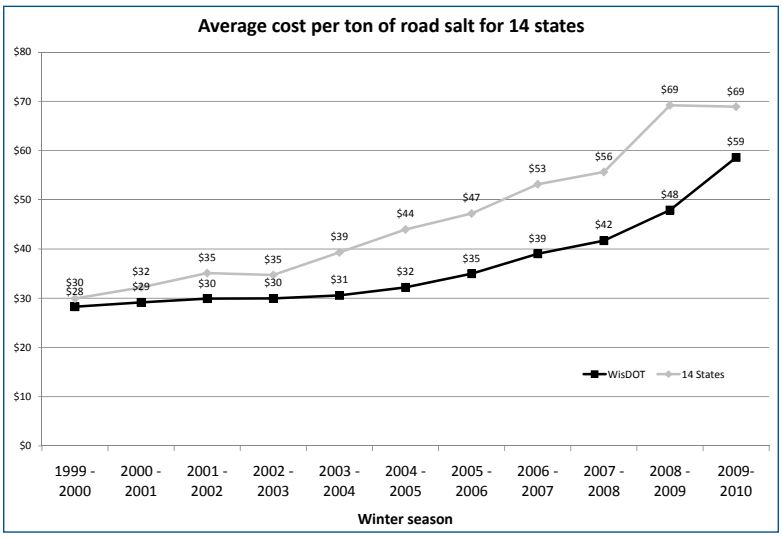
This winter marks the third year that all salt data in this report comes from WisDOT's Salt Inventory Reporting System (SIRS). In previous years, some tables used preliminary salt use data collected in the weekly winter storm reports. Sand use data continues to come from the storm reports, as does some detailed anti-icing and prewetting data. These materials use estimates are included in this report because they provide a level of detail and of correlation with storm events that is not available from SIRS or from final financial data. The source of each table's data is indicated below the table title.

Abrasives

County highway departments sometimes use sand and other abrasives to improve vehicles' traction on icy or snowy roads when temperatures are too low for salt to be effective. Abrasives are somewhat effective in low-speed trouble spots and intersections. Abrasives should be prewetted with a liquid agent for better adherence to the roadway.

Figure 3.4. Salt Prices Over Time

Source: Data from 14 states, 1999–2010



Source: Historical data supplied by Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, Missouri, North Dakota, New York, Ohio, Virginia, Washington and Wisconsin and compiled by Iowa DOT.

A total of 19,081 cubic yards of sand was used by 48 counties on state highways this winter, a decrease of 76 percent compared with 2007–2008's record-setting 80,133 cubic yards, and a 44% percent decrease from the average of the five previous winters (33,958 cubic yards).

With the two winters of 2007–2008 and 2008–2009 as the exception, use of abrasives has been declining in recent years (see Table 3.1), which is a positive trend and a goal for the department—the disadvantages of abrasives use include potential environmental impacts such as clogged storm drains, siltation of streams and lakes, and air pollution. Abrasives are also very expensive when sweeping and cleanup costs are considered. This year, counties in the southwest corner of the state, which tend to have more hilly terrain and lower-volume roads, used 49 percent of the statewide total, or 9,429 cubic yards. The Northwest Region contributed 24 percent of the total, the North Central Region used 13 percent, the Northeast Region used 13 percent, and the Southeast Region did not use any sand. Last year, the Southwest Region also used 49 percent of the statewide total.

The Bureau of Highway Maintenance commissioned a synthesis report, "Limitations of the Use of Abrasives in Winter Maintenance Operations" (see page 53), to substantiate WisDOT's guidance to Wisconsin counties on reducing sand use. The report cites factors recommending against the use of sand that have been supported by research, and offers the following general conclusions:

- Sand exhibits limited effectiveness at higher vehicle speeds, especially when it has not been prewetted. Mixing sand with salt to keep it from freezing also limits sand's effectiveness.
- Sand used in a salt-abrasive mixture does not contribute to accident reductions.
- Salt is more cost-effective than sand in winter maintenance operations.

Table 3.1. Statewide Sand Use

From storm reports data, 1999–2010

Year	Sand used (cubic yards)
2009–2010	19,081
2008–2009	44,179[1]
2007–2008	80,133[1]
2006–2007	13,636
2005–2006	15,997
2004–2005	15,843
2003–2004	17,959
2002–2003	19,864
2001–2002	18,154
2000–2001	67,108[1]
1999–2000	17,677[1]
1998–1999	35,709
1997–1998	15,254

1. Higher than normal sand use on the state system during the winters of 2007–2008 and 2000–2001 was caused by greater use of salt/sand mixes due to the low supply of salt toward the end of the winter. In 2008–2009, the higher total reflects counties' use of leftover sand from the previous winter.

Table 3.1 on page 37 compares this winter's statewide sand use with previous years'. Refer to Table A-8 on page 150 of the Appendix for county-by-county sand use data for this winter.

The billed cost of sand varies greatly across the state, depending on the local availability of the sand and transportation costs. In 2002–2003, the last year for which data is available, most counties paid about $10.00 to $16.00 per cubic yard, with a statewide range of $3.50 to $34.00 per cubic yard.

For more information on using and storing abrasives, see Chapter 35 of the State Highway Maintenance Manual. A Wisconsin Transportation Bulletin on salt and sand use is also available at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/best-practices/pdf/iie6.pdf.

Prewetting

Prewetting salt and sand with liquid deicing agents before or during their application to the pavement has several advantages. When used with salt, prewetting reduces loss of salt from bouncing and traffic action, which reduces the amount of material needed. Prewetting also improves salt penetration into ice and snow pack, and begins dissolving the salt, which allows it to work more quickly. When used with abrasives, prewetting helps keep the sand on the pavement and may allow crews to use higher truck spreading speeds.

WisDOT encourages all county highway departments to prewet their salt and sand, and to explore stocking more than one deicing agent so that different agents can be used as conditions warrant. For example, salt brine can be reasonably used at pavement temperatures down to about 15°F, whereas agents such as magnesium chloride and calcium chloride are effective at lower pavement temperatures, to about 0°F. See Table 3.2 for details on statewide prewetting agent use.

BEST PRACTICES: Prewetting

WisDOT encourages counties to prewet both salt and sand before applying it to the roadway. Agencies across the country and worldwide consider prewetting a best practice, and some require that all material be prewetted before it is placed. Studies have shown that prewetting significantly improves the amount of material that stays on the road.

Dane County is taking prewetting to the next level as it tests a salt slurry generator from Monroe Equipment that first grinds salt into fine particles and then mixes it with liquid deicer to create a slurry. This mixture is then dispensed onto the roadway by a spinner disc. The slurry reportedly begins melting ice faster than standard prewetted salt, and more material stays on the road. This allows operators to reduce the amount of material used—saving time and money and reducing environmental impacts.

For more information on prewetting, see Chapter 35 of the State Highway Maintenance Manual.

A salt slurry generator mounted on a salt truck

At about 14 cents per gallon for material and production costs, salt brine is a relatively inexpensive choice for prewetting (see Table 3.5 on page 42). Salt brine use has increased significantly since counties first tested it a decade ago; 51 counties used salt brine for prewetting this winter (see Table A-6 on page 142 of the Appendix for details). Counties used a near record amount of salt brine for prewetting this winter—932,154 gallons—despite a 28 percent decrease in the amount of salt used statewide compared with last winter. Overall use of prewetting liquids decreased 17 percent compared with last year's total, and salt brine use decreased 9 percent.

In addition to salt brine, some counties used calcium chloride, magnesium chloride, or agricultural-based products for prewetting this year. See Table A-7 on page 144 for details.

Although once the only option for prewetting, calcium chloride is a more corrosive chemical than other prewetting liquids, and can damage equipment and be more difficult for operators to handle. WisDOT encourages counties to explore other options for prewetting, such as salt brine. This winter, only 2 counties (Forest and St. Croix) used exclusively calcium chloride products for prewetting salt.

Several counties have also tested pretreated salt, in which a liquid prewetting agent is spray-applied to the salt supply before the salt is placed in storage. See https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm for details.

While prewetting salt is a common practice in Wisconsin—66 of 72 counties (92 percent) prewetted their salt this winter—prewetting abrasives is far less common. Of the 48 counties that used sand this winter, only 5 counties prewetted it (see Table A-8 on page 150 for details). WisDOT strongly encourages counties to prewet their sand, since keeping sand on the pavement can reduce the amount of material used, which saves money and reduces environmental impacts.

Table 3.2. Statewide Prewetting Agent Use for Salt

Chemical	Gallons used	Counties using
Salt brine	932,154	51
Calcium chloride-based products		
Calcium chloride – solid	3 tons	1
Calcium chloride – liquid	61,651	12
Calcium chloride with rust inhibitor	0	0
Magnesium chloride-based products		
Magnesium chloride	5,562	3
Freeze Guard	0	0
Agricultural-based products		
Ice Ban-M50	0	0
Ice Ban-M80	11,090	3
Ice Ban-MC90	225	1
Ice Ban-MC95	59,867	12
GeoMelt	16,390	6
Total	**1,099,971 gallons of liquid; 03 tons solid CaCl**	**66**

Anti-icing

Anti-icing is a proactive snow and ice control strategy that involves applying a small amount of liquid deicing agent to pavements and bridge decks before a storm to prevent snow and ice from bonding with the surface. It is often used prior to light snowfall or freezing drizzle, and is also effective at preventing frost from forming on bridge decks and pavements.

Anti-icing can reduce salt use, reduce materials costs, and improve safety. The benefits of anti-icing include:

- Less chemicals are required to prevent ice bonding than to remove ice after it has bonded to the pavement.
- Clean-up after a storm may be easier with less ice bonded to pavement.
- Application can be made during regular working hours, reducing some overtime costs.
- Anti-icing applications may last for several days, particularly in preventing frost on bridge decks.
- Better pavement conditions (improved friction) can be achieved, reducing the number of crashes.

This winter, counties used a record 683,144 gallons of anti-icing liquid (see Table A-4 on page 134 for details). Currently, 65 of 72 counties (90 percent) are equipped to perform anti-icing operations, and this winter 61 counties made at least one anti-icing application. (Counties may choose not to anti-ice if weather conditions do not warrant it.) On the whole, anti-icing use has steadily increased in Wisconsin since the technology became part of winter operations in the state in 1999. Use of anti-icing materials was up around 36 percent over last year, even though some back-to-back storms limited anti-operations this year. Salt brine, the most commonly used anti-icing agent, has limited effectiveness at temperatures below 15°F. Some counties are mixing agents such as magnesium chloride with salt brine to lower the working temperature of the salt brine.

Accurate weather forecast information is critical to the success of anti-icing—if a forecasted storm does not arrive, resources may be wasted; if a storm hits sooner than expected, the opportunity for anti-icing may be lost. Through Wisconsin's Road Weather Information System, counties have access to detailed weather information, including the Meridian weather forecast system, and 58 weather stations with pavement sensors across the state. See page 42 for more information on RWIS.

BEST PRACTICES: Anti-icing

Anti-icing is a best practice not only nationwide, but across the globe. Agencies are finding that this technique, once reserved for bridge decks and trouble spots, yields excellent results on highways as well. More agencies are turning to anti-icing to help them use labor and materials efficiently, especially as salt prices continue to rise.

This winter, Wisconsin counties used 683,144 gallons of anti-icing liquid—the most on record and an increase of 51 percent over last winter's total. Yet at 0.5 percent of total winter expenditures, anti-icing continues to represent a small fraction of winter costs.

For more information on anti-icing, see WisDOT's Winter Information Web page at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/index.shtm (click "Best Practices," then "Anti-icing").

Table 3.3. Cost of Anti-icing vs. Deicing

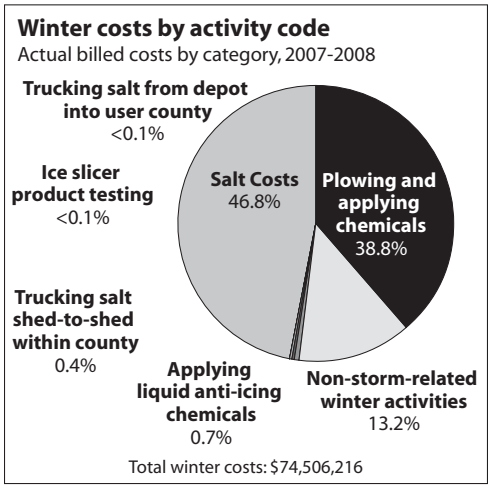
Winter Service Group	Average cost of anti-icing treatment for possible frost				Average cost of deicing treatment for frost event				Counties reporting anti-icing costs
	2006-2007	2007-2008	2008-2009	2009-2010	2006-2007	2007-2008	2008-2009	2009-2010	2009-2010
A	$2,765	$1,437	$892	$849	$3,919	$2,804	$5,220	$6,754	7
B	$838	$760	$818	$876	$3,517	$5,817	$3,151	$1,802	8
C	$820	$725	$961	$845	$1,485	$3,157	$1,669	$1,994	14
D	$610	$566	$629	$620	$1,842	$2,081	$1,377	$1,266	15

Anti-icing Costs

In Wisconsin, proactive anti-icing applications for possible frost events are about three times less costly than reactive deicing operations for actual frost events. Table 3.3 compares the two strategies based on storm reports data. Costs vary from year to year in part because of variations in the number of counties reporting this data and the number of events represented.

At $523,085, anti-icing costs made up only 0.7 percent of total winter maintenance costs this winter (see Figure 3.5). This percentage has remained fairly steady over the years—always less than 1 percent of total statewide winter costs. Investing in anti-icing is a cost-effective way to reduce overall materials use.

Figure 3.5. Anti-icing as a Percentage of Winter Costs



Note: Total cost data differs slightly from cost data elsewhere in this report due to rounding.

Anti-icing Agents

As with prewetting, the use of salt brine for anti-icing operations has increased significantly since its introduction a decade ago, including an 85 percent increase between the 2004–2005 and 2006–2007 winter seasons. This winter, 52 of 72 counties (75 percent) used a total of 649,909 gallons of salt brine for anti-icing. This is a 39 percent increase compared with last winter. See Table A-6 on page 142 of the Appendix for county-by-county data on salt brine use.

WisDOT encourages counties to explore stocking more than one agent for prewetting and anti-icing, so that a choice of agents is available for use according to pavement temperature and weather conditions. Table 3.4 shows the agents used for anti-icing in Wisconsin this winter; see Table A-4 on page 134 of the Appendix for county-by-county anti-icing data.

Table 3.4. Statewide Anti-icing Agent Use

Chemical	Gallons used	Counties using
Salt brine	649,909	54
Calcium chloride – liquid	630	2
Calcium chloride with rust inhibitor	0	0
Magnesium chloride	3,207	4
Freeze Guard	1,100	2
Ice Ban-M80	2,845	2
Ice Ban-MC95	13,383	7
GeoMelt	10,720	3
Total	**683,144**	

Table 3.5. Cost of Prewetting and Anti-icing Agents

Chemical	Average (per gallon)	Range (per gallon)
Salt brine	$0.14	$0.05 - $0.40 (47 counties)
Calcium chloride	$0.75	$0.45 - $1.22 (11 counties)
Calcium chloride with rust inhibitor	$0.76	$0.76 (1 county)
Magnesium chloride	$0.99	$0.64 - $1.29 (7 counties)
Ice Ban MC-95	$1.16	$0.75 - $1.32 (11 counties)
Ice Ban M-50	$1.51	$1.51 (1 county)
GeoMelt	$2.14	$1.90 - $2.26 (3 counties)

Cost of Deicing Agents

The cost of agents used for prewetting and anti-icing varies. Salt brine can be produced relatively cheaply (about $0.14 per gallon) at the county yard using salt brine production units purchased by WisDOT. Many counties have their own salt brine production units; others purchase salt brine from neighboring counties. Other agents tend to be more expensive, but may be useful at lower temperatures.

The average billed cost of selected agents this winter is detailed in Table 3.5. The unit cost of all products varies among counties based on the amount of material ordered and transportation costs.

3B. Equipment and Technology

As winter maintenance technology and practices evolve, the counties are continually expanding their arsenal of snow and ice control strategies. Some of the counties' snowplows are equipped with underbody plows, which can be used in place of the front plow for removing lighter snowfalls of up to 4 inches. A portion of the counties' salt spreaders are equipped with ground speed controllers, and some have on-board prewetting units. In recent years, Road Weather Information Systems have become an increasingly important part of counties' efforts.

Road Weather Information Systems

WisDOT has had a Road Weather Information System in place since 1986, and continues to expand and enhance the information available through this system. Designed to provide maintenance crews with the most accurate information about current and future weather conditions, WisDOT's RWIS system includes:

- 58 weather and pavement condition sensors along state highways.
- Detailed weather forecasts from Meridian forecast service.
- A winter storm warning service for county highway departments.
- Over 500 mobile infrared pavement temperature sensors on patrol trucks around the state.

WisDOT contracts with an RWIS consultant to manage its RWIS program. This on-site consultant serves as WisDOT's staff meteorologist and RWIS program manager, and provides ongoing technical and administrative support for the state's RWIS systems.

A roadside weather sensor.

Major activities in WisDOT's RWIS program this year included:

- Coordinating with Meridian on forecast services.
- Performing an annual weather forecast verification study, and monitoring comments from counties using the service.
- Providing RWIS training for regional operations staff and county highway departments.
- Overseeing maintenance and repair of the department's RWIS equipment.

In addition, the RWIS program manager works to coordinate WisDOT's RWIS activities within Wisconsin and with other state and national agencies, including:

- Coordinating activities with the National Weather Service.
- Participating in the Aurora research program (see page 46), and in multi state RWIS user group projects.
- Participating in national RWIS initiatives, including MDSS and Clarus (see page 47).
- Providing RWIS presentations to WisDOT groups and agencies outside WisDOT.

Other ongoing services provided by the RWIS program manager include:

- Managing contracts for weather forecast and winter storm warning services, and for system maintenance.
- Coordinating use of Winter Severity Index data as an accurate tool to measure the relative severity of winter seasons.
- Establishing a plan for replacement of aging infrastructure, such as roadside towers and television monitors at rest areas.
- Ongoing assessment of new RWIS technology.
- Representing the Bureau of Highway Maintenance Winter Section at The University of Wisconsin Traffic Operations and Safety Lab committee meetings.
- Maintenance of traveler weather information systems at rest areas and safety weigh enforcement facilities.
- Supporting counties' use of vehicle-mounted infrared pavement temperature sensors.
- RWIS program management (budgeting, billing, planning, etc.).

BEST PRACTICES: Ground speed controllers

Ground speed controllers have been shown to reduce salt use by controlling the amount of salt spread according to the speed of the truck. These controllers can also provide accurate data on salt use.

In addition to reducing costs, controlling salt application can help limit the amount of chlorides that get into the environment, minimizing the degradation of plant species and water quality near roadways.

The deadline of November 1, 2010, for having all trucks on state winter maintenance patrol sections equipped with ground speed controllers has been postponed pending the outcome of discussions between the Wisconsin Counties Association and WisDOT management. See Guideline 36.25 in the Winter Maintenance Manual for more information.

Weather Forecast Service Use and Satisfaction

The weekly winter storm reports ask the counties to report whether they used the Meridian forecast service, and ask them to rate the quality of the forecast if they did use it. The Meridian forecast was used in 83 percent of winter storm events this year, approximately the same as the previous winter. Regionally, the usage rate varied from a high of 89 percent in the Northcentral Region to a low of 69 percent in the Southwest Region. The Northeast Region rated the service the highest (2.49 on a scale of 1 to 3), while the Southwest Region rated it lowest at 2.25. The statewide average was 2.31, the same as last year's. For more details on the evaluation of the Meridian forecast service, see a summary report on page 117 of the Appendix, or view the full report at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm. For more detail on the use of the service, see Table A-2 on page 122 of the Appendix.

For more information on RWIS activities in Wisconsin, see the program's annual report at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.

Equipment Calibration

Ensuring correct calibration of winter operations equipment—including salt spreaders, anti-icing applicators, and prewetting application equipment—is a key step in providing precise, consistent materials application, which reduces waste and saves money. Winter vehicles should be calibrated prior to the start of the season and whenever equipment is repaired. WisDOT regional staff are tasked with working with the counties to ensure proper calibration.

Product and Equipment Testing

Winter maintenance is a continuously evolving field—new technology and innovations are developed each year. In previous years, WisDOT managed test and evaluation projects of the most promising new equipment by the counties, these test results are available on the WisDOT extranet.

WisDOT encourages county highway departments to consider new technologies when purchasing equipment. Testing new products—both equipment and materials—can lead to improved processes and more efficient operations. BHO staff are available to assist counties in structuring a testing and evaluation program for any products they wish to test.

Recent product and equipment evaluation projects have included:

Alternative anti-icing and deicing materials

- Pretreated salt, where a liquid prewetting agent is spray-applied to the salt supply before the salt is placed in storage, exhibited good results in county tests.
- Counties reported that prewetting salt with a mixture of salt brine and GeoMelt has been effective as an anti-icing agent.

Winter maintenance technology and equipment

- TowPlow – WisDOT purchased two Tow-plows during the winter of 2009–2010. One TowPlow was placed in Marquette County and another in Eau Claire County. During the winter of 2009–2010, Marquette County was able to try out this new plowing trailer technology in two separate storms. Their initial impression was that it worked very well. Eau Claire County was unable to complete the necessary modifications necessary to their plow truck to be able to test out the TowPlow. The study on the TowPlow being conducted by the TOPS lab will continue through the winter on 2010–11.
- Calibration Scales – Proper calibration of equipment has been shown to save on salt costs. Therefore, WisDOT has purchased three portable calibration scales to be tested over the next two winters. The scales made by ScaleTech of Iowa consist of a cubic yard metal bucket with a computerized scale meter. The scales allow operators to calibrate several trucks without lifting heavy pails of salt. Once the scale bucket is filled the salt is dumped back into the snowplow truck with assistance of a fork lift or end loader. WisDOT is hoping that by making the procedure of calibrating trucks easier and less back breaking that counties will calibrate their equipment more often.

  More information on many test projects is available at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm (scroll to the "Winter maintenance research reports" heading).

Winter Maintenance Research

In an effort to stay informed of the latest methods, equipment and materials, WisDOT joins other state DOTs in funding research projects of common interest. These pooled fund projects allow WisDOT to leverage its research dollars to support projects at a higher funding level that are important to all research partners. WisDOT participates in these three pooled fund projects:

- **Clear Roads.** In 2008–2009, Wisconsin handed over the roll of lead state in this pooled fund project to Minnesota. The pooled fund project focuses on rigorous testing of winter maintenance materials, equipment and methods for use by highway maintenance crews. Launched in 2004, Clear Roads now has 18 member states and has initiated 11 research projects.

  Clear Roads research addresses topics that may be of interest to Wisconsin counties and WisDOT regional staff. See the Clear Roads Web site (http://www.clearroads.org) for:

CLEAR ROADS
research for winter highway maintenance

- A final report and two-page research brief on a project that evaluated the **calibration accuracy of manual and ground-speed-control spreaders.** The report provides guidelines to help snowplow operators establish and maintain accurate calibration of ground speed controllers. The project also included the development of a Calibration Guide for use in the field. See http://www.clearroads.org/research-projects/05-02calibration.html.

- Other projects that have been completed:

  - **Development of Standardized Test Procedures for Evaluating Deicing Chemicals**
    Expected results: Standard tests that will help simplify the deicer evaluation process for state DOTs.

  - **Determining Effectiveness of Deicing Materials and Procedures**
    Expected results: A portable test method for determining the effectiveness of deicers that could be used by any interested state in a variety of locations under a variety of winter conditions.

  - **Development of Standardized Test Procedures for Carbide Insert Snowplow Blade Wear**
    Expected results: Testing procedures that could be used by an independent testing laboratory to determine life expectancy of any carbide insert snowplow blade.

  - **Identifying the Parameters for Effective Implementation of Liquid-only Plow Routes**
    Expected results: Identifying the parameters for the safe and effective use of liquid-only routes during winter storm events and an assessment of the viability of field testing.

- **Transportation Synthesis Reports** that compile research and best practices on topics including:
  - Limitations of abrasives
  - Post-storm meetings
  - Recording material use
  - Training winter operations supervisors
  - Material spreader use

These reports are available for download at http://www.clearroads.org/synthesis-reports.html.

- An **e-newsletter** of winter maintenance news items, publications and research in progress. Read the newsletter online at http://www.clearroads.org/winter-maintenance-news.html.

Clear Roads also initiated a **national multimedia winter safety campaign** designed to educate drivers about the importance of driving safely in winter conditions. The Clear Roads Web site houses sample campaign materials, photos and videos with the "Ice and Snow… Take It Slow" slogan developed for the campaign. WisDOT used the campaign this winter, both on its Web site and as part of its public service announcements.

- **Aurora.** Aurora is an international pooled fund partnership of public agencies that work together to perform joint research on road weather information systems (RWIS). Its membership includes 13 state DOTs, FHWA , and two international agencies. WisDOT became a member of Aurora in 1997. The department did not fund participation in this project in FY 2009, but WisDOT did resume membership in FY 2010.

  The Aurora program performs research in many RWIS-related areas, some of which have applications in Wisconsin. WisDOT concluded its role as the project champion for a study of the new Vaisala Spectro pavement sensor, which identifies and distinguishes between water, snow, ice, slush and frost on roadway surfaces. The sensor helps maintenance crews identify current driving conditions, and provides pavement information to initiate automatic deicer spraying equipment. This study, performed by the Ontario Ministry of Transport and the University of North Dakota under WisDOT's guidance, has been completed and final reports are available.

See http://www.aurora-program.org/ for more information about this pooled fund project.

- **SICOP.** The Snow and Ice Pooled Fund Cooperative Program sponsors testing of new winter maintenance technologies that are developed in the U.S. and internationally. SICOP was developed by AASHTO and is overseen by AASHTO's Winter Maintenance Technical Service Program. WisDOT has been involved in several SICOP programs, including:
  - Developing and implementing a computer-based training program on anti-icing practices and RWIS systems for snowplow drivers, managers and operators.
  - Participating in a survey about the use of automatic vehicle location systems and GPS technology in winter maintenance.
  - Participating in a survey about the use of Fixed Anti-icing Spray System Technology (FAST).
  - Contributing to the Snow and Ice Listserv, a community of hundreds of winter maintenance professionals. The listserv provides a forum for discussing a wide range of winter maintenance issues.
  - Assisting in planning for the 2009 National Winter Maintenance Peer Exchange, which was hosted by WisDOT in August 2009.

See http://www.sicop.net/ for more information about this pooled fund project.

In addition, WisDOT participates in the following partnership initiatives:

- **Maintenance Decision Support System.** The objective of this FHWA project is to produce a prototype tool for decision support to winter road maintenance managers. The concept is to use small-scale computer model weather forecasts combined with rules of practice for winter maintenance to generate treatment recommendations throughout storm events.

WisDOT joined the MDSS pooled fund project in September 2009. In FY 2010, WisDOT took advantage of Dane County's countywide implementation of AVL/GPS by adding the MDSS component to the system and evaluating its performance in Dane and Rock Counties. MDSS was also paired with AVL/GPS along the Interstate 94 corridor between the Illinois state line in Kenosha County and Hudson, Wis. in FY 2010. WisDOT has committed to implementing MDSS statewide in FY 2011.

See http://www.rap.ucar.edu/projects/rdwx_mdss/ for more information.

- **Clarus.** A joint effort of FHWA and the National Weather Service, this initiative aims to consolidate all road weather data into a national database. A WisDOT representative attended the annual project meeting in Charlotte, N.C., in September 2009. WisDOT continues to participate through its membership in the North/West Passage pooled fund effort. Clarus is now in the regional demonstration phase, with teams of contractors and states being chosen to implement the previously developed concepts of operations. Due to limitations placed on the proposing teams by FHWA, WisDOT is not participating in the demonstrations, but WisDOT staff did help evaluate a project dealing with spring weight restrictions. It is anticipated that Clarus will be transitioned to the National Weather Service in FY 2011. At that time, WisDOT will begin using outputs from Clarus.

See http://www.clarusinitiative.org/ for more information.

National MDSS Conference

On May 19, 2010, FHWA sponsored a MDSS conference in Madison. In attendance were 121 snow professionals representing 10 states including: Wisconsin, Colorado, Indiana, Minnesota, Utah, North Dakota, Illinois, Georgia, and Washington DC. The conference highlighted positive experiences and costs savings that have been realized by several states who have already implemented the MDSS protocols.

3C. Labor

Over 1,500 employees of Wisconsin's county highway departments are licensed to operate a snowplow, and over 700 of them are permanently assigned to the state highway system. Because a snowstorm can hit at any time of day, snowplow operators frequently put in overtime, and may plow for extended periods during heavy snowfall.

Labor costs vary from county to county according to each area's union contracts, which also define when overtime hours can be charged. This winter, counties spent $17.6 million on labor, for an average of $526 per lane mile. Per-lane-mile labor expenditures decreased 22 percent compared with last year's winter. An average of 24 percent of counties' winter maintenance costs were spent on labor, with a high of 30 percent in the Southeast Region, where hourly labor rates tend to be higher. Labor hours were down 10 percent for regular hours and 40 percent for overtime hours compared with last winter, a significant reduction in light of this winter's decline in overall severity index. See Table 4.10 on page 86 for county-by-county labor expenditures, and see Table 3.6 on page 58 for county-by-county estimated labor hours and costs from the winter storm reports.

Winter Operations Training

Before each winter season, BHO provides and supports a variety of training efforts for WisDOT regional staff and county highway departments. Recent efforts have included:

- **AASHTO Computer-Based Training.** AASHTO offers seven computer-based training courses that can be completed by winter maintenance staff at their own pace as schedules permit. Course topics include anti-icing/RWIS, mitigating environmental impacts, equipment maintenance, plowing techniques, deicing, mitigating blowing snow, and winter maintenance management. Counties are encouraged to have their operators complete the appropriate training courses, including courses for supervisors. For more information, see http://www.transportation.org/sites/sicop/docs/CBT_Handout.pdf.

- **RWIS Training.** WisDOT's RWIS program manager provides training for both WisDOT regional operations staff and county highway departments. A summary of these training activities can be found in the RWIS Annual Report, available at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm.

- **Regional Operations/County Fall Training Sessions.** These sessions are held in all regions in preparation for the upcoming winter season, at some locations in conjunction with Snowfighters' Roadeos. WisDOT provided support and participated in some of these training sessions.

- **Snowfighters' Roadeos.** These events are held by some counties annually, with some roadeos held jointly by two or three counties. WisDOT prepared a Roadeo Manual in August 1997 to assist counties in organizing these roadeos (see https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/best-practices/pdf/vib1.pdf). In addition, organizations such as the Wisconsin chapter of the American Public Works Association and the Wisconsin County Highways Association periodically host statewide Snowfighters' Roadeos.

Past training efforts have included:

- **Winter Operations Workshops.** Facilitated by BHO staff, these interactive one-day workshops for WisDOT regional staff and county highway department patrol superintendents covered winter maintenance topics such as use of RWIS and weather forecast programs, anti-icing, living snow fences, and winter maintenance guidelines. The workshops were first held in October 2004 and held again at five locations in October 2005.

- **Division of State Patrol Winter Maintenance Training Sessions.** Presented by BHO, this training was last held in November 2007 with the new DSP trooper recruit class. As a follow-up to these sessions, local meetings of WisDOT regional operations staff, county highway departments and WisDOT regional state patrol staffs were held prior to the winter season.

County-by-County Tables and Figures for Section 3: Snow and Ice Control

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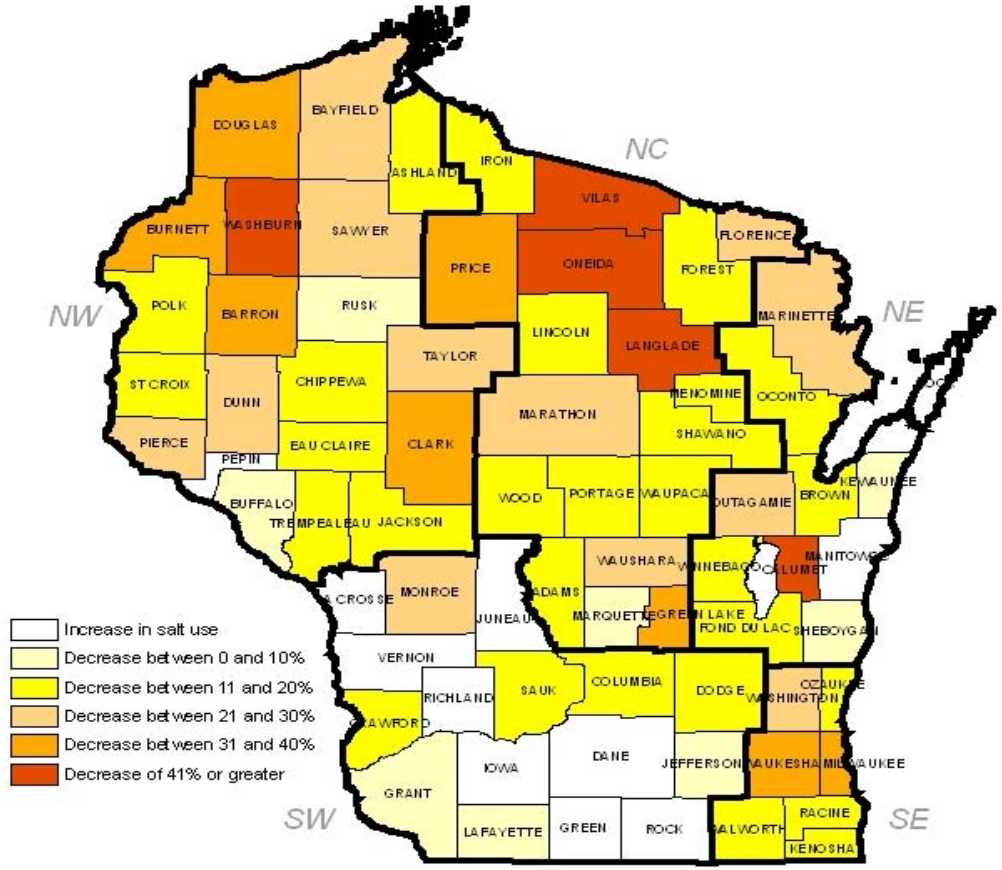
Figure 3.6. 2009-2010 Salt Use per Lane Mile vs. 5-Year Average

County	Salt Use Decrease
Richland	-34%
Vernon	-23%
LaCrosse	-22%
Door	-17%
Juneau	-11%
Iowa	-10%
Rock	-10%
Dane	-7%
Manitowoc	-5%
Green	-4%
Pepin	-3%
Grant	1%
Buffalo	1%
Rusk	3%
Lafayette	4%
Marquette	5%
Jefferson	5%
Kewaunee	7%
Sheboygan	10%
Oconto	10%
Fond du Lac	11%
Crawford	12%
Brown	12%
Chippewa	13%
Walworth	13%
Eau Claire	14%
Adams	14%
Forest	15%
Waupaca	15%
Trempealeau	15%
Shawano	15%
Ashland	16%
Columbia	16%
Portage	16%
Kenosha	16%
Ozaukee	17%

County	Salt Use Decrease
Polk	17%
Saint Croix	17%
Menominee	17%
Dodge	17%
Sauk	17%
Jackson	17%
Racine	18%
Wood	19%
Iron	19%
Winnebago	19%
Lincoln	19%
Pierce	20%
Waushara	20%
Dunn	22%
Marinette	22%
Outagamie	23%
Bayfield	23%
Sawyer	23%
Washington	26%
Monroe	26%
Marathon	27%
Taylor	27%
Florence	28%
Clark	31%
Milwaukee	32%
Green Lake	32%
Price	34%
Douglas	35%
Barron	35%
Burnett	36%
Waukesha	37%
Calumet	42%
Oneida	42%
Vilas	43%
Langlade	45%
Washburn	50%



State and Regional	Salt Use Decrease
Statewide average	16%
SW Region	1%
NE Region	13%
NW Region	22%
NC Region	24%
SE Region	27%

2009-2010 D.O.T SALT PRICE COMPARISON & 5 YEAR AVERAGE USE

Alaska:
Straight Rock Salt @ $146/ton
5 year avg. use = 18,000 ton

Washington.:
Straight Rock Salt @ $125/ton
5 year avg. use = 58,000 tons

Oregon.:
No Solid Salt Used

California:
Straight Rock Salt @ $88/ton
5 year avg. use = 22,000 tons

Nevada:
Straight Rock Salt @ $59/ton
5 year avg. use = 70,000 ton

Idaho:
-Straight Rock Salt @ $65/ton
-Evaporated Salt @ $61/ton
5 year avg. use = 50,000 tons

Montana:
-Straight Rock Salt @ $81/ton
5 year avg. use = 24,000 tons
*Solar Salt @ $87-$110/ton
5 year avg. use = 24,000tons

Wyoming:
-Straight Rock Salt @ $95/ton
-Bulk Salt @ $81/ton
-Salt/Sand mix @ $71/ton
5 year avg. use = 16,000 tons

Utah:
-Straight Rock Salt @ $30/ton
5 year avg. use = 80,000 tons
-Solar Salt @ $29/ton
5 year avg. use = 145,000 tons
Total Products = 225,000 tons

Colorado:
Ice Slicer/Salt@ $78/ton
5 year avg. use = 100,000 tons

Arizona:
Straight Rock Salt @ $109/ton
5 year avg. use = 25,000 tons

New Mexico:
Straight Rock Salt @ $33 - $56/ton
5 year avg. use = 5,000 tons

North Dakota:
Straight Rock Salt @ $62/ton
5 year avg. use = 30,000 tons

South Dakota:
Straight Rock Salt @ $69/ton
5 year avg. use = 48,000 tons

Nebraska:
Straight Rock Salt @ $48/ton
5 year avg. use = 85,000 tons

Kansas:
Straight Rock Salt at $43/ton
5 year avg. use = 100,000 tons

Oklahoma:
Straight Rock Salt @ $65/ton
5 year avg. use = 50,000 tons

Texas:
Straight Rock Salt @ $41/ton
5 year avg. use = 2,000 tons

Minnesota:
Straight Rock Salt @ $55/ton
5 year avg. use = 229,000 tons

Iowa:
Straight Rock Salt @ $67/ton
5 year avg. use = 200,000 tons

Missouri:
Straight Rock Salt @ $63/ton
5 year avg. use = 220,000 tons

Arkansas:
Straight Rock Salt @ $137/ton
5 year avg. use = 13,000 tons

Louisiana:
No bulk salt

Wisconsin:
Straight Rock Salt @ $61/ton
5 year avg. use = 420,000 tons

Michigan:
-Straight Rock Salt @ $57/ton
-5 year avg. use = 625,000 tons

Illinois:
Straight Rock Salt @ $79/ton
5 year avg. use = 495,000 tons

Indiana:
-Straight Rock Salt @ $65/ton
-5 year avg. use = 395,000 tons

Ohio:
Straight Rock Salt @ $62/ton
5 year avg. use = 540,000 tons

Kentucky:
Straight Rock Salt @ $70/ton
5 year avg. use = 220,000 tons

Tennessee:
Straight Rock Salt @ $61/ton
5 year avg. use = 90,000 tons

Mississippi:
Straight Rock Salt @ $100/ton
5 year avg. use = 223,000 tons

Vermont:
Straight Rock Salt @ $62/ton
5 year avg. use = 105,000 tons

New York:
-Straight Rock Salt @ $52/ton
-5 year avg. use = 950,000 tons

Pennsylvania:
Straight Rock Salt @ $56/ton
5 year avg. use = 831,000 tons

Virginia:
Straight Rock Salt @ $77/tons
5 year avg. use = 150,000 tons

West Virginia:
Straight Rock Salt @ $69/ton
5 year avg. use = 200,000 tons

Maine:
-Straight Rock Salt @ $72/ton
-5 year avg. use = 100,000 tons

New Hampshire:
Straight Rock Salt @ $64/ton
5 year avg. use = 200,000 tons

Massachusetts:
Straight Rock Salt @ $75/ton
5 year avg. use = 525,000 tons

Rhode Island:
Straight Rock Salt @ $84/ton

Connecticut:
Straight Rock Salt @ $75/ton
5 year avg. use = 90,000 tons

New Jersey:
Straight Rock Salt @ $67/ton
5 year avg. use = 100,000 tons

Delaware:
Straight Rock Salt @ $66/ton

DC:
Straight Rock Salt @ $56/ton

Maryland:
Straight Rock Salt @ $69/ton
5 year avg. use = 238,000 tons

BC AB SK MB ON QC NC SC GA AL FL

PRODUCTION FACILITIES

SOLAR SALT:
Produced by using the "solar power" of wind and sunlight to evaporate in large open ponds.

EVAPORATED SALT:
Made by boiling saturated brine, under a partial vacuum with steam heat.

MINED SALT:
Mined from below ground.

*Inhibited salts contain a corrosion inhibitor which increases the cost of the product.

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Transportation Synthesis Report
RESEARCH & LIBRARY SERVICES
research@dot.state.wi.us

Limitations of the Use of Abrasives in Winter Maintenance Operations

Prepared for
Bureau of Highway Operations

Prepared by
CTC & Associates LLC
WisDOT Research & Library Unit
December 30, 2008

Transportation Synthesis Reports are brief summaries of currently available information on topics of interest to WisDOT staff throughout the department. Online and print sources for TSRs include NCHRP and other TRB programs, AASHTO, the research and practices of other transportation agencies, and related academic and industry research. Internet hyperlinks in TSRs are active at the time of publication, but changes on the host server can make them obsolete. To request a TSR, e-mail research@dot.state.wi.us or call (608) 261-8198.

Request for Report

In the interest of developing more effective winter maintenance operating procedures, WisDOT's Bureau of Highway Operations is interested in knowing more about the limitations of the use of sand in winter maintenance operations. As the lead state for the Clear Roads winter maintenance pooled fund, WisDOT will share the results of this research with the Clear Roads member states.

Summary

While sand, the most common abrasive used in winter maintenance, cannot melt snow and ice, it does play a role in many winter maintenance programs. According to NCHRP Report 526, *Snow and Ice Control: Guidelines for Materials and Methods*, "the primary function of abrasives is to provide temporary traction (friction) improvement on snow/ice surfaces." Many agencies use sand to maintain safety at hills, curves, intersections and low-volume roads, and on packed snow or ice that is too thick for chemicals to penetrate. We summarize **WisDOT's Current Practice** in the use of abrasives in winter maintenance below.

Sand's use over time has declined due to a variety of **Limiting Factors**, including its **Effectiveness**, **Environmental Impacts**, **Safety Implications** and **Cost**. See below for findings from reports and studies that address the limitations of the use of sand in winter maintenance operations. We conclude with **Recommended Best Practices** for the use of abrasives in winter maintenance programs compiled from two 2001 documents.

WisDOT's Current Practice

Chapter 35 of the State Highway Maintenance Manual provides recommendations for the use of abrasives in winter operations. Sand and other locally available abrasive materials can be used when high winds or storm conditions preclude the use of salt, or when pavement temperatures are too low (10°F or less) for deicing agents to work effectively. When conditions warrant, abrasives may be applied to predetermined low-speed areas such as certain grades, curves, intersections, structures and isolated areas where hazards exist. Abrasives should not be used where vehicle speeds exceed 45 mph. Prewetting of abrasives with a deicing agent is recommended to improve adherence to the roadway. Contact the WisDOT Library at library@dot.state.wi.us for a copy of WisDOT's State Highway Maintenance Manual.

Limiting Factors

Effectiveness

Sand has exhibited limited effectiveness at higher vehicle speeds, especially when it has not been prewetted. Mixing sand with salt to keep it from freezing also limits sand's effectiveness.

- Studies suggest that at highway speeds sand is swept off the road after relatively few vehicle passes (eight to 12) and that friction gains from sanding (when the sand remains on the road) are minimal (Nixon 2001b, page 1).

- Snow- and ice-covered roadways that have been treated with abrasives provide friction values that are far less than "bare" or "wet" pavement (NCHRP, page 25).

- During storm periods when anti-icing operations are successful, abrasive applications provide no consistent or apparent benefit in hard-braking friction, traction or pavement condition (FHWA 1998, page 208 of the PDF).

- Mixing sand with 50 to 100 pounds of salt per cubic yard is necessary to prevent freezing and keep it workable (Wisconsin Transportation Center, page 4).

- A mix of abrasives and chemical will usually be no more effective as an anti-icing treatment during snowstorms than the same amount of chemical placed alone (FHWA 1996b; click on *2.5 Abrasives Use*).

- A 1973 study (Keyser, pages 4-6 of the Word file) indicates that the melting of snow and ice will be delayed by using a mixture of salt and sand.

- In a blend, sand and salt often work against each other. The salt in the mix may blow away as vehicles travel the roadway. If the sand remains on snow, tires can push the sand down into the slush, making it ineffective for improving traction. Also, salt melts less ice when mixed with sand (Wisconsin Transportation Center, page 4).

- Use of salt/abrasives mixes at moderately or much higher application rates than straight chemical does not lead to corresponding improvements in hard-braking friction or pavement conditions. Comparisons of test and control operations using identical salt/abrasives mixes show that more frequent applications at similar rates also do not lead to corresponding improvements in friction or pavement conditions and even indicate that the more frequent applications can lead to slightly worse conditions (FHWA 1998, Section 7.4.1 on page 208 of the PDF).

Environmental Impacts
Studies have shown that sand remains in the environment after its application, resulting in negative impacts on land, water and health.

- An Oregon DOT study in the early 1990s found that 50 to 90 percent of sand applied to pavements remains in the environment after cleanup (FHWA 1996c).

- Up to 70 percent of sand entering Lake Tahoe was shown to be from snow and ice control. Sand was being carried by snowmelt into culverts that drained into the lake (FHWA 1996a).

- Sand creates debris deposits on roadways, mixing with oil, grease and other automotive byproducts. Sand remaining on roadways clogs storm water catch basins and fills streambeds, clouding the water, hurting aquatic animals and leading to an increase in microorganisms. If collected at the end of winter maintenance, sand may have to be disposed of as a hazardous waste. Sand is also ground into a fine dust by traffic, which can trigger respiratory problems like asthma (EPA).

- The use of abrasives can contribute to increased levels of ambient PM_{10}, the very small airborne particulate matter that is inhaled into the lungs and can cause respiratory problems. Researchers found that the use of abrasives increased the rate of road dust re-entrainment. Street sweeping, a practice intended to minimize air quality impacts of roadway abrasives, was found to actually increase the observed emission rate (Gertler, page 5984).

- Uncovered sand piles mixed with salt are susceptible to leaching. One study indicated that 10 inches of precipitation leached out 50 percent of the salt (Walker, page 2).

Safety Implications
Some research has concluded that sand used in a salt-abrasive mixture does not contribute to accident reductions.

- Accident rate reductions on two-lane highways were less with salt-abrasive mixtures than with salt only. Accident rates dropped dramatically after achievement of bare pavement with salt only but more slowly with salt-abrasive mixes. Accident reductions for freeways were much less and took much longer to occur when salt-abrasive mixtures were used, as compared with the use of salt only (Kuemmel and Bari, page 9 of the PDF).

Cost
Research indicates that salt is more cost-effective than sand in winter maintenance operations.

- Abrasives must be used in large quantities and applied frequently, making abrasives more expensive than salt in terms of material and manpower (Salt Institute 2004, page 8).

- When mixed with enough ice control chemical, abrasives will support anti-icing and deicing strategies; however, this is very inefficient and costly, as the abrasives for the most part are "going along for the ride" while the chemical portion of the mix is doing the work (NCHRP, page 14).

- A loaded salt truck, spreading at the rate of 500 pounds per two-lane mile for general storm conditions, can treat a 22.5-mile stretch of roadway, traveling a total of 45 miles. A sand truck requires seven loads, must travel a distance of 187 miles to treat the same section of road, and requires four times more fuel (Salt Institute 1995, page 3).

- Benefit-cost calculations showed that the application of salt-abrasive mixtures did not recover winter maintenance costs on two-lane highways during the 12-hour analysis period. Benefit-cost calculations showed that freeway operations recovered costs in six hours, substantially longer than the 35 minutes with salt only (Kuemmel and Bari, page 11 of the PDF).

- Cost analyses indicate that, where cleanup is performed, the most significant reduction in operational costs will result from the elimination of the use of abrasives as an anti-icing treatment (FHWA 1998, page 208 of the PDF).

- The cost for distributing abrasives on roads is several times higher than those for distribution of salt. Tests carried out on selected road sections in Zurich and Chur, Switzerland, indicate that in a normal winter, the costs for distributing abrasives over a 1-kilometer section are approximately six times higher than those for distributing salt. In a severe winter this factor rose to as high as 10 (Schlup and Ruess, page 49).

- Windshield damage from airborne particulates is 365 percent higher in areas using sand and abrasives instead of salt (Salt Institute 2004, page 9).

Recommended Best Practices

Two 2001 reports published by Wilfrid Nixon provide recommendations for the use of abrasives based on road type. The first report offers general recommendations for the use of dry abrasives (see pages 20-22 of the PDF). The second report expands on those recommendations to consider three different abrasive types: dry abrasives, abrasives prewetted with liquid deicers at the spreader or tailgate, and abrasives applied using a hot method (see pages 44-45). Examples of hot methods include heating abrasives to high temperatures (approximately 180°C) just before application and mixing the abrasives with hot water (about 90°C) as they are placed on the road. Nixon considers the hot application methods experimental, though promising. Nixon's guidelines for abrasive use include:

Rural Roads. Rural roads can see high-speed traffic. For this reason, if electing to apply dry abrasives, limit application to hills and curves on low-speed, low-volume roads. Application of prewetted abrasives on paved roads allows the abrasives to stay on the roadway longer than if the abrasives had been applied dry. Prewetted abrasives can also melt the snowpack and provide for extended increase in road surface friction.

Rural Intersections. Given the low speeds associated with rural intersections, abrasives could be applied dry. However, if the intersection is not gravel, prewetting the abrasive will allow the treatment to remain in place longer.

High-Speed Urban Roads. No benefit is expected when applying dry abrasives to these roads where posted speed limits exceed 30 mph. Application of prewetted abrasives may be appropriate for this road type; hot abrasives may also be considered.

Low-Speed Urban Roads. Limit dry abrasive application to the parts of the road where braking, accelerating or maneuvering is done, and only use this approach when the snowpack is expected to persist. Application of prewetted abrasives will allow the material to remain on the road surface longer. Again, hot application methods may be appropriate.

Urban Intersections. Dry abrasives can be used where the intersection is likely to be snow- or ice-covered for a longer-than-normal period of time. Prewetted abrasives will remain in place longer; hot application methods might also be considered.

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Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group A)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
MARATHON	NC	880.19	27.83	8.33	$320	3174	2640	5814	45.4%	6.61	0.24
RACINE	SE	704.86	29.38	12.08	$440	2185	2836	5021	56.5%	7.12	0.24
PORTAGE	NC	547.20	26.31	9.65	$351	2069	1765	3834	46.0%	7.01	0.27
LA CROSSE	SW	488.24	29.17	15.00	$420	2801	1575	4375	36.0%	8.96	0.31
OZAUKEE	SE	304.03	21.21	17.37	$373	1694	575	2269	25.3%	7.46	0.35
KENOSHA	SE	573.11	20.57	11.81	$491	1941	2257	4198	53.8%	7.32	0.36
BROWN	NE	711.91	20.33	13.45	$397	2580	2588	5167	50.1%	7.26	0.36
DANE	SW	1501.97	24.31	24.06	$509	4450	8889	13339	66.6%	8.88	0.37
WINNEBAGO	NE	568.31	20.77	12.23	$389	1677	2641	4317	61.2%	7.60	0.37
MILWAUKEE	SE	1784.17	20.33	14.44	$515	7716	5624	13340	42.2%	7.48	0.37
EAU CLAIRE	NW	537.26	21.82	10.02	$405	2698	1927	4625	41.7%	8.61	0.39
WAUKESHA	SE	1070.09	17.68	16.28	$404	3761	4476	8237	54.3%	7.70	0.44
Group A Avg		805.94	23.31	13.73	$418	3062	3149	6211	48.3%	7.67	0.34

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group B)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
ONEIDA	NC	396.79	36.32	9.39	$368	2126	1088	3214	33.8%	8.10	0.22
WASHINGTON	SE	581.11	25.25	13.83	$307	1955	1750	3705	47.2%	6.38	0.25
SAINT CROIX	NW	618.98	26.43	9.78	$342	2116	2138	4254	50.3%	6.87	0.26
SHAWANO	NC	515.09	29.42	10.59	$323	2531	1414	3944	35.8%	7.66	0.26
CHIPPEWA	NW	669.29	26.60	10.72	$318	2678	2096	4773	43.9%	7.13	0.27
SHEBOYGAN	NE	520.30	23.69	13.40	$354	2093	1303	3396	38.4%	6.53	0.28
WALWORTH	SE	682.81	21.72	16.63	$403	2039	2277	4317	52.8%	6.32	0.29
WAUSHARA	NC	345.71	17.25	6.92	$250	968	866	1834	47.2%	5.30	0.31
DUNN	NW	516.55	22.14	10.03	$379	1747	1847	3594	51.4%	6.96	0.31
MANITOWOC	NE	417.99	23.64	14.57	$401	1702	1408	3110	45.3%	7.44	0.31
DODGE	SW	606.62	21.15	16.19	$298	2323	1841	4164	44.2%	6.86	0.32
OUTAGAMIE	NE	523.98	24.09	12.02	$337	3194	1070	4264	25.1%	8.14	0.34
MARQUETTE	NC	244.53	18.39	13.99	$277	924	633	1557	40.6%	6.37	0.35
SAUK	SW	591.55	22.20	15.22	$343	2949	1824	4773	38.2%	8.07	0.36
ROCK	SW	598.50	23.46	17.37	$491	2458	2793	5251	53.2%	8.77	0.37
COLUMBIA	SW	743.95	24.87	18.56	$487	4021	3094	7114	43.5%	9.56	0.38
JEFFERSON	SW	458.21	18.09	19.85	$425	1697	1827	3524	51.9%	7.69	0.43
Group B Avg		531.29	23.81	13.47	$359	2207	1722	3929	43.7%	7.30	0.31

Final totals as of Thursday, September 16, 2010

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
CLARK	NW	402.28	25.55	7.92	$231	1319	722	2040	35.4%	5.07	0.20
WASHBURN	NW	372.14	23.44	6.59	$218	975	799	1774	45.1%	4.77	0.20
VILAS	NC	305.24	36.76	12.16	$363	1430	946	2376	39.8%	7.78	0.21
VERNON	SW	450.00	27.72	11.65	$219	1690	973	2663	36.5%	5.92	0.21
WOOD	NC	372.22	25.31	9.02	$258	1213	810	2023	40.0%	5.43	0.21
TREMPEALEAU	NW	434.99	21.99	9.86	$200	1446	617	2063	29.9%	4.74	0.22
CRAWFORD	SW	385.21	30.05	8.00	$268	1631	939	2570	36.5%	6.67	0.22
DOUGLAS	NW	439.23	30.33	8.18	$328	1744	1266	3010	42.1%	6.85	0.23
LINCOLN	NC	418.33	32.30	8.22	$320	2128	983	3110	31.6%	7.43	0.23
GRANT	SW	624.14	29.85	11.50	$272	2542	1784	4325	41.2%	6.93	0.23
LAFAYETTE	SW	293.88	27.21	7.06	$273	1000	882	1882	46.9%	6.40	0.24
MONROE	SW	646.13	27.38	9.28	$278	2380	1811	4191	43.2%	6.49	0.24
JUNEAU	SW	498.79	23.47	15.57	$251	1601	1211	2812	43.1%	5.64	0.24
WAUPACA	NC	546.64	21.04	9.86	$246	1515	1288	2802	45.9%	5.13	0.24
JACKSON	NW	514.30	28.44	11.21	$303	2232	1332	3564	37.4%	6.93	0.24
KEWAUNEE	NE	110.41	23.77	9.01	$284	426	235	661	35.6%	5.98	0.25
DOOR	NE	268.55	23.64	11.44	$347	954	850	1804	47.1%	6.72	0.28
CALUMET	NE	201.29	28.95	6.09	$398	892	785	1677	46.8%	8.33	0.29
OCONTO	NE	471.83	28.95	9.33	$386	2437	1535	3972	38.7%	8.42	0.29

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
IOWA	SW	451.03	26.64	13.18	$399	2108	2080	4188	49.7%	9.28	0.35
FOND DU LAC	NE	599.20	23.23	10.43	$438	2816	2560	5376	47.6%	8.97	0.39
Group C Avg		419.33	26.95	9.79	$299	1642	1162	2804	41.0%	6.66	0.25

Final totals as of Thursday, September 16, 2010

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
MENOMINEE	NC	90.26	22.48	13.86	$131	258	95	353	26.9%	3.91	0.17
RICHLAND	SW	328.72	28.61	9.60	$214	1077	601	1678	35.8%	5.10	0.18
FLORENCE	NC	141.07	29.77	13.20	$239	406	357	763	46.8%	5.41	0.18
ASHLAND	NW	247.57	43.38	9.76	$391	940	1050	1990	52.8%	8.04	0.19
BAYFIELD	NW	316.90	42.88	10.00	$357	1595	946	2541	37.2%	8.02	0.19
PRICE	NC	320.57	37.23	9.68	$332	1178	1109	2287	48.5%	7.13	0.19
ADAMS	NC	192.72	29.92	12.79	$282	706	409	1114	36.7%	5.78	0.19
PIERCE	NW	366.08	32.49	8.85	$299	1469	835	2304	36.2%	6.29	0.19
MARINETTE	NE	417.29	29.16	8.38	$332	1803	628	2430	25.8%	5.82	0.20
GREEN LAKE	NC	151.30	24.65	5.01	$214	514	238	751	31.6%	4.96	0.20
IRON	NC	250.91	46.53	15.51	$442	1544	850	2394	35.5%	9.54	0.21
FOREST	NC	312.38	31.51	13.93	$267	1329	719	2048	35.1%	6.55	0.21
BURNETT	NW	233.64	24.77	7.31	$234	844	440	1284	34.3%	5.50	0.22
SAWYER	NW	367.44	26.51	6.24	$263	1320	864	2184	39.5%	5.94	0.22
POLK	NW	385.05	27.97	9.97	$309	1440	1071	2511	42.6%	6.52	0.23
RUSK	NW	213.47	29.65	8.15	$286	1063	426	1489	28.6%	6.97	0.24
TAYLOR	NW	233.25	27.78	8.88	$280	1054	498	1552	32.1%	6.65	0.24
BARRON	NW	423.09	31.23	3.77	$342	2161	1133	3294	34.4%	7.79	0.25
BUFFALO	NW	316.05	24.47	5.59	$259	1241	740	1981	37.4%	6.27	0.26

Table 3.6. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Salt per Lane Mi	Labor Cost per Lane Mi	Reg Hrs	OT Hrs	Total Hours	% OT	Total Hrs per Lane Mi	Total Hrs per Lane Mi/SI
PEPIN	NW	111.05	21.72	6.57	$268	367	283	650	43.5%	5.85	0.27
LANGLADE	NC	292.69	23.42	8.37	$277	1209	665	1874	35.5%	6.40	0.27
GREEN	SW	311.37	26.31	8.84	$355	1454	1166	2620	44.5%	8.41	0.32
Group D Avg		273.77	30.11	9.28	$290	1135	687	1822	37.3%	6.49	0.22

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4 Performance

In this section...

Since weather can vary drastically from year to year, planning and budgeting for winter highway maintenance can be challenging. Throughout the winter, WisDOT staff and county highway departments evaluate progress in several areas, including materials use, money spent, and response time. When the season is complete, WisDOT can gather all the data and analyze this winter's performance across all regions and compared to previous winters.

This section begins with a description of the winter maintenance portion of Compass, WisDOT's operations performance measurement program, which measures trends in areas like response time and winter costs per lane mile. This section also discusses costs, using charts to visually compare spending in different categories from region to region and from year to year, and presents winter crash rates and customer satisfaction data.

Performance and Costs

	2009–2010 Statewide
Total lane miles	**33,532**
Total patrol sections	**767**
Average lane miles per patrol section	**43.72**
Average time to bare/wet pavement[1]	**1.14 hours**
Average crew reaction time from start of storm	**3.18 hours**
Total winter costs[2]	**$74,506,207**
Total winter costs per lane mile	**$2,222**
Total winter crashes[3]	**5,697**
Total winter crashes per 100 million VMT	**22**

1. Time to bare/wet pavement and crew reaction time data are from storm reports.
2. Cost data are actual costs as billed to WisDOT by the counties.
3. Crash data are from WisDOT's Bureau of Transportation Safety.

An Economical Choice

Proactive anti-icing operations are about three times less costly than treating frost once it has formed. Anti-icing costs made up only 0.7 percent of total winter maintenance costs this year.
See page 41 for more information on anti-icing costs.

4A. Winter Maintenance Management

History of Snow and Ice Control in Wisconsin

The counties' plowing and salting strategies have evolved considerably over the past several decades. For many years beginning in the 1950s, WisDOT maintained a "bare pavement" policy for state highways, striving to ensure that the roadways were kept essentially clear of ice and snow during winter. Snowplows operated continuously during storms and simultaneously applied deicing salts. In the 1970s, however, economic and environmental concerns compelled the department to modify this policy. The national energy crisis and the high cost of employee overtime strained the maintenance budget, and WisDOT made the decision to reduce winter maintenance coverage on less traveled state highways. To address the risk of environmental damage by chloride chemicals, the policy was modified further to include provisions calling for the prudent use of chemicals, and limiting each application of salt to 300 pounds per lane mile.

In 2002, a detailed salt application table was added to the maintenance manual's winter guidelines. The table provides variable salt application rates for initial and repeated applications, depending on the type of precipitation, pavement temperature, wind speeds, and other weather variables. Anti-icing application rates were also established; county highway departments were instructed to perform anti-icing applications prior to predicted frost, black ice, or snow events in order to minimize the amount of salt used during the event.

Storm Reports

One way that WisDOT has worked to increase efficiency in recent years is through the Winter Storm Reports. Every week during the winter, the county highway departments complete online storm report forms. These storm reports let county and WisDOT staff track the season's weather and the counties' response to it throughout the season, which allows the counties to adjust their resource use midseason if necessary. The storm reports track data such as types of storm events, salt use, anti-icing applications, labor hours, and cost estimates. Uses for this data include:

WisDOT Central Office

- Create weekly reports and maps that track salt use and costs. These can help identify inconsistencies in service levels provided by neighboring counties.
- Calculate the severity index; use this to justify additional funding if conditions are more severe than normal

WisDOT Regional Offices

- Justify additional funding if conditions are more severe than normal
- Manage salt inventory
- Post-storm analysis of county's response
- Training tool for new staff

Counties

- Post-storm analysis of crew's response
- Compare their response (materials use, anti-icing, labor hours, etc.) to that of neighboring counties
- Justify funding to county boards

See https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/storms/howtouse.shtm for more detail on how to use the storm report data.

WisDOT relies on the county highway departments to make the storm reports a reliable tool by entering data accurately each week. Historically, the cost and salt use data in the storm reports has been relatively accurate when compared with final costs billed to WisDOT and end-of-season salt inventory figures.

Winter Patrol Sections

Many factors influence a county's response to winter storms, including the timing of snow events, the mix of highway types and classifications in a county, and the type of equipment being used. Another important factor is the length of each county's patrol sections.

Each county highway department divides the state highways it is responsible for plowing into patrol sections. In general, one snowplow operator is assigned to each patrol section. This winter, the state highway system was divided into 767 winter patrol sections, an average of 10.6 sections per county. The length of patrol sections varies, with counties that are more urban (Group A) tending to have shorter patrol sections than more rural counties (Group D). Local traffic patterns, highway geometrics, number of traffic lanes, intersections, interchanges, and other factors affect the length of patrol sections in each county.

In responding to a storm, operators in longer patrol sections may use more salt in an effort to melt any snow that accumulates between plowings. In addition, drivers may notice that some roads appear to be cleared faster than others, since the longer a patrol section, the longer it takes a snowplow operator to clear all the roads in his section. Three counties have undertaken snowplow route optimization studies in the past to make their patrol section lengths as efficient as possible; see https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/winter/reports/reports.shtm for details.

Table 4.1 shows the average patrol section length for the counties in each Winter Service Group. For county-by-county patrol section data, see Table 4.8 on page 81.

Table 4.1. Average Patrol Section Lengths by Winter Service Group

Winter service group	Average patrol section length (lane miles)	Range of average patrol section lengths by county (lane miles)
A	39.6	29 – 51
B	44.4	35 – 62
C	45.1	26 – 56
D	48.4	37 – 61
Statewide average	43.8	26 – 62

BEST PRACTICES: Proactive approach

In general, a faster reaction time leads to faster clear pavement. WisDOT encourages county highway departments to have crews on the roads as soon as possible after a storm begins, within the guidelines for each county's service group and each highway's expected level of service.

Responding at the beginning of a storm reduces the amount of traffic that has packed down the snow before the plows and salt spreaders go to work. Since packed snow tends to require more effort to remove, minimizing the thickness of packed snow allows the counties to conserve resources and operate more efficiently.

For more information, contact Mike Sproul at michael.sproul@dot.wi.gov or (608) 266-8680.

4B. Response Time

WisDOT tracks two types of response time data—the time it takes a maintenance crew to get on the road after the start of a storm, and the time it takes the pavement to return to a bare/wet condition after the end of a storm. The first measure can impact the second. In general, a quicker response means the crews are dealing with less packed snow. However, WisDOT guidelines dictate that lower-volume highways receive 18-hour winter maintenance coverage rather than 24-hour coverage, so slower average reaction times are expected on 18-hour roads.

Maintenance Crew Reaction Time

Being proactive in getting on the road—even before the start of a storm—can result in bare/wet pavement being achieved faster and with less effort. Knowing this, county highway departments are becoming more proactive in their response to winter storms. Plows and salt spreader trucks are often on the road before a storm starts or shortly afterward.

Using data from the weekly winter storm reports, Table 4.2 shows the average reaction time to storm events in each Winter Service Group. The counties had become more proactive in responding to winter storm events over the last five winter seasons, responding an average of 13 percent faster last winter than in 2001–2002. However, this winter the average reaction time was 29% slower than in 2002–2003. As expected, average reaction times for Group A counties, which provide the highest level of service (24-hour coverage), were less than those counties that provide 18-hour coverage.

In recent years, the statewide average reaction time was lowest in 2004–2005 and 2005–2006, and has increased somewhat during the last four winters. This year's average reaction time was 3.18 hours. The increase in reaction time may be do to the increased use of the anti-icing technique. However, faster reaction times can result in higher labor costs.

Table 4.2. Maintenance Crew Reaction Time

From winter storm reports, 2002/2003–2009/2010

	Average reaction time (hours)								Percent change
Winter Service Group	2002–2003	2003–2004	2004–2005	2004–2006	2006–2007	2007–2008	2008–2009	2009–2010	2009–2010 vs. 2002–2003
A	1.44	1.45	1.25	1.55	1.70	1.50	1.40	2.31	+60%
B	1.92	2.01	1.97	1.59	1.80	1.73	1.91	2.34	+22%
C	2.92	2.89	2.42	2.79	2.82	2.86	2.82	3.21	+10%
D	3.56	4.37	3.23	3.60	3.81	3.83	4.16	4.87	+37%
Statewide average (unweighted)	2.46	2.68	2.22	2.38	2.53	2.48	2.57	3.18	+29%

Time to Bare/Wet Pavement

As explained in Section 1, county highway departments provide different levels of effort during and after a storm according to each highway's category rating, as determined by average daily traffic. It would be expected that an urban freeway (Category 1) would receive more materials, labor and equipment—and would show a quicker recovery to bare/wet pavement—than a rural two-lane highway (Category 5). For more information on these categories, see page 8.

Table 4.3. Average Time to Bare/Wet Pavement

Highway Category	Average Time to Bare/Wet Pavement (hours after end of storm)					
	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010
1	1.86	-1.21	–2.50	2.20	1.35	-1.02
2	1.91	0.20	-0.55	0.76	1.01	-1.58
3	2.08	1.77	1.57	3.14	2.40	1.65
4	1.95	2.47	2.70	4.01	3.06	2.32
5	2.03	3.40	2.73	4.84	3.74	2.41
Statewide average	**2.07**	**1.92**	**1.46**	**3.27**	**2.54**	**1.14**

Note: "Average Time to Bare/Wet Pavement" is defined as the time from the end of the storm to the time that the pavement was reported to be bare or wet. A negative "hours after end of storm" number or an extremely low number is caused by a number of storm events when the pavement was reported to be bare/wet before the reported end of the storm or the pavement was bare/wet at the same time as the end of the storm.

"Time to bare/wet pavement" is measured from the reported end time of a storm. Table 4.3 shows that the trend for average time to bare/wet pavement is as expected: More heavily traveled highways show a shorter average time to bare/wet pavement. From storm to storm, however, most variability is due to weather effects (type, duration and severity of storms throughout the winter season), according to analysis performed through the Compass program.

The average time to bare/wet pavement decreased over the first four winters that this measure was tracked, but for the winters of 2007–2008 and 2008–2009 multiple factors combined to make it more challenging for crews to clear roads quickly, which increased the statewide average. This winter's statewide average was 1.14 hours, an improvement over last winter's 2.54 hours and the lowest time to bare/wet pavement since the measure was recorded.

4C. Compass

Developed in 2001, Compass is WisDOT's quality assurance and asset management program for highway operations. Annual Compass reports provide information on winter maintenance activities as well as other aspects of highway operations.

Measures for winter operations were established in 2003, and data from the winter of 2003–2004 was used to establish baseline measures for future winter seasons. The measures that were chosen included:

- time to bare/wet pavement
- winter weather crashes per vehicle miles traveled
- cost per lane mile per Winter Severity Index point

Table 4.4 on page 70 gives the statewide average values for these measures for the last six winters. More detail on these measures is provided later in this section.

Table 4.4. Statewide Compass Measures for Winter

	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
Time to bare/wet pavement (after end of storm)	2 hours, 4 minutes	1 hour, 55 minutes	1 hour, 28 minutes	3 hours, 16 minutes	2 hours, 32 minutes	1 hours 8 minutes
Cost per lane mile	$1,374	$1,400	$1,549	$2,591	$2,365	$2,222
Winter Severity Index	31.9	31.8	28.4	37.2	36.2	26.6
Cost per lane mile per Winter Severity Index point	$43.07	$44.03	$54.54	$69.65	$65.33	$59.73
Winter weather crashes	25 per 100 million vehicle miles traveled	24 per 100 million vehicle miles traveled	23 per 100 million vehicle miles traveled	43 per 100 million vehicle miles traveled	40 per 100 million vehicle miles traveled	22 per 100 million vehicle miles traveled

WisDOT has gathered several years of baseline data and plans to establish targets for these measures. Until then, the data can be used to make a year-to-year comparison in these areas. Other winter measures that are being investigated for possible future use include:

1. Percent of winter operations equipment that is calibrated before winter begins
2. Average traffic speed recovery after a storm event (progress reports are available from WisDOT)

Annual Compass reports are available at https://trust.dot.state.wi.us/extntgtwy/dtid_bho/extranet/compass/reports/index.shtm.

4D. Costs

The total billed cost of statewide winter operations this winter was $74.5 million, making it the third most costly winter on record. While this figure represents a 6 percent decrease from last year's total costs, this winter's statewide costs were 52 percent higher than the average of costs in the more typical Wisconsin winters of 2005–2006 and 2006–2007. Compared with the typical winters average, the Southwest, Southeast and Northeast regions registered the steepest increases at 79 percent, 79 percent and 62 percent, respectively. Costs in the Northwest Region were 34 percent higher than a typical winter, and costs in the North Central Region were 30 percent higher.

While the counties experienced moderate decreases in labor and equipment costs, increased salt costs kept overall costs high.

Higher fuel prices have raised salt transportation costs in recent years: The average of $58.60 per ton paid this winter is an increase of 24 percent over last winter and an increase of 66 percent compared with the average of $35.22 four winters ago.

As Figure 4.1 shows, all regions experienced a decrease in costs compared with last winter, with the Northeast Region experiencing the most significant drop in costs. This year's 27% less severe winter contributed to this decrease in costs.

The average Winter Severity Index declined in all regions compared with last winter.

Figure 4.1. Change in Costs Since 2005–2006

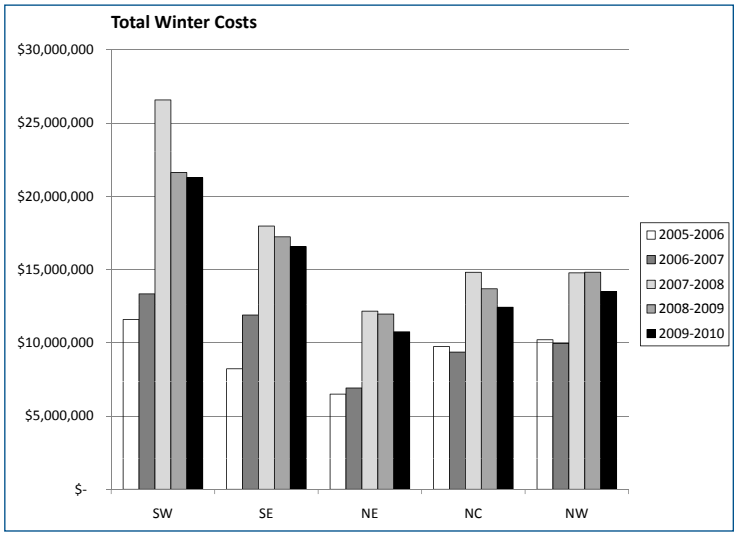


Figure 4.8 on page 91 shows county-by-county cost increases compared with the average of the previous five winters. Five counties saw increases of more than 85 percent, and an additional six counties saw increases of between 61 and 80 percent. Unlike last winter, when all counties with the highest increases were in the Southwest Region, the counties that registered the highest increases this winter are scattered throughout the state. Every county recorded an increase, with Menominee County reporting the lowest increase at 1 percent.

In individual expenditure categories for the 2009–2010 winter, statewide:

- **Salt expenditures** were $34.8 million. This was a 30% increase compared with the previous winter, and a 120 percent increase over the 2006–2007 winter, with the Northeast and Southeast regions seeing the steepest increases from last winter at 48 percent and 39 percent, respectively.
- **Equipment expenditures** were $18.3 million, a decrease of 27 percent compared with the previous winter and a 6 percent decrease over the 2006–2007 winter, with the Northeast and Northcentral Regions experiencing a 35 percent decrease compared with last winter.
- **Labor expenditures** were $17.6 million, a decrease of 22 percent over the previous winter, with the Northeast Region seeing the greatest decrease at 28 percent.
- **Expenditures for materials other than salt** were $2.3 million, a decrease of 21 percent compared with the previous winter. Expenditures at the region level ranged from a 19 percent increase over the 2008–2009 winter in the Southwest Region to a 35 percent decrease in the Northeast and Northcentral Regions. Statewide expenditures in this category were 88 percent higher than in the winter of 2006–2007.

Figure 4.5 on page 75 shows each region's expenditures per lane mile in each category.

This winter's statewide average cost per lane mile of $2,222 was lower than last year's average of $2,365, but still higher than the 2006–2007 and 2007–2008 winter's averages of $1,549 and $1,400 per lane mile, and significantly higher than the $1,100 to $1,200 per lane mile that was common in the late 1990s and early 2000s. Figure 4.2 shows the trends in winter costs per lane mile and severity index over the last 13 winters. On the whole, winter costs per lane mile tend to increase as statewide average severity increases. Increases in labor rates and salt pricing will affect overall winter maintenance cost even in less severe winters.

Figure 4.2. Winter Costs per Lane Mile

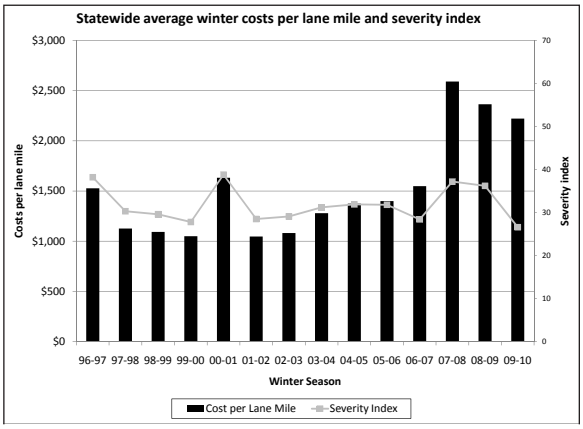


Table 4.5. Total Winter Costs Relative to Winter Severity

Region	Average Winter Severity Index	Actual cost per lane mile	Relative cost per severity index point
SW	25.72	$2,370	$92.15
SE	22.31	$2,906	$130.26
NE	24.57	$2,234	$90.92
NC	28.69	$1,965	$68.49
NW	27.98	$1,747	$62.44
Statewide	**26.57**	**$2,222**	**$59.73**

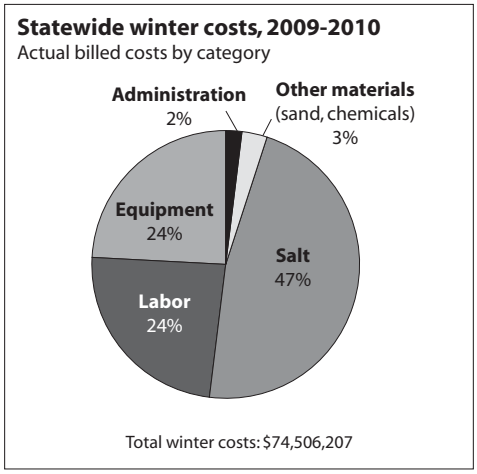
Table 4.5 on page 71 lists the total cost per lane mile for winter maintenance in each region, along with the region's Winter Severity Index. The level of service provided in each county affects total costs, as do the factors listed below. For these reasons, the Southeast Region historically experiences significantly higher costs relative to winter severity than the other regions.

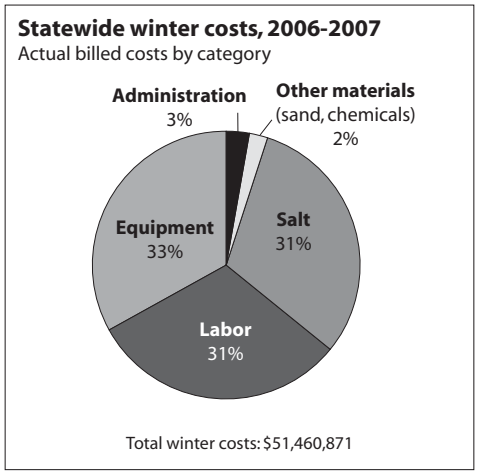
Components of Winter Costs

Major components of winter costs include labor, equipment, salt, other materials such as sand and chemicals, and administrative costs. A region's expenditures in each area are affected by the severity of its winter and the portion of its highways receiving 24-hour coverage. In addition:

- **Labor costs** are based on rates set in each county's union contracts. Hourly rates tend to be higher in more urban counties. Timing of storms can increase labor costs if more overtime hours are required.
- **Equipment costs** are determined by the state Machinery Management Committee, which assigns an hourly rate to each piece of equipment that includes depreciation from the purchase price, maintenance costs, and fuel costs. Rising fuel costs have contributed to increased equipment costs, as have some counties' purchase of larger, more expensive vehicles. These larger vehicles are often more useful for year-round maintenance tasks and are also more efficient in the winter, as they can accommodate larger plows and carry more salt.
- **Salt costs** are affected by salt prices per ton, which vary because of transportation costs. For example, salt entering the state at the Port of Milwaukee doesn't have to travel as far to reach counties in the Southeast region as it does to reach counties in the center of the state.
- **Costs for materials** other than salt, such as sand, are also affected by transportation costs. In addition, some counties use more expensive deicing agents that are more effective at lower temperatures (see Table 3.5 on page 42 for details on deicing agent costs).
- **Administrative costs** are calculated at 4.25 percent of each county's combined labor, equipment and materials costs, and cover the overhead costs for office activities.

Figure 4.3. Statewide Winter Costs by Category





A comparison of total costs from year to year shows that the breakdown of costs among these five categories has changed from three winters ago, even when winter severity indicies are similar. To illustrate this, Figure 4.3 shows the breakdown of costs for this winter compared with the winter of 2006–2007, when the statewide severity index of 28.4 was slightly greater.

However, the breakdown of expenditures by category varies among regions because of the factors described above. For example, the Southeast Region spends more on labor because hourly labor rates tend to be higher in those counties, while equipment expenditures make up a smaller percentage of that region's total expenditures. Figure 4.4 on page 73 shows the distribution of costs by category for each region.

Figure 4.4. Regional Winter Costs by Category

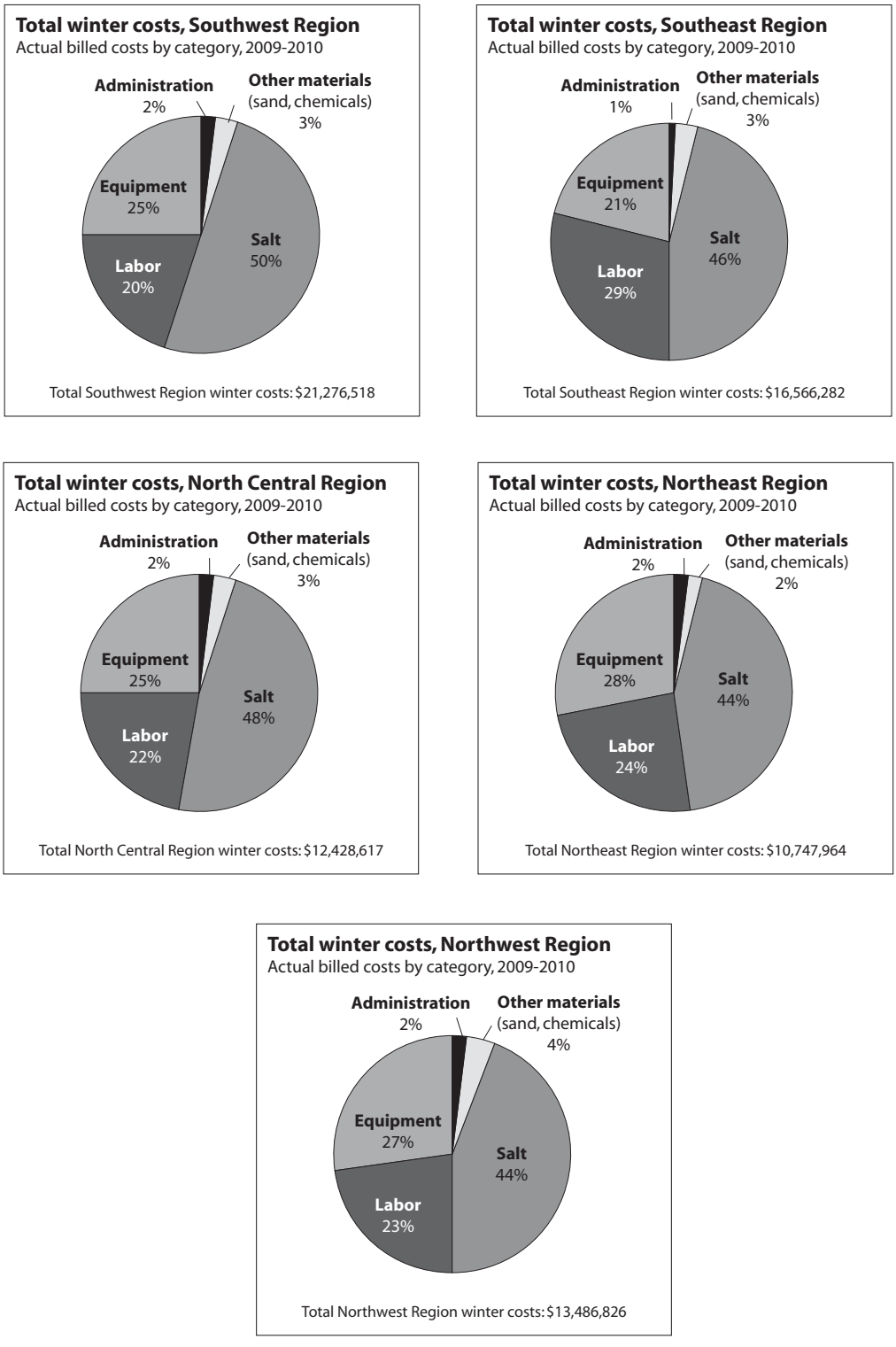
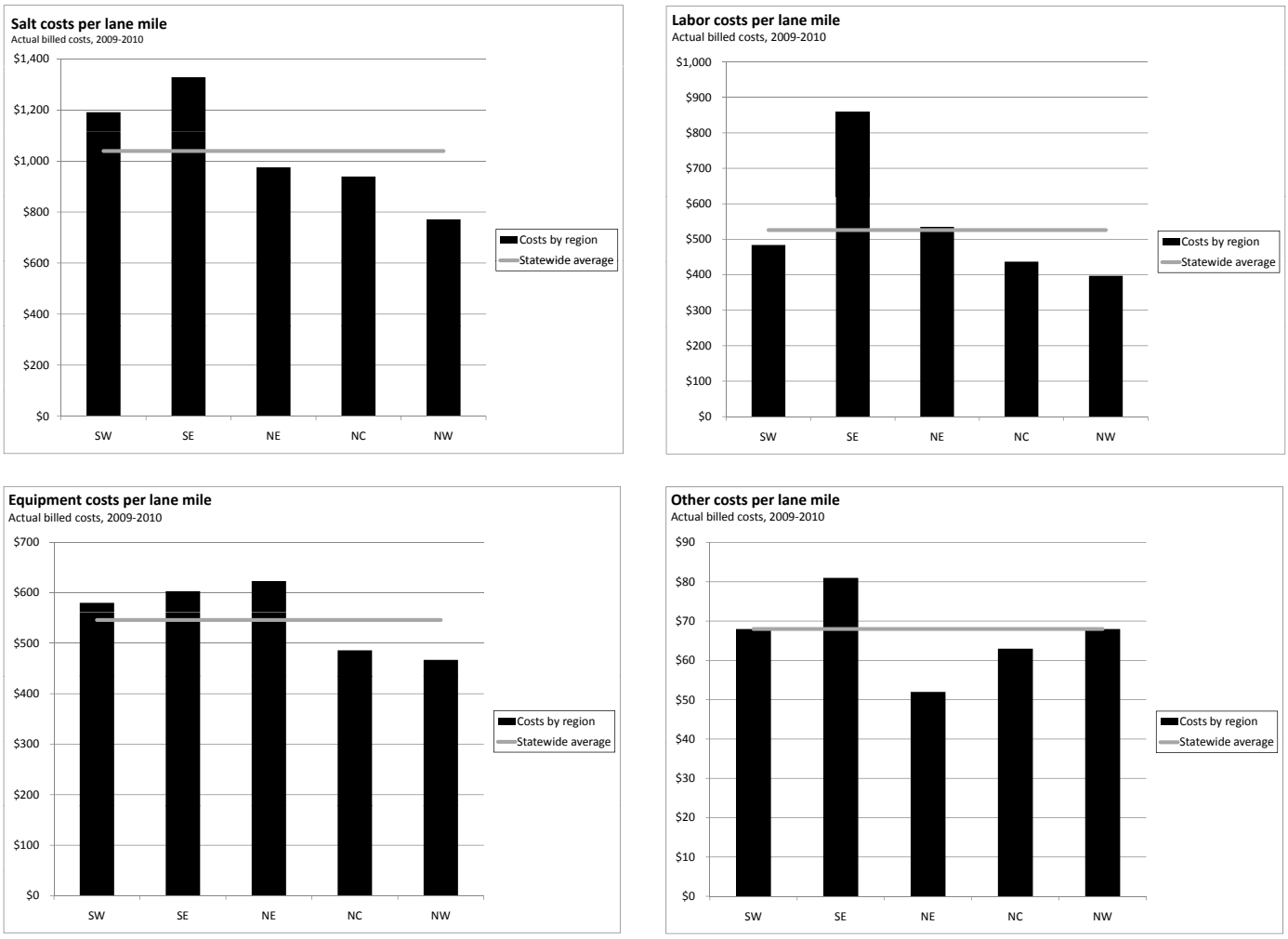


Table 4.6. Winter Costs as Billed to WisDOT by Counties

From the WisDOT accounting system, 2009-2010

	Labor Costs	Equipment Costs	County Furnished Material Costs	Administration Costs	Cost of Salt Used	Total Costs for Winter	Five Year Avg Cost for Winter ('05-'09 avg)	% Costs over Five Year Average
Region 1 / Southwest	$4,348,365	$5,210,669	$610,595	$416,803	$10,690,086	$21,276,518	$16,724,600	127%
Region 2 / Southeast	$4,893,681	$3,436,334	$459,986	$207,837	$7,568,444	$16,566,282	$12,762,900	130%
Region 3 / Northeast	$2,574,181	$2,995,243	$250,416	$238,138	$4,689,986	$10,747,964	$8,732,100	123%
Region 4 / Northcentra	$2,765,092	$3,071,266	$400,485	$255,824	$5,935,950	$12,428,617	$11,362,800	109%
Region 5 / Northwest	$3,067,642	$3,602,626	$572,169	$294,481	$5,949,908	$13,486,826	$11,820,600	114%
Region Totals	**$17,648,961**	**$18,316,138**	**$2,293,651**	**$1,413,083**	**$34,834,374**	**$74,506,207**	**$61,403,000**	**121%**

Figure 4.5. Costs per Lane Mile by Category



Statewide winter cost data is presented in Table 4.6 on page 74. County-by-county cost data is available in Table 4.10 on page 86.

A Note About Cost Data

The tables at the end of this section were generated with data from two sources—final costs as billed to WisDOT, and preliminary costs from the winter storm reports. The tables created from preliminary storm reports data (such as Table 4.11 on page 92, Cost per Lane Mile per Severity Index Ranking) are included in this report because they provide county-by-county breakdowns of cost data not available elsewhere. Many of the tables in the Appendix also include cost data from the storm reports. The source of each table's data is indicated below the table title.

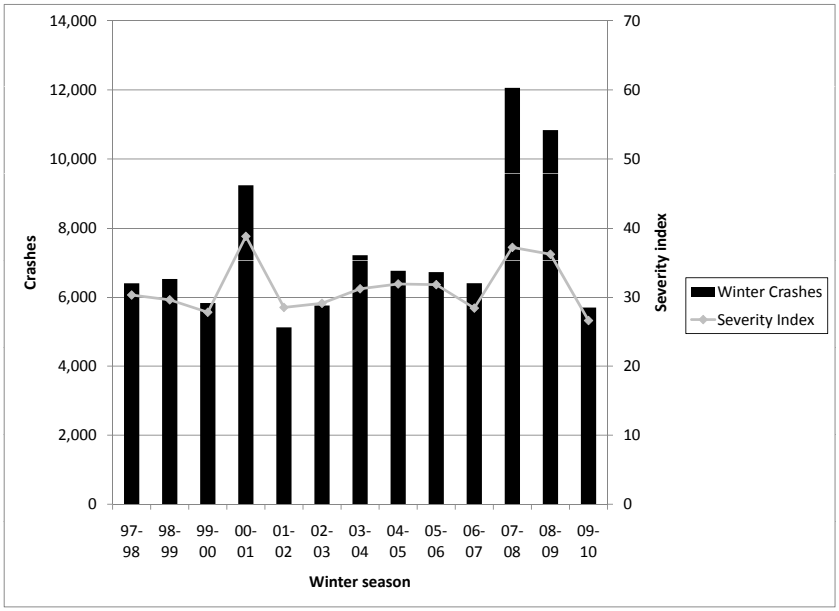
Final cost data includes expenses for all winter activities, including putting up snow fence, transporting salt, filling salt sheds, thawing out frozen culverts, calibrating salt spreaders, producing and storing salt brine, and anti-icing applications, as well as plowing and salting. Cost data from storm reports, however, include only plowing, sanding, salting and anti-icing expenses.

4E. Travel and Crashes

From black ice to freezing rain to white-out snowstorms, winter weather creates challenging conditions for even the most careful drivers. Many factors influence winter crash rates, most of which cannot be controlled by winter maintenance crews. However, 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 some winter crashes.

In the winter of 2009–2010, there were 5,697 reported winter weather crashes (those that occurred on pavements covered with snow, slush or ice). The crash rate (number of crashes per 100 million vehicle miles traveled) decreased drastically (45%) this winter to a statewide average of 22, down from last winter's crash rate of 40. Last winter, 10,837 winter crashes were reported.

Figure 4.6. Winter Crashes and Winter Severity Index



Source: WisDOT Bureau of Transportation Safety

Crash rates tend to decrease in less severe winters, and this winter's rate was similar to the winter of 2006–2007 when the severity index was lower. Figure 4.6 shows the trends in total crashes statewide over the last 13 years overlaid with the Winter Severity Index.

It's important to note that crash rates provide only a portion of the picture of overall winter safety. Crash rates include only "reportable" crashes, which exclude those that cause property damage under $1,000 that aren't required by law to be reported to police. Also, crashes in urban areas are more likely to occur at lower speeds and cause fewer deaths, while crashes on high-speed rural roads are more likely than low-speed crashes to be fatal.

Crashes and Vehicle Miles Traveled

More urban areas such as the Southeast Region often have fewer winter weather crashes per 100 million vehicle miles traveled. This is partly due to the fact that a single crash in a county with low VMT has a bigger impact on the overall crash rate. In addition, urban regions have more highways with 24-hour coverage, which means that these roadways are more likely to be in passable condition. This year, all regions saw a decline in crash rates compared with last year's unusually high rate, while others experienced increases. The Southwest Region saw the steepest decline in crash rate, with this year's crash rate at 42 crashes per 100 million VMT reflecting a 26 percent decrease over last year's crash rate. The North Central and Northeast regions had increases in crash rates of 12 percent and 9 percent, respectively. The Northwest and Southeast regions showed the lowest crash rate, with both reporting 35 crashes per 100 million VMT (see Table 4.7). Table 4.12 on page 99 gives the estimated number of vehicle miles traveled in each county this winter (November 2008 to April 2009), and the number of crashes that occurred in each county.

Table 4.7. Crashes and Vehicle Miles Traveled by Region

Region	Average Winter Severity Index	VMT (100 million)	Crashes	Crashes per 100 million VMT (2008–2009)	Crashes per 100 million VMT (2009–2010)
NC	28.69	31.54	729	46	**23**
NE	24.57	47.03	1,182	47	**25**
NW	27.98	36.89	812	35	**22**
SE	22.31	80.68	1,276	35	**16**
SW	25.66	64.95	1,698	42	**26**
Statewide	**26.57**	**261.09**	**5,697**	**40**	22

Source: WisDOT Bureau of Transportation Safety

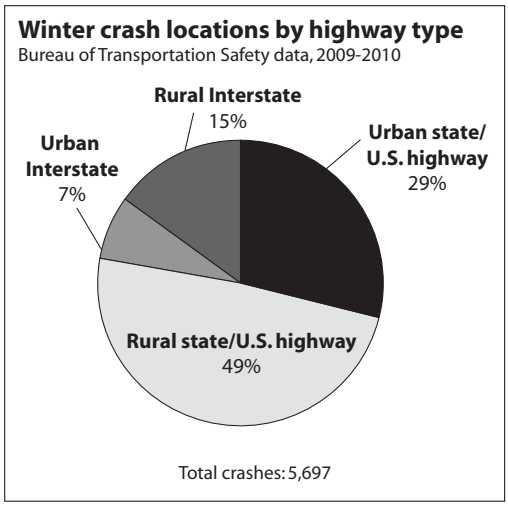
WisDOT tracks crashes according to the type of road where they occurred (urban or rural, and Interstate or other state or U.S. highway), and whether the road was divided or nondivided. Figure 4.7 shows that most winter crashes occur on rural state or U.S. highways, largely because there are more lane miles in this category than in the others. Table 4.13 on page 102 shows the breakdown of crashes in each county according to highway type.

How VMT Is Calculated

WisDOT's Traffic Forecasting Section uses a number of factors to estimate Vehicle Miles of Travel for the state's roads. Annual average daily traffic counts are taken in about one-third of Wisconsin's counties every year, and estimates are made for the counties not counted. In addition, forecasters factor in gallons of gas sold, fuel tax collected, and average vehicle miles per gallon.

Total winter VMT for all counties is shown in Table 4.12 on page 99. This winter, total VMT ranged from a low of 21.8 million in Menominee County to a high of 3.2 billion in Milwaukee County. VMT estimates at the county level tend to be less reliable than at the statewide level, because current traffic counts are not available for all counties, and more variability exists in the data at finer levels of resolution.

Figure 4.7. Winter Crash Locations



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County-by-County Tables and Figure for Section 4: Performance

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Table 4.8. Winter Maintenance Sections

NC Region

County	Lane Miles	Winter Patrol Sections 2009 Survey	Lane Miles per Patrol Section	Winter Service Group
Adams	192.48	5	38.50	D
Florence	141.07	3	47.02	D
Forest	312.38	6	52.06	D
Green Lake	151.30	3	50.43	D
Iron	250.91	6	41.82	D
Langlade	292.69	6	48.78	D
Lincoln	418.33	10	41.83	C
Marathon	878.99	19	46.26	A
Marquette	243.91	5	48.78	B
Menominee	90.26	2	45.13	D
Oneida	396.79	10	39.68	B
Portage	504.28	13	38.79	A
Price	320.57	6	53.43	D
Shawano	516.24	14	36.87	B
Vilas	305.24	6	50.87	C
Waupaca	546.58	12	45.55	C
Waushara	345.71	7	49.39	B
Wood	362.92	14	25.92	C
Region Average			**44.51**	

NW Region

County	Lane Miles	Winter Patrol Sections 2009 Survey	Lane Miles per Patrol Section	Winter Service Group
Ashland	247.57	5	49.51	D
Barron	423.09	11	38.46	D
Bayfield	316.90	6	52.82	D
Buffalo	315.77	7	45.11	D
Burnett	233.64	5	46.73	D
Chippewa	667.85	16	41.74	B
Clark	402.28	10	40.23	C
Douglas	439.23	9	48.80	C
Dunn	516.55	11	46.96	B
Eau Claire	559.86	13	43.07	A
Jackson	504.10	9	56.01	C
Pepin	111.05	3	37.02	D
Pierce	366.08	7	52.30	D
Polk	385.05	7	55.01	D
Rusk	213.47	5	42.69	D
Saint Croix	616.98	10	61.70	B
Sawyer	367.44	6	61.24	D
Taylor	233.25	4	58.31	D
Trempeleau	432.31	11	39.30	C
Washburn	372.14	7	53.16	C
Region Average			**48.51**	

NE Region

County	Lane Miles	Winter Patrol Sections 2009 Survey	Lane Miles per Patrol Section	Winter Service Group
Brown	711.75	18	39.54	A
Calumet	201.31	6	33.55	C
Door	268.55	6	44.76	C
Fond du Lac	594.34	16	37.15	C
Kewaunee	110.41	3	36.80	C
Manitowoc	414.69	11	37.70	B
Marinette	388.36	8	48.55	D
Oconto	437.71	10	43.77	C
Outagamie	520.01	15	34.67	B
Sheboygan	520.30	11	47.30	B
Winnebago	567.36	17	33.37	A
Region Average			**39.74**	

SW Region

County	Lane Miles	Winter Patrol Sections 2009 Survey	Lane Miles per Patrol Section	Winter Service Group
Columbia	745.80	15	49.72	B
Crawford	385.21	7	55.03	C
Dane	1674.08	36	46.50	A
Dodge	606.62	17	35.68	B
Grant	624.14	11	56.74	C
Green	311.45	7	44.49	D
Iowa	451.03	10	45.10	C
Jefferson	458.21	13	35.25	B
Juneau	498.13	10	49.81	C
LaCrosse	480.28	13	36.94	A
Lafayette	293.88	6	48.98	C
Monroe	644.23	13	49.56	C
Richland	328.72	6	54.79	D
Rock	592.56	13	45.58	B
Sauk	591.55	12	49.30	B
Vernon	450.00	10	45.00	C
Region Average			**46.78**	

SE Region

County	Lane Miles	Winter Patrol Sections 2009 Survey	Lane Miles per Patrol Section	Winter Service Group
Kenosha	554.27	19	29.17	A
Milwaukee	1795.60	35	51.30	A
Ozaukee	304.03	9	33.78	A
Racine	676.84	17	39.81	A
Walworth	691.89	13	53.22	B
Washington	580.03	14	41.43	B
Waukesha	1062.40	29	36.63	A

	Lane Miles	Winter Patrol Sections 2009 Survey	Lane Miles per Patrol Section
Statewide Totals	33,531.00	765.0	43.83
Statewide Averages	465.71	10.6	43.83
Group A Averages	814.14	19.83	39.60
Group B Averages	530.92	12.18	44.41
Group C Averages	416.29	9.33	45.14
Group D Averages	272.43	5.64	48.37

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group A

From Winter Storm Reports, 2009-2010

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitations types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
		(Average Time in Hours)						
MARATHON	NC	2.60	3.00	2.11	-2.45	2.65	27.83	54.26
LA CROSSE	SW	5.96	6.00	5.34	4.05	6.01	29.17	67.42
EAU CLAIRE	NW	2.18	2.19	1.83	1.64	2.13	21.82	69.08
PORTAGE	NC	1.57	1.59	1.54	1.71	1.71	26.31	73.16
RACINE	SE	1.80	1.84	1.11	0.92	1.78	29.38	80.45
OZAUKEE	SE	0.87	0.80	0.67	1.01	1.02	21.21	98.42
BROWN	NE	5.18	4.82	5.31	4.57	4.32	20.33	99.67
WINNEBAGO	NE	3.48	3.48	2.43	3.27	2.00	20.77	101.96
DANE	SW	1.80	1.65	2.38	1.80	1.80	24.31	104.23
MILWAUKEE	SE	0.00	0.00	0.00	0.00	0.00	20.33	114.13
KENOSHA	SE	0.95	0.97	1.03	0.46	0.89	20.57	132.89
WAUKESHA	SE	3.47	3.47	3.86	3.24	3.42	17.68	151.06
Group A Averages		2.49	2.48	2.30	1.69	2.31	23.31	95.56

Final totals as of Wednesday, October 13, 2010 **Page 1 of 1**

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group B

From Winter Storm Reports, 2009-2010

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitations types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
		(Average Time in Hours)						
SHAWANO	NC	3.19	3.20	2.34	2.46	3.26	29.42	56.24
ONEIDA	NC	9.33	8.79	7.74	6.22	9.22	36.32	61.10
SAINT CROIX	NW	1.49	1.08	0.77	0.72	0.96	26.43	61.59
CHIPPEWA	NW	3.70	3.86	4.17	6.98	3.53	26.60	66.09
WAUSHARA	NC	3.04	2.76	2.51	2.37	3.12	17.25	68.09
DUNN	NW	0.93	0.92	0.88	0.48	0.91	22.14	70.70
WASHINGTON	SE	0.96	1.07	0.67	1.36	0.98	25.25	75.32
MANITOWOC	NE	2.91	2.91	2.00	2.04	2.93	23.64	79.60
OUTAGAMIE	NE	2.20	2.20	2.26	2.26	2.26	24.09	80.63
SHEBOYGAN	NE	2.84	2.98	2.79	3.14	3.15	23.69	81.01
MARQUETTE	NC	3.96	3.77	3.62	3.15	3.72	18.39	85.62
ROCK	SW	0.52	0.67	0.71	0.37	0.70	23.46	86.94
DODGE	SW	3.93	3.91	4.99	10.98	3.20	21.15	95.51
WALWORTH	SE	0.68	0.70	0.63	0.71	0.71	21.72	99.93
SAUK	SW	0.34	0.15	0.40	0.20	0.38	22.20	106.84
JEFFERSON	SW	-0.50	-0.05	1.24	1.71	0.15	18.09	108.02
COLUMBIA	SW	0.52	0.54	-0.04	0.54	0.54	24.87	127.42
Group B Averages		2.35	2.32	2.22	2.69	2.34	23.81	82.98

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group C

From Winter Storm Reports, 2009-2010

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitations types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
		(Average Time in Hours)						
VERNON	SW	1.86	1.81	1.93	2.17	2.17	27.72	36.38
CRAWFORD	SW	3.62	4.80	3.55	3.82	3.94	30.05	44.55
LAFAYETTE	SW	3.03	3.72	2.65	3.00	3.00	27.21	46.11
GRANT	SW	1.16	1.46	0.92	0.87	1.18	29.85	46.84
LINCOLN	NC	4.38	4.20	4.20	3.39	4.49	32.30	47.86
OCONTO	NE	3.79	3.75	2.78	3.01	3.84	28.95	49.90
DOUGLAS	NW	2.59	2.64	2.46	2.60	2.68	30.33	50.70
JACKSON	NW	1.12	1.94	2.31	2.21	2.17	28.44	55.13
CLARK	NW	3.62	3.74	3.52	4.34	3.78	25.55	56.93
MONROE	SW	2.31	2.37	2.04	1.92	2.37	27.38	57.03
WASHBURN	NW	3.48	3.57	3.59	5.16	3.48	23.44	60.88
IOWA	SW	2.56	2.65	2.15	3.05	2.65	26.64	61.36
TREMPEALEAU	NW	3.25	3.25	2.89	3.64	3.32	21.99	61.60
CALUMET	NE	4.33	4.47	3.74	3.76	4.85	28.95	61.60
KEWAUNEE	NE	3.51	3.39	2.25	2.38	3.59	23.77	63.28
WOOD	NC	5.98	6.04	5.67	5.66	6.01	25.31	64.68
VILAS	NC	4.88	4.88	4.47	6.48	4.88	36.76	68.78
JUNEAU	SW	1.41	1.11	1.21	1.18	1.34	23.47	72.18
DOOR	NE	2.75	2.76	2.18	2.46	2.79	23.64	72.20
WAUPACA	NC	1.82	1.82	1.62	1.82	1.82	21.04	77.54
FOND DU LAC	NE	3.33	3.33	2.63	2.76	3.09	23.23	86.67
Group C Averages		3.09	3.22	2.80	3.13	3.21	26.95	59.15

Final totals as of Wednesday, April 20, 2011 **Page 1 of 1**

Table 4.9. Storm Start vs. Crew Out by Precipitation Type, Group D

From Winter Storm Reports, 2009-2010

Note: 1) A negative number indicates that the crews were on the road when the storm started. 2) A discrepancy is inherent in these calculation because an individual storm may have several precipitations types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
		(Average Time in Hours)						
RUSK	NW	4.28	3.78	3.42	3.41	3.96	29.65	36.02
BUFFALO	NW	2.56	2.54	2.48	3.68	2.61	24.47	39.50
RICHLAND	SW	8.64	9.64	9.55	8.38	9.11	28.61	39.92
PIERCE	NW	6.03	6.58	7.14	7.82	5.87	32.49	41.30
GREEN LAKE	NC	7.20	7.37	7.49	8.40	6.67	24.65	41.85
MENOMINEE	NC	6.52	6.52	7.39	6.02	6.04	22.48	41.93
SAWYER	NW	2.51	2.57	2.79	1.58	2.60	26.51	42.40
ASHLAND	NW	4.21	4.22	4.04	3.67	4.20	43.38	47.21
MARINETTE	NE	4.36	6.21	5.51	6.49	5.54	29.16	48.23
PRICE	NC	5.93	6.14	6.16	6.11	6.31	37.23	50.22
IRON	NC	3.29	3.31	2.37	1.72	3.36	46.53	50.52
BARRON	NW	2.31	1.96	2.00	1.67	2.13	31.23	50.73
PEPIN	NW	4.67	4.87	4.73	5.38	5.49	21.72	51.12
TAYLOR	NW	3.60	4.19	3.75	4.03	3.85	27.78	52.42
GREEN	SW	2.77	2.66	1.83	-1.02	2.62	26.31	55.17
POLK	NW	2.80	2.80	2.51	2.06	3.01	27.97	55.22
ADAMS	NC	8.14	8.19	7.83	7.73	8.48	29.92	58.14
BAYFIELD	NW	4.37	4.53	4.12	4.63	4.24	42.88	58.66
FOREST	NC	4.41	4.29	7.48	16.33	5.64	31.51	59.67
LANGLADE	NC	5.75	5.75	5.16	5.69	5.64	23.42	60.93
FLORENCE	NC	4.26	4.51	4.51	5.06	5.06	29.77	66.83
BURNETT	NW	6.46	6.23	5.70	5.67	5.80	24.77	71.35
Group D Averages		4.78	4.95	4.91	5.21	4.92	30.11	50.88

Table 4.10. Winter Maintenance Costs per Lane Mile, Fiscal Year 2010
Final billed costs from WisDOT accounting system

	Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2010 Winter Costs	2010 LOS Lane Miles	Winter Costs Per Lane Mile
REGION 1 / SOUTHWEST												
Columbia	$506,842	$681	$608,623	$818	$63,319	$85	$47,954	$1,612,709	24,965	$2,839,447	743.95	$3,817
Crawford	$162,102	$421	$194,505	$505	$20,480	$53	$15,415	$259,652	4,089	$652,154	385.21	$1,693
Dane	$1,085,920	$723	$1,048,508	$698	$75,735	$50	$91,683	$2,705,866	43,643	$5,007,712	1,501.97	$3,334
Dodge	$246,765	$407	$337,959	$557	$21,735	$36	$24,464	$938,742	15,141	$1,569,665	606.62	$2,588
Grant	$206,463	$331	$278,929	$447	$44,809	$72	$21,543	$481,170	7,369	$1,032,914	624.14	$1,655
Green	$127,186	$408	$151,264	$486	$40,012	$129	$12,904	$176,851	2,638	$508,217	311.37	$1,632
Iowa	$214,721	$476	$277,851	$616	$57,420	$127	$22,347	$301,579	5,087	$873,918	451.03	$1,938
Jefferson	$214,038	$467	$277,351	$605	$27,704	$60	$20,919	$596,422	10,373	$1,136,434	458.21	$2,480
Juneau	$165,693	$332	$203,320	$408	$19,709	$40	$16,013	$522,282	7,779	$927,017	498.79	$1,859
La Crosse	$219,930	$450	$292,614	$599	$8,105	$17	$21,560	$395,322	6,592	$937,531	488.24	$1,920
Lafayette	$112,403	$382	$147,873	$503	$87,612	$298	$14,211	$157,083	2,622	$519,182	293.88	$1,767
Monroe	$200,646	$311	$321,686	$498	$20,085	$31	$22,322	$562,056	9,083	$1,126,795	646.13	$1,744
Richland	$85,500	$260	$106,551	$324	$14,731	$45	$8,396	$194,723	2,945	$409,901	328.72	$1,247
Rock	$366,508	$612	$429,558	$718	$19,669	$33	$33,559	$621,576	9,982	$1,470,870	598.50	$2,458
Sauk	$249,276	$421	$321,818	$544	$59,256	$100	$25,983	$966,704	13,814	$1,623,037	591.55	$2,744
Vernon	$184,372	$410	$212,259	$472	$30,214	$67	$17,530	$197,349	3,137	$641,724	450.00	$1,426
SW TOTAL	**$4,348,365**	**$484**	**$5,210,669**	**$580**	**$610,595**	**$68**	**$416,803**	**$10,690,086**	**169,258**	**$21,276,518**	**8,978.31**	**$2,370**

Talbe 4.10. Winter Maintenance Costs per Lane Mile, Fiscal Year 2010
Final billed costs from the WisDOT accounting system

	Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2010 Winter Costs	2010 LOS Lane Miles	Winter Costs Per Lane Mile
REGION 2 / SOUTHEAST												
Kenosha	$432,642	$755	$326,609	$570	$24,618	$43	$32,059	$528,416	9,436	$1,344,344	573.11	$2,346
Milwaukee	$2,548,192	$1,428	$1,180,472	$662	$26,596	$15	$0	$2,546,964	47,166	$6,302,224	1,784.17	$3,532
Ozaukee	$245,670	$808	$226,298	$744	$13,659	$45	$19,914	$400,990	7,304	$906,531	304.03	$2,982
Racine	$411,257	$583	$395,313	$561	$186,262	$264	$41,110	$688,794	12,772	$1,722,736	704.86	$2,444
Walworth	$386,565	$566	$374,434	$548	$15,772	$23	$31,868	$902,893	15,896	$1,711,532	682.81	$2,507
Washington	$331,019	$570	$326,376	$562	$60,259	$104	$29,684	$700,427	11,635	$1,447,765	581.11	$2,491
Waukesha	$538,336	$503	$606,832	$567	$132,820	$124	$53,202	$1,799,961	33,271	$3,131,151	1,070.09	$2,926
SE TOTAL	**$4,893,681**	**$859**	**$3,436,334**	**$603**	**$459,986**	**$81**	**$207,837**	**$7,568,444**	**137,480**	**$16,566,282**	**5,700.18**	**$2,906**
REGION 3 / NORTHEAST												
Brown	$358,146	$503	$515,443	$724	$30,703	$43	$36,526	$821,542	14,520	$1,762,360	711.91	$2,476
Calumet	$105,549	$524	$141,600	$703	$3,327	$17	$10,325	$140,834	2,385	$401,635	201.29	$1,995
Door	$154,212	$574	$172,754	$643	$23,424	$87	$14,507	$163,112	2,705	$528,009	268.55	$1,966
Fond du Lac	$304,157	$508	$343,506	$573	$52,186	$87	$28,826	$543,503	9,110	$1,272,178	599.20	$2,123
Kewanee	$61,332	$555	$91,225	$826	$4,379	$40	$6,446	$74,382	1,265	$237,764	110.41	$2,153
Manitowoc	$278,413	$666	$273,102	$653	$40,054	$96	$24,308	$466,442	8,260	$1,082,319	417.99	$2,589
Marinette	$164,393	$394	$155,053	$372	$38,193	$92	$14,782	$310,290	5,315	$682,711	417.29	$1,636
Oconto	$208,008	$441	$263,742	$559	$462	$1	$19,519	$336,853	5,770	$828,584	471.83	$1,756
Outagamie	$338,498	$646	$364,259	$695	$22,467	$43	$29,170	$586,137	10,215	$1,340,531	523.98	$2,558
Sheboygan	$300,181	$577	$308,961	$594	$13,139	$25	$25,564	$558,495	9,450	$1,206,340	520.30	$2,319
Winnebago	$301,292	$530	$365,598	$643	$22,082	$39	$28,165	$688,398	11,560	$1,405,535	568.31	$2,473
NE TOTAL	**$2,574,181**	**$535**	**$2,995,243**	**$623**	**$250,416**	**$52**	**$238,138**	**$4,689,986**	**80,555**	**$10,747,964**	**4,811.06**	**$2,234**

Table 4.10. Winter Maintenance Costs per Lane Mile, Fiscal Year 2010
Final billed costs from the WisDOT accounting system

	Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2010 Winter Costs	2010 LOS Lane Miles	Winter Costs Per Lane Mile
REGION 4 / NORTHCENTRAL												
Adams	$110,782	$575	$98,506	$511	$12,895	$67	$8,792	$197,925	2,944	$428,900	192.72	$2,226
Florence	$46,123	$327	$77,034	$546	$10,230	$73	$5,339	$196,736	3,074	$335,462	141.07	$2,378
Forest	$101,601	$325	$175,119	$561	$20,853	$67	$12,253	$369,534	5,783	$679,360	312.38	$2,175
Green Lake	$71,461	$472	$52,129	$345	$7,106	$47	$5,399	$72,972	1,131	$209,067	151.30	$1,382
Iron	$173,375	$691	$214,682	$856	$10,275	$41	$16,437	$349,965	5,250	$764,734	250.91	$3,048
Langlade	$123,294	$421	$136,588	$467	$15,324	$52	$11,184	$210,109	3,372	$496,499	292.69	$1,696
Lincoln	$173,988	$416	$209,698	$501	$9,729	$23	$16,289	$291,479	4,403	$701,183	418.33	$1,676
Marathon	$339,072	$385	$402,925	$458	$34,370	$39	$31,862	$684,376	10,338	$1,492,605	880.19	$1,696
Marquette	$113,702	$465	$104,214	$426	$12,659	$52	$9,546	$261,560	3,894	$501,681	244.53	$2,052
Menominee	$15,592	$173	$30,063	$333	$3,565	$39	$2,055	$33,892	559	$85,167	90.26	$944
Oneida	$187,655	$473	$220,148	$555	$37,559	$95	$18,344	$527,000	7,750	$990,706	396.79	$2,497
Portage	$265,086	$484	$227,150	$415	$16,356	$30	$20,910	$455,096	6,980	$984,598	547.20	$1,799
Price	$140,864	$439	$157,413	$491	$13,160	$41	$12,432	$342,175	5,101	$666,044	320.57	$2,078
Shawano	$227,572	$442	$274,016	$532	$100,813	$196	$24,874	$424,850	7,120	$1,052,125	515.09	$2,043
Vilas	$170,003	$557	$193,495	$634	$28,114	$92	$16,144	$482,843	7,212	$890,599	305.24	$2,918
Waupaca	$197,853	$362	$226,290	$414	$38,415	$70	$19,027	$487,115	8,245	$968,700	546.64	$1,772
Waushara	$149,505	$432	$134,427	$389	$16,709	$48	$12,302	$211,007	3,276	$523,950	345.71	$1,516
Wood	$157,564	$423	$137,369	$369	$12,353	$33	$12,635	$337,316	4,825	$657,237	372.22	$1,766
NC TOTAL	**$2,765,092**	**$437**	**$3,071,266**	**$486**	**$400,485**	**$63**	**$255,824**	**$5,935,950**	**91,257**	**$12,428,617**	**6,323.84**	**$1,965**

Table 4.10. Winter Maintenance Costs per Lane Mile, Fiscal Year 2010
Final billed costs from the WisDOT accounting system

	Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2010 Winter Costs	2010 LOS Lane Miles	Winter Costs Per Lane Mile
REGION 5 / NORTHWEST												
Ashland	$130,836	$528	$163,522	$661	$62,665	$253	$14,483	$190,816	2,891	$562,322	247.57	$2,271
Barron	$219,970	$520	$235,736	$557	$18,036	$43	$19,425	$190,019	2,774	$683,186	423.09	$1,615
Bayfield	$137,207	$433	$173,609	$548	$17,254	$54	$13,318	$364,378	5,705	$705,766	316.90	$2,227
Buffalo	$88,826	$281	$115,331	$365	$3,858	$12	$8,592	$120,226	2,024	$336,833	316.05	$1,066
Burnett	$70,425	$301	$93,711	$401	$22,991	$98	$7,580	$168,470	2,672	$363,177	233.64	$1,554
Chippewa	$311,733	$466	$284,379	$425	$45,342	$68	$26,209	$568,582	8,099	$1,236,245	669.29	$1,847
Clark	$148,652	$370	$155,376	$386	$7,157	$18	$12,691	$350,267	4,899	$674,143	402.28	$1,676
Douglas	$179,290	$408	$249,391	$568	$36,046	$82	$18,969	$377,797	6,224	$861,493	439.23	$1,961
Dunn	$267,365	$518	$237,766	$460	$33,419	$65	$22,077	$428,885	6,463	$989,512	516.55	$1,916
Eau Claire	$215,350	$401	$238,974	$445	$21,659	$40	$19,541	$404,670	6,580	$900,194	537.26	$1,676
Jackson	$158,517	$308	$252,840	$492	$30,773	$60	$18,199	$496,302	7,305	$956,631	514.30	$1,860
Pepin	$59,629	$537	$41,542	$374	$4,840	$44	$4,354	$56,634	879	$166,999	111.05	$1,504
Pierce	$162,148	$443	$188,932	$516	$32,964	$90	$15,228	$251,661	3,947	$650,933	366.08	$1,778
Polk	$133,700	$347	$203,122	$528	$31,062	$81	$15,016	$261,745	4,222	$644,645	385.05	$1,674
Rusk	$63,515	$298	$110,197	$516	$12,075	$57	$7,328	$122,808	1,806	$315,923	213.47	$1,480
Sawyer	$120,059	$327	$130,469	$355	$8,721	$24	$10,740	$224,721	3,272	$494,710	367.44	$1,346
St. Croix	$298,255	$482	$315,078	$509	$103,400	$167	$28,436	$454,232	7,638	$1,199,401	618.98	$1,938
Taylor	$74,064	$318	$91,506	$392	$24,077	$103	$7,820	$223,412	3,015	$420,879	233.25	$1,804
Trempealeau	$136,052	$313	$167,658	$385	$25,107	$58	$13,355	$357,542	5,993	$699,714	434.99	$1,609
Washburn	$92,049	$247	$153,487	$412	$30,723	$83	$11,120	$336,742	5,026	$624,121	372.14	$1,677
NW TOTAL	**$3,067,642**	**$397**	**$3,602,626**	**$467**	**$572,169**	**$74**	**$294,481**	**$5,949,908**	**91,435**	**$13,486,826**	**7,718.61**	**$1,747**

Table 4.10. Winter Maintenance Costs per Lane Mile, Fiscal Year 2010

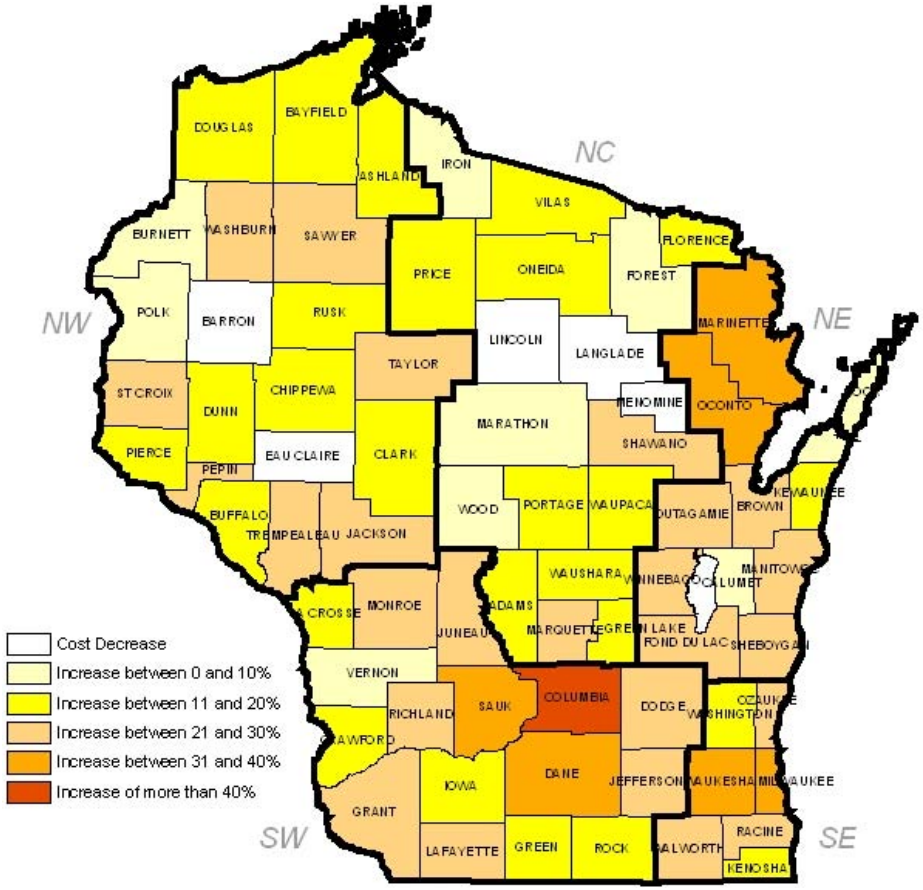
Final billed costs from the WisDOT accounting system

	Labor	Labor $'s per Lane Mile	Equipment	Equip $'s per Lane Mile	Materials	Materials $'s Lane Mile	Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2010 Winter Costs	2010 LOS Lane Miles	Winter Costs Per Lane Mile
STATEWIDE SUMMARY												
SW Region	$4,348,365	$484	$5,210,669	$580	$610,595	$68	$416,803	$10,690,086	169,258	$21,276,518	8,978.31	$2,370
SE Region	$4,893,681	$859	$3,436,334	$603	$459,986	$81	$207,837	$7,568,444	137,480	$16,566,282	5,700.18	$2,906
NE Region	$2,574,181	$535	$2,995,243	$623	$250,416	$52	$238,138	$4,689,986	80,555	$10,747,964	4,811.06	$2,234
NC Region	$2,765,092	$437	$3,071,266	$486	$400,485	$63	$255,824	$5,935,950	91,257	$12,428,617	6,323.84	$1,965
NW Region	$3,067,642	$397	$3,602,626	$467	$572,169	$74	$294,481	$5,949,908	91,435	$13,486,826	7,718.61	$1,747
Statewide Totals	$17,648,961	$526	$18,316,138	$546	$2,293,651	$68	$1,413,083	$34,834,374	569,985	$74,506,207	33,532.00	$2,222

Figure 4.8. 2009-2010 Winter Costs vs. 5-Year Average

County	Cost Increase
Menominee	-29%
Langlade	-17%
Barron	-3%
Lincoln	-1%
Eau Claire	-1%
Forest	1%
Door	3%
Vernon	4%
Marathon	5%
Polk	8%
Wood	8%
Iron	8%
Burnett	10%
Calumet	10%
Clark	10%
Green	10%
Green Lake	10%
Chippewa	11%
La Crosse	11%
Waupaca	11%
Oneida	11%
Price	11%
Iowa	11%
Portage	13%
Dunn	14%
Douglas	14%
Pierce	14%
Washington	15%
Adams	16%
Rusk	16%
Bayfield	16%
Florence	16%
Vilas	16%
Rock	17%
Crawford	17%
Buffalo	17%

County	Cost Increase
Kenosha	18%
Kewanee	18%
Ashland	19%
Waushara	19%
Jefferson	20%
Grant	20%
Walworth	20%
St. Croix	20%
Washburn	21%
Racine	21%
Marquette	21%
Winnebago	22%
Trempealeau	22%
Juneau	23%
Outagamie	23%
Brown	23%
Lafayette	23%
Manitowoc	24%
Fond du Lac	24%
Richland	24%
Sawyer	24%
Taylor	24%
Sheboygan	25%
Monroe	26%
Ozaukee	26%
Dodge	27%
Shawano	27%
Pepin	28%
Jackson	29%
Marinette	33%
Oconto	38%
Milwaukee	39%
Waukesha	39%
Sauk	39%
Dane	40%
Columbia	42%



State and Regional	Cost Difference
Statewide Average	17%
NC	8%
NW	15%
SW	22%
NE	22%
SE	25%

Table 4.11.Cost per Lane Mile per Severity Index Ranking (Group A)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
MARATHON	NC	880.19	27.83	34.1	7329	8.33	0.30	$1,112,000	$1,266	45.47
RACINE	SE	704.86	29.38	72.4	8517	12.08	0.41	$1,049,000	$1,491	50.73
PORTAGE	NC	547.20	26.31	38.6	5278	9.65	0.37	$769,000	$1,409	53.54
LA CROSSE	SW	488.24	29.17	59.9	7324	15.00	0.51	$935,000	$1,922	65.89
EAU CLAIRE	NW	537.26	21.82	45.1	5382	10.02	0.46	$808,000	$1,503	68.89
WINNEBAGO	NE	568.31	20.77	43.4	6952	12.23	0.59	$876,000	$1,565	75.35
KENOSHA	SE	573.11	20.57	50.4	6770	11.81	0.57	$915,000	$1,597	77.62
BROWN	NE	711.91	20.33	43.2	9577	13.45	0.66	$1,121,000	$1,579	77.63
MILWAUKEE	SE	1,784.17	20.33	40.4	25769	14.44	0.71	$2,966,000	$1,664	81.86
OZAUKEE	SE	304.03	21.21	55.9	5282	17.37	0.82	$543,000	$1,791	84.48
WAUKESHA	SE	1,070.09	17.68	29.2	17426	16.28	0.92	$1,811,000	$1,695	95.87
DANE	SW	1,501.97	24.31	41.8	36131	24.06	0.99	$3,776,000	$2,532	104.14
Group A Averages		805.94	23.31	46.2	11811	13.73	0.61	$1,390,083	$1,668	73.46

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group B)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
WAUSHARA	NC	345.71	17.25	40.9	2393	6.92	0.40	$340,000	$982	56.96
SAINT CROIX	NW	618.98	26.43	53.4	6051	9.78	0.37	$827,000	$1,336	50.54
SHAWANO	NC	515.09	29.42	61.6	5454	10.59	0.36	$717,000	$1,398	47.53
DUNN	NW	516.55	22.14	46.9	5182	10.03	0.45	$736,000	$1,424	64.32
ONEIDA	NC	396.79	36.32	77.7	3726	9.39	0.26	$567,000	$1,435	39.52
OUTAGAMIE	NE	523.98	24.09	51.5	6298	12.02	0.50	$760,000	$1,470	61.01
CHIPPEWA	NW	669.29	26.60	49.4	7176	10.72	0.40	$996,000	$1,487	55.91
WASHINGTON	SE	581.11	25.25	69.1	8034	13.83	0.55	$860,000	$1,490	59.01
MARQUETTE	NC	244.53	18.39	55.0	3420	13.99	0.76	$375,000	$1,534	83.43
SHEBOYGAN	NE	520.30	23.69	57.0	6970	13.40	0.57	$798,000	$1,545	65.21
DODGE	SW	606.62	21.15	54.6	9823	16.19	0.77	1,017,000	$1,676	79.24
MANITOWOC	NE	417.99	23.64	70.1	6089	14.57	0.62	$712,000	$1,713	72.44
WALWORTH	SE	682.81	21.72	59.9	11354	16.63	0.77	1,179,000	$1,730	79.63
SAUK	SW	591.55	22.20	55.9	9006	15.22	0.69	1,113,000	$1,882	84.77
JEFFERSON	SW	458.21	18.09	45.1	9095	19.85	1.10	$929,000	$2,028	112.06
ROCK	SW	598.50	23.46	47.4	10397	17.37	0.74	1,265,000	$2,122	90.45
COLUMBIA	SW	743.95	24.87	55.5	13808	18.56	0.75	1,686,000	$2,267	91.14

Final totals as of Wednesday, April 20, 2011

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group B)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
Group B Averages		531.29	23.81	55.9	7310	13.47	0.59	$875,118	$1,619	70.19

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group C)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
WASHBURN	NW	372.14	23.44	58.0	2454	6.59	0.28	$352,000	$945	40.33
LAFAYETTE	SW	293.88	27.21	58.3	2074	7.06	0.26	$297,000	$1,012	37.20
TREMPEALEAU	NW	434.99	21.99	22.7	4288	9.86	0.45	$462,000	$1,063	48.33
CLARK	NW	402.28	25.55	55.4	3187	7.92	0.31	$440,000	$1,095	42.84
WAUPACA	NC	546.64	21.04	54.9	5388	9.86	0.47	$622,000	$1,139	54.11
CRAWFORD	SW	385.21	30.05	43.6	3082	8.00	0.27	$443,000	$1,154	38.39
KEWAUNEE	NE	110.41	23.77	54.5	995	9.01	0.38	$129,000	$1,173	49.32
DOUGLAS	NW	439.23	30.33	125.2	3591	8.18	0.27	$526,000	$1,198	39.50
MONROE	SW	646.13	27.38	56.0	5996	9.28	0.34	$788,000	$1,219	44.53
WOOD	NC	372.22	25.31	42.3	3357	9.02	0.36	$454,000	$1,223	48.33
VERNON	SW	450.00	27.72	58.4	5242	11.65	0.42	$567,000	$1,260	45.46
CALUMET	NE	201.29	28.95	56.0	1225	6.09	0.21	$255,000	$1,272	43.96
LINCOLN	NC	418.33	32.30	65.0	3439	8.22	0.25	$530,000	$1,275	39.46
GRANT	SW	624.14	29.85	56.1	7175	11.50	0.39	$888,000	$1,422	47.65
OCONTO	NE	471.83	28.95	73.1	4403	9.33	0.32	$672,000	$1,427	49.29
JACKSON	NW	514.30	28.44	77.0	5763	11.21	0.39	$736,000	$1,432	50.35
DOOR	NE	268.55	23.64	43.9	3073	11.44	0.48	$391,000	$1,462	61.85

Final totals as of Monday, November 22, 2010

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group C)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
FOND DU LAC	NE	599.20	23.23	55.9	6251	10.43	0.45	$919,000	$1,534	66.02
JUNEAU	SW	498.79	23.47	49.9	7765	15.57	0.66	$800,000	$1,606	68.41
VILAS	NC	305.24	36.76	99.1	3712	12.16	0.33	$503,000	$1,652	44.93
IOWA	SW	451.03	26.64	55.1	5946	13.18	0.49	$749,000	$1,661	62.36
Group C Averages		419.33	26.95	60.0	4210	9.79	0.37	$548,714	$1,296	48.70

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group D)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
GREEN LAKE	NC	151.30	24.65	61.6	758	5.01	0.20	$124,000	$821	33.32
BUFFALO	NW	316.05	24.47	43.4	1768	5.59	0.23	$285,000	$905	37.00
PEPIN	NW	111.05	21.72	39.5	730	6.57	0.30	$112,000	$1,007	46.36
SAWYER	NW	367.44	26.51	77.1	2292	6.24	0.24	$375,000	$1,021	38.53
BARRON	NW	423.09	31.23	58.0	1596	3.77	0.12	$441,000	$1,042	33.35
BURNETT	NW	233.64	24.77	56.6	1708	7.31	0.30	$252,000	$1,077	43.49
RICHLAND	SW	328.72	28.61	49.1	3155	9.60	0.34	$371,000	$1,130	39.48
MARINETTE	NE	417.29	29.16	63.9	3495	8.38	0.29	$474,000	$1,138	39.02
LANGLADE	NC	292.69	23.42	46.0	2451	8.37	0.36	$335,000	$1,149	49.05
PIERCE	NW	366.08	32.49	53.9	3238	8.85	0.27	$436,000	$1,190	36.65
RUSK	NW	213.47	29.65	70.4	1740	8.15	0.27	$263,000	$1,230	41.48
POLK	NW	385.05	27.97	52.1	3840	9.97	0.36	$501,000	$1,301	46.51
MENOMINEE	NC	90.26	22.48	68.8	1251	13.86	0.62	$119,000	$1,323	58.85
TAYLOR	NW	233.25	27.78	43.8	2071	8.88	0.32	$308,000	$1,327	47.79
PRICE	NC	320.57	37.23	56.1	3103	9.68	0.26	$445,000	$1,391	37.36
GREEN	SW	311.37	26.31	56.6	2751	8.84	0.34	$440,000	$1,427	54.23
FLORENCE	NC	141.07	29.77	68.6	1862	13.20	0.44	$204,000	$1,454	48.83

Final totals as of Monday, November 22, 2010

Table 4.11. Cost per Lane Mile per Severity Index Ranking (Group D)

From Winter Storm Reports, 2009-2010

County	Region	Lane Miles	Severity Index	Snow Depth (in)	Salt (ton)	Salt per LM	Salt per LM per Severity Index	Total Cost	Total $/LM	Cost per LM per Severity Index
BAYFIELD	NW	316.90	42.88	127.4	3170	10.00	0.23	$468,000	$1,479	34.49
ADAMS	NC	192.72	29.92	50.7	2465	12.79	0.43	$288,000	$1,494	49.93
FOREST	NC	312.38	31.90	67.3	4351	13.93	0.44	$476,000	$1,522	47.72
ASHLAND	NW	247.57	43.38	190.3	2417	9.76	0.23	$394,000	$1,591	36.68
IRON	NC	250.91	46.53	209.4	3892	15.51	0.33	$500,000	$1,991	42.80
Group D Averages		273.77	30.13	73.2	2459	9.28	0.31	$345,955	$1,273	42.86

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2009 - April 2010

COUNTY	WINTER VMT	CRASHES	CRASHES/ 100,000,000 VMT
Northwest Region			
ASHLAND	78,100,000.00	14	18
BARRON	230,500,000.00	32	14
BAYFIELD	91,600,000.00	21	23
BUFFALO	74,800,000.00	20	27
BURNETT	72,100,000.00	8	11
CHIPPEWA	360,900,000.00	79	22
CLARK	179,100,000.00	54	30
DOUGLAS	213,800,000.00	40	19
DUNN	290,300,000.00	83	29
EAU CLAIRE	484,000,000.00	121	25
JACKSON	244,900,000.00	42	17
PEPIN	31,500,000.00	6	19
PIERCE	134,100,000.00	56	42
POLK	180,100,000.00	19	11
RUSK	69,800,000.00	7	10
ST.CROIX	499,900,000.00	125	25
SAWYER	91,100,000.00	7	8
TAYLOR	81,100,000.00	10	12
TREMPEALEAU	165,300,000.00	49	30
WASHBURN	115,600,000.00	19	16
Total	**3,688,600,000.00**	**812**	**22**
Southeast Region			
KENOSHA	689,000,000.00	140	20
MILWAUKEE	3,167,100,000.00	468	15
OZAUKEE	477,400,000.00	74	16
RACINE	756,000,000.00	138	18
WALWORTH	522,400,000.00	85	16
WASHINGTON	593,300,000.00	127	21
WAUKESHA	1,862,700,000.00	244	13
Total	**8,067,900,000.00**	**1,276**	**16**

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2009 - April 2010

COUNTY	WINTER VMT	CRASHES	CRASHES/ 100,000,000 VMT
Northwest Region			
ASHLAND	78,100,000.00	14	18
BARRON	230,500,000.00	32	14
BAYFIELD	91,600,000.00	21	23
BUFFALO	74,800,000.00	20	27
BURNETT	72,100,000.00	8	11
CHIPPEWA	360,900,000.00	79	22
CLARK	179,100,000.00	54	30
DOUGLAS	213,800,000.00	40	19
DUNN	290,300,000.00	83	29
EAU CLAIRE	484,000,000.00	121	25
JACKSON	244,900,000.00	42	17
PEPIN	31,500,000.00	6	19
PIERCE	134,100,000.00	56	42
POLK	180,100,000.00	19	11
RUSK	69,800,000.00	7	10
ST.CROIX	499,900,000.00	125	25
SAWYER	91,100,000.00	7	8
TAYLOR	81,100,000.00	10	12
TREMPEALEAU	165,300,000.00	49	30
WASHBURN	115,600,000.00	19	16
Total	**3,688,600,000.00**	**812**	**22**
Southeast Region			
KENOSHA	689,000,000.00	140	20
MILWAUKEE	3,167,100,000.00	468	15
OZAUKEE	477,400,000.00	74	16
RACINE	756,000,000.00	138	18
WALWORTH	522,400,000.00	85	16
WASHINGTON	593,300,000.00	127	21
WAUKESHA	1,862,700,000.00	244	13
Total	**8,067,900,000.00**	**1,276**	**16**

Table 4.12. Crashes per 100 Million Vehicle Miles of Travel

Bureau of Transportation Safety data, November 2009 - April 2010

COUNTY	WINTER VMT	CRASHES	CRASHES/ 100,000,000 VMT
Southwest Region			
COLUMBIA	430,000,000.00	105	24
CRAWFORD	95,700,000.00	20	21
DANE	2,160,800,000.00	484	22
DODGE	414,600,000.00	102	25
GRANT	232,100,000.00	70	30
GREEN	138,600,000.00	43	31
IOWA	159,500,000.00	43	27
JEFFERSON	421,500,000.00	65	15
JUNEAU	278,800,000.00	101	36
LA CROSSE	455,600,000.00	196	43
LAFAYETTE	91,700,000.00	38	41
MONROE	330,200,000.00	139	42
RICHLAND	86,200,000.00	24	28
ROCK	721,600,000.00	132	18
SAUK	348,800,000.00	104	30
VERNON	128,900,000.00	32	25
Total	**6,494,600,000.00**	**1,698**	**26**
Statewide Totals	**26,108,800,000.00**	**5,697**	**22**

Table 4.13. Motor Vehicle Crashes on Roads with Snow/Ice/Slush
Bureau of Transportation Safety data, Nov. 1, 2009 - April 30, 2010 State, U.S. and Interstate Highways only

NC Region

County	Total	Urban STH	Rural STH	Urban IH	Rural IH	Urban State Highway			Rural State Highway		
						Non-div	Divided	Unkn	Non-div	Divided	Unkn
ADAMS	21	0	21	0	0	0	0	0	20	1	0
FLORENCE	4	0	4	0	0	0	0	0	4	0	0
FOREST	15	0	15	0	0	0	0	0	15	0	0
GREEN LAKE	22	4	18	0	0	4	0	0	18	0	0
IRON	6	0	6	0	0	0	0	0	6	0	0
LANGLADE	22	4	18	0	0	4	0	0	18	0	0
LINCOLN	33	4	29	0	0	4	0	0	8	21	0
MARATHON	213	59	121	3	30	23	35	1	35	86	0
MARQUETTE	19	0	4	0	15	0	0	0	4	0	0
MENOMINEE	1	0	1	0	0	0	0	0	1	0	0
ONEIDA	47	1	46	0	0	0	1	0	42	4	0
PORTAGE	67	11	35	7	14	1	10	0	15	20	0
PRICE	11	0	11	0	0	0	0	0	10	1	0
SHAWANO	49	3	46	0	0	3	0	0	19	27	0
VILAS	19	0	19	0	0	0	0	0	18	1	0
WAUPACA	75	5	70	0	0	2	3	0	27	43	0
WAUSHARA	36	0	25	0	11	0	0	0	24	1	0
WOOD	69	45	24	0	0	11	34	0	20	4	0
Total	729	136	513	10	70	52	83	1	304	209	0

NE Region

County	Total	Urban STH	Rural STH	Urban IH	Rural IH	Urban State Highway			Rural State Highway		
						Non-div	Divided	Unkn	Non-div	Divided	Unkn
BROWN	253	170	46	14	23	49	121	0	26	20	0
CALUMET	55	8	47	0	0	2	6	0	41	6	0
DOOR	30	5	25	0	0	1	4	0	19	6	0
FOND DU LAC	138	47	91	0	0	28	19	0	50	41	0
KEWAUNEE	20	0	20	0	0	0	0	0	18	2	0
MANITOWOC	102	32	38	1	31	12	20	0	33	4	1
MARINETTE	48	8	40	0	0	7	1	0	27	13	0
OCONTO	38	0	38	0	0	0	0	0	11	26	1
OUTAGAMIE	170	76	94	0	0	23	52	1	50	44	0
SHEBOYGAN	113	28	48	1	36	17	11	0	23	25	0
WINNEBAGO	215	69	146	0	0	40	29	0	38	108	0
Total	1,182	443	633	16	90	179	263	1	336	295	2

Table 4.13. Motor Vehicle Crashes on Roads with Snow/Ice/Slush
Bureau of Transportation Safety data, Nov. 1, 2009 - April 30, 2010 State, U.S. and Interstate Highways only

NW Region

		Urban	Rural	Urban	Rural	Urban State Highway			Rural State Highway		
County	Total	STH	STH	IH	IH	Non-div	Divided	Unkn	Non-div	Divided	Unkn
ASHLAND	14	4	10	0	0	2	2	0	10	0	0
BARRON	32	1	31	0	0	0	1	0	10	21	0
BAYFIELD	21	0	21	0	0	0	0	0	20	1	0
BUFFALO	20	0	20	0	0	0	0	0	20	0	0
BURNETT	8	0	8	0	0	0	0	0	8	0	0
CHIPPEWA	79	6	73	0	0	1	5	0	14	58	1
CLARK	54	0	54	0	0	0	0	0	28	26	0
DOUGLAS	40	18	20	2	0	7	11	0	10	10	0
DUNN	83	10	24	12	37	7	3	0	18	6	0
EAU CLAIRE	121	41	25	0	55	4	37	0	13	12	0
JACKSON	42	0	13	0	29	0	0	0	13	0	0
PEPIN	6	0	6	0	0	0	0	0	6	0	0
PIERCE	56	8	48	0	0	8	0	0	46	2	0
POLK	19	0	19	0	0	0	0	0	15	4	0
RUSK	7	0	7	0	0	0	0	0	7	0	0
SAINT CROIX	125	15	62	12	36	9	6	0	32	30	0
SAWYER	7	0	7	0	0	0	0	0	7	0	0
TAYLOR	10	0	10	0	0	0	0	0	10	0	0
TREMPEALEAU	49	0	44	0	5	0	0	0	42	2	0
WASHBURN	19	0	19	0	0	0	0	0	9	10	0
Total	812	103	521	26	162	38	65	0	338	182	1

SE Region

		Urban	Rural	Urban	Rural	Urban State Highway			Rural State Highway		
County	Total	STH	STH	IH	IH	Non-div	Divided	Unkn	Non-div	Divided	Unkn
KENOSHA	140	48	64	4	24	25	23	0	18	44	2
MILWAUKEE	468	279	0	189	0	73	204	2	0	0	0
OZAUKEE	74	11	20	4	39	6	5	0	5	15	0
RACINE	138	74	24	3	37	31	43	0	18	6	0
WALWORTH	85	9	52	4	20	6	3	0	30	22	0
WASHINGTON	127	52	75	0	0	24	28	0	24	51	0
WAUKESHA	244	77	63	55	49	9	68	0	30	32	1
Total	1,276	550	298	259	169	174	374	2	125	170	3

Table 4.13. Motor Vehicle Crashes on Roads with Snow/Ice/Slush
Bureau of Transportation Safety data, Nov. 1, 2009 - April 30, 2010 State, U.S. and Interstate Highways only

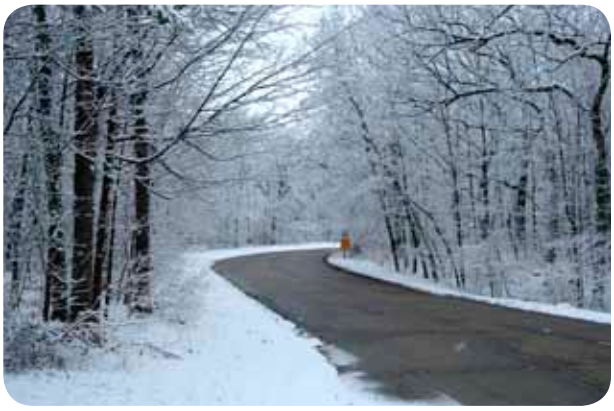
SW Region

County	Total	Urban STH	Rural STH	Urban IH	Rural IH	Urban State Highway Non-div	Urban State Highway Divided	Urban State Highway Unkn	Rural State Highway Non-div	Rural State Highway Divided	Rural State Highway Unkn
COLUMBIA	105	5	55	2	43	4	1	0	45	10	0
CRAWFORD	20	6	14	0	0	5	1	0	13	1	0
DANE	484	201	161	20	102	26	175	0	95	66	0
DODGE	102	7	95	0	0	6	1	0	40	55	0
GRANT	70	3	67	0	0	3	0	0	45	22	0
GREEN	43	6	37	0	0	0	6	0	33	4	0
IOWA	43	0	43	0	0	0	0	0	17	26	0
JEFFERSON	65	17	36	0	12	14	3	0	35	1	0
JUNEAU	101	0	31	0	70	0	0	0	31	0	0
LA CROSSE	196	90	64	18	24	41	49	0	39	25	0
LAFAYETTE	38	0	38	0	0	0	0	0	19	19	0
MONROE	139	16	34	7	82	8	8	0	34	0	0
RICHLAND	24	0	24	0	0	0	0	0	19	5	0
ROCK	132	38	61	13	20	22	16	0	51	10	0
SAUK	104	14	55	0	35	8	6	0	41	14	0
VERNON	32	0	32	0	0	0	0	0	32	0	0
Total	1,698	403	847	60	388	137	266	0	589	258	0

STH = State highways or non-interstate US highways
IH = Interstate highways Non-div = Non-divided
Rural = An unincorporated area or an incorporated area with a population under 5,000
Urban = An incorporated area with a population of 5,000 or more.

*2010 figures are preliminary at this time.
**Does not include deer or other animal crashes

5 Looking Ahead



The winter of 2009–2010 wasn't as snowy as the winters of 2007–2008 and 2008–2009, but it was still one of the costliest winters ever. Increasing salt costs continue to be an issue, and the primary reason for rising winter maintenance costs. Use of anti-icing liquid and salt brine for prewetting increased this year, which can help counties use less salt, keep roads safer, and decrease winter maintenance costs.

In 2010–2011, WisDOT will continue to focus on becoming more efficient so that current winter levels of service can be maintained. However, ever-increasing costs are making it more difficult to maintain the current levels of service without making cuts to other non-winter maintenance areas. Most of the effort next winter will be to conduct winter operations more efficiently and cost-effectively using the new MDSS program. This effort will include the continued implementation of AVL/GPS technologies and the continued emphasis on best practices.

Areas of focus for the 2010–2011 winter:

1. Automatic Vehicle Location/Global Positioning System (AVL/GPS) equipment will become standard in 2010–2011 with a statewide implementation plan. The testing and evaluation of the equipment will continue throughout the 2010–2011 winter season. The goal will be to have AVL/GPS equipment installed on all county highway department trucks on state patrol sections by November 2011.
2. MDSS program training will be conducted statewide in the fall of 2010. Emphasis will be placed on following the treatment recommendations provided by the MDSS program.
3. WisDOT will continue to evaluate the costs and benefits of the Tow Plow unit. These plows were delivered to Marquette and Eau Claire County in the later part of the winter of 2009–2010 and were only used twice by Marquette County. A detailed evaluation of the plow will be conducted during the winter of 2010–2011.
4. WisDOT purchased three portable Scale-Tec calibration scales in 2009. The scales are thought to be a good value and have multiple uses for a highway department operation. WisDOT Regions will partner with County Highway Departments to provide more Scale -Tec scales for highway operations in 2010–2011.
5. The Dane County Highway Department will continue to evaluate a salt slurry spreader from Monroe Equipment.
6. The Standing corn purchasing program was determined to be a success in areas of the state where it was used in 2009–2010. If corn prices are favorable, the program will be expanded and evaluated for use as living snow fence.
7. WisDOT Region staff will continue to work with counties to assure that material application guidelines are adhered to and that new technologies are implemented properly.
8. WisDOT Region staff will be taking a more active role with the counties in preparation for and reacting to winter events.
9. WisDOT Regions will continue to be more diligent in conducting post-storm analyses.
10. Continued emphasis will be placed on the accuracy of storm reports that are submitted by the counties.
11. WisDOT will emphasize the need for counties to keep equipment calibrated.
12. WisDOT will continue to stress the advantages of using best practices such as prewetting salt and anti-icing.
13. WisDOT will encourage counties in the Southwest and Southeast regions to incorporate underbody plows into their fleets.
14. WisDOT will continue to stress the advantages of using best practices such as prewetting salt and anti-icing.

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Appendix

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Wisconsin Department of Transportation
New regional organization
Effective May 29, 2005 (updated July 18, 2005)

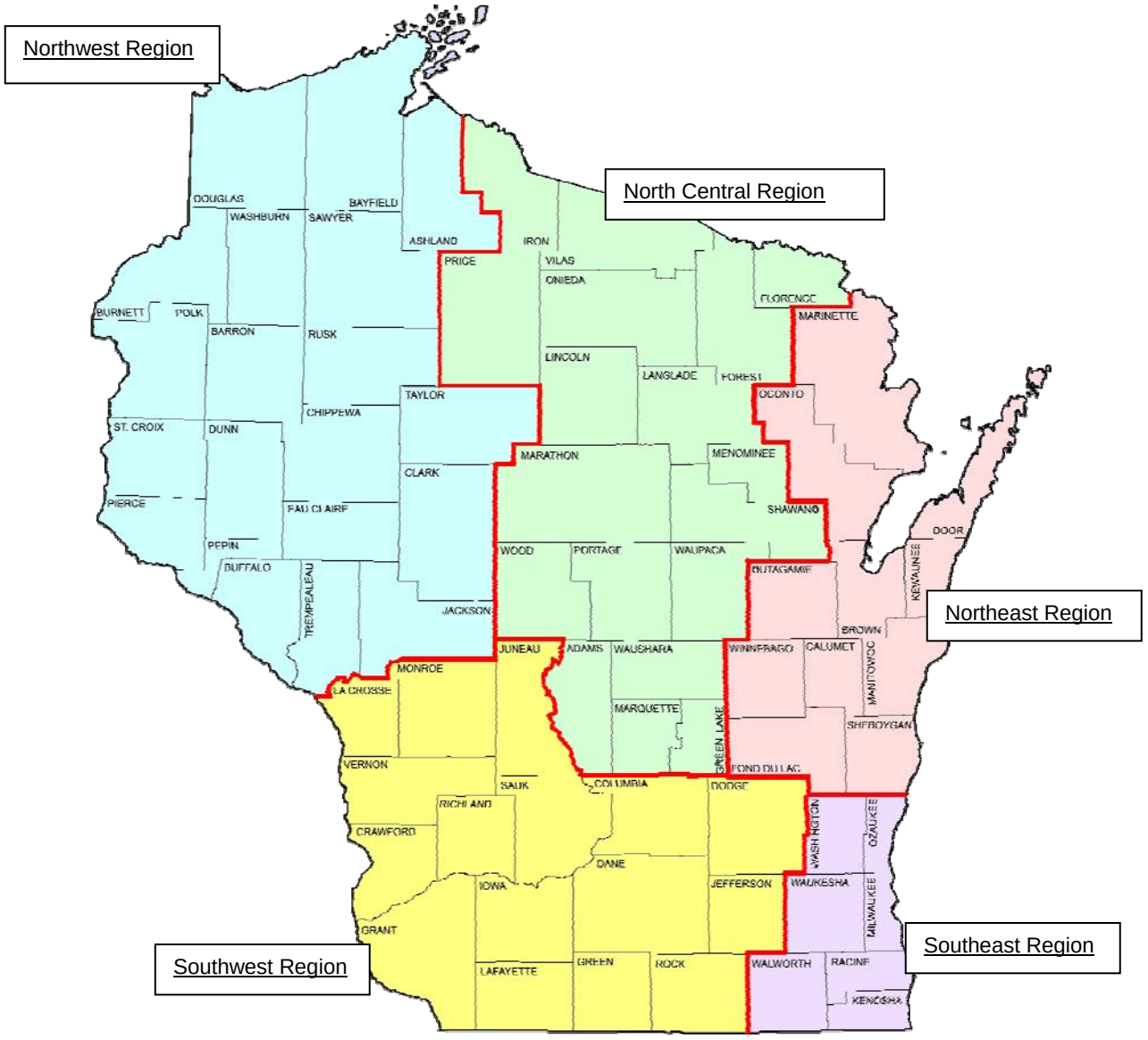


Figure A-1

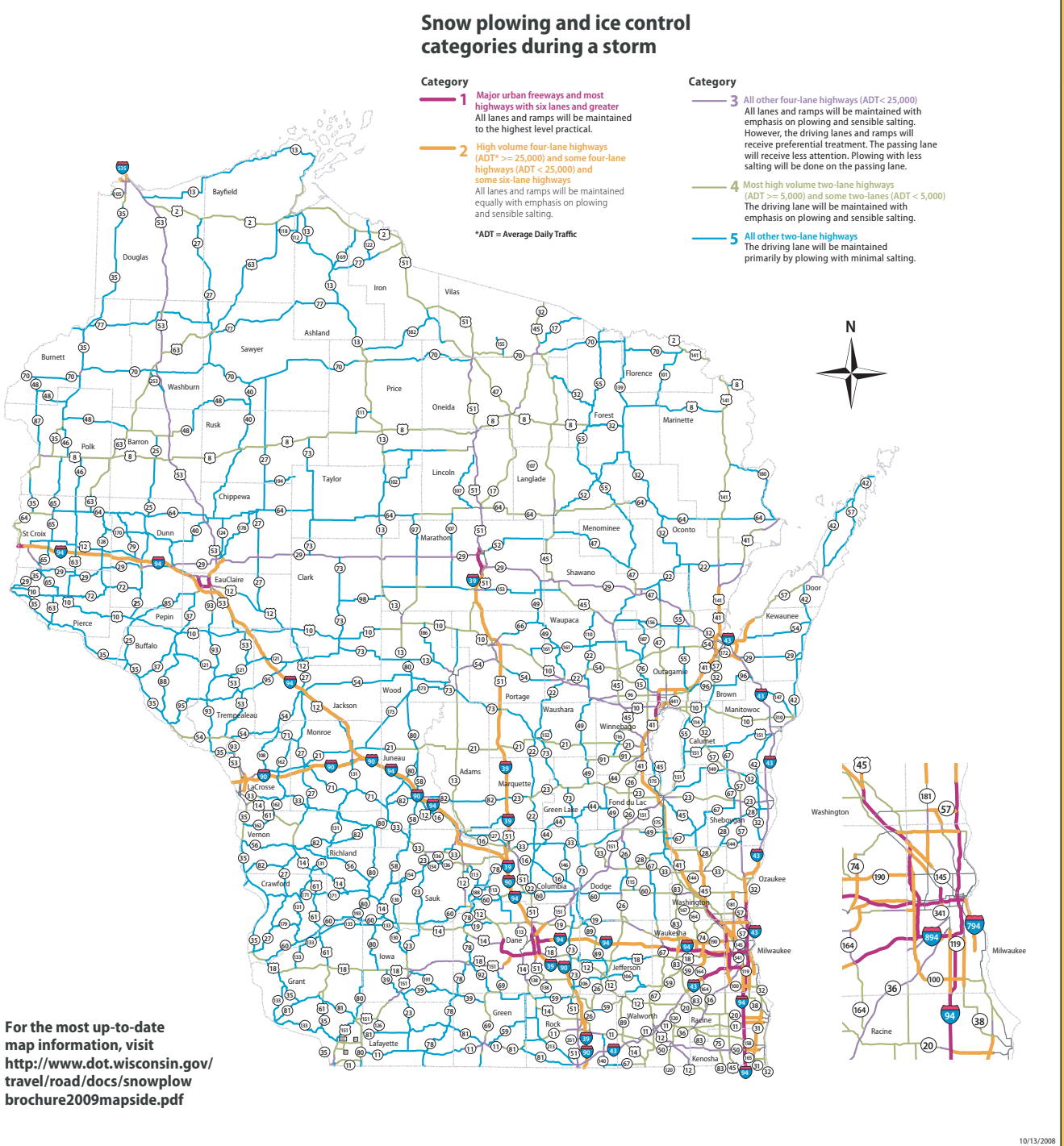

Snow plowing and ice control categories during a storm
Category
1 Major urban freeways and most highways with six lanes and greater
All lanes and ramps will be maintained to the highest level practical.
2 High volume four-lane highways (ADT* >= 25,000) and some four-lane highways (ADT < 25,000) and some six-lane highways
All lanes and ramps will be maintained equally with emphasis on plowing and sensible salting.
*ADT = Average Daily Traffic
Category
3 All other four-lane highways (ADT< 25,000)
All lanes and ramps will be maintained with emphasis on plowing and sensible salting. However, the driving lanes and ramps will receive preferential treatment. The passing lane will receive less attention. Plowing with less salting will be done on the passing lane.
4 Most high volume two-lane highways (ADT >= 5,000) and some two-lanes (ADT < 5,000)
The driving lane will be maintained with emphasis on plowing and sensible salting.
5 All other two-lane highways
The driving lane will be maintained primarily by plowing with minimal salting.
N
Douglas
Bayfield
Iron
Vilas
Ashland
Sawyer
Burnett
Washburn
Price
Oneida
Florence
Forest
Marinette
Rusk
Polk
Barron
Taylor
Lincoln
Langlade
Chippewa
St Croix
Dunn
Marathon
Menominee
Oconto
Clark
EauClaire
Shawano
Door
Pepin
Pierce
Buffalo
Waupaca
Kewaunee
Outagamie
Wood
Portage
Brown
Jackson
Waushara
Manitowoc
Trempealeau
Monroe
Winnebago
Calumet
Juneau
Adams
Marquette
LaCrosse
Green Lake
Fond du Lac
Sheboygan
Vernon
Richland
Ozaukee
Crawford
Columbia
Dodge
Washington
Sauk
Waukesha
Dane
Milwaukee
Jefferson
Iowa
Grant
Walworth
Racine
Green
Rock
Lafayette
Kenosha
Washington
Milwaukee
Racine
For the most up-to-date map information, visit http://www.dot.wisconsin.gov/travel/road/docs/snowplowbrochure2009mapside.pdf
10/13/2008

Figure A-2

Table A.1. Storm Report Summary

From Winter Storm Reports, 2009-2010

Notes: 1) Costs shown in table are estimated and do not include the 4.25% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of June '07 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region NC County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Incident									Mat'l	Equip	Labor	Total		
ADAMS	192.72	29.92	50.7	18	21	13	15	4,360	2,444	1,916	12.7	7.2	705.5	408.5	$853	$353	$282	$1,487	$286,549	0.42
FLORENCE	141.07	29.77	68.6	5	31	13	9	3,870	1,803	2,067	12.8	22.0	406.0	356.5	$862	$326	$239	$1,427	$199,764	0.43
FOREST	312.38	31.51	67.3	1	24	22	6	7,204	3,604	3,600	11.5	0.0	1329.0	718.5	$750	$353	$267	$1,370	$427,823	0.37
GREEN LAKE	151.3	24.65	61.6	3	23	16	5	2,309	763	1,546	5.0	0.0	513.5	237.5	$333	$277	$214	$823	$124,207	0.20
IRON	250.91	46.53	209.4	4	45	17	5	7,685	3,927	3,758	15.7	252.0	1544.0	850.0	$1,043	$515	$442	$2,001	$501,973	0.34
LANGLADE	292.69	23.42	46.0	6	20	22	7	6,759	2,488	4,271	8.5	0.0	1209.0	665.3	$541	$338	$277	$1,157	$337,049	0.36
LINCOLN	418.33	32.30	65.0	8	29	16	11	6,781	3,526	3,255	8.4	432.0	2127.5	982.6	$579	$390	$320	$1,288	$535,433	0.26
MARATHON	880.19	27.83	34.1	20	24	29	8	16,766	7,365	9,401	8.4	141.1	3174.0	2640.0	$566	$383	$320	$1,268	$1,114,240	0.30
MARQUETTE	244.53	18.39	55.0	9	16	9	3	5,610	2,471	3,139	10.1	0.0	924.0	632.5	$688	$308	$277	$1,273	$311,401	0.55
MENOMINEE	90.26	22.48	68.8	0	26	11	2	2,487	1,292	1,195	14.3	47.0	257.8	94.8	$976	$247	$131	$1,354	$122,068	0.64
ONEIDA	396.79	36.32	77.7	9	29	19	10	9,421	3,379	6,042	8.5	232.0	2125.8	1087.8	$591	$417	$368	$1,376	$543,759	0.23
PORTAGE	547.2	26.31	38.6	4	29	18	6	9,500	5,042	4,458	9.2	179.0	2069.0	1765.0	$609	$420	$351	$1,381	$753,355	0.35
PRICE	320.57	37.23	56.1	10	31	21	12	6,703	3,104	3,599	9.7	162.0	1178.0	1108.5	$656	$402	$332	$1,391	$445,104	0.26
SHAWANO	515.09	28.75	58.6	4	27	24	5	10,099	4,973	5,126	9.7	188.2	2530.5	1395.5	$589	$429	$321	$1,339	$686,347	0.34
VILAS	305.24	36.76	99.1	4	46	7	9	9,593	3,679	5,914	12.1	809.0	1429.5	946.0	$818	$464	$363	$1,645	$500,421	0.33
WAUPACA	546.64	21.04	54.9	2	20	19	3	9,625	5,352	4,273	9.8	0.0	1514.5	1287.5	$582	$307	$246	$1,135	$619,468	0.47
WAUSHARA	345.71	17.25	40.9	7	19	3	3	4,571	2,213	2,358	6.4	0.0	967.5	866.3	$416	$282	$250	$949	$327,987	0.37
WOOD	372.22	25.31	42.3	16	25	10	12	6,934	3,675	3,259	9.9	58.0	1212.5	810.0	$713	$312	$258	$1,283	$476,212	0.39
Region Total		--	--	--	--	--	--	130,277	61,100	69,177	--	2529	--	--	--	--	--	--	$8,313,160	
Region Average		28.65	66.4	7.2	26.9	16.1	7.3	7,238	3,394	3,843	10.1	141	1401.0	936.3	$676	$363	$292	$1,330	$461,842	0.37

Final totals as of Tuesday, May 11, 2010

Table A.1. Storm Report Summary

From Winter Storm Reports, 2009-2010

Notes: 1) Costs shown in table are estimated and do not include the 4.25% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of June '07 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region NE County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Incident									Mat'l	Equip	Labor	Total		
BROWN	711.91	20.33	43.2	17	21	3	4	16,472	8,626	7,846	12.1	0.0	2579.5	2587.5	$695	$411	$397	$1,503	$1,066,832	0.60
CALUMET	201.29	28.95	56.0	12	29	22	3	2,767	1,498	1,269	7.4	0.0	892.0	785.4	$462	$493	$398	$1,353	$270,638	0.26
DOOR	268.55	23.64	43.9	13	21	24	3	3,891	2,761	1,130	10.3	22.0	954.3	850.0	$641	$403	$347	$1,392	$372,253	0.43
FOND DU LAC	599.2	23.23	55.9	14	25	10	6	10,374	5,634	4,740	9.4	0.0	2816.0	2560.0	$561	$473	$438	$1,472	$882,096	0.40
KEWAUNEE	110.41	23.77	54.5	1	17	22	3	2,058	981	1,077	8.9	178.3	425.5	235.0	$522	$359	$284	$1,165	$128,651	0.37
MANITOWOC	417.99	23.64	70.1	2	22	14	5	8,493	6,278	2,215	15.0	80.0	1702.0	1408.0	$870	$468	$401	$1,738	$722,245	0.64
MARINETTE	417.29	29.16	63.9	16	25	24	11	6,614	3,333	3,281	8.0	0.0	1802.5	627.5	$474	$310	$332	$1,115	$464,426	0.27
OCONTO	471.83	28.10	69.1	10	29	23	5	7,306	4,026	3,280	8.5	0.0	2436.5	1520.0	$506	$487	$385	$1,378	$648,415	0.30
OUTAGAMIE	523.98	24.09	51.5	6	24	15	4	11,438	5,908	5,530	11.3	0.0	3193.8	1069.8	$691	$399	$337	$1,427	$738,095	0.47
SHEBOYGAN	520.3	23.69	57.0	10	18	20	5	11,345	6,898	4,447	13.3	2216.0	2093.0	1303.3	$810	$373	$354	$1,536	$793,462	0.56
WINNEBAGO	568.31	20.77	43.4	6	23	17	2	11,908	6,733	5,175	11.8	0.0	1676.9	2640.5	$759	$394	$389	$1,542	$863,363	0.57
Region Total		--	--	--	--	--	--	92,666	52,676	39,990	--	2496	--	--	--	--	--	--	$6,950,474	
Region Average		24.49	55.3	9.7	23.1	17.6	4.6	8,424	4,789	3,635	10.5	227	1870.2	1417.0	$635	$416	$369	$1,420	$631,861	0.44

Table A.1. Storm Report Summary

From Winter Storm Reports, 2009-2010

Notes: 1) Costs shown in table are estimated and do not include the 4.25% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of June '07 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region NW County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Inci-dent									Mat'l	Equip	Labor	Total		
ASHLAND	247.57	43.38	190.3	14	35	16	11	5,158	2,426	2,732	9.8	165.0	939.5	1050.1	$731	$472	$391	$1,593	$394,487	0.23
BARRON	423.09	31.23	58.0	8	31	35	12	3,970	1,863	2,107	4.4	418.1	2161.0	1133.3	$302	$441	$342	$1,085	$458,951	0.14
BAYFIELD	316.9	42.88	127.4	4	34	25	10	5,033	3,661	1,372	11.6	149.0	1595.0	946.0	$740	$481	$357	$1,578	$499,857	0.27
BUFFALO	316.05	24.47	43.4	6	21	16	8	3,067	1,709	1,358	5.4	127.0	1241.0	740.0	$328	$307	$259	$894	$281,881	0.22
BURNETT	233.64	24.77	56.6	6	18	20	9	3,900	1,718	2,182	7.4	0.0	844.0	440.0	$533	$312	$234	$1,080	$252,262	0.30
CHIPPEWA	669.29	26.60	49.4	0	25	19	5	14,414	5,686	8,728	8.5	1207.0	2677.5	2095.5	$596	$417	$318	$1,331	$890,912	0.32
CLARK	402.28	25.55	55.4	6	25	13	8	6,481	3,590	2,891	8.9	0.0	1318.5	721.5	$641	$294	$231	$1,166	$468,987	0.35
DOUGLAS	439.23	30.33	125.2	9	25	26	5	8,163	3,616	4,547	8.2	120.0	1744.0	1266.0	$500	$374	$328	$1,202	$527,773	0.27
DUNN	516.55	22.14	46.9	0	20	18	3	13,018	5,624	7,394	10.9	353.0	1747.0	1853.0	$723	$380	$380	$1,482	$765,702	0.49
EAU CLAIRE	537.26	21.82	45.1	9	19	35	4	12,367	4,638	7,729	8.6	51.0	2698.0	1926.8	$531	$483	$405	$1,418	$761,952	0.40
JACKSON	514.3	28.44	77.0	23	30	19	26	9,882	5,949	3,933	11.6	145.0	2232.0	1332.0	$788	$365	$303	$1,457	$749,097	0.41
PEPIN	111.05	21.72	39.5	0	21	12	4	1,365	738	627	6.6	172.0	367.0	283.0	$428	$315	$268	$1,012	$112,361	0.31
PIERCE	366.08	32.49	53.9	7	27	22	9	6,602	3,312	3,290	9.0	465.0	1469.0	834.5	$577	$327	$299	$1,203	$440,531	0.28
POLK	385.05	27.97	52.1	0	18	34	2	7,152	3,842	3,310	10.0	353.0	1440.0	1070.8	$643	$350	$309	$1,301	$500,829	0.36
RUSK	213.47	29.65	70.4	0	26	31	8	3,108	1,650	1,458	7.7	180.5	1062.5	426.0	$529	$386	$286	$1,201	$256,397	0.26
SAINT CROIX	618.98	26.43	53.4	1	27	13	9	11,050	6,210	4,840	10.0	338.5	2116.0	2138.0	$597	$412	$342	$1,351	$836,191	0.38
SAWYER	367.44	26.51	77.1	0	36	10	9	4,499	2,555	1,944	7.0	12.0	1320.0	863.5	$486	$321	$263	$1,070	$393,322	0.26
TAYLOR	233.25	27.78	43.8	9	22	25	11	4,582	2,283	2,299	9.8	36.0	1053.8	498.0	$736	$379	$280	$1,395	$324,150	0.35
TREMPEALEAU	434.99	21.99	22.7	7	19	21	7	7,025	3,579	3,446	8.2	209.0	1446.0	617.0	$515	$250	$200	$965	$419,611	0.37
WASHBURN	372.14	23.44	58.0	8	23	18	5	7,188	2,409	4,779	6.5	125.3	975.0	799.4	$434	$286	$218	$937	$348,693	0.28
Region Total		--	--	--	--	--	--	138,024	67,058	70,966	--	4626	--	--	--	--	--	--	$9,683,947	
Region Average		27.98	67.3	5.9	25.1	21.4	8.3	6,901	3,353	3,548	8.5	231	1522.3	1051.7	$568	$368	$301	$1,236	$484,197	0.31

Final totals as of Tuesday, May 11, 2010

Table A.1. Storm Report Summary

From Winter Storm Reports, 2009-2010

Notes: 1) Costs shown in table are estimated and do not include the 4.25% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of June '07 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region SE County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season			Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile				Estimated Total Cost to Date	Salt per LM per Severity Index
				Anti-Icing	Storms	Incident									Mat'l	Equip	Labor	Total		
KENOSHA	573.11	20.57	50.4	10	22	5	4	12,614	5,880	6,734	10.3	0.0	1941.0	2256.5	$580	$438	$491	$1,510	$865,200	0.50
MILWAUKEE	1784.17	20.33	40.4	3	21	6	5	55,347	29,381	25,966	16.5	0.0	7715.5	5624.0	$900	$358	$515	$1,773	$3,161,011	0.81
OZAUKEE	304.03	21.21	55.9	5	23	23	2	9,601	5,279	4,322	17.4	0.0	1694.0	575.0	$972	$445	$373	$1,791	$542,345	0.82
RACINE	704.86	29.38	72.4	20	27	16	3	17,031	8,447	8,584	12.0	0.0	2185.0	2836.0	$653	$392	$440	$1,485	$1,045,725	0.41
WALWORTH	682.81	21.72	59.9	1	19	11	4	19,984	11,345	8,639	16.6	0.0	2039.3	2277.3	$949	$377	$403	$1,729	$1,178,695	0.76
WASHINGTON	581.11	25.25	69.1	5	27	13	1	16,344	7,691	8,653	13.2	0.0	1955.3	1749.8	$816	$332	$307	$1,455	$839,849	0.52
WAUKESHA	1070.09	17.68	29.2	6	19	7	3	43,151	16,104	27,047	15.0	0.0	3761.0	4476.0	$777	$452	$404	$1,632	$1,743,635	0.85
Region Total		--	--	--	--	--	--	174,072	84,127	89,945	--	0	--	--	--	--	--	--	$9,376,459	
Region Average		22.31	53.9	7.1	22.6	11.6	3.1	24,867	12,018	12,849	14.4	0	3041.6	2827.8	$807	$399	$419	$1,625	$1,339,494	0.67

Table A.1. Storm Report Summary

From Winter Storm Reports, 2009-2010

Notes: 1) Costs shown in table are estimated and do not include the 4.25% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of June '07 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Region / SW / County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season: Anti-Icing	Events this Season: Storms	Events this Season: Incident	Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Sand Used (CY)	Total Reg. Hours	Total OT Hours	Estimated Cost Per Lane Mile: Mat'l	Equip	Labor	Total	Estimated Total Cost to Date	Salt per LM per Severity Index
COLUMBIA	743.95	24.87	55.5	26	26	22	4	22,105	14,205	7,900	19.1	571.0	4020.5	3093.8	$1,241	$574	$487	$2,301	$1,711,270	0.77
CRAWFORD	385.21	30.05	43.6	6	21	25	7	4,683	3,357	1,326	8.7	1596.0	1631.0	939.3	$568	$362	$268	$1,199	$459,986	0.29
DANE	1501.97	24.31	41.8	1	22	3	3	51,060	25,063	25,997	16.7	400.0	4450.0	8889.0	$1,071	$495	$509	$2,075	$3,089,649	0.69
DODGE	606.62	21.15	54.6	8	23	12	3	18,229	10,654	7,575	17.6	0.0	2322.5	1841.0	$1,089	$373	$298	$1,761	$1,068,045	0.83
GRANT	624.14	29.85	56.1	5	25	35	6	11,298	7,395	3,903	11.8	1563.0	2541.5	1783.5	$774	$399	$272	$1,445	$902,006	0.40
GREEN	311.37	26.31	56.6	0	24	30	7	3,906	2,437	1,469	7.8	256.0	1453.8	1166.0	$552	$453	$355	$1,359	$419,025	0.30
IOWA	451.03	26.64	55.1	0	24	14	5	9,046	5,796	3,250	12.9	197.0	2108.0	2079.5	$762	$481	$399	$1,642	$740,456	0.48
JEFFERSON	458.21	18.09	45.1	0	22	5	3	16,479	7,929	8,550	17.3	0.0	1696.8	1827.3	$997	$459	$425	$1,881	$861,461	0.96
JUNEAU	498.79	23.47	49.9	10	22	12	6	10,420	7,128	3,292	14.3	74.0	1601.0	1210.8	$968	$302	$251	$1,520	$757,662	0.61
LA CROSSE	488.24	29.17	59.9	13	21	28	5	11,302	4,617	6,685	9.5	748.0	2800.5	1574.8	$671	$499	$420	$1,590	$773,015	0.32
LAFAYETTE	293.88	27.21	58.3	3	21	12	6	4,125	2,232	1,893	7.6	1595.0	999.9	882.1	$455	$316	$273	$1,044	$306,875	0.28
MONROE	646.13	27.38	56.0	8	26	17	8	11,335	6,696	4,639	10.4	201.0	2379.5	1811.0	$659	$348	$278	$1,286	$831,095	0.38
RICHLAND	328.72	28.61	49.1	4	23	13	11	3,260	2,296	964	7.0	388.0	1076.8	600.8	$462	$281	$214	$957	$314,526	0.24
ROCK	598.5	23.46	47.4	16	19	12	7	18,090	10,529	7,561	17.6	50.0	2458.0	2793.3	$1,120	$525	$491	$2,136	$1,273,456	0.75
SAUK	591.55	22.20	55.9	26	21	15	7	17,580	9,199	8,381	15.6	19.0	2949.3	1824.0	$1,088	$474	$343	$1,905	$1,126,802	0.70
VERNON	450	27.72	58.4	9	24	20	9	6,915	3,822	3,093	8.5	1771.0	1689.5	973.0	$534	$308	$219	$1,062	$477,705	0.31
Region Total		--	--	--	--	--	--	219,833	123,355	96,478	--	9429	--	--	--	--	--	--	$15,113,033	
Region Average		25.66	52.7	8.4	22.8	17.2	6.1	13,740	7,710	6,030	12.6	589	2261.2	2080.6	$813	$415	$344	$1,573	$944,565	0.52

Final totals as of Tuesday, May 11, 2010

Table A.1. Storm Report Summary

From Winter Storm Reports, 2009-2010

Notes: 1) Costs shown in table are estimated and do not include the 4.25% Administrative Costs; 2) Material Costs includes Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on $60 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds as of June '07 (modified as required) plus early seasonal fill plus seasonal fill plus vendor reserve available.

Statewide Total	--	--	--	--	--	--	754,872	388,316	366,556	--	19081.2	--	--	--	--	--	--	--	$49,437,074	--
Statewide Average	26.55	60.7	7.5	24.5	17.6	6.5	10,484	5,393	5,091	10.7	265.0	1857.0	1480.0	$683	$387	$330	$1,400	$686,626	0.43	

WEATHER MANAGEMENT SOLUTIONS, LLC

EVALUATION OF WEATHER FORECAST SERVICES

Michael J. Adams

2010

Executive Summary

Introduction

In order to assess the quality of weather and pavement temperature forecasts provided to the Wisconsin Department of Transportation (WisDOT) and the county highway departments who provide winter maintenance on the state trunk highway system, the WisDOT Road Weather Information System (RWIS) Program Manager performed a verification study on these forecasts. The primary aim of this study is to uncover any potential problems in forecast accuracy. The ultimate goal of this project is to use the findings of this study to improve the quality of weather and pavement temperature forecast information provided by Meridian Environmental Technology, Inc. (Meridian), or any other provider of forecast information.

In addition, Meridian conducted two surveys of the county highway departments (the users of the forecast information) during the winter. The aim of these surveys is twofold. They enable Meridian and WisDOT to gauge customer satisfaction. They also promote interaction between Meridian and the users of the service they provide.

For all information presented in this report, results for the winter seasons of 1998-99 through 2004-05 are for forecasts provided by Surface Systems, Inc., while results after that are for forecasts provided by Meridian.

Verification Procedures

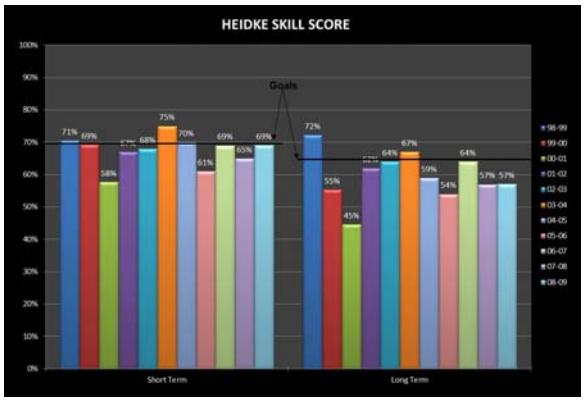
Forecasts for eight locations were examined: Madison, Milwaukee, Green Bay, Wausau, La Crosse, Eau Claire, and Rhinelander, and Rice Lake. The time period covered by the verification study was December 1, 2009 through March 31, 2010. Four specific criteria were examined: snow, freezing precipitation, wind speed, and pavement temperature.

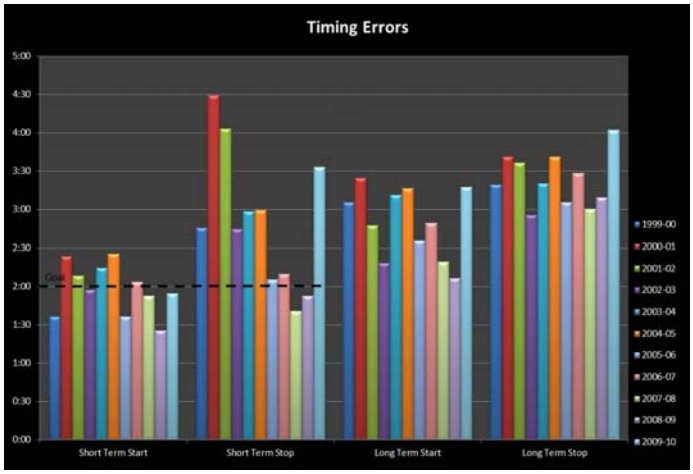
For the first two criteria, the verification methodology was based on a paper presented by John Thornes at the 1998 Standing International Road Weather Commission (SIRWEC) conference. It is based on common meteorological forecast verification techniques. The basis of the method is to choose two time periods (in our case 0 to 6 hours and 6 to 24 hours after forecast issuance) during the forecasts and see if the particular criterion was forecast to occur and whether it actually occurred during the periods being examined. In other words, was snow forecast to occur and did it occur? Two-by-two contingency tables are then constructed. A number of statistics were calculated, each of which provides a different piece of intelligence. Goal scores for each statistic have also been established. For pavement temperature and wind speed, the forecast values 3 and 9 hours after forecast issuance times were compared to the actual values and error statistics were computed. In addition, the timing error for the start and stop of precipitation and the lead time provided by the winter storm warning service were also examined. Some minor adjustments to the methodology used in previous verification studies were required due to the different format of the Meridian forecasts.

Results of this and previous studies are made available to Meridian or whoever the current forecast provider is. It is expected that Meridian will use the results of these studies to continue to improve upon their weather support to WisDOT and the county highway departments.

Verification Results

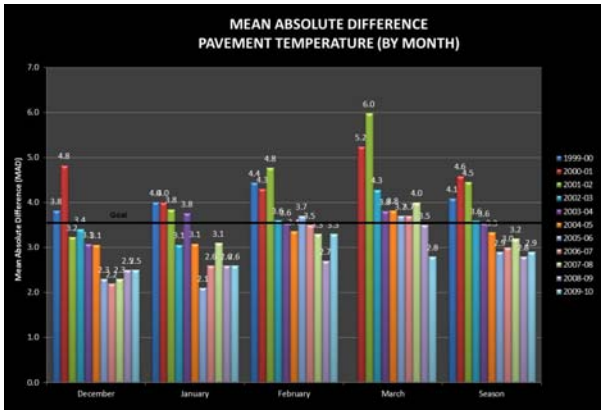
- **Precipitation forecasts.** Accuracy was again slightly better than the previous winter, and the results in the short term came close to meeting established goals.

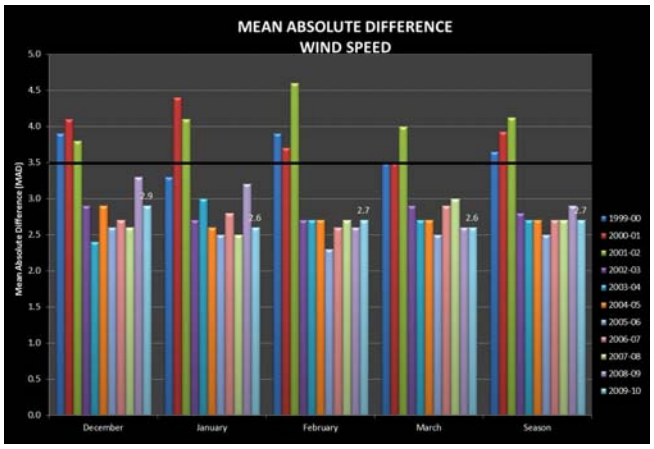




- **Timing error.** Timing errors for both short term and long term start of snow worsened significantly.

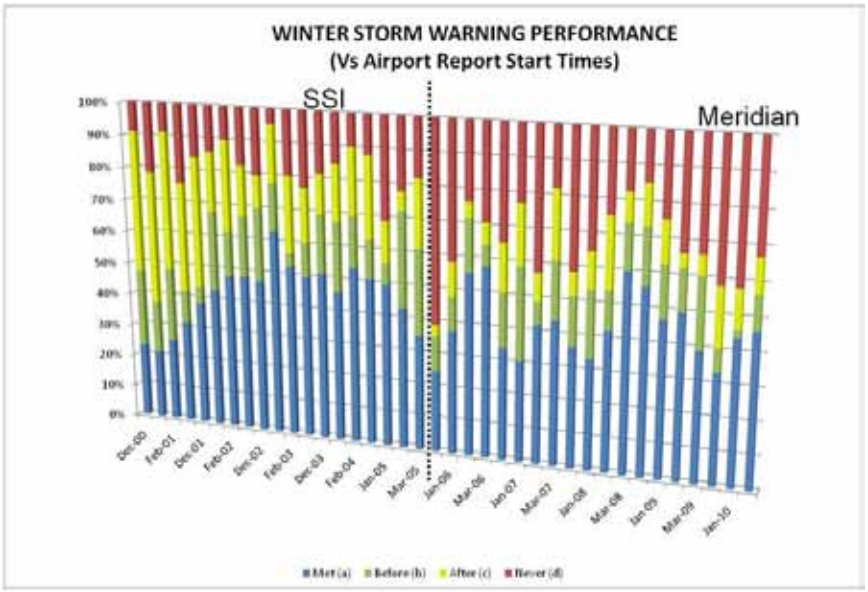
- **Pavement temperature.** Performance continued to be excellent, but was very slightly worse than the previous winter. The only issue was with forecasts valid during the daylight hours, which were slightly worse than the year before.





Winds. Wind forecast accuracy improved back to the level it had been at before the previous winter. There were no issues of note.

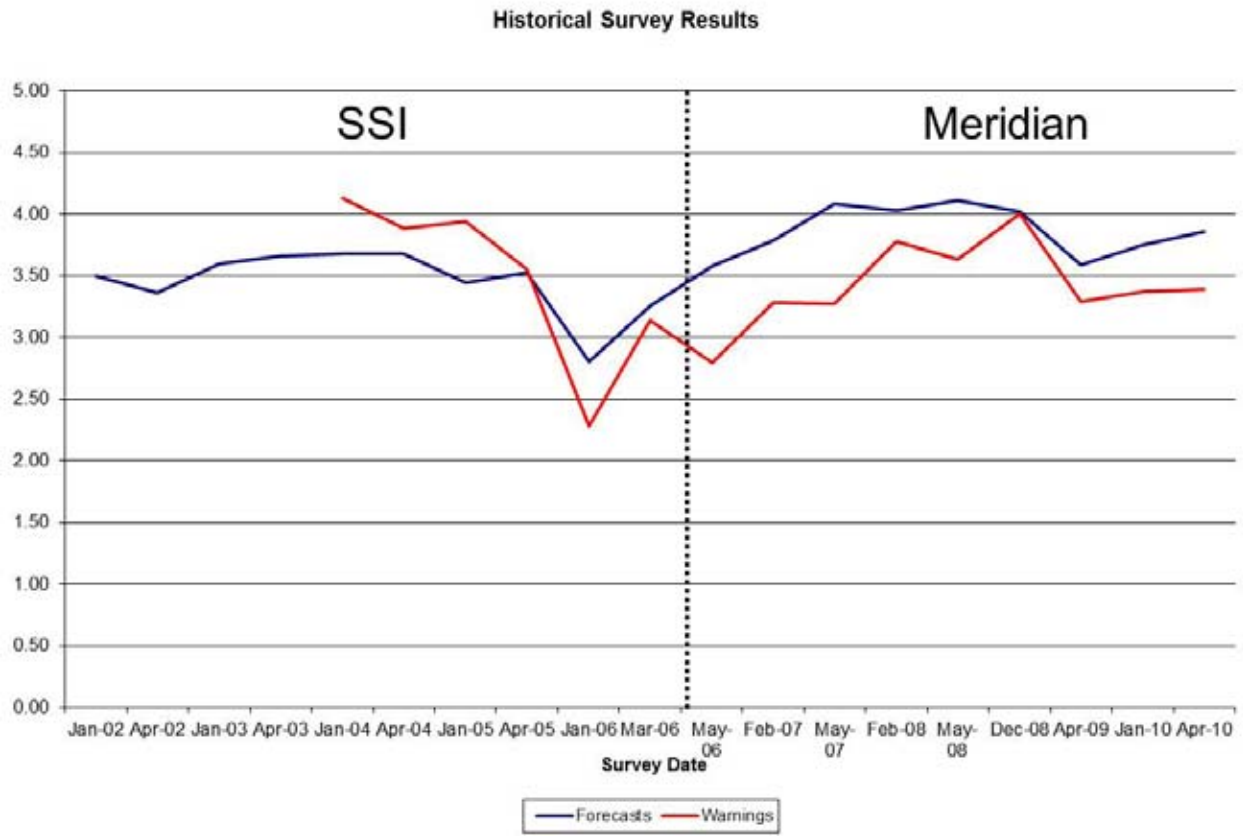
- **Winter storm warnings.** Performance was slightly better than previous seasons, but again failed to meet expectations. For the winter, 51 percent of events were preceded by a warning issued more than two hours in advance, as required by WisDOT's contract with Meridian. About 23 percent of events were preceded by no warning at all, though many of these were likely inconsequential.



Legend:
Met: warning issued more than 2 hours before event onset
Before: warning issued before event onset
After: warning issued after event onset
Never: no warning ever issued for event

Survey Results

Surveys taken during January and May 2010, brought mixed results. The forecast service remains highly rated, but the warning and alert service is not so highly perceived. The lack of ability to customize the service likely leads to much of the lower rating.



Recommendations

Meridian will prepare a plan of action to address winter storm warning performance, including the high number of false alarms and the low percentage of warnings that met the required two-hour lead time, no later than September 1, 2010 and implement solutions into MDSS no later than October 15, 2010.

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2009-2010

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
SW	JEFFERSON	2	0	0	2	20	9%	9,095	45.1	18.1	1.10	22	5	1	0
	VERNON	4	24	0	28	5	85%	5,242	58.4	27.7	0.42	24	20	4	9
	CRAWFORD	2	12	8	22	5	81%	3,082	43.6	30.0	0.27	21	25	6	6
	DANE	8	9	6	23	0	100%	36,131	41.8	24.3	0.99	22	3	3	1
	DODGE	16	2	0	18	13	58%	9,823	54.6	21.1	0.77	23	12	1	8
	GRANT	12	9	5	26	4	87%	7,175	56.1	29.8	0.39	25	35	4	5
	IOWA	1	6	17	24	0	100%	5,946	55.1	26.6	0.49	24	14	4	0
	COLUMBIA	13	8	5	26	26	50%	13,808	55.5	24.9	0.75	26	22	1	26
	JUNEAU	5	14	2	21	11	66%	7,765	49.9	23.5	0.66	22	12	4	10
	LA CROSSE	0	0	0	0	34	0%	7,324	59.9	29.2	0.51	21	28	2	13
	LAFAYETTE	13	5	6	24	0	100%	2,074	58.3	27.2	0.26	21	12	4	3
	MONROE	9	4	15	28	6	82%	5,996	56.0	27.4	0.34	26	17	4	8
	RICHLAND	2	21	1	24	3	89%	3,155	49.1	28.6	0.34	23	13	7	4
	ROCK	26	4	0	30	5	86%	10,397	47.4	23.5	0.74	19	12	4	16
	SAUK	8	16	0	24	23	51%	9,006	55.9	22.2	0.69	21	15	4	26
	GREEN	20	2	2	24	0	100%	2,751	56.6	26.3	0.34	24	30	6	0
Region Average		8.8	8.5	4.2	21.5	9.7	71.5%	8,673.1	52.7	25.7	0.56	22.8	17.2	3.7	8.4

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2009-2010

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
SE	OZAUKEE	1	12	11	24	4	86%	5,282	55.9	21.2	0.82	23	23	1	5
	KENOSHA	13	0	1	14	18	44%	6,770	50.4	20.6	0.57	22	5	3	10
	MILWAUKEE	12	8	1	21	3	88%	25,769	40.4	20.3	0.71	21	6	2	3
	RACINE	18	6	4	28	19	60%	8,517	72.4	29.4	0.41	27	16	2	20
	WALWORTH	6	11	3	20	0	100%	11,354	59.9	21.7	0.77	19	11	3	1
	WAUKESHA	4	21	0	25	0	100%	17,426	29.2	17.7	0.92	19	7	3	6
	WASHINGTON	18	11	3	32	0	100%	8,034	69.1	25.3	0.55	27	13	1	5
Region Average		10.3	9.9	3.3	23.4	6.3	82.4%	11,878.9	53.9	22.3	0.68	22.6	11.6	2.1	7.1

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2009-2010

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
NW	EAU CLAIRE	18	8	2	28	0	100%	5,382	45.1	21.8	0.46	19	35	2	9
	ASHLAND	24	16	8	48	1	98%	2,417	190.3	43.4	0.23	35	16	3	14
	BARRON	11	15	4	30	9	77%	1,596	58.0	31.2	0.12	31	35	7	8
	BAYFIELD	27	7	0	34	4	89%	3,170	127.4	42.9	0.23	34	25	4	4
	BUFFALO	5	14	3	22	5	81%	1,768	43.4	24.5	0.23	21	16	2	6
	BURNETT	7	7	10	24	0	100%	1,708	56.6	24.8	0.30	18	20	3	6
	CLARK	21	6	1	28	3	90%	3,187	55.4	25.6	0.31	25	13	4	6
	DOUGLAS	15	11	6	32	2	94%	3,591	125.2	30.3	0.27	25	26	2	9
	DUNN	0	2	0	2	18	10%	5,182	46.9	22.1	0.45	20	17	1	0
	SAWYER	7	23	6	36	0	100%	2,292	77.1	26.5	0.24	36	10	4	0
	JACKSON	9	29	14	52	1	98%	5,763	77.0	28.4	0.39	30	19	0	23
	WASHBURN	10	9	1	20	11	65%	2,454	58.0	23.4	0.28	23	18	3	8
	TAYLOR	19	2	3	24	7	77%	2,071	43.8	27.8	0.32	22	25	4	9
	SAINT CROIX	0	10	17	27	1	96%	6,051	53.4	26.4	0.37	27	13	4	1
	CHIPPEWA	4	5	12	21	4	84%	7,176	49.4	26.6	0.40	25	19	2	0
	RUSK	5	2	2	9	17	35%	1,740	70.4	29.6	0.27	26	31	4	0
	POLK	10	6	1	17	0	100%	3,840	52.1	28.0	0.36	18	34	0	0
	PIERCE	6	26	2	34	0	100%	3,238	53.9	32.5	0.27	27	22	7	7
	PEPIN	19	2	0	21	0	100%	730	39.5	21.7	0.30	21	12	3	0
	TREMPEALEAU	14	9	1	24	2	92%	4,288	22.7	22.0	0.45	19	21	3	7
Region Average		11.6	10.5	4.7	26.7	4.3	84.4%	3,382.2	67.3	28.0	0.31	25.1	21.4	3.1	5.9

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2009-2010

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
NE	DOOR	19	12	0	31	3	91%	3,073	43.9	23.6	0.48	21	24	0	13
	MANITOWOC	24	0	0	24	0	100%	6,089	70.1	23.6	0.62	22	14	0	2
	CALUMET	13	12	6	31	10	76%	1,225	56.0	28.9	0.21	29	22	1	12
	FOND DU LAC	21	13	3	37	2	95%	6,251	55.9	23.2	0.45	25	10	1	14
	KEWAUNEE	10	4	4	18	0	100%	995	54.5	23.8	0.38	17	22	1	1
	OCONTO	29	0	1	30	10	75%	4,403	73.1	29.0	0.32	30	23	1	10
	OUTAGAMIE	5	17	5	27	3	90%	6,298	51.5	24.1	0.50	24	15	2	6
	SHEBOYGAN	13	8	7	28	0	100%	6,970	57.0	23.7	0.57	18	20	4	10
	WINNEBAGO	7	11	6	24	5	83%	6,952	43.4	20.8	0.59	23	17	0	6
	MARINETTE	13	9	5	27	14	66%	3,495	63.9	29.2	0.29	25	24	5	16
	BROWN	38	0	0	38	0	100%	9,577	43.2	20.3	0.66	21	3	2	17
Region Average		17.5	7.8	3.4	28.6	4.3	88.7%	5,029.8	55.7	24.6	0.46	23.2	17.6	1.5	9.7

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2009-2010

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
NC	PRICE	17	13	3	33	8	80%	3,103	56.1	37.2	0.26	31	21	7	10
	FLORENCE	0	31	1	32	4	89%	1,862	68.6	29.8	0.44	31	13	6	5
	FOREST	3	18	4	25	0	100%	4,351	67.3	31.9	0.44	24	22	3	1
	GREEN LAKE	0	9	16	25	1	96%	758	61.6	24.6	0.20	23	16	2	3
	IRON	18	0	30	48	1	98%	3,892	209.4	46.5	0.33	45	17	5	4
	LANGLADE	10	11	3	24	2	92%	2,451	46.0	23.4	0.36	20	22	2	6
	LINCOLN	10	18	4	32	5	86%	3,439	65.0	32.3	0.25	29	16	4	8
	MARATHON	19	1	2	22	22	50%	7,329	34.1	27.8	0.30	24	29	5	20
	MARQUETTE	3	16	5	24	1	96%	3,420	55.0	18.4	0.76	16	9	1	9
	MENOMINEE	20	2	4	26	0	100%	1,251	68.8	22.5	0.62	26	11	0	0
	PORTAGE	28	0	1	29	4	88%	5,278	38.6	26.3	0.37	29	18	3	4
	SHAWANO	22	2	3	27	5	84%	5,454	61.6	29.4	0.36	28	24	1	4
	VILAS	15	30	3	48	2	96%	3,712	99.1	36.8	0.33	46	7	4	4
	WAUPACA	4	12	1	17	5	77%	5,388	54.9	21.0	0.47	20	19	0	2
	WAUSHARA	16	2	1	19	7	73%	2,393	40.9	17.2	0.40	19	3	2	7
	WOOD	22	15	4	41	0	100%	3,357	42.3	25.3	0.36	25	10	7	16
	ADAMS	8	27	1	36	3	92%	2,465	50.7	29.9	0.43	21	13	12	18
	ONEIDA	25	11	2	38	0	100%	3,726	77.7	36.3	0.26	29	19	5	9
Region Average		13.3	12.1	4.9	30.3	3.9	88.8%	3,534.9	66.5	28.7	0.39	27.0	16.1	3.8	7.2

Table A-2. Weather Forecasting Service Usage

From Winter Storm Reports, 2009-2010

Region	County	Good	Fair	Poor	Times Used	Times Not Used	% of Events Used	Salt Used (tons)	Snow Amount (inches)	Severity Index	Salt per LM per Severity Index	No. of Storms Events	No. of Incidents Reported	No.of Freezing Rains	No. of Anti-Ice Appl.
Statewide Average		12.2	10.0	4.3	26.4	5.6	83.1%	5,673.9	60.8	26.6	0.44	24.5	17.6	3.1	7.5

Table A.3. Anti-icing Details

From Winter Storm Reports, 2009-2010

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
NC	ADAMS	18	11	3	10	10	2	5	0	4,890	3,807	8,697
	FLORENCE	5	2	2	2	0	0	0	3,168	1,770	1,315	6,253
	FOREST	1	0	0	0	0	1	0	23	120	69	213
	GREEN LAKE	3	1	0	1	1	1	1	400	480	409	1,289
	IRON	4	0	0	0	1	3	1	0	540	433	973
	LANGLADE	6	3	2	2	1	1	0	420	2,160	1,634	4,214
	LINCOLN	8	4	2	4	2	4	0	1,630	1,710	1,746	5,086
	MARATHON	20	1	1	0	0	3	18	5,464	17,460	12,124	35,048
	MARQUETTE	9	1	2	1	1	4	4	0	4,980	4,745	9,725
	ONEIDA	9	0	0	1	0	5	5	337	3,375	2,493	6,204
	PORTAGE	4	0	0	0	0	2	2	180	1,920	1,305	3,405
	PRICE	10	2	0	1	1	1	7	438	3,150	2,157	5,745
	SHAWANO	4	0	0	0	0	1	3	192	1,290	822	2,304
	VILAS	4	2	0	0	0	1	2	154	1,590	1,031	2,775
	WAUPACA	2	0	0	0	0	2	0	58	930	604	1,592
	WAUSHARA	7	0	0	0	0	0	7	0	3,000	2,519	5,519
	WOOD	16	4	3	4	1	12	0	5,775	4,620	3,832	14,227
Region Total		130	31	15	26	18	43	55	18,238	53,985	41,045	113,268
Region Average		8	--	--	--	--	--	--	1,073	3,176	2,414	6,663

Table A.3. Anti-icing Details

From Winter Storm Reports, 2009-2010

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
NE	BROWN	17	0	0	0	0	17	0	327	4,860	3,541	8,728
	CALUMET	12	2	0	0	0	1	10	1,210	3,480	2,358	7,048
	DOOR	13	0	1	0	1	10	10	2,668	5,970	4,163	12,801
	FOND DU LAC	14	1	9	1	0	2	0	0	13,080	9,429	22,509
	KEWAUNEE	1	0	0	1	0	0	0	0	330	232	562
	MANITOWOC	2	0	0	0	0	0	2	240	900	659	1,799
	MARINETTE	16	1	0	1	1	2	12	1,438	6,390	5,773	13,601
	OCONTO	10	0	0	0	0	0	10	463	7,890	5,647	13,999
	OUTAGAMIE	6	1	3	2	1	1	3	3,780	4,260	2,980	11,020
	SHEBOYGAN	10	3	3	2	2	3	0	1,864	6,390	4,881	13,135
	WINNEBAGO	6	0	0	0	0	1	5	4,236	2,580	5,336	12,152
Region Total		107	8	16	7	5	37	52	16,225	56,130	44,997	117,352
Region Average		10	--	--	--	--	--	--	1,475	5,103	4,091	10,668

Table A.3. Anti-icing Details

From Winter Storm Reports, 2009-2010

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
NW	ASHLAND	14	0	0	0	0	14	0	4,150	4,170	2,828	11,147
	BARRON	8	0	0	0	0	4	4	0	5,940	2,099	8,039
	BAYFIELD	4	0	0	0	0	4	1	315	1,800	1,126	3,241
	BUFFALO	6	0	0	0	0	3	3	642	2,100	1,638	4,380
	BURNETT	6	4	1	1	1	5	0	1,286	2,370	2,512	6,168
	CLARK	6	0	0	0	0	3	3	144	2,460	1,858	4,462
	DOUGLAS	9	5	0	1	0	4	1	0	4,890	2,628	7,518
	EAU CLAIRE	9	0	0	0	0	4	6	0	5,700	2,586	8,286
	JACKSON	23	0	0	0	0	22	16	1,240	11,640	8,077	20,957
	PIERCE	7	0	3	2	2	5	2	0	2,520	3,382	5,902
	SAINT CROIX	1	0	0	0	0	0	1	0	300	199	499
	TAYLOR	9	1	0	1	1	0	7	143	2,910	1,758	4,810
	TREMPEALEAU	7	1	1	2	0	3	2	4,128	4,260	3,120	11,508
	WASHBURN	8	0	0	0	0	0	8	0	2,820	1,824	4,644
Region Total		117	11	5	7	4	71	54	12,048	53,880	35,632	101,561
Region Average		8	--	--	--	--	--	--	861	3,849	2,545	7,254

Table A.3. Anti-icing Details

From Winter Storm Reports, 2009-2010

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
SE	KENOSHA	10	0	0	0	0	0	10	760	4,800	3,622	9,182
	MILWAUKEE	3	0	0	0	0	0	3	1,898	7,140	10,182	19,219
	OZAUKEE	5	0	0	0	0	1	4	174	3,960	2,930	7,064
	RACINE	20	0	0	0	0	0	20	2,129	8,190	9,006	19,325
	WALWORTH	1	0	0	1	0	0	0	45	360	302	707
	WASHINGTON	5	0	0	0	0	2	4	210	1,200	1,559	2,969
	WAUKESHA	6	1	0	0	0	1	5	830	1,800	1,238	3,867
Region Total		50	1	0	1	0	4	46	6,045	27,450	28,838	62,333
Region Average		7	--	--	--	--	--	--	864	3,921	4,120	8,905

Table A.3. Anti-icing Details

From Winter Storm Reports, 2009-2010

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
SW	COLUMBIA	26	0	0	0	0	0	26	3,889	29,460	20,622	53,971
	CRAWFORD	6	0	0	0	0	2	4	918	2,100	1,310	4,328
	DANE	1	0	0	0	0	1	0	779	2,400	1,720	4,899
	DODGE	8	0	0	0	0	0	8	0	3,840	2,278	6,118
	GRANT	5	0	0	0	0	1	4	0	2,340	1,271	3,611
	JUNEAU	10	0	0	0	0	1	7	3,210	4,320	3,457	10,987
	LA CROSSE	13	1	2	0	0	11	12	17,107	6,360	4,206	27,673
	LAFAYETTE	3	0	0	0	0	0	3	51	660	552	1,263
	MONROE	8	0	0	0	0	4	8	11,768	9,030	6,177	26,975
	RICHLAND	4	0	0	1	0	0	3	96	2,100	1,457	3,653
	ROCK	16	1	3	1	0	0	15	4,810	12,630	9,594	27,034
	SAUK	26	1	1	2	0	2	19	0	11,220	6,710	17,930
	VERNON	9	0	0	0	0	7	9	0	6,180	3,666	9,846
Region Total		135	3	6	4	0	29	118	42,628	92,640	63,019	198,287
Region Average		10	--	--	--	--	--	--	3,279	7,126	4,848	15,253

Table A.3. Anti-icing Details

From Winter Storm Reports, 2009-2010

Region	County	Anti-Icing applic.	What weather prediction caused you to anti-ice? Or did you do anti-icing on a routine schedule?						Estimated Costs			
			Wet Snow	Dry Snow	Frz Rain	Sleet	Frost	Routine	$ Mat'l	$ Equip	$ Labor	$ Total
Statewide Total		539	54	42	45	27	184	325	95,185	284,085	213,531	592,801

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2009-2010

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
NC	ADAMS	0	37,560	0	0	0	0	0	0	0	0	0	0	0	0
	FLORENCE	0	19,800	0	0	0	0	0	0	0	0	0	0	0	0
	FOREST	30	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	0	4,000	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	0	120	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	0	4,200	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	0	16,300	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	0	45,530	0	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	0	40,500	0	0	0	0	0	0	0	0	0	0	0	0
	MENOMINEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	0	3,368	0	0	0	0	0	0	0	0	0	0	0	0
	PORTAGE	0	1,800	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	0	4,375	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	0	1,600	0	0	0	0	0	0	0	0	0	0	0	0
	VILAS	0	1,100	0	0	0	0	0	0	0	0	0	0	100	0
	WAUPACA	0	580	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	0	1,850	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	0	27,500	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		30	210,183	0	0	0	0	0	0	0	0	0	0	100	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2009-2010

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
NE	BROWN	0	3,272	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	0	5,500	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	0	26,676	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	0	0	0	0	0	0	0	0	2,430	0	0	0	0	0
	KEWAUNEE	0	195	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	0	2,000	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	0	14,375	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	0	4,625	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	0	21,000	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	0	11,650	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	0	35,300	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	124,593	0	0	0	0	0	0	2,430	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2009-2010

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
NW	ASHLAND	0	0	0	0	0	0	0	0	3,217	0	0	0	0	0
	BARRON	0	2,175	0	0	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	0	1,575	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	0	4,940	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	0	0	0	0	0	0	0	0	1,005	0	0	0	0	0
	CHIPPEWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	0	1,800	0	0	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	0	500	0	0	0	0	0	0	3,650	0	0	0	0	0
	DUNN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EAU CLAIRE	0	0	180	0	0	100	0	0	1,255	0	0	0	0	0
	JACKSON	0	24,800	0	0	1,830	0	0	0	0	0	0	0	0	0
	PEPIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	0	3,940	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RUSK	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAINT CROIX	0	140	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TAYLOR	0	2,855	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	0	10,600	2,200	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	0	3,000	0	0	1,015	0	0	0	0	0	0	0	0	0
Region Total		0	56,325	2,380	0	2,845	100	0	0	9,127	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2009-2010

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
SE	KENOSHA	0	0	0	0	0	0	0	0	576	0	0	0	0	0
	MILWAUKEE	0	12,650	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	0	1,450	0	0	0	0	0	0	0	0	0	0	0	0
	RACINE	0	5,550	747	0	0	0	0	0	0	0	0	0	0	0
	WALWORTH	0	300	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	0	1,750	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	600	10,350	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		600	32,050	747	0	0	0	0	0	576	0	0	0	0	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2009-2010

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
SW	COLUMBIA	0	77,780	0	0	0	1,000	0	0	0	0	0	0	0	0
	CRAWFORD	0	7,650	0	0	0	0	0	0	0	0	0	0	0	0
	DANE	0	3,895	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	0	0	0	0	0	0	0	0	1,250	0	0	0	0	0
	GRANT	0	1,150	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	0	4,340	0	1,350	0	0	0	0	0	0	0	0	160	0
	LA CROSSE	0	24,033	0	0	0	0	0	0	0	0	0	0	5,230	0
	LAFAYETTE	0	0	80	0	0	0	0	0	0	0	0	0	0	0
	MONROE	0	53,790	0	0	0	0	0	0	0	0	0	0	5,230	0
	RICHLAND	0	1,600	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	0	24,050	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	0	11,995	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	0	16,475	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	226,758	80	1,350	0	1,000	0	0	1,250	0	0	0	10,620	0

Table A.4. Annual Anti-icing Agent Usage

From Winter Storm Reports, 2009-2010

Region	County	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB_M50 (gal)	IB_M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo-Melt (gal)	Ice Stop (gal)
Grand Total		630	649,909	3,207	1,350	2,845	1,100	0	0	13,383	0	0	0	10,720	0

Table A-5. Actual Anti-icing Costs

Final billed costs from the WisDOT accounting system, October 2009 - April 2010
County charges to Activity Code #73 (Applying Liquid Anti-icing Agents)

REGION	GROUP	COUNTY	TOTAL
SOUTHWEST	B	COLUMBIA	$29,921
	C	CRAWFORD	$3,199
	A	DANE	$30,827
	B	DODGE	$6,200
	C	GRANT	$2,512
	D	GREEN	$0
	C	IOWA	$0
	B	JEFFERSON	$1,074
	C	JUNEAU	$0
	A	LACROSSE	$8,948
	C	LAFAYETTE	$1,165
	C	MONROE	$14,812
	D	RICHLAND	$2,907
	B	ROCK	$18,071
	B	SAUK	$15,050
	C	VERNON	$8,915
		TOTAL	**$143,601**
SOUTHEAST	A	KENOSHA	$8,674
	A	MILWAUKEE	$20,608
	A	OZAUKEE	$8,290
	A	RACINE	$13,987
	B	WALWORTH	$1,066
	B	WASHINGTON	$6,752
	A	WAUKESHA	$4,206
		TOTAL	**$63,583**
NORTHEAST	A	BROWN	$18,043
	C	CALUMET	$3,116
	C	DOOR	$7,473
	C	FOND DU LAC	$29,942
	C	KEWAUNEE	$0
	B	MANITOWOC	$5,493
	D	MARINETTE	$13,170
	C	OCONTO	$9,586
	B	OUTAGAMIE	$0
	B	SHEBOYGAN	$6,127
	A	WINNEBAGO	$9,013
		TOTAL	**$101,963**

Table A-5. Actual Anti-icing Costs

Final billed costs from the WisDOT accounting system, October 2009 - April 2010
County charges to Activity Code #73 (Applying Liquid Anti-icing Agents)

REGION	GROUP	COUNTY	TOTAL
NORTH CENTRAL	D	ADAMS	$7,201
	D	FLORENCE	$2,607
	D	FOREST	$0
	D	GREEN LAKE	$671
	D	IRON	$536
	D	LANGLADE	$2,420
	C	LINCOLN	$2,654
	A	MARATHON	$24,815
	B	MARQUETTE	$12,134
	D	MENOMINEE	$0
	B	ONEIDA	$2,584
	A	PORTAGE	$2,572
	D	PRICE	$4,486
	B	SHAWANO	$5,456
	C	VILAS	$0
	C	WAUPACA	$3,508
	B	WAUSHARA	$9,643
	C	WOOD	$3,421
		TOTAL	**$84,708**
NORTHWEST	D	ASHLAND	$7,900
	D	BARRON	$0
	D	BAYFIELD	$3,040
	D	BUFFALO	$4,019
	D	BURNETT	$4,657
	B	CHIPPEWA	$0
	C	CLARK	$2,017
	C	DOUGLAS	$31,868
	B	DUNN	$304
	A	EAU CLAIRE	$9,907
	C	JACKSON	$22,911
	D	PEPIN	$0
	D	PIERCE	$4,885
	D	POLK	$0
	D	RUSK	$0
	D	SAWYER	$0
	B	ST. CROIX	$0
	D	TAYLOR	$4,951
	C	TREMPEALEAU	$23,563
	C	WASHBURN	$9,208
		TOTAL	**$129,230**
		STATE TOTAL	**$523,085**
		61/72 COUNTIES (85%)	

Table A-6. Salt Brine Use

From Winter Storm Reports, 2009-2010

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
SOUTHWEST	B	COLUMBIA	13,861	77,780	91,641
	C	CRAWFORD	15,190	7,650	22,840
	A	DANE	136,254	3,895	140,149
	B	DODGE	150	0	150
	C	GRANT	0	1,150	1,150
	D	GREEN	10,567	0	10,567
	C	IOWA	0	0	0
	B	JEFFERSON	8,945	0	8,945
	C	JUNEAU	1,534	4,340	5,874
	A	LA CROSSE	14,261	24,033	38,294
	C	LAFAYETTE	0	0	0
	C	MONROE	1,025	53,790	54,815
	D	RICHLAND	0	1,600	1,600
	B	ROCK	24,685	24,050	48,735
	B	SAUK	0	11,995	11,995
	C	VERNON	250	16,475	16,725
		TOTAL	**226,722**	**226,758**	**453,480**
SOUTHEAST	A	KENOSHA	0	0	0
	A	MILWAUKEE	9,500	12,650	22,150
	A	OZAUKEE	17,789	1,450	19,239
	A	RACINE	5,499	5,550	11,049
	B	WALWORTH	11,669	300	11,969
	B	WASHINGTON	45,480	1,750	47,230
	A	WAUKESHA	51,932	10,350	62,282
		TOTAL	**141,869**	**32,050**	**173,919**
NORTHEAST	A	BROWN	31,133	3,272	34,405
	C	CALUMET	7,348	5,500	12,848
	C	DOOR	15,099	26,676	41,775
	C	FOND DU LAC	0	0	0
	C	KEWAUNEE	4,285	195	4,480
	B	MANITOWOC	36,466	2,000	38,466
	D	MARINETTE	7,980	14,375	22,355
	C	OCONTO	15,933	4,625	20,558
	B	OUTAGAMIE	53,256	21,000	74,256
	B	SHEBOYGAN	36,980	11,650	48,630
	A	WINNEBAGO	108,623	35,300	143,923
		TOTAL	**317,103**	**124,593**	**441,696**

Table A-6. Salt Brine Use

From Winter Storm Reports, 2009-2010

REGION	GROUP	COUNTY	PREWETTING (GALLONS)	ANTI-ICING (GALLONS)	TOTAL (GALLONS)
NORTH CENTRAL	D	ADAMS	0	37,560	37,560
	D	FLORENCE	9,575	19,800	29,375
	D	FOREST	0	0	0
	D	GREEN LAKE	3,610	4,000	7,610
	D	IRON	14,645	120	14,765
	D	LANGLADE	15,205	4,200	19,405
	C	LINCOLN	35,357	16,300	51,657
	A	MARATHON	18,175	45,530	63,705
	B	MARQUETTE	0	40,500	40,500
	D	MENOMINEE	560	0	560
	B	ONEIDA	21,754	3,368	25,122
	A	PORTAGE	20,575	1,800	22,375
	D	PRICE	8,650	4,375	13,025
	B	SHAWANO	26,479	1,600	28,079
	C	VILAS	11,055	1,100	12,155
	C	WAUPACA	8,275	580	8,855
	B	WAUSHARA	1,057	1,850	2,907
	C	WOOD	6,300	27,500	33,800
		TOTAL	**201,272**	**210,183**	**411,455**
NORTHWEST	D	ASHLAND	0	0	0
	D	BARRON	2,170	2,175	4,345
	D	BAYFIELD	845	1,575	2,420
	D	BUFFALO	5,449	4,940	10,389
	D	BURNETT	0	0	0
	B	CHIPPEWA	0	0	0
	C	CLARK	3,170	1,800	4,970
	C	DOUGLAS	0	500	500
	B	DUNN	0	0	0
	A	EAU CLAIRE	0	0	0
	C	JACKSON	0	24,800	24,800
	D	PEPIN	0	0	0
	D	PIERCE	4,930	3,940	8,870
	D	POLK	2,880	0	2,880
	D	RUSK	0	0	0
	D	SAWYER	0	140	140
	B	ST. CROIX	0	0	0
	D	TAYLOR	23,665	2,855	26,520
	C	TREMPEALEAU	2,825	10,600	13,425
	C	WASHBURN	790	3,000	3,790
		TOTAL	**46,724**	**56,325**	**103,049**
		STATE TOTAL	**933,690**	**649,909**	**1,583,599**
		# OF COUNTIES	66	62	70
PREVIOUS USE		2008-2009	1,028,457	467,943	1,496,400
		2007-2008	965,797	305,409	1,271,206
		2006-2007	530,733	456,875	987,608
		2005-2006	570,203	394,991	965,194
		2004-2005	398,661	246,813	695,474
		2003-2004	285,710	241,780	527,490
		2002-2003	174,413	228,524	402,937
		2001-2002	144,505	194,349	338,854
		2000-2001	111,816	48,149	159,965

Table A-7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2009-2010

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NC	ADAMS	2,465	0	0	0	0	0	0	0	1,590	0	0	0	0	0	0	0
	FLORENCE	1,862	0	0	9,575	0	0	0	0	0	0	350	0	0	0	0	0
	FOREST	4,351	0	5,065	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	758	0	290	3,610	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	3,892	0	0	14,645	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	2,451	0	0	15,205	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	3,439	0	0	35,357	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	7,329	0	0	18,175	879	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	3,420	0	0	0	0	0	0	0	0	0	1,975	0	0	0	0	0
	MENOMINEE	1,251	0	0	560	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	3,726	0	0	21,754	0	0	0	0	0	0	0	0	0	0	83	0
	PORTAGE	5,278	0	0	20,030	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	3,103	0	0	8,650	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	5,454	0	0	26,479	0	0	0	0	0	0	0	0	0	0	0	0
	VILAS	3,712	0	0	11,055	0	0	0	0	0	0	0	0	0	0	586	0
	WAUPACA	5,388	0	0	8,275	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	2,393	0	1,296	1,057	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	3,357	0	0	6,260	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		63,629	0	6,651	200,687	879	0	0	0	1,590	0	2,325	0	0	0	669	0

Table A-7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2009-2010

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NE	BROWN	9,577	0	0	31,133	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	1,225	0	0	7,348	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	3,073	0	0	15,099	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	6,251	0	0	0	0	0	0	0	0	0	10,577	0	0	0	0	0
	KEWAUNEE	995	0	980	4,285	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	6,089	0	0	36,466	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	3,495	0	0	7,980	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	4,403	0	0	15,933	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	6,298	0	0	53,256	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	6,970	0	0	36,980	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	6,952	0	0	108,623	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		55,328	0	980	317,103	0	0	0	0	0	0	10,577	0	0	0	0	0

Table A-7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2009-2010

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NW	ASHLAND	2,417	0	0	0	0	0	0	0	0	0	12,974	0	0	0	0	0
	BARRON	1,596	0	0	2,095	0	0	208	0	0	225	0	0	0	0	0	0
	BAYFIELD	3,170	0	0	845	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	1,768	0	0	5,399	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	1,708	0	0	0	0	0	0	0	0	0	11,750	0	0	0	0	0
	CHIPPEWA	7,176	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	3,187	0	0	3,170	0	0	0	0	770	0	0	0	0	0	0	0
	DOUGLAS	3,591	0	0	0	0	0	0	0	0	0	6,952	0	0	0	0	0
	DUNN	5,182	0	385	0	0	0	0	0	0	0	0	0	0	0	2,635	0
	EAU CLAIRE	5,382	0	0	0	0	0	0	0	8,560	0	230	0	0	0	0	0
	JACKSON	5,763	0	0	0	100	0	8,320	0	0	0	0	0	0	0	0	0
	PEPIN	730	0	0	0	0	0	0	0	2,112	0	0	0	0	0	0	0
	PIERCE	3,238	0	260	4,930	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	3,840	0	0	2,805	0	0	0	0	0	0	7,218	0	0	0	0	0
	RUSK	1,740	0	0	0	0	0	0	0	0	0	605	0	0	0	0	0
	SAINT CROIX	6,051	0	19,127	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	2,292	0	0	0	0	0	0	0	0	0	2,331	0	0	0	0	0
	TAYLOR	2,071	0	110	23,665	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	4,288	0	0	2,825	4,575	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	2,454	0	0	790	0	0	2,562	0	0	0	0	0	0	0	0	0
Region Total		67,644	0	19,882	46,524	4,675	0	11,090	0	11,442	225	42,060	0	0	0	2,635	0

Table A-7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2009-2010

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SE	KENOSHA	6,770	0	0	0	0	0	0	0	0	0	1,910	0	0	0	0	0
	MILWAUKEE	25,769	3	24,957	9,500	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	5,282	0	2,693	17,789	0	0	0	0	0	0	0	0	0	0	0	0
	RACINE	8,517	0	570	5,499	0	0	0	0	0	0	0	0	0	0	0	0
	WALWORTH	11,354	0	0	11,669	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	8,034	0	0	45,480	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	17,426	0	3,843	51,932	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		83,152	3	32,063	141,869	0	0	0	0	0	0	1,910	0	0	0	0	0

Table A-7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2009-2010

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SW	COLUMBIA	13,808	0	0	13,861	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	3,082	0	0	14,440	0	0	0	0	0	0	0	0	0	0	510	0
	DANE	36,131	0	0	136,254	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	9,823	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0
	GRANT	7,175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	2,751	0	0	10,567	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	5,946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	9,095	0	2,075	8,945	8	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	7,765	0	0	1,534	0	0	0	0	0	0	0	0	0	20	436	0
	LA CROSSE	7,324	0	0	14,261	0	0	0	0	0	0	0	0	0	0	12,140	0
	LAFAYETTE	2,074	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	5,996	0	0	1,025	0	0	0	0	0	0	0	0	0	0	0	0
	RICHLAND	3,155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	10,397	0	0	24,685	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	9,006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	5,242	0	0	250	0	0	0	0	0	0	2,995	0	0	0	0	0
Region Total		138,770	0	2,075	225,972	8	0	0	0	0	0	2,995	0	0	20	13,086	0

Table A-7. Annual Prewetting Agent Usage for Salt

From Winter Storm Reports, 2009-2010

Region	County	Salt (ton)	CaCl2 (ton)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
Statewide Total		408,523	3	61,651	932,154	5,562	0	11,090	0	13,032	225	59,867	0	0	20	16,390	0

Table A-8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2009-2010

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NC	ADAMS	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FLORENCE	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FOREST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN LAKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IRON	252	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LANGLADE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LINCOLN	432	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MARATHON	141	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MARQUETTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MENOMINEE	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ONEIDA	232	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PORTAGE	179	0	545	0	0	0	0	0	0	0	0	0	0	0	0
	PRICE	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SHAWANO	188	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VILAS	809	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WAUPACA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WAUSHARA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WOOD	58	0	40	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		2,529	0	585	0	0	0	0	0	0	0	0	0	0	0	0

Table A-8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2009-2010

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NE	BROWN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CALUMET	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DOOR	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FOND DU LAC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	KEWAUNEE	178	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MANITOWOC	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MARINETTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	OCONTO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	OUTAGAMIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SHEBOYGAN	2,216	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WINNEBAGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		2,496	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2009-2010

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
NW	ASHLAND	165	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BARRON	418	0	75	0	0	0	0	0	0	0	0	0	0	0	0
	BAYFIELD	149	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BUFFALO	127	0	50	0	0	0	0	0	0	0	0	0	0	0	0
	BURNETT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CHIPPEWA	1,207	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CLARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DOUGLAS	120	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DUNN	353	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EAU CLAIRE	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JACKSON	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PEPIN	172	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PIERCE	465	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	POLK	353	0	75	0	0	0	0	0	0	0	0	0	0	0	0
	RUSK	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAINT CROIX	339	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAWYER	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TAYLOR	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TREMPEALEAU	209	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASHBURN	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		4,626	0	200	0	0	0	0	0	0	0	0	0	0	0	0

Table A-8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2009-2010

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SE	KENOSHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MILWAUKEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	OZAUKEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RACINE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WALWORTH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	WAUKESHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2009-2010

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
SW	COLUMBIA	571	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CRAWFORD	1,596	0	750	0	0	0	0	0	0	0	0	0	0	100	0
	DANE	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DODGE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GRANT	1,563	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN	256	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IOWA	197	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JEFFERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JUNEAU	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LA CROSSE	748	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	LAFAYETTE	1,595	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MONROE	201	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RICHLAND	388	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ROCK	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SAUK	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VERNON	1,771	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Region Total		9,429	0	750	0	0	0	0	0	0	0	0	0	0	100	0

Table A-8. Annual Abrasives and Prewetting Agent Usage for Abrasives

From Winter Storm Reports, 2009-2010

Region	County	Sand (CY)	CaCl2 (gal)	NaCl Brine (gal)	MgCl2 (gal)	IB-M50 (gal)	IB-M80 (gal)	Freeze Guard (gal)	CaCl2 DOW (gal)	MC90 (gal)	MC95 (gal)	Caliber M1000 (gal)	Caliber M2000 (gal)	Clear Lane (gal)	Geo Melt (gal)	Ice Stop (gal)
Statewide Total		19,081	0	1,535	0	0	0	0	0	0	0	0	0	0	100	0

Table A-9. History of Salt Use on State Trunk Highways

From Salt Inventory Reporting System

Winter	Tons of Salt	Lane Miles	Tons/Lane Mile	Million Vehicle Miles Traveled STH System (Winter)
1959/60	93,673	19,521	4.8	8,828
1960/61	54,805	19,948	2.7	9,254
1961/62	109,412	19,966	5.5	9,558
1962/63	77,719	19,756	3.9	9,782
1963/64	82,033	19,717	4.2	10,064
1964/65	149,329	19,911	7.5	10,566
1965/66	111,634	19,505	5.7	11,122
1966/67	181,230	20,137	8.0	11,933
1967/68	137,729	22,395	6.2	12,140
1968/69	193,004	22,675	8.5	12,870
1969/70	199,353	22,831	8.7	13,853
1970/71	273,010	23,120	11.8	15,133
1971/72	223,249	25,543	8.7	14,325
1972/73	256,571	25,673	10.0	15,301
1973/74	218,189	N/A	N/A	16,198
1974/75	237,916	N/A	N/A	15,807
1975/76	257,154	N/A	N/A	16,198
1976/77	188,011	N/A	N/A	18,556
1977/78	210,054	N/A	N/A	19,621
1978/79	235,193	N/A	N/A	21,053
1979/80	220,180	N/A	N/A	20,403
1980/81	151,021	N/A	N/A	19,360
1981/82	192,740	N/A	N/A	20,210
1982/83	234,529	27,407	8.6	20,056
1983/84	224,368	27,416	8.2	20,873
1984/85	217,136	27,598	7.9	21,214
1985/86	304,296	27,632	11.0	22,110
1986/87	196,035	27,613	7.1	23,176
1987/88	224,573	27,743	8.1	24,346
1988/89	230,403	27,872	8.3	24,550
1989/90	297,004	28,024	10.6	25,370
1990/91	364,174	28,006	13.0	26,247
1991/92	337,079*	28,104	12.0*	27,391
1992/93	416,594*	28,182	14.8*	28,252
1993/94	314,489*	28,221	11.1*	28,859
1994/95	295,479*	28,312	10.4*	29,210
1995/96	440,488*	28,374	15.5	30,077
1996/97	509,147*	28,545	17.8*	31,122
1997/98	413,824*	29,619	14.0*	32,083
1998/99	371,602	30,119	12.4	33,236
1999/00	346,963*	30,340	11.4*	33,825
2000/01	521,056	30,553	17.1	34,657
2001/02	308,954	30,909	10.0	34,076
2002/03	328,922	30,975	10.6	35,088
2003/04	390,664	31,429	12.4	35,662
2004/05	407,924	31,810	12.8	36,013
2005/06	410,570	33,022	12.4	35,642
2006/07	405,793	33,221	12.2	27,911
2007/08	644,484	33,297	19.4	27,931
2008/09	569,985	33,531	17.0	26,888
2009/10	408,523	33,532	12.2	26,109

* Quantities adjusted