ANNUAL WINTER MAINTENANCE REPORT 2023/2024

Mild Winter + Better Salt Management = Least Amount of Salt Used in 35 Years

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

JANUARY 2025

Acknowledgments

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

- Rebecca Szymkowski, Bureau of Highway Maintenance
- Cody Churchill, Bureau of Highway Maintenance
- Mike Adams, Bureau of Highway Maintenance
- Emil Juni, Bureau of Highway Maintenance
- Donald Lyden, Bureau of Transportation Safety

A great deal of effort went into preparing this report. The group wishes to thank our county partners in their ongoing efforts to make Wisconsin's winter maintenance as safe and efficient as possible. The individuals above would like to thank you for taking the time to review this report. If you have additional questions or require additional information, please contact Cody Churchill at the Bureau of Highway Maintenance (BHM), cody.churchill@dot.wi.gov.

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Glossary

AVL - GPS: Automated Vehicle Location - Global Positioning System

BHM: Bureau of Highway Maintenance

BMP: Best Management Practice

BTO: Bureau of Traffic Operations

DLA: Direct Liquid Application

FHWA: Federal Highway Administration

GUI: Graphical User Interface

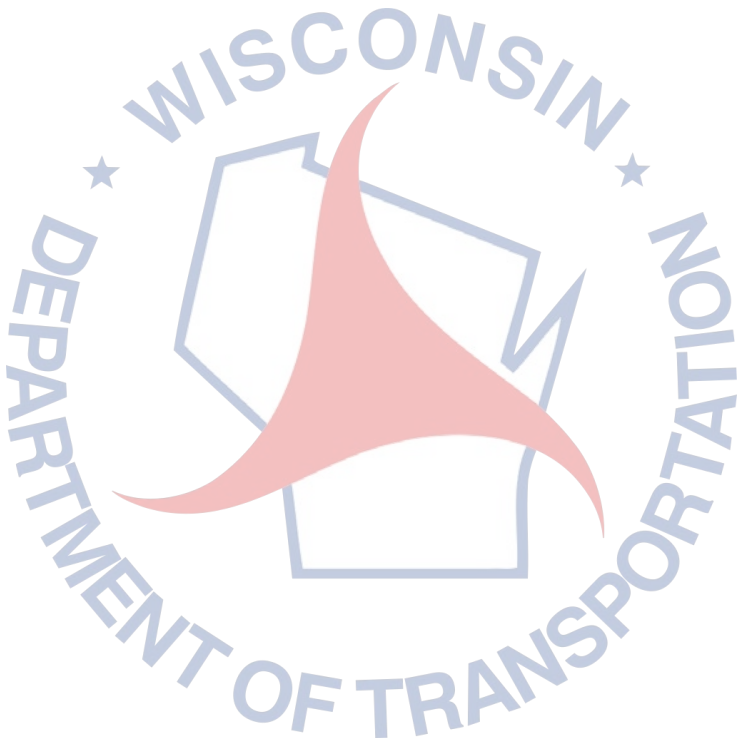
MDSS: Maintenance Decision Support System

NWS: National Weather Service

RWIS: Roadway Weather Information System

TMC: Traffic Management Center

WISDOT: State of Wisconsin Department of Transportation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1 Summary

Table 1.1. Statewide Summary: This Winter Versus Last Winter, by the Numbers

		2022-2023 Winter	2023-2024 Winter
Infrastructure	Lane miles	**34,723**	**34,736**
	Patrol sections[4]	**754**	**754**
	Average patrol section length[4]	**46.1**	**46.1**
Weather	Average statewide Winter Severity Index (100=normal)	**116.2**	**58.7**
	Number of storms, statewide average and range across counties	**Average: 38 Range: 14-69**	**Average: 21 Range: 7-46**
	Snowfall (in), statewide average and range across counties	**Average: 100.6 Range: 39.9 - 281.2**	**Average: 46.0 Range: 19.4 – 93.1**
Materials[1]	Salt used	**483,874 tons 13.9 tons per lane mile**	**255,155 tons 7.3 tons per lane mile**
	Average cost of salt	**$83.31 per ton**	**$91.21 per ton**
	Total liquids used (prewet, anti-icing, direct liquid application)	**20,153,562 gal.**	**14,788,855 gal.**
	Sand used	**10,849 cubic yd.**	**5,225 cubic yd.**
Costs, Equipment and Performance	Total winter costs[2]	**$118,759,205**	**$72,256,176**
	Total winter costs per lane mile	**$3,420**	**$2,080**
	Average crew reaction time from start of storm	**2.56 hours**	**2.65 hours**
	Percentage of roads to bare/wet pavement (Within WisDOT target times)	**73%**	**75%**
	Road Weather Information System (RWIS) stations	**75**	**75**
	Counties that used anti-icing agents during the winter season	**66 out of 72 (92%)**	**69 out of 72 (96%)**
Labor and Services	Regular county winter labor hours[3]	**184,644 hrs.**	**92,491 hrs.**
	Overtime county winter labor hours	**154,418 hrs.**	**84,607 hrs.**

1. All material usage quantities are from the county storm reports except for salt. Salt quantities are from WisDOT's Salt Inventory Reporting System.
2. Costs refer to final costs billed to WisDOT for all winter activities, including activities such as installing snow fences and thawing culverts.
3. Labor hours come from county storm reports, and reflect salting, sanding, plowing and anti-icing efforts.
4. Patrol sections and average length include hybrid sections in some counties which may include a portion of county highway.

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: Winter Operations
- Section 4: Performance
- Section 5: Looking Ahead

Each section has several subsections; refer to the Table of Contents for more detail. To improve readability, the 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 , D, E and F), which reflect the difference in the level of service provided on roads in these counties and facilitate comparisons within these groups. See Table 1.3 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.
- Maintenance Decision Support System (MDSS)

The final billed amounts are considered the most accurate source of cost and materials data, and are presented wherever possible.

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 34,736 lane miles of highway and ~4,600 bridges.

WisDOT contracts with the state's 72 county highway departments to provide snow and ice control on all state- and U.S.-owned highways in Wisconsin, including the Interstate system. This partnership was set up more than 100 years ago and 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 and facilities. This arrangement also allows for increased efficiencies in work crews, thus reducing labor costs to taxpayers.

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.

Snow Removal Strategy

WisDOT policy in the "Highway Maintenance Manual" specifies two types of snow removal strategies in an effort to be cost-effective while recognizing the public need for clear roads during hours when most travel is done. High-volume highways with the most traffic typically receive 24-hour coverage, while on lower-volume highways, 18-hour coverage is sufficient. On 18-hour routes, the service hours can be adjusted based on the timing or severity of the storms; passing lanes, if present, may require less attention than the driving lanes and ramps.

Table 1.2 shows these categories and what percent of the highways fall into each group.

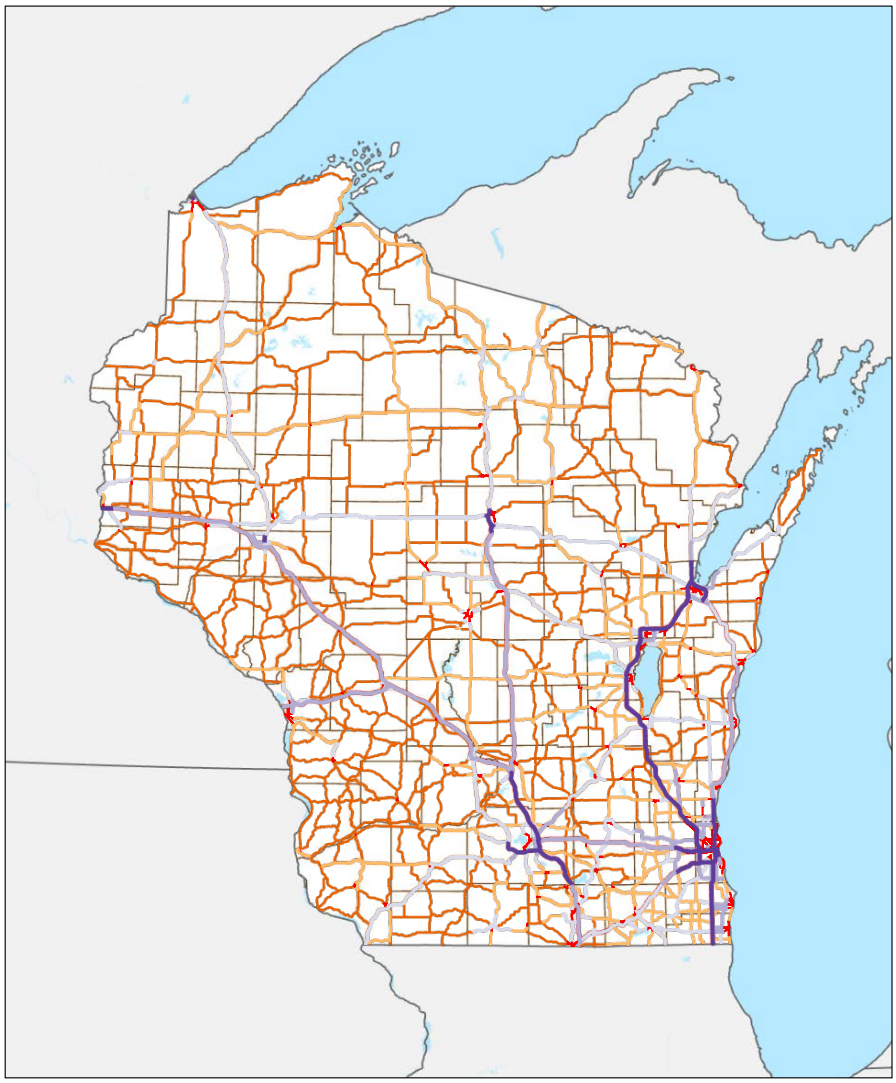
To fairly compare counties with similar levels of service, WisDOT assigns the 72 counties into six winter service groups – A, B, C, D, E, and F with winter service group A being the most urban and complex counties and F the most rural. Table 1.3 shows which counties are assigned to each group. These are the original assignments from when this method for comparison was developed over 20 years ago. Today's definition of the group might not fit all the counties assigned to that group, but for now the counties are still assigned to the Winter Service Group in this table. Be sure to look at Chapter 4B if you are interested in a county by county comparison of plow routes in this table and winter patrol sections – a plow route is the same as a winter patrol section.

Table 1.2. Lane Miles Per Category

Category	Definition	Lane miles	% of total
1	Major urban freeways and highways with six lanes and greater	4,003	12%
2	High volume four-lane highways (Average Daily Traffic ≥ 25,000)	3,115	9%
3	All other four-lane highways (ADT < 25,000)	8,158	23%
4	High volume two-lane highways (ADT ≥ 5,000)	3,843	11%
5	All other two-lane highways (ADT < 5,000)	15,617	45%
Total		*34,736*	

Figure 1.1. WisDOT Snow Plowing and Ice Control Categories During A Storm

For greater detail, please visit the website online at:
https://wisdot.maps.arcgis.com/apps/instant/portfolio/index.html?appid=21c938167cff47698b6a9c47faf1f114



12/12/2024

1:2,027,520

0 20 40 80 mi
0 37.5 75 150 km

Local Maintenance Responsibility

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.

Category 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.

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.

Category 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.

Category 5: All other two-lane highways
The driving lane will be maintained primarily by plowing with minimal salting.

**ADT = Average Daily Traffic*

Table 1.3. County Winter Service Groups

Winter Service Group	County Names	Number of Counties	% of Counties
A	Dane, Milwaukee,Waukesha	3	4%
B	Brown, Chippewa, Columbia, Dodge, Eau Claire, Fond du Lac, Grant, Jefferson, Kenosha, Marathon, Monroe, Outagamie, Portage, Racine, Rock, Sauk, St. Croix, Walworth, Washington, Waupaca, Winnebago	21	29%
C	Barron, Clark, Crawford, Douglas, Dunn, Iowa, Jackson, Juneau, La Crosse, Lincoln, Manitowoc, Oconto, Pierce, Shawano, Sheboygan, Vernon, Wood	17	24%
D	Bayfield, Buffalo, Door, Green, Lafayette, Marinette, Marquette, Oneida, Ozaukee, Polk, Richland, Trempealeau, Washburn, Waushara	14	19%
E	Ashland, Burnett, Calumet, Forest, Green Lake, Iron, Langlade, Pepin, Price, Rusk, Sawyer, Taylor, Vilas	13	18%
F	Adams, Florence, Kewaunee, Menominee	4	6%

THIS WINTER IN WISCONSIN

Table 1.4 on the following pages 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 of the Appendix), but the cost data in Table 1.4 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

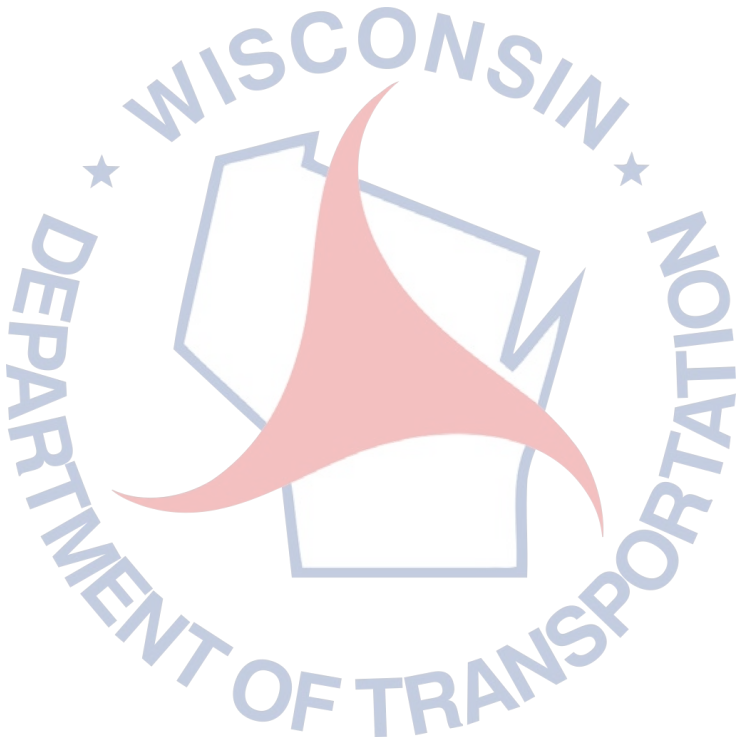

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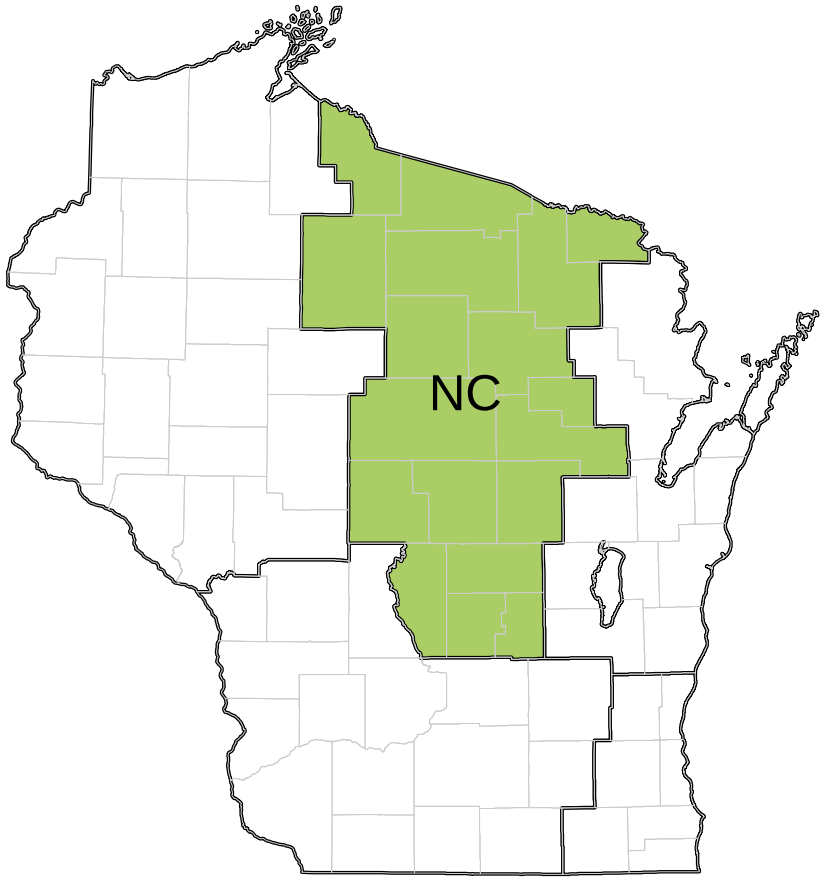
Table 1.4. Winter in Wisconsin, 2023-2024

County	Lane miles	MDSS 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	202.74	58.9	45.6	2,054	10.13	0.17	$ 223,578	$1,103	$ 407,068	$ 2,008	$ 34.09
Florence	137.43	59.8	52.6	1,121	8.16	0.14	$ 110,127	$801	$ 252,249	$ 1,835	$ 30.69
Forest	314.49	66.3	67.6	1,682	5.35	0.08	$ 162,969	$518	$ 464,120	$ 1,476	$ 22.26
Green Lake	154.11	56.4	47.3	373	2.42	0.04	$ 38,460	$250	$ 173,733	$ 1,127	$ 19.99
Iron	240.51	113.8	93.1	2,085	8.67	0.08	$ 225,097	$936	$ 619,807	$ 2,577	$ 22.65
Langlade	300.29	66.2	59.1	881	2.93	0.04	$ 86,937	$290	$ 410,178	$ 1,366	$ 20.63
Lincoln	399.39	66.1	47.7	2,333	5.84	0.09	$ 240,392	$602	$ 595,972	$ 1,492	$ 22.57
Marathon	905.42	65.9	40.3	7,072	7.81	0.12	$ 710,029	$784	$ 1,772,460	$ 1,958	$ 29.71
Marquette	246.61	59.6	49.5	1,050	4.26	0.07	$ 106,302	$431	$ 410,873	$ 1,666	$ 27.95
Menominee	90.66	59.5	48.2	691	7.62	0.13	$ 66,115	$729	$ 132,125	$ 1,457	$ 24.49
Oneida	395.39	66.9	55.4	1,769	4.47	0.07	$ 176,069	$445	$ 866,515	$ 2,192	$ 32.76
Portage	531.62	69.0	47.8	2,195	4.13	0.06	$ 205,013	$386	$ 988,653	$ 1,860	$ 26.95
Price	319.53	63.6	35.0	1,713	5.36	0.08	$ 177,364	$555	$ 526,980	$ 1,649	$ 25.93
Shawano	530.27	65.0	70.5	3,767	7.10	0.11	$ 321,250	$606	$ 1,034,169	$ 1,950	$ 30.00
Vilas	307.73	79.7	71.6	2,690	8.74	0.11	$ 293,291	$953	$ 787,657	$ 2,560	$ 32.12
Waupaca	556.87	60.4	48.7	4,307	7.73	0.13	$ 366,353	$658	$ 1,045,547	$ 1,878	$ 31.09
Waushara	343.69	63.5	52.8	1,404	4.09	0.06	$ 146,788	$427	$ 468,642	$ 1,364	$ 21.47
Wood	443.36	51.7	42.0	2,084	4.70	0.09	$ 207,858	$469	$ 659,422	$ 1,487	$ 28.77
Region total	**6,420.11**			**39,271**			**$ 3,863,991**		**$ 11,616,170**		
Region average	**356.67**	**66.2**	**54.2**	**2,182**	**6.12**	**0.09**	**$ 214,666**	**$602**	**$ 645,343**	**$ 1,809**	**$ 27.32**

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



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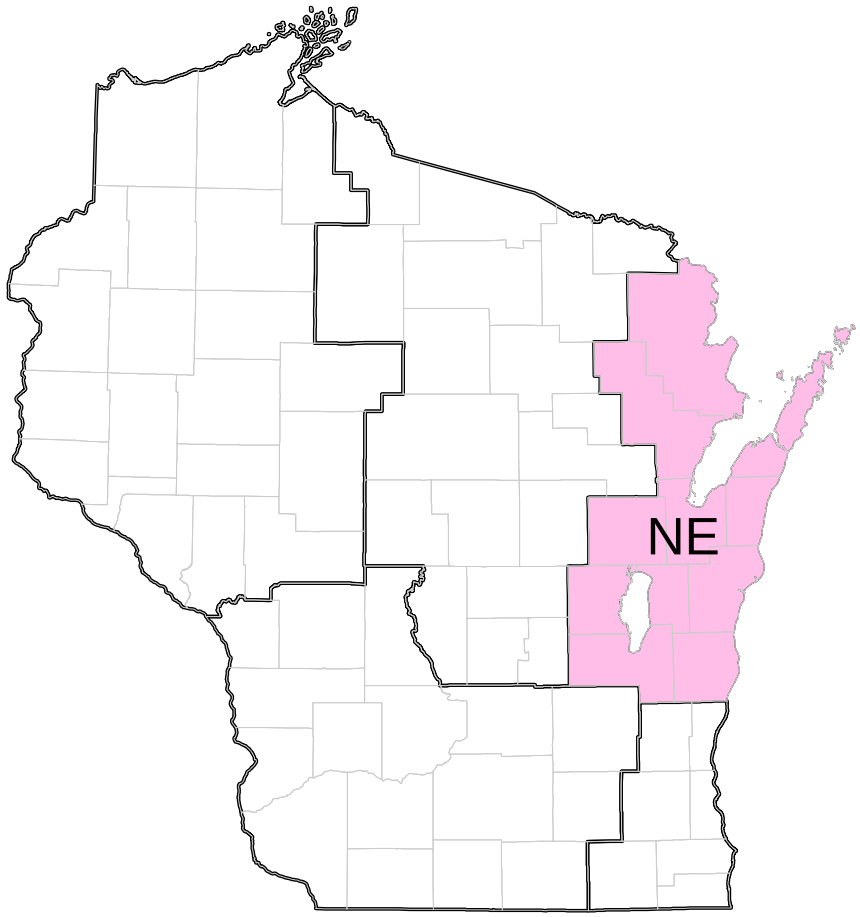
County	Lane miles	MDSS Severity Index	Snowfall (inches)	Total salt used (tons)	Salt used (tons) per lane mile	Salt used per lane mile per Severity Index	Total salt costs	Total salt costs per lane mile	Total winter costs	Total winter costs per lane mile	Total winter costs per lane mile per Severity Index
Northeast Region											
Brown	860.16	62.6	64.6	8,929	10.38	0.17	$ 644,677	$749	$ 2,261,437	$ 2,629	$ 42.00
Calumet	219.46	59.3	53.1	1,292	5.89	0.10	$ 114,967	$524	$ 521,176	$ 2,375	$ 40.05
Door	267.29	60.1	56.0	1,128	4.22	0.07	$ 102,574	$384	$ 473,769	$ 1,772	$ 29.49
Fond du Lac	611.86	61.9	47.0	3,148	5.14	0.08	$ 274,909	$449	$ 1,071,124	$ 1,751	$ 28.28
Kewaunee	126.39	61.9	60.1	789	6.25	0.10	$ 72,096	$570	$ 237,560	$ 1,880	$ 30.36
Manitowoc	419.96	56.0	30.8	3,788	9.02	0.16	$ 316,541	$754	$ 991,028	$ 2,360	$ 42.14
Marinette	414.39	58.4	63.7	2,817	6.80	0.12	$ 217,421	$525	$ 679,197	$ 1,639	$ 28.07
Oconto	481.73	62.6	49.2	3,389	7.04	0.11	$ 268,108	$557	$ 833,684	$ 1,731	$ 27.65
Outagamie	567.52	58.9	47.5	6,467	11.40	0.19	$ 519,635	$916	$ 1,621,036	$ 2,856	$ 48.49
Sheboygan	543.53	52.2	54.4	3,101	5.71	0.11	$ 296,580	$546	$ 1,446,369	$ 2,661	$ 50.98
Winnebago	688.27	59.6	45.8	4,997	7.26	0.12	$ 418,347	$608	$ 1,509,004	$ 2,192	$ 36.79
Region total	**5,200.56**			**39,847**			**$ 3,245,854**		**$ 11,645,384**		
Region average	**472.78**	**59.4**	**52.0**	**3,622**	**7.66**	**0.13**	**$ 295,078**	**$624**	**$ 1,058,671**	**$ 2,239**	**$ 37.69**

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



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Northwest Region											
Ashland	255.69	82.2	65.4	2,096	8.20	0.10	$ 213,247	$834	$ 601,709	$ 2,353	$ 28.63
Barron	428.61	49.8	34.1	3,046	7.11	0.14	$ 275,602	$643	$ 895,471	$ 2,089	$ 41.95
Bayfield	345.31	71.2	61.7	2,220	6.43	0.09	$ 200,089	$579	$ 699,199	$ 2,025	$ 28.44
Buffalo	311.87	50.7	35.2	982	3.15	0.06	$ 95,500	$306	$ 271,791	$ 871	$ 17.19
Burnett	235.35	46.1	34.1	1,365	5.80	0.13	$ 130,863	$556	$ 318,611	$ 1,354	$ 29.37
Chippewa	653.17	48.6	32.6	1,818	2.78	0.06	$ 181,382	$278	$ 890,580	$ 1,363	$ 28.06
Clark	401.81	59.5	29.6	2,961	7.37	0.12	$ 334,919	$834	$ 715,091	$ 1,780	$ 29.91
Douglas	465.66	69.9	57.1	4,416	9.48	0.14	$ 357,254	$767	$ 1,006,990	$ 2,163	$ 30.94
Dunn	521.20	46.7	37.8	4,313	8.28	0.18	$ 415,601	$797	$ 1,000,882	$ 1,920	$ 41.12
Eau Claire	531.32	51.4	28.1	2,664	5.01	0.10	$ 275,884	$519	$ 894,706	$ 1,684	$ 32.76
Jackson	520.32	57.2	39.7	5,139	9.88	0.17	$ 515,339	$990	$ 1,015,044	$ 1,951	$ 34.11
Pepin	109.41	43.9	28.9	375	3.43	0.08	$ 37,526	$343	$ 176,830	$ 1,616	$ 36.82
Pierce	368.08	44.7	26.6	2,207	6.00	0.13	$ 208,208	$566	$ 539,193	$ 1,465	$ 32.77
Polk	374.54	47.1	43.0	1,881	5.02	0.11	$ 171,472	$458	$ 467,863	$ 1,249	$ 26.52
Rusk	213.10	50.5	39.2	1,083	5.08	0.10	$ 109,502	$514	$ 233,829	$ 1,097	$ 21.73
Saint Croix	653.47	45.4	19.4	3,299	5.05	0.11	$ 299,120	$458	$ 1,228,834	$ 1,880	$ 41.42
Sawyer	357.20	61.4	32.7	1,616	4.52	0.07	$ 151,920	$425	$ 373,122	$ 1,045	$ 17.01
Taylor	232.44	61.2	36.1	946	4.07	0.07	$ 108,137	$465	$ 394,945	$ 1,699	$ 27.76
Trempeleau	420.25	51.1	35.1	4,848	11.54	0.23	$ 475,007	$1,130	$ 973,974	$ 2,318	$ 45.35
Washburn	385.68	54.8	28.4	2,150	5.57	0.10	$ 195,844	$508	$ 525,814	$ 1,363	$ 24.88
Region total	**7,784.48**			**49,425**			**$ 4,752,415**		**$ 13,224,480**		
Region average	**389.22**	**54.7**	**37.2**	**2,471**	**6.19**	**0.11**	**$ 237,621**	**$610**	**$ 661,224**	**$ 1,699**	**$ 31.07**

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

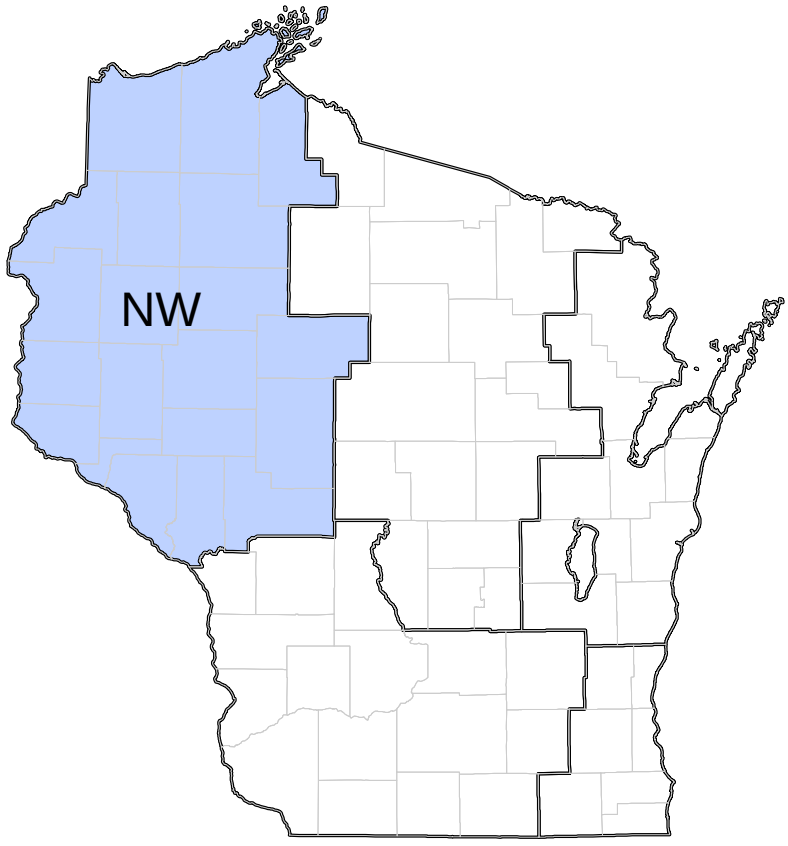


Table 1.4. Winter in Wisconsin, 2023-2024

County	Lane miles	MDSS 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
Southeast Region											
Kenosha	674.40	49.8	33.9	2,624	3.89	0.08	$ 210,047	$311	$ 1,093,510	$ 1,621	$ 32.56
Milwaukee	1,574.67	49.6	60.1	21,776	13.83	0.28	$ 1,659,134	$1,054	$ 6,392,115	$ 4,059	$ 81.84
Ozaukee	321.10	52.1	37.1	2,194	6.83	0.13	$ 167,617	$522	$ 744,084	$ 2,317	$ 44.48
Racine	774.85	51.8	39.0	5,497	7.09	0.14	$ 461,892	$596	$ 1,367,495	$ 1,765	$ 34.07
Walworth	697.33	58.9	51.8	5,594	8.02	0.14	$ 442,975	$635	$ 1,427,672	$ 2,047	$ 34.76
Washington	591.04	64.2	28.4	5,974	10.11	0.16	$ 520,219	$880	$ 1,549,186	$ 2,621	$ 40.83
Waukesha	1,059.84	70.5	45.7	9,787	9.23	0.13	$ 760,954	$718	$ 2,463,163	$ 2,324	$ 32.97
Region total	**5,693.23**			**53,446**			**$ 4,222,838**		**$ 15,037,224**		
Region average	**813.32**	**56.7**	**42.3**	**7,635**	**9.39**	**0.17**	**$ 603,263**	**$742**	**$ 2,148,175**	**$ 2,641**	**$ 46.58**

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

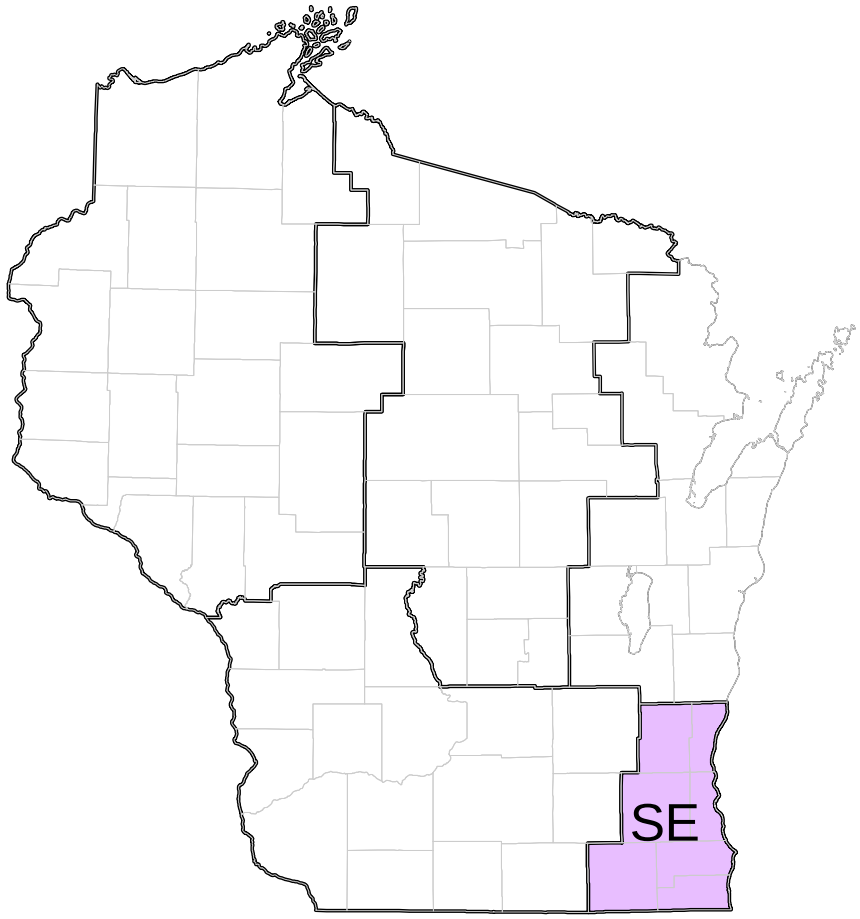
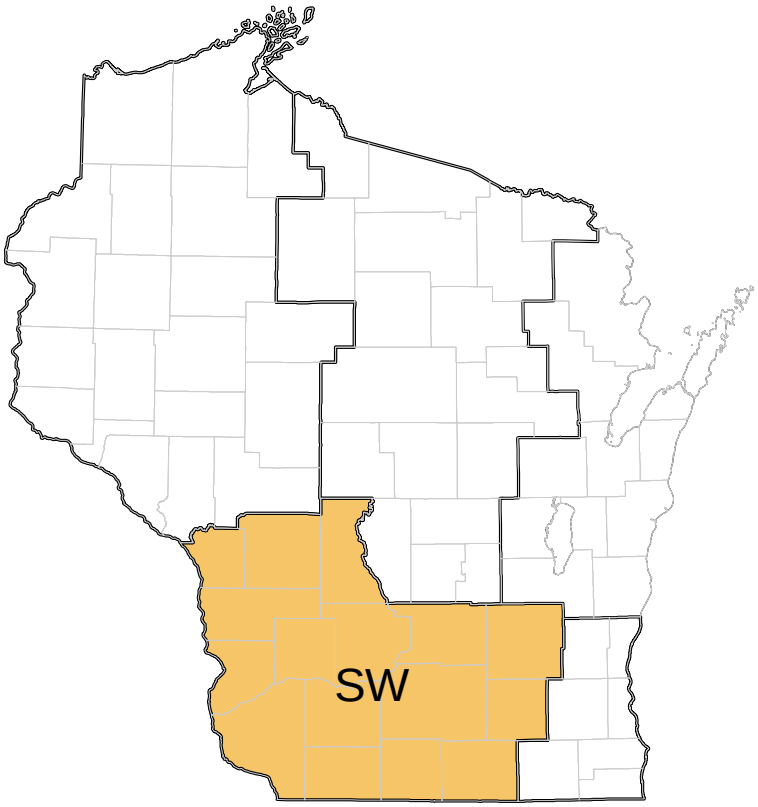
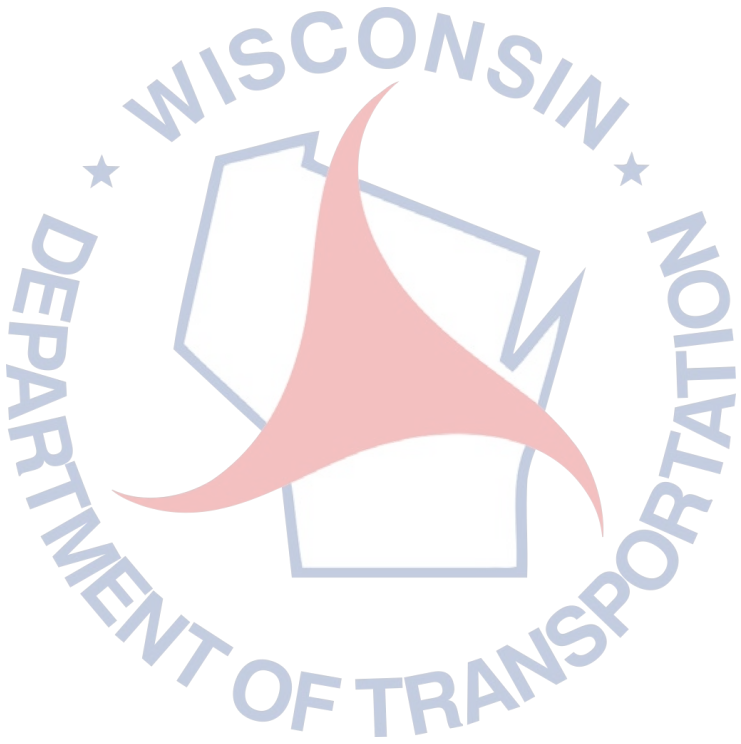


Table 1.4. Winter in Wisconsin, 2023-2024

County	Lane miles	MDSS 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
Southwest Region											
Columbia	801.13	66.9	50.1	8,171	10.20	0.15	$ 835,961	$1,043	$ 2,040,717	$ 2,547	$ 38.08
Crawford	398.22	50.2	41.1	1,792	4.50	0.09	$ 171,353	$430	$ 482,495	$ 1,212	$ 24.14
Dane	1,665.78	61.5	42.7	13,894	8.34	0.14	$ 1,249,478	$750	$ 5,195,630	$ 3,119	$ 50.72
Dodge	667.73	54.8	59.0	6,245	9.35	0.17	$ 517,287	$775	$ 1,435,736	$ 2,150	$ 39.24
Grant	646.92	48.1	51.7	4,041	6.25	0.13	$ 362,837	$561	$ 999,738	$ 1,545	$ 32.13
Green	311.98	53.4	40.9	1,386	4.44	0.08	$ 149,261	$478	$ 526,600	$ 1,688	$ 31.61
Iowa	457.10	52.3	46.3	3,593	7.86	0.15	$ 333,549	$730	$ 947,451	$ 2,073	$ 39.63
Jefferson	552.87	57.5	50.5	2,012	3.64	0.06	$ 180,235	$326	$ 866,429	$ 1,567	$ 27.25
Juneau	500.96	51.6	40.7	4,387	8.76	0.17	$ 449,334	$897	$ 1,028,691	$ 2,053	$ 39.80
LaCrosse	483.56	51.6	43.0	2,603	5.38	0.10	$ 227,502	$470	$ 834,376	$ 1,725	$ 33.44
Lafayette	294.51	46.4	46.2	1,599	5.43	0.12	$ 148,574	$504	$ 543,059	$ 1,844	$ 39.74
Monroe	679.49	62.7	41.8	6,452	9.50	0.15	$ 627,619	$924	$ 1,255,643	$ 1,848	$ 29.47
Richland	321.78	55.2	40.0	1,496	4.65	0.08	$ 150,887	$469	$ 395,269	$ 1,228	$ 22.25
Rock	791.89	56.7	42.0	5,224	6.60	0.12	$ 464,361	$586	$ 1,726,998	$ 2,181	$ 38.46
Sauk	594.09	62.0	45.0	6,930	11.66	0.19	$ 736,208	$1,239	$ 1,582,564	$ 2,664	$ 42.97
Vernon	469.79	58.7	35.3	3,342	7.11	0.12	$ 305,441	$650	$ 871,522	$ 1,855	$ 31.60
Region total	**9,637.80**			**73,167**			**$ 6,909,887**		**$ 20,732,917**		
Region average	**602.36**	**55.6**	**44.8**	**4,573**	**7.59**	**0.14**	**$ 431,868**	**$717**	**$ 1,295,807**	**$ 2,151**	**$ 38.69**




WISCONSIN
DEPARTMENT OF TRANSPORTATION

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, along with many others, combine to create varying challenges for Wisconsin's county highway departments each year.

This section describes the weather Wisconsin experienced during the 2023-2024 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, 2023-2024

	Statewide average	Range across counties
Total snowfall[1]	46.0 inches	19.4 – 93.1 inches
Winter Severity Index[2]	58.7	43.9 – 113.8
Winter storms	21	7 - 46
Frost events	5.2	0 - 19
Freezing rain events	6.5	0 - 23

1. All data in this table is from Winter Storm Reports, 2023-2024.
2. Winter Severity Index is calculated from the Maintenance Decision Support System (MDSS) tool.

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 65 for more information.*

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WINTER WEATHER CHALLENGES

Each year county highway departments face unique combinations of pavement 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 may also be 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 pavement 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 200+ inches along the shores of Lake Superior. In 2023-2024, an odd snowfall and a mild winter led to both the lowest and highest snowfall totals for the state to fall in the north with a range from 19 inches to 93 inches of snow, and a low snow fall total in the south coming in at 34 inches. The statewide average annual snowfall is 55.6 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

2023-2024 was an extremely mild winter especially coming off the severe winter of 2022-2023. We saw the state get hit evenly according to the winter severity index (see Figure 2.2) other than the few counties along Lake Superior. The Northwest region of the state surprisingly got hit with the least amount of winter. All in all, it is the mildest winter that has been seen in Wisconsin in sometime with only a few bigger storms hitting the state.

During the 2023-2024 winter season, county highway departments responded to:

- A statewide average of 21 winter snow events per county, 17 less than the previous winter. The high was 46 events in Vilas County and the low was 7 events in Richland County.
- A statewide average of 5 frost events.
- A statewide average of 7 freezing rain/sleet events.

Figure 2.1. Statewide Snowfall, 2023-2024
From Winter Storm Reports

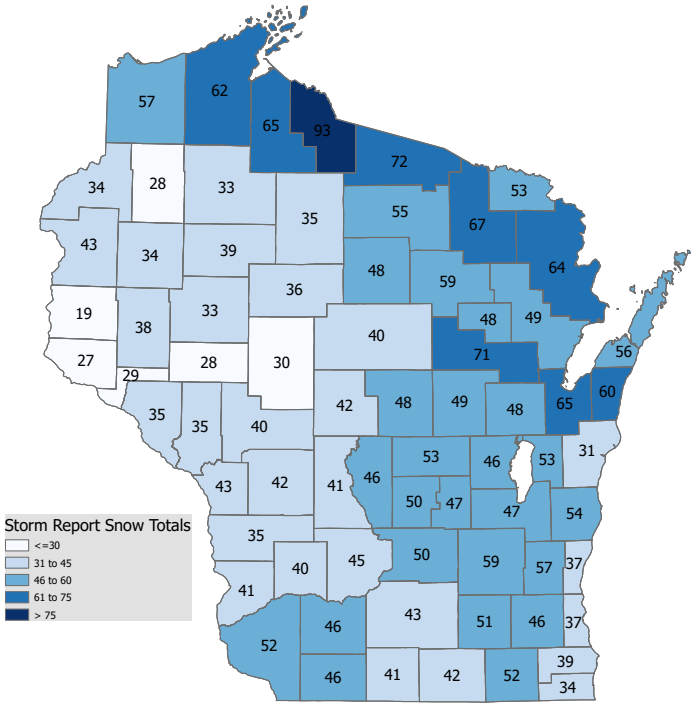


Figure 2.1 shows the total snowfall received in Wisconsin this winter based on storm report data. Snowfall varied significantly across the state; the highest snowfall recorded was in Iron County, at 93 inches; the lowest was in St. Croix County, at 19 inches. This winter's statewide average total snowfall was 46 inches, over 54 inches less than last year.

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, and modified several times since then, 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 material 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 three ways:

1. Season-to-season comparisons. This lets the department compare apples to apples when evaluating material use and costs over several seasons, and identify trends in winter weather that can be useful in planning material 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 used 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.

3. County comparisons. This allows tracking of county performance. Severity is used to normalize the weather, enabling more accurate tracking of trends in salt use and budget within a single county.

Figure 2.2. Winter Severity Index, 2023-2024

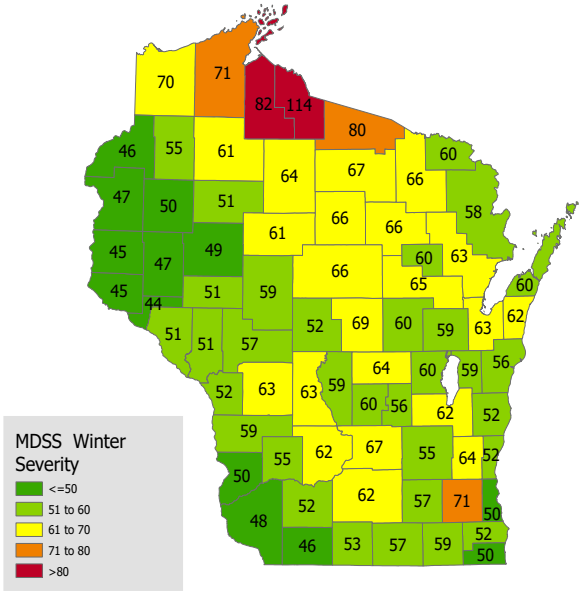
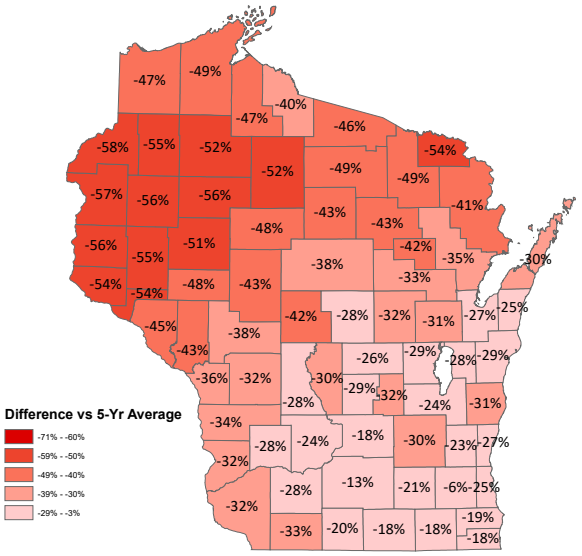


Figure 2.3. 2023-2024 Winter Severity Index vs. 5-Year Average (2018-2019 to 2022-2023)



The Maintenance Decision Support System (MDSS) is used to compute the Winter Severity Index. Results were originally scaled such that the 5-year average was 100 at the time the equation was entered (2014-2015 winter). The current 5-year winter severity average is 95.8. This winter:

- The statewide average Winter Severity Index for 2023-24 was 58.7, which is 39 percent less than the average of the previous five winters (95.8).
    - Iron and Ashland Counties had the highest severity indexes of 114 and 82 respectively.
    - Pepin and St. Croix Counties had the lowest severity indexes of 44 and 45 respectively.

The entire state this winter was less severe than their respective 5-year average (see Figure 2.3), with all of the Northwest region being extremely below average. 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.

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. This includes Figure 3.1, as well as Figure 3.2 (salt used per lane mile), Figure 4.1 (winter costs), and Figure 4.6 (winter crashes).

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

- A description of the formula used in the Maintenance Decision Support System to calculate out the winter severity index.
- A table showing Winter Severity Index values for each county for the previous 10 winter seasons.

On the following pages, 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.

COUNTY-BY-COUNTY
TABLES FOR SECTION 2
WINTER WEATHER

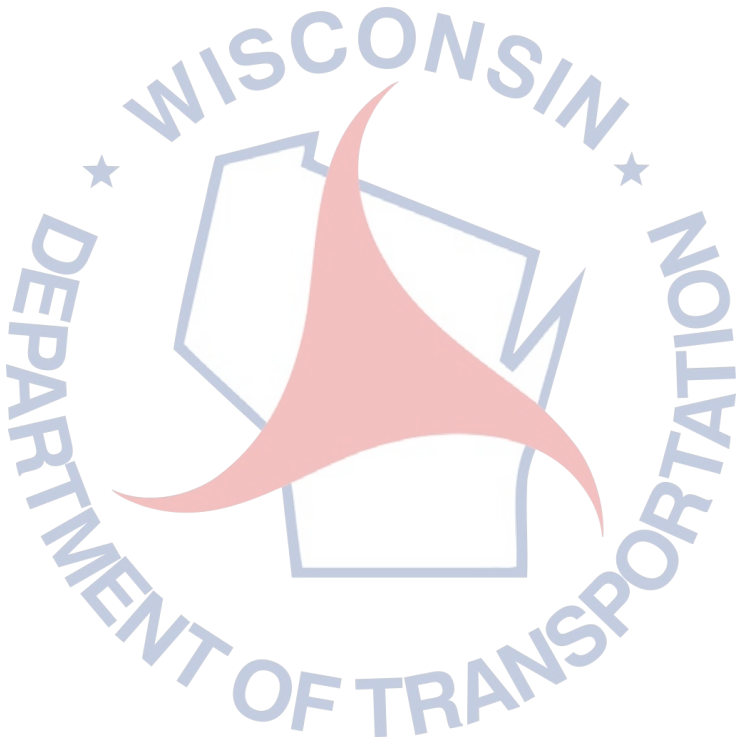

WISCONSIN
DEPARTMENT OF TRANSPORTATION

Table 2.1

Storms and Incidents - End of Season

From Winter Storm Reports, 2023-2024

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	GREEN LAKE	47.3	154.11	373	2.42	16	11	3	2	0	7	0	1	3	0	0	4	1
	LANGLADE	59.1	300.29	881	2.93	28	20	8	8	0	8	3	2	3	4	0	1	11
	WAUSHARA	52.8	343.69	1404	4.09	20	16	1	3	3	6	1	0	2	2	0	1	2
	PORTAGE	47.8	531.62	2195	4.13	23	15	7	9	3	10	1	0	5	1	4	4	14
	MARQUETTE	49.5	246.61	1050	4.26	24	17	9	5	8	3	2	3	11	0	0	0	13
	ONEIDA	55.4	395.39	1769	4.47	26	13	14	12	1	13	0	0	5	7	1	5	7
	WOOD	42.0	443.36	2084	4.70	28	24	2	12	5	8	3	3	18	5	0	6	18
	FOREST	67.3	314.49	1682	5.35	37	22	6	11	0	6	2	0	0	5	0	0	1
	PRICE	35.0	319.53	1713	5.36	30	18	18	11	4	4	1	2	3	3	0	3	13
	LINCOLN	47.7	399.39	2333	5.84	25	16	6	9	6	7	1	2	0	3	1	6	12
	SHAWANO	70.5	530.27	3767	7.10	22	15	3	7	0	16	5	1	14	3	6	4	6
	MENOMINEE	48.2	90.66	691	7.62	23	14	3	4	0	6	0	1	0	4	0	1	2
	WAUPACA	48.7	556.87	4307	7.73	15	15	1	2	0	13	2	1	9	6	6	3	2
	MARATHON	40.3	905.42	7072	7.81	24	18	1	9	3	14	4	4	1	8	1	5	16
	FLORENCE	52.6	137.43	1121	8.16	27	22	3	5	2	10	2	0	4	5	0	5	4
	IRON	93.1	240.51	2085	8.67	32	14	12	1	7	13	8	7	1	5	0	1	0
	VILAS	71.6	307.73	2690	8.74	46	25	18	12	9	16	6	8	4	8	3	9	5
	ADAMS	45.6	202.74	2054	10.13	20	18	8	7	2	5	1	1	2	3	0	1	10
Region Average		54.1	356.67	2182	6.08	26	17	7	7	3	9	2	2	5	4	1	3	8

Table 2.1

Storms and Incidents - End of Season

From Winter Storm Reports, 2023-2024

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	DOOR	56.0	267.29	1128	4.22	22	14	13	1	1	20	8	6	8	12	1	5	8
	FOND DU LAC	47.0	611.86	3148	5.14	19	17	2	3	0	7	2	0	3	1	0	2	4
	SHEBOYGAN	54.4	543.53	3101	5.71	21	18	1	4	2	24	5	5	19	4	6	10	18
	CALUMET	53.1	219.46	1292	5.89	19	26	3	3	0	19	9	8	13	4	1	10	18
	KEWAUNEE	60.1	126.39	789	6.24	18	18	1	3	7	15	8	8	5	4	0	8	3
	MARINETTE	63.7	414.39	2817	6.80	32	15	7	10	0	15	1	0	0	7	4	3	32
	OCONTO	49.2	481.73	3389	7.04	19	15	7	9	0	13	2	0	11	3	2	5	16
	WINNEBAGO	45.8	688.27	4997	7.26	15	16	6	2	0	12	1	1	8	3	5	5	13
	MANITOWOC	30.8	419.96	3788	9.02	15	12	3	0	0	2	0	0	3	0	0	2	26
	BROWN	64.6	860.16	8929	10.38	22	15	7	1	1	4	2	2	2	0	0	1	49
	OUTAGAMIE	47.5	567.52	6467	11.40	17	13	5	1	0	19	7	3	10	7	0	6	1
Region Average		52.0	472.78	3622	7.19	20	16	5	3	1	14	4	3	7	4	2	5	17

Table 2.1

Storms and Incidents - End of Season

From Winter Storm Reports, 2023-2024

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	CHIPPEWA	32.6	653.17	1818	2.78	16	13	6	3	1	6	2	0	3	1	0	0	6
	BUFFALO	35.2	311.87	982	3.15	27	12	10	8	10	7	5	3	1	2	0	2	8
	PEPIN	28.9	109.41	375	3.43	15	8	21	4	5	4	2	2	3	2	1	1	10
	TAYLOR	36.1	232.44	946	4.07	22	17	5	5	0	5	2	2	2	4	1	3	5
	SAWYER	32.7	357.20	1616	4.52	26	19	7	4	1	13	4	7	0	8	0	9	0
	EAU CLAIRE	28.1	531.32	2664	5.01	18	19	2	4	0	1	0	0	1	0	0	0	8
	POLK	43.0	374.54	1881	5.02	18	13	6	0	0	19	6	0	7	6	0	1	16
	SAINT CROIX	19.4	653.47	3299	5.05	12	10	5	2	2	2	0	0	1	1	0	0	1
	RUSK	39.2	213.10	1083	5.08	22	21	9	12	3	7	3	3	9	4	1	3	8
	WASHBURN	18.9	385.68	2150	5.57	20	15	6	9	6	5	1	1	16	1	1	3	18
	BURNETT	34.1	235.35	1365	5.80	17	12	5	6	9	4	0	0	0	2	0	3	8
	PIERCE	26.6	368.08	2207	6.00	12	10	2	1	0	6	0	2	4	3	1	0	4
	BAYFIELD	61.7	345.31	2220	6.43	34	19	13	3	0	17	1	2	4	7	1	8	5
	BARRON	34.1	428.61	3046	7.11	18	11	2	5	4	15	2	4	4	14	2	6	3
	CLARK	29.6	401.81	2961	7.37	15	7	9	2	2	10	1	1	5	7	5	3	5
	ASHLAND	65.4	255.69	2096	8.20	30	9	17	4	0	8	4	2	0	0	2	5	9
	DUNN	37.8	521.20	4313	8.27	22	8	13	1	0	6	2	0	4	0	0	1	7
	DOUGLAS	57.1	465.66	4416	9.48	33	11	18	7	1	15	0	0	9	0	3	9	41
	JACKSON	39.7	520.32	5139	9.88	20	15	4	2	12	15	1	2	1	8	6	10	23
	TREMPEALEAU	35.1	420.25	4848	11.54	15	9	9	0	0	18	6	2	0	8	1	7	10
Region Average		36.8	389.22	2471	6.19	21	13	8	4	3	9	2	2	4	4	1	4	10

Final totals as of Tuesday, June 25, 2024

Table 2.1

Storms and Incidents - End of Season

From Winter Storm Reports, 2023-2024

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	4.5	674.40	2624	3.89	17	11	4	4	0	7	3	1	3	0	1	0	3
	OZAUKEE	37.1	321.10	2194	6.83	16	18	4	1	6	5	2	0	8	1	3	0	11
	RACINE	39.0	774.85	5497	7.09	25	8	12	4	4	0	0	0	0	0	0	0	22
	WALWORTH	51.8	697.33	5594	8.02	22	15	6	4	1	10	2	3	14	3	4	2	23
	WAUKESHA	45.7	1,059.84	9787	9.23	14	10	3	4	3	3	0	1	3	3	1	0	12
	WASHINGTON	57.3	591.04	5974	10.11	22	23	8	5	1	13	4	4	18	0	7	6	19
	MILWAUKEE	37.1	1,574.67	21776	13.83	15	13	3	5	2	0	0	0	3	0	0	0	5
Region Average		38.9	813.32	7635	8.43	19	14	6	4	2	5	2	1	7	1	2	1	14

Table 2.1

Storms and Incidents - End of Season

From Winter Storm Reports, 2023-2024

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	JEFFERSON	50.5	552.87	2012	3.64	20	21	4	3	1	11	2	0	13	2	2	5	14
	GREEN	40.9	311.98	1386	4.44	20	13	5	3	1	9	0	2	4	1	0	3	9
	CRAWFORD	41.1	398.22	1792	4.50	18	14	6	7	2	21	8	7	11	7	2	11	7
	RICHLAND	25.0	321.78	1496	4.65	7	8	2	2	1	21	5	3	1	5	0	15	6
	LA CROSSE	43.0	483.56	2603	5.38	8	8	0	0	0	4	0	1	2	2	1	1	0
	LAFAYETTE	46.2	294.51	1599	5.43	26	17	5	4	0	8	2	4	7	0	1	2	5
	GRANT	51.7	646.92	4041	6.25	14	9	3	2	0	12	0	4	1	2	0	5	1
	ROCK	42.0	791.89	5224	6.60	21	17	5	2	0	2	1	1	4	0	0	1	11
	VERNON	35.3	469.79	3342	7.11	28	16	17	7	5	15	11	9	13	1	0	9	12
	IOWA	46.3	457.10	3593	7.86	19	15	4	3	1	4	1	2	1	2	1	0	13
	DANE	42.7	1,665.78	13894	8.34	19	16	4	5	0	0	0	0	12	0	0	0	17
	JUNEAU	40.7	500.96	4387	8.76	19	13	6	1	2	12	2	1	0	3	5	5	9
	DODGE	59.0	667.73	6245	9.35	18	15	0	0	3	8	3	1	3	2	3	4	23
	MONROE	41.8	679.49	6452	9.50	19	21	0	5	2	8	3	0	2	4	0	4	8
	COLUMBIA	50.1	801.13	8171	10.20	16	16	0	3	6	19	9	10	7	1	6	17	25
	SAUK	20.5	594.09	6930	11.66	14	10	4	7	2	3	0	0	1	3	2	0	3
Region Average		42.3	602.36	4573	7.10	18	14	4	3	2	10	3	3	5	2	1	5	10

Table 2.1

Storms and Incidents - End of Season

From Winter Storm Reports, 2023-2024

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 Snow	Blowing Snow	Frost	Ice	Bridge Decks	Clean Up	
Statewide Averages		--	482	3544	6.74	21.0	15.0	6.3	4.6	2.3	9.6	2.6	2.2	5.2	3.3	1.5	3.9	10.8

3 Winter Operations

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 2023-2024 winter season, including material use, best practices in equipment and technology, and training efforts. Most 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. There are also counties that have been using direct liquid applications (DLA) for deicing during a winter event, in which salt brine is used in place of prewetted rock salt during plowing.

Statewide Materials Use, 2023-2024

Total salt used[1]	255,155 tons
Total salt used per lane mile	7.3 tons
Total cost of salt used[2]	$22,994,986
Average cost per ton of salt	$91.21
Total abrasives used	5,225 cubic yards
Total brine and blends used	14,788,855 gal.

There's More on the Web!

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

See https://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/default.aspx

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.

Photo Credit: Pixabay-Creative Commons License

3A. MATERIALS

Salt (Sodium Chloride) remains the primary material used in winter maintenance. The common practice of prewetting has improved the efficiency of materials use (by keeping more of the material on the road instead of scattering off the edges), and proactive anti-icing applications have reduced the amount of salt needed to keep roads clear. Direct Liquid Application is also becoming more common across the State as it saves taxpayer dollars and reduces harm to the groundwater and environment.

Salt

Salt is a critical part of a highway crew's response to winter storms in Wisconsin. 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.

Due to 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. Best practices to reduce salt use include Direct Liquid Application, prewetting, anti-icing, under body plows, etc.

Historically, counties have used disproportionately more salt during more severe winters. Between the winters of 2006 -07 and 2015-16, Winter Severity Index fluctuated greatly, as did salt usage. Between 2016-19 both Winter Severity Index and salt usage remained relatively stable. Figure 3.1 plots the average statewide salt use per lane mile versus the average statewide Winter Severity Index. Looking back over the past 30 plus years of data, this year's salt use and severity index was kind of an outlier but most similarly compares to 2020/2021. This winter's statewide Winter Severity Index of 58.7 was 49 percent lower than the previous year and salt use decreased 47 percent from the previous year, at 255,155 tons. See Table 1.4 for county-by- county salt use data for this winter. It is important to note as well that this was the lowest Winter Severity Index in 10 years since using the new MDSS index and is the least salt usage year during the same time frame.

Wisconsin counties applied a statewide average of 7.3 tons of salt per lane mile on state highways, a decrease of 47.5 percent compared with the 2022-2023 winters. (See Figure 3.1). When compared with nearby states, which differ by winter severity and level of service standards, Wisconsin salt use is becoming more comparable in the past few years due to better salt management practices.

Figure 3.1. Salt Use per Lane Mile and Average Severity Index From Salt Inventory Reporting System, 1992–2024

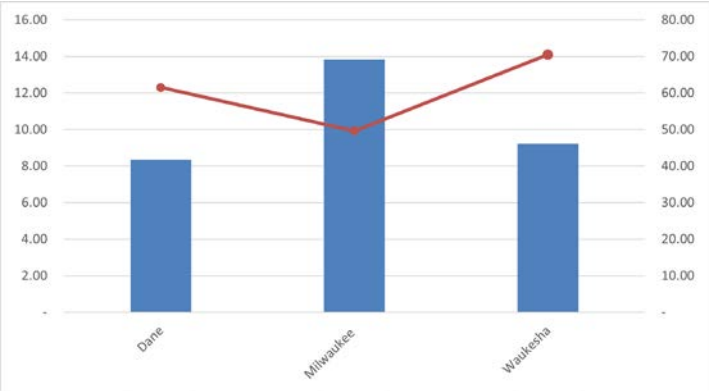
Figure 3.2 shows salt use per lane mile in each county, overlaid with severity index to allow a further "apples to apples" comparison of salt use in each county. The counties in Winter Service Groups A and B have more urban highways and tend to use more salt per lane mile for a given level of severity. See Figure 3.11 for a statewide map of tons of salt used per lane-mile.

For more detail on salt use in previous years, see Table A-6, "History of Salt Use on State Trunk Highways," in the Appendix.

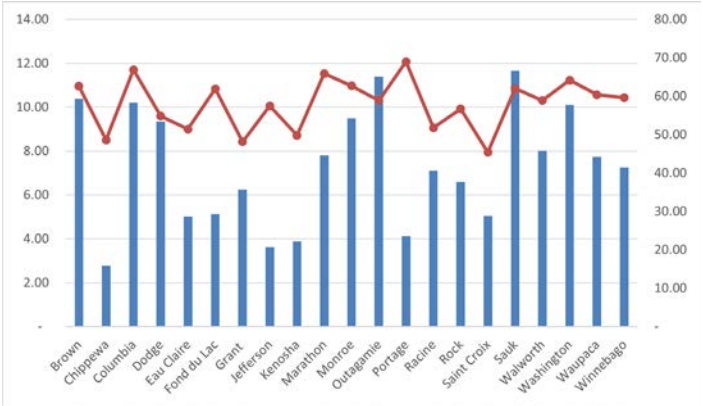
Figure 3.2. Salt Used per Lane Mile and Severity Index

From Salt Inventory Reporting System, 2023-2024

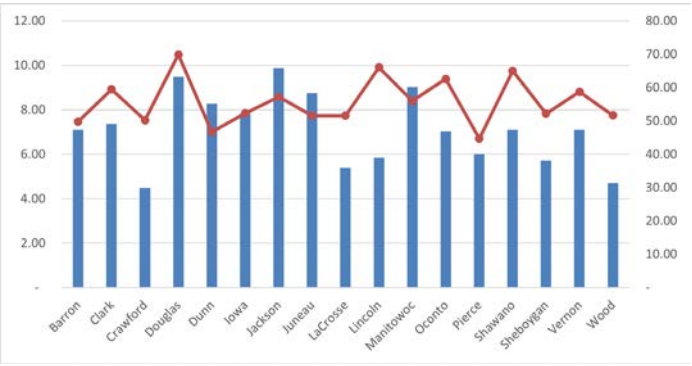
Salt Used per Lane Mile and Severity Index (Group A)



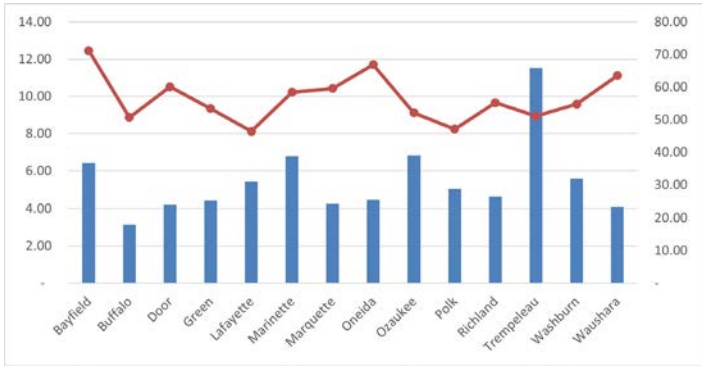
Salt Used per Lane Mile and Severity Index (Group B)



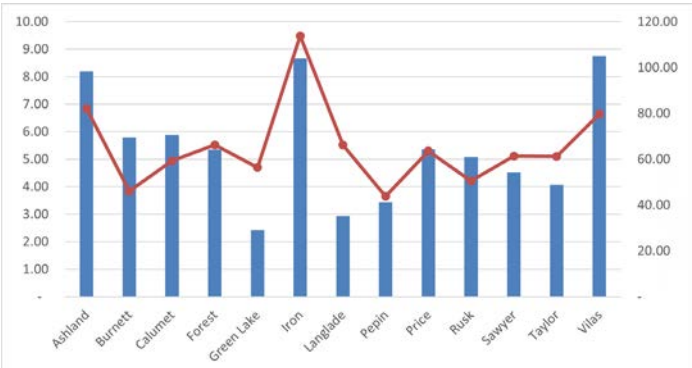
Salt Used per Lane Mile and Severity Index (Group C)



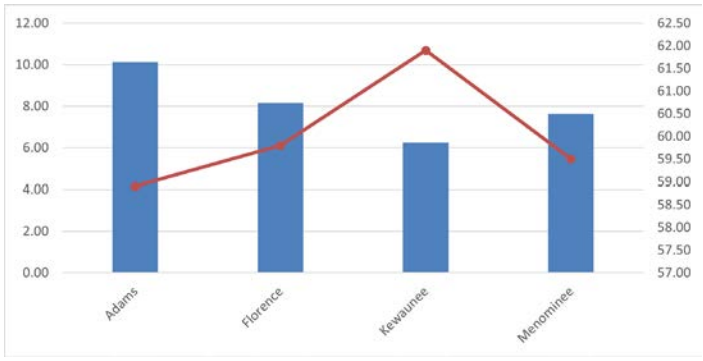
Salt Used per Lane Mile and Severity Index (Group D)



Salt Used per Lane Mile and Severity Index (Group E)



Salt Used per Lane Mile and Severity Index (Group F)



Salt used (tons) per lane mile — Severity Index

Cost of Salt

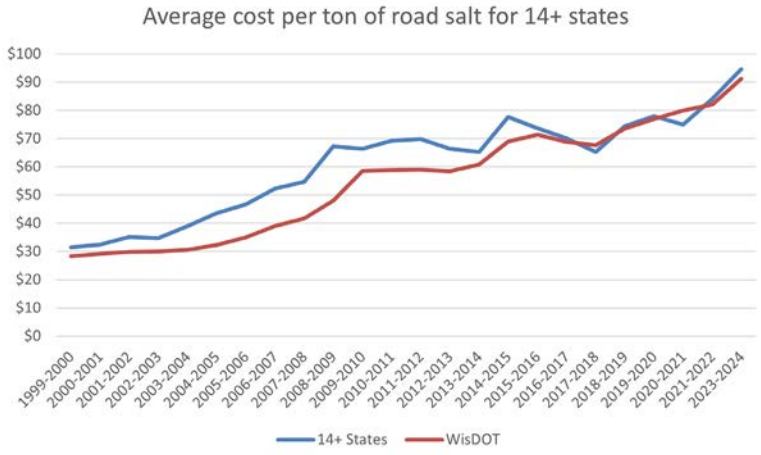
This winter, WisDOT spent $22,994,986 on salt statewide, purchasing salt at an average of $91.21 per ton. This is an increase of 9.4 percent from last year. Over the past few years, the gap between $/ton has closed with the other similar snowy states, according to data compiled by Clear Roads. See Figures 3.3 and 3.4.

The department speculates that the flexibility of its contracting method might account for similar prices to its peers, despite having to import all salt into the state. Wisconsin's contracts include a 100 percent 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.

Figure 3.3. Salt Prices Over Time (through 2023-2024)

Source: Historical data supplied by Clear Roads. From 1999 to present, the number of states reporting data has increased from 14 to 36 states.



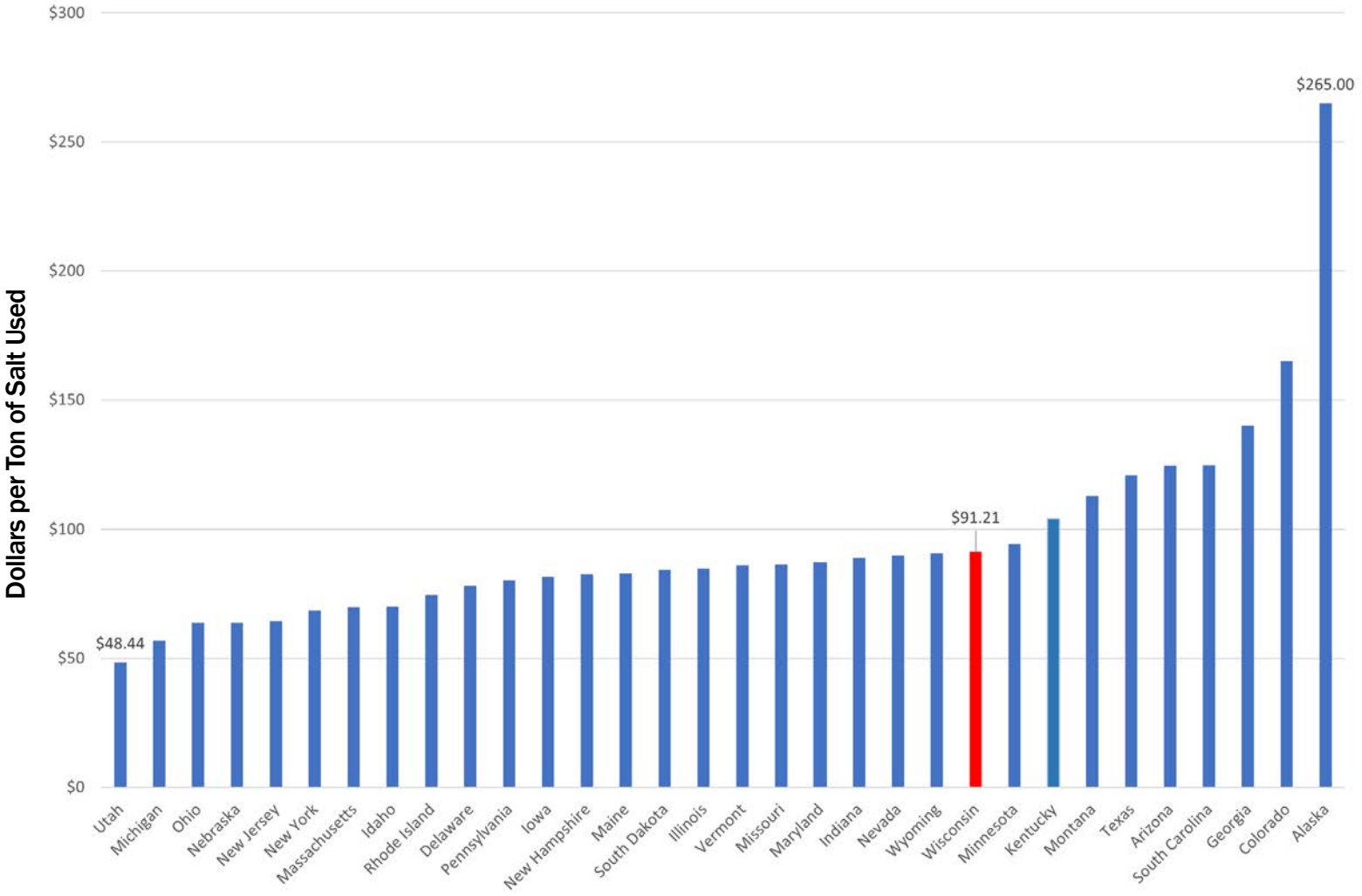
States Included in Figure 3.4: Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Utah, Vermont, Washington, West Virginia, and Wyoming

A Note About Materials Data

This winter marks the 15th 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 the anti-icing, prewetting, and direct liquid application data. These materials use estimates are included in this report because they provide a level of detail and 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.

Figure 3.4. Salt Prices Across the United States 2023-2024

Source: Clear Roads



Abrasives

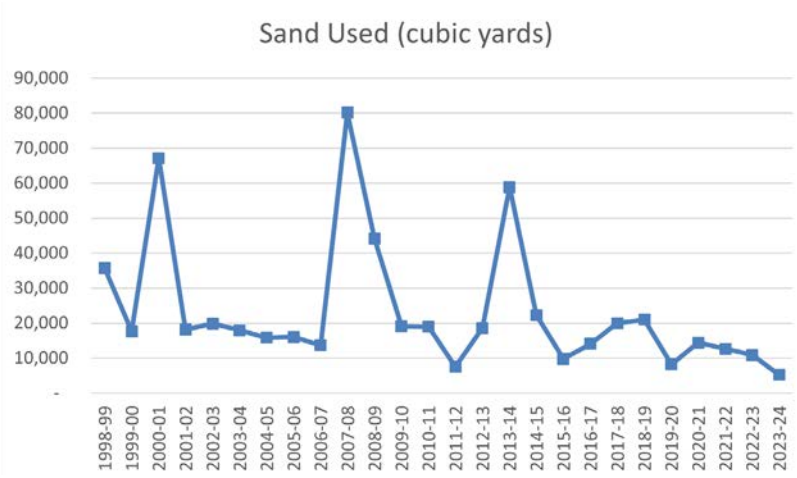
County highway departments sometimes use sand and other abrasives to improve vehicles' traction on icy or snowy roads or when temperatures are too low for salt to be effective. Abrasives are somewhat effective in low-speed trouble spots and intersections. Abrasives should be prewetted with a liquid agent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

A total of 5,225 cubic yards of sand was used by 43 counties on state highways this winter, a 61 percent decrease from the average of the five previous winters (13,419 cubic yards).

In 2008, the Bureau of Highway Maintenance commissioned a synthesis report, "Limitations of the Use of Abrasives in Winter Maintenance Operations" 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 used in a salt-abrasive mixture has not been shown to reduce accidents.
- Salt is more cost-effective than sand in winter maintenance operations.
- A salt-sand mixture requires approximately three times more material applied to the road to achieve the same effectiveness as pre-wetted salt and results in plows making more frequent return trips to the sand pile to fill up.

Figure 3.5. Statewide Sand Use From Storm Reports Data, 1998-2024



The 2008 synthesis report is available on-line at: https://clearroads.org/project/limitations-of-the-use-of-abrasives-in-winter-maintenance-operations/

Figure 3.5 compares this winter's statewide sand use with previous years. The spikes in the figure are due to salt shortages during those years.

Prewetting

Prewetting salt and sand with liquid deicing agents before or during their application to the pavement has several advantages. When used with dry rock 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 dry 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 one or more deicing agents 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 3.1 for details on statewide prewetting agent use.

Salt brine is a relatively inexpensive choice for prewetting. Salt brine use has increased significantly since counties first tested it over 20 years ago; all 72 counties used salt brine for prewetting this winter (see Table A-5 of the Appendix for details). Counties used 4,384,594 gallons of salt brine and salt brine blends for prewetting this winter, a 36% decrease to the year prior. While most counties in the state are applying brine as a prewetting agent on a regular basis, there are also some counties that have started to apply brine directly to the road during winter storm events known as direct liquid application (DLA). The 2023-2024 winter was the fifth-year tracking usage of direct liquid application, in which 32 counties used DLA during the winter for a total of 5,065,678 gallons a 42 percent decrease from last year.

It is important to note that the dramatic decreases in prewet and DLA use are due to the mild winter and lack of storms for material to be used in.

In addition to salt brine, some counties used calcium chloride, magnesium chloride, or agricultural-based products for prewetting this year. See Table 3.1 and Table A-5 in the Appendix for details. Organic blends seem to be preferred over the straight chemical products because they adhere to the pavement longer. The addition of the organics helps reduce corrosion of equipment. 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.

BEST PRACTICES: On-Board Prewetting

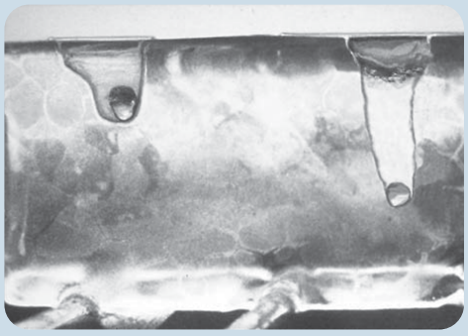
WisDOT encourages counties to prewet salt before applying it to the roadway. Agencies across the country and worldwide consider prewetting a best practice, and some require that all material be prewetted before it is placed. Studies have shown that prewetting significantly improves the amount of material that stays on the road. On-Board prewetting is preferred because it is the simplest way to ensure that salt is being uniformly prewetted.

Some counties choose to prewet their salt directly in the pile. The benefit to this approach is that less equipment is required on salt trucks.

Wisconsin Transportation Bulletin No. 22 (December 2005) notes that as much as 26 percent more salt stays on the roadway when prewetted versus when dry salt is used. Pre-wetting salt has been used since the late 1960s. In addition to reduced loss of salt from bounce and scatter, advantages of pre-wetting salt include:

1) Quicker melting.
2) Better salt penetration into ice and snow pack.
3) Salt melts at lower temperature if wetted with other deicing chemicals (generally limited to pavement temperatures above 20°F).

For more information on prewetting, see Chapter 6, Section 20 of the State Highway Maintenance Manual.



Faster melting action is the main benefit of pre-wetting salt. After 20 minutes the difference is significant. This photo shows two salt particles penetrating ice. The one on the right was pre-wetted.

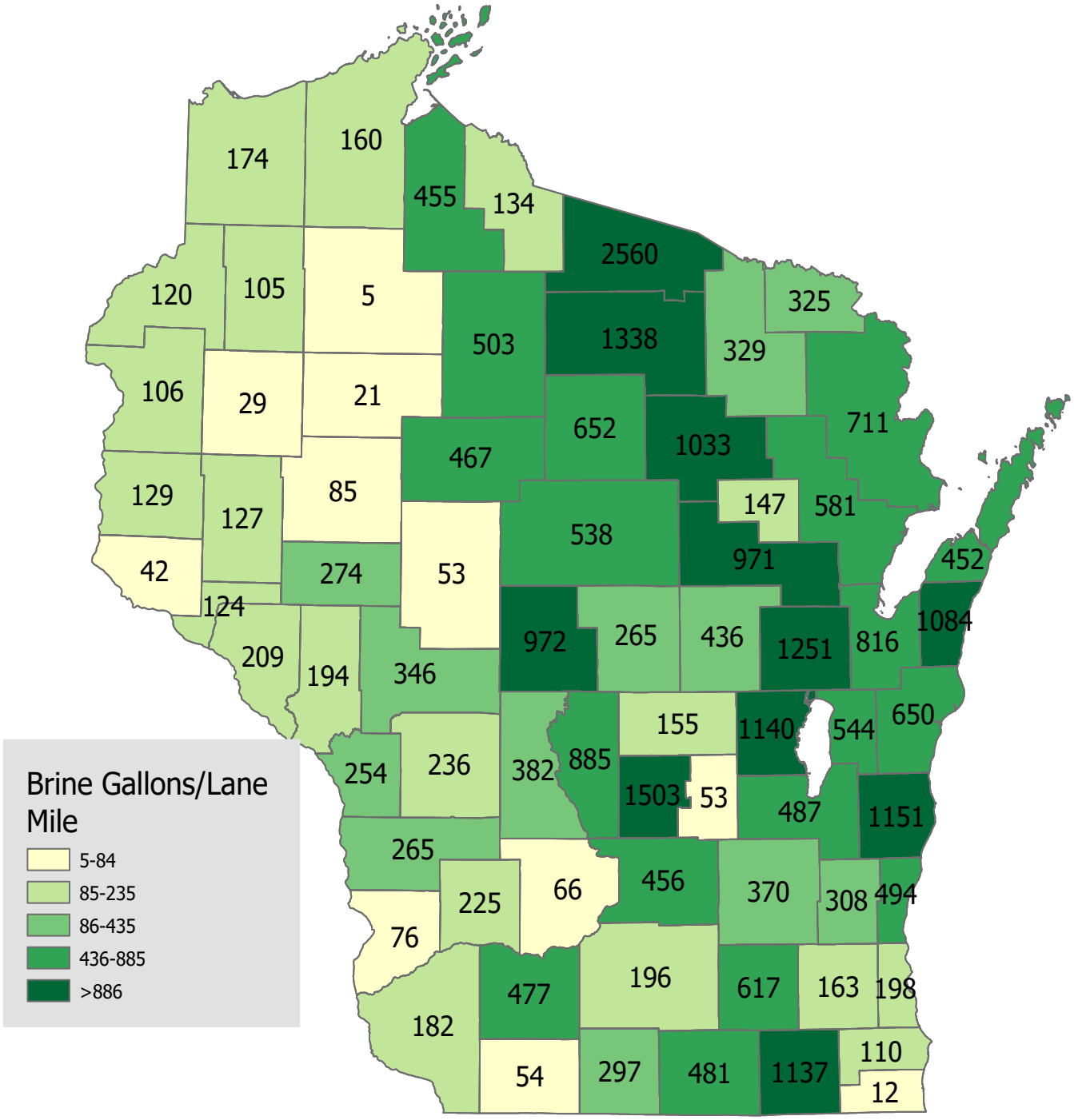
Some counties are still using pretreated salt, in which a liquid prewetting agent is spray-applied to the salt supply before the salt is placed in storage. According to the Minnesota Snow and Ice Control Field Handbook for Snowplow Operators (published by the Minnesota Local Road Research Board), when treating a stockpile of salt, a liquid deicing chemical should be applied at a rate of 8 to 10 gallons/ton. Since liquid prewetting increases the leach risk of the stockpile, salt should be stored on an impervious pad.

While prewetting salt is a best practice in Wisconsin, prewetting abrasives is far less common but still considered a best practice. 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. The Minnesota Snow and Ice Control Field Handbook for Snowplow Operators recommends prewetting sand at a rate of 4 gallons of salt brine/ton of sand. Figure 3.6 shows the total gallons of brine used per lane mile in each county for winter 2023-2024.

Table 3.1. Statewide Brine Agent Usage

Agent	***Prewet Gallons Used***	*# counties using PreWet*	***Anti-Icing Gallons Used***	*# counties using Anti-Icing*	***Direct Liquid Gallons used***	*# counties using Direct Liquid*
Salt (NaCl) Brine	4,226,947	72	4,874,121	69	5,065,678	32
Calcium Chloride						
$CaCl_2$ - Liquid	61,562	11	935	2	186,110	8
Magnesium Chloride						
$MgCl_2$ - Liquid	12,904	3	3,445	1	10	1
Proprietary Mixtures						
FreezeGuard	15,362	6	200	1	-	0
GeoMelt	-	-	11,974	1	-	0
IceBite 55	-	-	-	-	-	0
Beet 55	3,123	2	334	1	-	0
AMP	7,422	2	10,727	1	75,709	2
BeetHeet	57,274	13	31,476	9	143,542	2
Total Liquid Used	**4,384,594**		**4,933,212**		**5,471,049**	
Total (Anti-Icing, Prewet, DLA):	***14,788,855***					

Figure 3.6. Total Gallons of Brine Per Lane-Mile



Statewide Average = 426 Gal/Ln-Mi

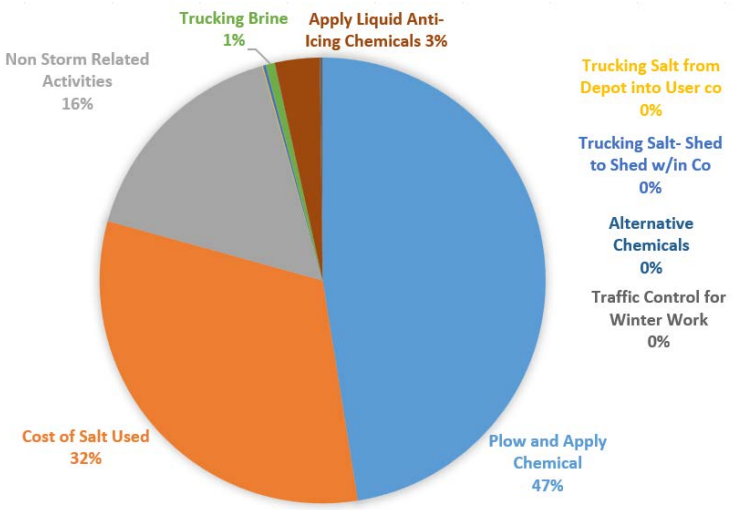
Map created: July 2024

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.

This winter, counties used 4,933,212 gallons of anti-icing liquid, an 8% increase from the year prior (see table A-3 in the Appendix for details). Currently, 69 of 72 countries (96 percent) are performing anti-icing operations and made at least one anti-icing application (counties may choose not to anti-ice if weather conditions do not warrant it). See Table A-4 in the Appendix for county-by-county data on salt brine use.

Figure 3.7. Winter Costs by Activity Code, 2023-2024



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

WisDOT encourages counties to explore stocking one or more agents for prewetting, anti-icing and direct liquid application so that a choice of agents is available for use according to pavement temperature and weather conditions. Table 3.1 shows the agents used for anti-icing in Wisconsin this winter.

BEST PRACTICES: Anti-icing (see Figure 3.7)

Anti-icing is a best practice not only nationwide, but across the globe. Anti-icing is the process of applying brine to the dry pavement- in the right conditions- prior to a winter storm. 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, and to reduce overall salt usage.

This winter, Wisconsin counties used 4,933,212 gallons of anti- icing liquid—an increase of 8% from 2022-23. Yet at 3.25 percent of total winter expenditures anti- icing continues to represent a small fraction of winter costs which is why anti-icing is a highly recommended practice when appropriate. For more information on anti-icing, see Chapter 6, Section 15 and Section 20 of the State Highway Maintenance Manual.

Direct Liquid Application

The use of Direct Liquid Application (DLA) is relatively new in Wisconsin but starting to become more common practice. Liquid brine, a simple mixture of salt and water, is applied directly to the pavement for deicing to replace rock salt as the primary storm management tool. This not only reduces the amount of salt applied but has been found to be more effective than solid salt.

In an effort to support the implementation of this practice in Wisconsin, WisDOT funded the purchase of high-capacity brine makers (HCBM) for the counties, starting from the 2018-2019 winter season. Every year since then, WisDOT continued funding the purchase of HCBMs in more counties. As of October 2024, WisDOT has funded a total of 53 HCBMs. We look to continue this effort as 2 additional counties are seeking to get funding for HCBMs in Fiscal Year 2026 (see Figure 3.8).

Counties receiving funding to purchase an HCBM have outfitted some or most of their trucks with tanks capable of holding enough liquid to treat specific routes, along with high- pressure spray nozzles. This type of nozzle has proven more effective at penetrating the snowpack and reaching the road surface. Multiple counties have brought DLA to the interstate and 4-lane highways and find it to be more valuable to apply brine at higher speeds which were more equivalent to traffic speeds during winter operations to eliminate the bounce and scatter effect. Figure 3.9 shows the counties that used DLA at some point this past winter and how many gallons they used.

WisDOT has sponsored multiple research studies to learn more about DLA and its best practices and benefits. WisDOT contracted with UW TOPS Lab to conduct a two-phase analysis of DLA technique in collaboration with the counties. The final report of phase 2 of this project was completed at the end of 2021, which builds on data collected from the counties in the 2020-21 winter season. This project analyzed the cost-benefits of DLA, and measured the salt use reduction, the difference in achieving time to bare/wet, and friction rating of pavement when using liquids compared to granular salt. More than 10 counties supplied data to UW TOPS Lab for this project.

Some of the highlights from this project are:

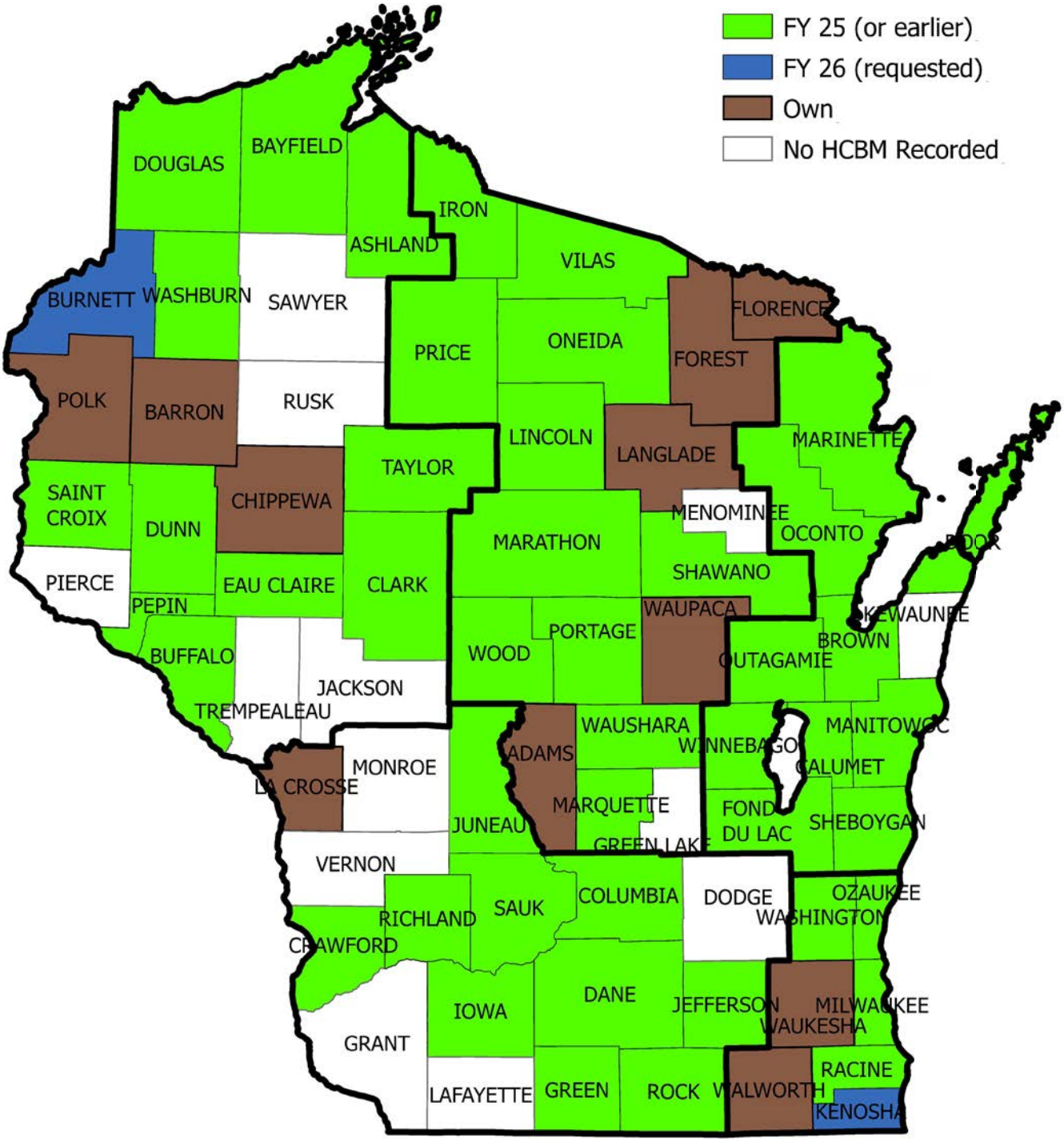
- Benefits of DLA far outweigh the infrastructure costs to move to a more liquid application model for winter highway maintenance events. Looking at only materials (salt) savings, over the winter 2020-21 period, DLA method saved WisDOT $5.95 per lane mile. With over 35 thousand miles in the state highway system and an average of 35 events each year, this is a significant saving.
- Comparing the use of DLA vs. granular salt, the counties who participated in the study successfully reduced overall salt use by 23%, with data showing that during certain storms, salt use was reduced by well over 50%.
- Analysis of friction rating and time to bare/wet pavement comparing DLA use vs. granular salt showed that condition rating of pavement surface was on average of 15% better with DLA, and time to bare/wet pavement was reached 11.9% quicker.

WisDOT also championed a research study focusing on DLA through Clear Roads, a national research consortium focused on rigorous testing of winter maintenance materials, equipment, and methods for use by highway maintenance crews. This study is also done by UW TOPS Lab was completed in December 2021. It focuses on expanding the application rate guidance for liquid application. The result of this study is a comprehensive guidance on best practices of application rates of DLA, more specifically for lower temperatures.

BEST PRACTICES: Direct Liquid Application (see Figure 3.9)

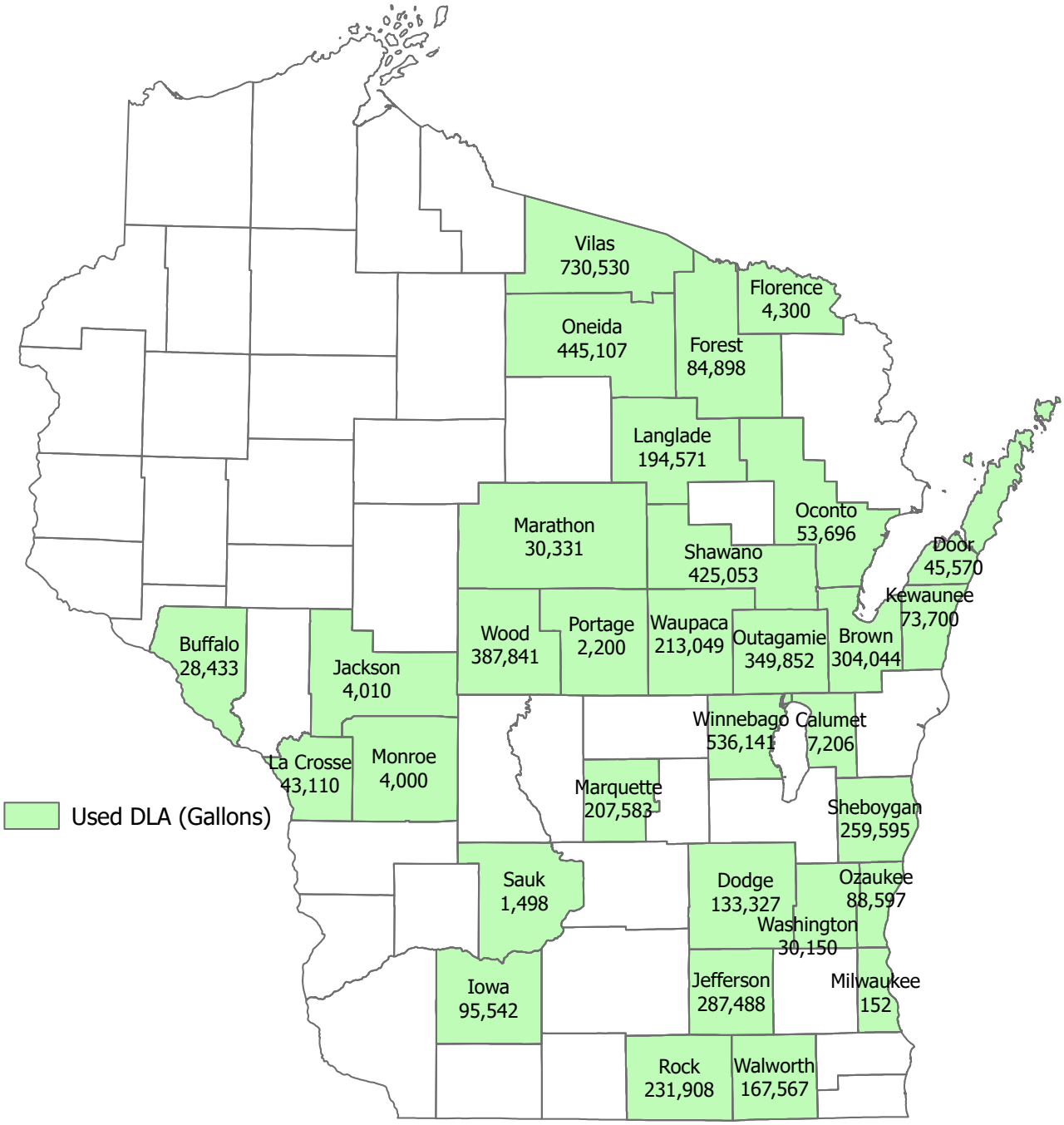
Direct Liquid Application is gaining traction in Wisconsin. Salt brine (possibly combined with other agents) is applied directly to the roadway during winter events to break the bond between snow and the pavement. High-capacity brine-makers are used to mix brines of various recipes. Specially equipped plow trucks with large tanks are used to apply the brine instead of rock salt. This results in faster time to bare/wet pavement and greatly reduced amounts of salt used.

Figure 3.8. State Funded High Capacity Brinemakers



Map created: October 2024

Figure 3.9. Counties Using Direct Liquid Application



Map created: June 2024

3B. EQUIPMENT AND TECHNOLOGY

As winter maintenance technology and practices evolve, the counties are continually expanding their arsenal of snow and ice control strategies. Winter Maintenance Research is one venue that helps crews continue to stay up to date on the latest tools and practices. There are several research initiatives that WisDOT is part of including Clear Roads and Aurora. In recent years, Road Weather Information Systems (RWIS) have become an effective tool for anticipating winter weather. These systems are automatic weather stations and measure real-time conditions. The Maintenance Decision Support System (MDSS) is another key system WisDOT has implemented. MDSS assists in assessing conditions and recommends appropriate treatments for routes. Equipment calibration is another strategy which not only ensures materials are applied to the roadway consistently, but also reduces product waste and costs.

Another tool a few counties have started using is tow plows, which are typically used on multi-lane highways or on roads with wider shoulders. A tow plow is just as it sounds, it is a plow that is towed by the snow plow which allows one driver to plow two lanes of highway and apply chemicals as well. This increases efficiency as one driver can plow two lanes in one pass with the truck and tow plow.

Winter Maintenance Research

WisDOT joins other state DOTs in funding research projects of common interest. The three pooled fund groups where WisDOT participates are Clear Roads, Aurora, and Maintenance Decision Support System (MDSS). The projects from these entities allow WisDOT to combine funds with other states to provide more effective research for the dollar.

CLEAR ROADS. Clear Roads research is grouped into six areas: methods, equipment, materials, training, technology, and safety. Launched in 2004 by Wisconsin and a few other states, Clear Roads now has 39 member states, led by the Minnesota DOT. They have completed 92 research projects conducted by universities and consultants and 17 projects are currently in progress.

See the Clear Roads website for a complete list of projects: clearroads.org/all-research-and-synthesis-projects/

Examples of recently completed research include:

- Expanding Application Rate Guidance for Salt Brine Blends for Direct Liquid Application and Anti-Icing
- Measuring the Efficiencies of Town Plows and Wing Plows
- Implementation of Liquid-only plow routes
- Review and Summary of Pre-wet Methods and Procedures

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 15 state DOTs and FHWA. WisDOT attended two in-person meetings and participated in monthly virtual meetings. WisDOT is a member of two project technical panels:

- Standardized Framework for Winter Weather Road Conditions Indices
- An Intelligent Human-Centric Communication System for Adverse Weather and Road Conditions

For a full list of Aurora projects, please go to aurora-program.org/.

Road Weather Information Systems (RWIS)

A roadside weather station.

WisDOT has had a Road Weather Information System (RWIS) 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:

- 75 weather and pavement condition sensors along state highways.
- Detailed weather forecasts via the Maintenance Decision Support System (MDSS).
- A winter storm warning service for WisDOT and county highway departments.
- Over 1,000 mobile infrared pavement temperature sensors on patrol trucks around the state.

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

The health of the system has continued to improve in the past year. Funding limitations had prevented needed upgrades to the RWIS infrastructure prior to FY 23. In FY 24, the following improvements were accomplished:

- Replacement of inoperative atmospheric sensors
- Replacement of some pavement sensors
- Replacement of some non-intrusive pavement sensors

On the docket for FY 25 are the following tasks:

- Replacement of remaining inoperative pavement sensors (many with non-invasive technology)
- Installation of cameras at all sites not near an existing ITS freeway camera

BEST PRACTICES: Underbody Plow

WisDOT encourages counties to use underbody plows when possible. If the plow blade is positioned in this way, it will apply downward pressure and can remove more snow pack and ice than a front-mounted plow. The underbody plow is most effective when removing hard packed snow and ice. Unevenness in pavement can also cause operating issues for this type of blade.
Photo credit: fancy-cats-are-happy-cats (https://commons.wikimedia.org/wiki/File:DesCoPlow.tif)

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

- Management of the MDSS, as well as attending three meetings of the MDSS Pooled Fund Technical Panel.
- Assisting with WisDOT's AVL-GPS.
- Coordinating with DTN on forecast services.
- Responding to comments from counties using any weather technology
- Providing MDSS and RWIS training for regional operations staff, the TMC, and county highway departments.
- Overseeing maintenance and repair of the department's RWIS equipment.
- Representing WisDOT on the Aurora Program board and the MDSS Technical Panel.

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 such as Pathfinder with the National Weather Service.
- Participating in national RWIS initiatives
- Providing RWIS presentations to WisDOT groups and agencies both inside and outside WisDOT.

Other ongoing services provided by the RWIS program manager include:

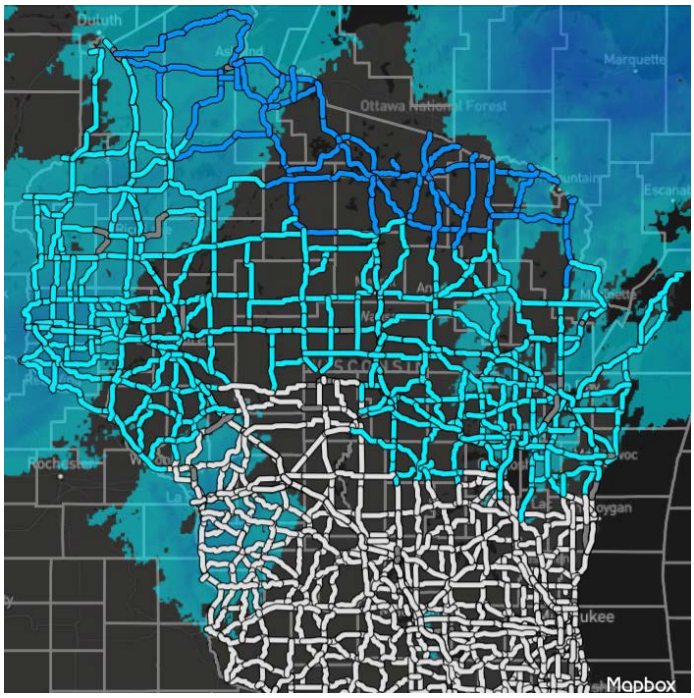
- Managing contracts for weather forecast and winter storm warning services, and for system maintenance.
- Coordinating use of Winter Severity Index data as an accurate tool to measure the relative severity of winter seasons and researching a potential new winter severity index based on MDSS data.
- Establishing a plan for replacement of aging infrastructure, such as roadside towers and communications.
- RWIS program management (budgeting, billing, planning, etc.).
- Developing enhanced methods of data display using GIS technology.

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. See Chapter 6, Section 20 in the Winter Maintenance Manual for more information.
Photo credit: apwa.net

Maintenance Decision Support System (MDSS)



BACKGROUND. Project management of MDSS activities continued to be a major focus for WisDOT.

CONFIGURATION. BHM continued to update routes as required when the counties made changes at their level. It was requested that all counties send in updated route information and began inputting any changes. Continued to include BTO in the process, as they are now using road conditions pulled from MDSS to 511. They must be notified anytime there is a change in route configuration.

MANAGEMENT TOOLS. BHM continues to attempt to use the comparison of actual versus recommended salt use.

TRAINING. WisDOT and DTN conducted virtual training in Fall 2023. Attendance was better than the previous year's in person training. Thanks to WisDOT's efforts, the MDSS pooled fund undertook a major effort to revise the entire MDSS training program run by DTN. The effort is well underway and will include at least four self-paced modules.

MONITORING. WisDOT received reports on usage on a monthly basis, and then an annual one at the end of the winter season. We plan to analyze this data to guide development of a training agenda in the fall.

511 Road Conditions. Using MDSS, every state highway is now mapped for road conditions. There were several times during the winter that TMC operators were forced to override the model output because of inaccuracies. It remains a work in progress.

COORDINATION. WisDOT attended one in-person and two virtual (one due to a blizzard at the meeting location causing the in-person meeting to be switched to virtual) MDSS Pooled Fund Study Technical Panel meetings. We interacted with other pooled fund members to elicit ideas that would help WisDOT. We provided presentations on WisDOT's experience in implementing MDSS and its work with the management tools and GIS route configuration. BHM worked with DTN on a continuing basis to resolve any issues that arose and to better understand the workings of the system. As mentioned above, WisDOT requested that training be included on the latest agenda, then actually led the session discussing it.

WisDOT made several suggestions to the Pooled Fund Technical Panel for projects to be funded in the FY 2023 work plan, then coordinated WisDOT's response to project voting. We pushed for a method to use MDSS to calculate actual route cycle times, as well as a management-level exportable dashboard showing treatment recommendations across a large area.

Equipment Calibration

Ensuring correct calibration of winter operations equipment—including salt spreaders, anti-icing applicators, prewetting application equipment, and DLA applicators—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.

CALIBRATION SCALES. Proper calibration has been and always will be an important part of winter maintenance. If the calibration is off by even 10 percent, thousands of dollars' worth of salt can be wasted in one winter season.

The winter readiness program also ensures that all truck spreaders are calibrated ahead of each winter season by the counties.

Here is additional information on calibration in a completed Clear Roads study: clearroads.org/project/17-s1/

Product and Equipment Innovations

Winter maintenance is a continuously evolving field—new technology and innovations are developed each year and best practices are being disseminated to staff as efficiently as possible. Many useful research projects have been developed by Clear Roads and funded by DOTs in the Clear Roads program across the US (including Wisconsin). Here is a list of the few recent ones that can be found on the Clear Roads website:

- Measuring the Efficiencies of Tow Plows and Wing Plows
- Standard Specifications for Plow Blades with Carbide Inserts
- Inventory and Use of Salt Spreading Systems
- Alternative Methods for Deicing
- Effective Snow and Ice Personnel and Equipment Management for Storm Activation
- Training Video for the Implementation of Liquid-Only Plow Routes

3C. LABOR

Over 1,500 employees of Wisconsin's county highway departments are licensed to operate a snowplow, and over 1,000 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 contracts, which also define when overtime hours can be charged. This winter, counties spent over $19.3 million on labor, for an average of $557 per lane mile. Per-lane-mile labor expenditures decreased 33 percent compared with last year's winter. An average of 27 percent of counties' winter maintenance costs were spent on labor, with a high of 35 percent in the Southeast Region, where hourly labor rates tend to be higher. Labor hours were down 50 percent for regular hours and down 45 percent for overtime hours compared with last winter. See Table 4.10 (page 86) for county-by-county labor expenditures and Table 3.2 (page 55) for county-by-county estimated labor hours and costs from the winter storm reports.

Photo Credit: Pixabay Commons License

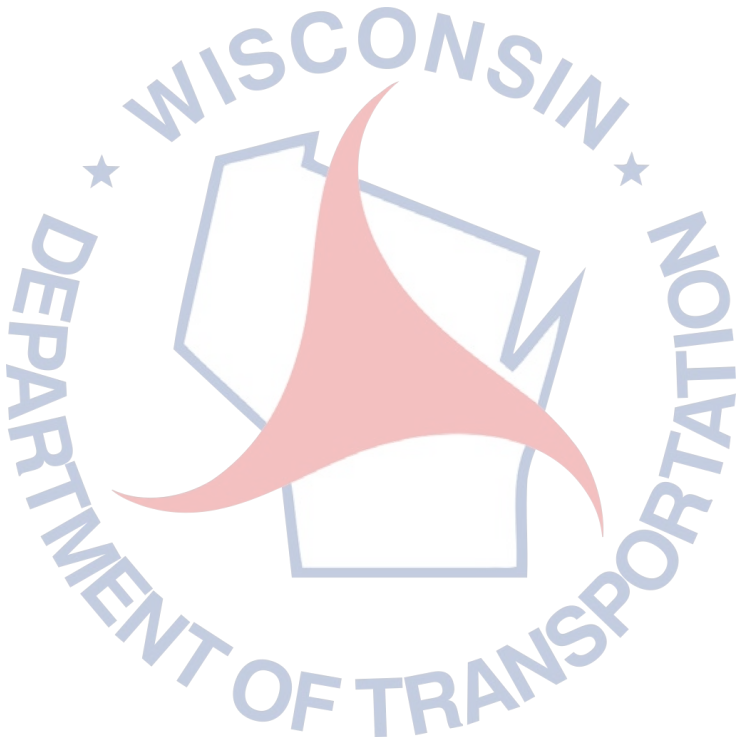
Winter Operations Training

Before each winter season, BHM provides and supports a variety of training efforts for WisDOT regional staff and county highway departments. Recent efforts over the last few years have included:

- MDSS/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.
- Regional Operations/County Fall Training Sessions. These sessions are held in all regions in preparation for the upcoming winter season and WisDOT provides support and participated in some of these training sessions.
- Clear Roads. Clear Roads continues to create many training documents for a wide variety of winter activities, and they can be seen at: clearroads.org/all-research-and-synthesis-projects/
- Winter Tech Talk. Organized a Winter Tech Talk in December 2023 which was a large scale one-day in-person event held at UW-Oshkosh campus in Fond du Lac. The event was for winter maintenance operators from the counties to meet, learn, discuss, and share information regarding winter maintenance practices, more specifically related to improvement in liquid use, including direct liquid application.
- Plow Driver Training. The Bureau of Highway Maintenance prepared and gave plow driver training to three counties prior to the 23/24 winter season. These sessions demonstrated the benefits of using more liquids and having a better salt management program.

We hope to provide additional training/education opportunities over the upcoming year to continue with the progress that has been made over the past years.

COUNTY-BY-COUNTY TABLES AND FIGURES FOR SECTION 3: SNOW AND ICE CONTROL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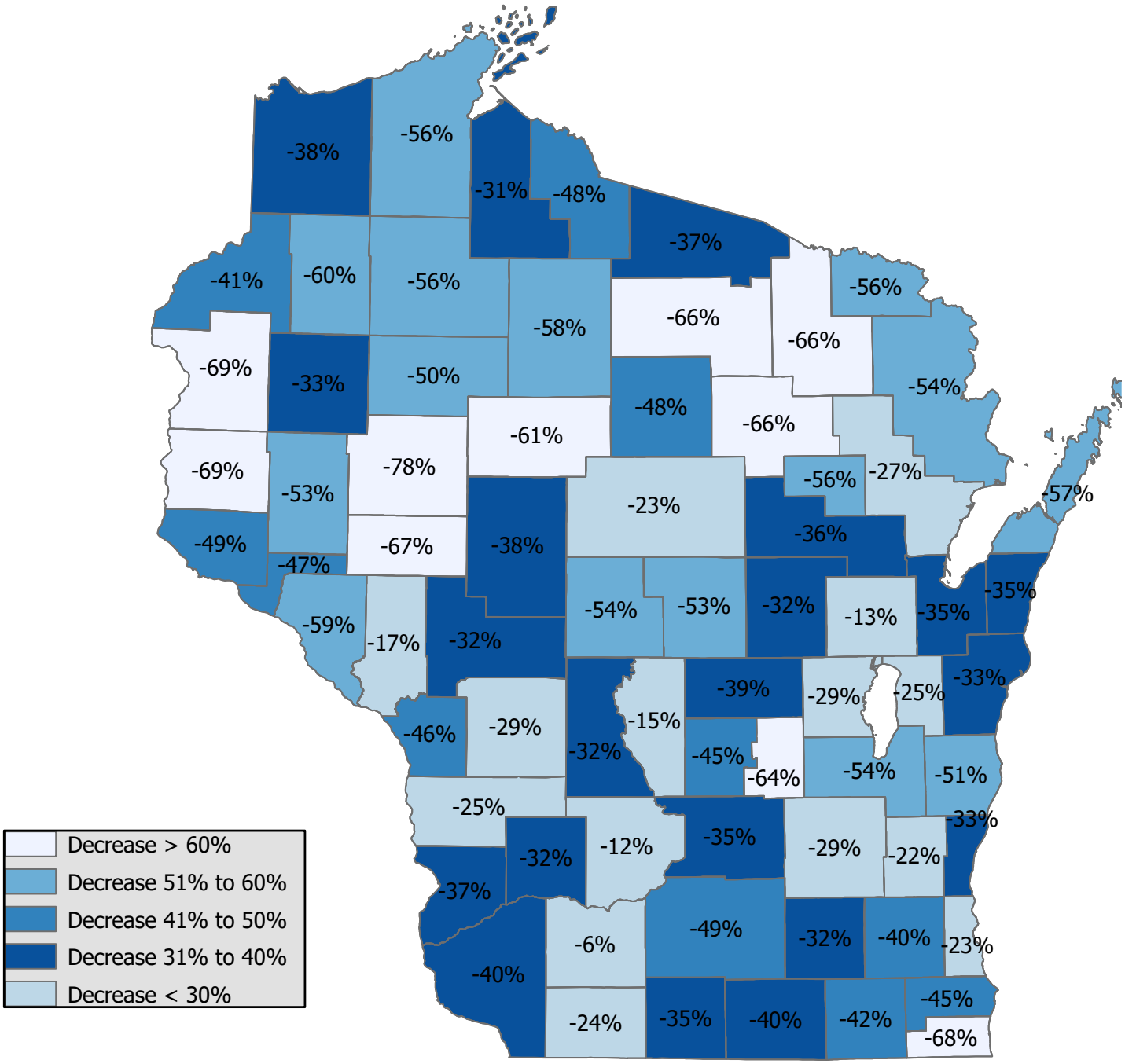
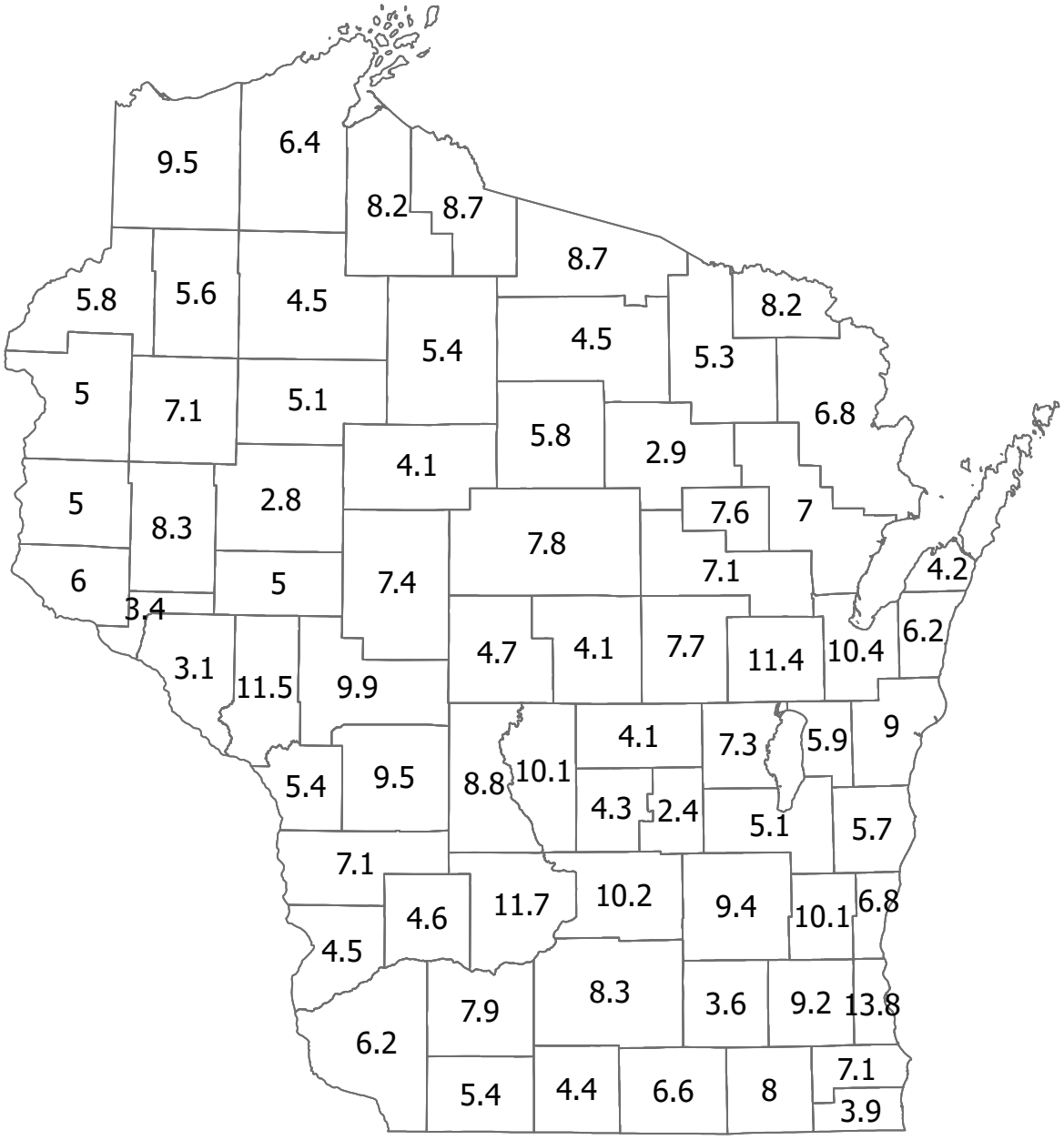
DEPARTMENT OF TRANSPORTATION

Figure 3.10 2023-2024 Salt Use per Lane Mile vs. 5-Year Average



Map created: July 2024

Figure 3.11 Tons of Salt/Lane-Mile 2023-2024



Map created: July 2024

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group A)

From Winter Storm Reports, 2023-2024

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
MILWAUKEE	SE	1574.67	54.75	13.83	$653	5771	5724	11495	49.8%	7.30	0.13
DANE	SW	1665.78	60.21	8.34	$743	3664	8574	12238	70.1%	7.35	0.12
WAUKESHA	SE	1059.84	53.09	9.23	$364	3847	2119	5966	35.5%	5.63	0.11
Group A Avg		1,433.43	56.02	10.47	$587	4427	5472	9900	51.8%	6.76	0.12

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group B)

From Winter Storm Reports, 2023-2024

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
ROCK	SW	791.89	50.66	6.60	$480	1833	2745	4578	60.0%	5.78	0.11
DODGE	SW	667.73	53.30	9.35	$382	1885	2161	4046	53.4%	6.06	0.11
KENOSHA	SE	674.40	54.09	3.89	$421	2295	1840	4135	44.5%	6.13	0.11
BROWN	NE	860.16	59.76	10.38	$401	2279	3371	5650	59.7%	6.57	0.11
EAU CLAIRE	NW	531.32	46.79	5.01	$272	2209	500	2709	18.5%	5.10	0.11
WINNEBAGO	NE	688.27	49.39	7.26	$320	1689	1796	3485	51.5%	5.06	0.10
JEFFERSON	SW	552.87	62.30	3.64	$394	1493	1903	3396	56.0%	6.14	0.10
WALWORTH	SE	697.33	64.79	8.02	$417	2213	2143	4356	49.2%	6.25	0.10
FOND DU LAC	NE	611.86	54.84	5.14	$356	1331	1844	3175	58.1%	5.19	0.09
OUTAGAMIE	NE	567.52	64.45	11.40	$383	2020	1410	3430	41.1%	6.04	0.09
PORTAGE	NC	531.62	73.22	4.13	$343	2273	1157	3430	33.7%	6.45	0.09
WASHINGTON	SE	591.04	75.45	10.11	$412	1859	2027	3886	52.2%	6.57	0.09
COLUMBIA	SW	801.13	67.74	10.20	$342	2682	2000	4682	42.7%	5.84	0.09
SAUK	SW	594.09	50.63	11.66	$249	1067	1428	2495	57.2%	4.20	0.08
CHIPPEWA	NW	653.17	48.57	2.78	$244	870	1729	2599	66.5%	3.98	0.08
GRANT	SW	646.92	50.39	6.25	$226	1273	1348	2621	51.4%	4.05	0.08
MONROE	SW	679.49	61.43	9.50	$264	1275	1943	3218	60.4%	4.74	0.08
RACINE	SE	774.85	61.74	7.09	$332	1970	1623	3593	45.2%	4.64	0.08

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group B)

From Winter Storm Reports, 2023-2024

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
SAINT CROIX	NW	653.47	31.17	5.05	$164	406	1023	1429	71.6%	2.19	0.07
MARATHON	NC	905.42	82.52	7.81	$271	2100	2556	4656	54.9%	5.14	0.06
WAUPACA	NC	556.87	57.46	7.73	$205	974	1000	1974	50.7%	3.54	0.06
Group B Avg		668.16	58.13	7.29	$328	1714	1788	3502	51.4%	5.22	0.09

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2023-2024

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
MANITOWOC	NE	419.96	34.16	9.02	$305	1896	775	2671	29.0%	6.36	0.19
IOWA	SW	457.10	54.55	7.86	$396	1470	1364	2834	48.1%	6.20	0.11
JUNEAU	SW	500.96	52.69	8.76	$304	1127	1386	2513	55.2%	5.02	0.10
SHEBOYGAN	NE	543.53	70.51	5.71	$421	1650	1739	3389	51.3%	6.24	0.09
LA CROSSE	SW	483.56	27.54	5.38	$158	367	732	1099	66.6%	2.27	0.08
CLARK	NW	401.81	39.00	7.37	$171	520	731	1251	58.4%	3.11	0.08
BARRON	NW	428.61	62.07	7.11	$274	1284	686	1970	34.8%	4.60	0.07
DOUGLAS	NW	465.66	87.46	9.48	$281	2379	587	2966	19.8%	6.37	0.07
JACKSON	NW	520.32	60.10	9.88	$221	1158	1055	2213	47.7%	4.25	0.07
PIERCE	NW	368.08	35.40	6.00	$146	495	425	920	46.2%	2.50	0.07
DUNN	NW	521.20	57.34	8.27	$252	917	1080	1997	54.1%	3.83	0.07
SHAWANO	NC	530.27	85.33	7.10	$279	1647	1106	2753	40.2%	5.19	0.06
VERNON	SW	469.79	88.46	7.11	$261	1015	1313	2328	56.4%	4.96	0.06
WOOD	NC	443.36	82.08	4.70	$248	1045	978	2023	48.3%	4.56	0.06
OCONTO	NE	481.73	74.62	7.04	$241	1108	864	1972	43.8%	4.09	0.05
CRAWFORD	SW	398.22	74.48	4.50	$215	858	664	1522	43.6%	3.82	0.05
LINCOLN	NC	399.39	79.32	5.84	$209	1087	502	1589	31.6%	3.98	0.05

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group C)

From Winter Storm Reports, 2023-2024

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
Group C Avg		460.80	62.65	7.13	$258	1178	940	2118	45.6%	4.55	0.08

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group D)

From Winter Storm Reports, 2023-2024

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
RICHLAND	SW	321.78	34.68	4.65	$174	647	514	1161	44.3%	3.61	0.10
TREMPEALEAU	NW	420.25	54.83	11.54	$324	1188	1003	2191	45.8%	5.21	0.10
OZAUKEE	SE	321.10	44.04	6.83	$263	702	573	1275	44.9%	3.97	0.09
GREEN	SW	311.98	61.51	4.44	$260	757	725	1482	48.9%	4.75	0.08
DOOR	NE	267.29	68.64	4.22	$340	450	848	1298	65.3%	4.86	0.07
LAFAYETTE	SW	294.51	71.67	5.43	$255	780	656	1436	45.7%	4.88	0.07
MARQUETTE	NC	246.61	65.94	4.26	$261	535	548	1083	50.6%	4.39	0.07
POLK	NW	374.54	60.71	5.02	$211	807	628	1435	43.8%	3.83	0.06
ONEIDA	NC	395.39	93.73	4.47	$303	1786	537	2323	23.1%	5.88	0.06
WAUSHARA	NC	343.69	60.22	4.09	$199	805	478	1283	37.3%	3.73	0.06
BAYFIELD	NW	345.31	99.05	6.43	$299	1420	537	1957	27.4%	5.67	0.06
MARINETTE	NE	414.39	95.04	6.80	$322	1243	902	2145	42.1%	5.18	0.05
WASHBURN	NW	385.68	57.29	5.57	$185	622	531	1153	46.1%	2.99	0.05
BUFFALO	NW	311.87	73.17	3.15	$162	624	406	1030	39.4%	3.30	0.05
Group D Avg		339.60	67.18	5.49	$254	883	635	1518	43.2%	4.45	0.07

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group E)

From Winter Storm Reports, 2023-2024

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	109.41	45.20	3.43	$315	362	282	644	43.8%	5.89	0.13
CALUMET	NE	219.46	67.63	5.89	$393	1044	488	1532	31.9%	6.98	0.10
GREEN LAKE	NC	154.11	49.59	2.42	$194	269	254	523	48.6%	3.39	0.07
IRON	NC	240.51	103.24	8.67	$351	784	685	1469	46.6%	6.11	0.06
BURNETT	NW	235.35	48.94	5.80	$149	357	314	671	46.8%	2.85	0.06
ASHLAND	NW	255.69	90.08	8.20	$278	905	403	1308	30.8%	5.12	0.06
PRICE	NC	319.53	79.29	5.36	$227	866	552	1418	38.9%	4.44	0.06
TAYLOR	NW	232.44	55.28	4.07	$148	329	314	643	48.8%	2.77	0.05
VILAS	NC	307.73	129.77	8.74	$281	1815	170	1985	8.6%	6.45	0.05
LANGLADE	NC	300.29	84.91	2.93	$211	813	417	1230	33.9%	4.10	0.05
RUSK	NW	213.10	83.19	5.08	$206	396	352	748	47.1%	3.51	0.04
SAWYER	NW	357.20	71.69	4.52	$155	617	441	1058	41.7%	2.96	0.04
FOREST	NC	314.49	101.61	5.35	$199	712	516	1228	42.0%	3.90	0.04
Group E Avg		250.72	77.73	5.42	$239	713	399	1112	39.2%	4.50	0.06

Table 3.2. Labor Hours/Lane Miles/Severity Index Ranking (Group F)

From Winter Storm Reports, 2023-2024

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	90.66	62.34	7.62	$171	252	96	348	27.6%	3.84	0.06
KEWAUNEE	NE	126.39	67.52	6.24	$230	285	198	483	41.0%	3.82	0.06
ADAMS	NC	202.74	65.34	10.13	$178	602	129	731	17.6%	3.61	0.06
FLORENCE	NC	137.43	77.24	8.16	$195	418	161	579	27.8%	4.21	0.05
Group F Avg		139.31	68.11	8.04	$193	389	146	535	28.5%	3.87	0.06

4 Winter Performance Measures

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 operations performance measurements, which measure 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, 2023-2024

Total lane miles	34,736
Total patrol sections	754
Average lane miles per patrol section	46.1
Roads to bare/wet pavement within WisDOT targets[1]	75%
Total tons of salt/lane-mile	7.3
Total gallons of brine and blends/lane-mile	426
Average crew reaction time from start of storm	2.65 hours
Total winter costs[2]	$ 72,256,176
Total winter costs per lane mile	$ 2,080
Total winter crashes[3]	4,124
Total winter crashes per 100 million VMT	13

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.

Photo Credit: Citypages.com (Google - Creative Commons License)

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 3.25 percent of total winter maintenance costs this year. ***See page 40 for more information on anti-icing costs.***

4A. WINTER PERFORMANCE MEASURES

Performance 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 include:

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

Between November 2023 and May 2024, WisDOT participated in an NCHRP Implementation Project Workshop regarding Snow and Ice Performance Measures. The workshop gathers participants from seven winter states who shared and discussed the different ways of developing winter-related performance measures and how each state could develop and further improve their performance measures for winter maintenance.

Table 4.1 gives the statewide average values for these measures for the last five winters. More detail on these measures is provided later in this section.

WisDOT has gathered several years of baseline data, this data can be used to make a year-to-year comparison in these areas.

Table 4.1. Statewide Winter Performance Measures for Winter

	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Percentage of roads to bare/wet pavement (Within WisDOT target times)	72%	68%	72%	73%	75%
Cost per lane mile	$2,428	$2,107	$2,457	$3,420	$2,080
Winter Severity Index	94.3	64.1	97.1	116.2	58.7
Cost per lane mile per Winter Severity Index point	$25.28	$31.09	$25.30	$29.43	$35.44
Winter weather crashes	21 per 100 million VMT	23 per 100 million VMT	19 per 100 million VMT	25 per 100 million VMT	13 per 100 million VMT

4B. 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. With the implementation of MDSS, this process has become more automated. Patrol superintendents receive treatment recommendations based on the characteristics of the route, such as traffic volume and pavement type, residual de-icers, actions already performed and forecasted weather.

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 mid season if necessary. 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.
- Mobility, Accountability, Preservation, Safety, and Service (MAPSS) measures: https://mapss.wisconsindot.gov/Public/Measure/6
- DTSD Performance Measures.

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://transportal.cee.wisc.edu/storm-report/ 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.

BEST PRACTICES: Automatic Vehicle Location (AVL-GPS)

AVL-GPS is used to determine the location of a vehicle and allows management to monitor the location of an entire fleet. This system can assist in the management of labor, equipment and materials. WisDOT primarily uses data from AVL-GPS to improve MDSS recommendations.

Additionally, AVL can record and transmit operational data from snowplows. Data such as application rates, pavement temperatures, and the position of blades and plows can all be captured. This data can be stored and used for reporting and analysis at a later date.

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 754 winter patrol sections, an average of 10.5 sections per county. 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 their section.

Table 4.2. Average Patrol Section Lengths by Winter Service Group

Winter Service Group	Average Patrol Section Length (lane miles)	Min Lane Miles per Section	Max Lane Miles per Section
A	46.3	40.8	50.5
B	47.2	35.4	59.6
C	45.8	30.6	57.9
D	48.1	29.7	62.4
E	47.9	36.5	59.5
F	43.5	40.5	45.8

Table 4.2 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 (page 79).

4C. 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. Sometimes counties wait until the sun comes out so their salting and plowing efforts are more effective, which can increase average reaction times.

Table 4.3. Maintenance Crew Reaction Time

From winter storm reports, 2013/2014–2023/2024

	10-Year Average reaction time (hours)										10-year Average	Average reaction time (hours)	Percent change
Winter Service Group	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2013-2014 to 2022-2023	*2023-2024*	*2023-2024 vs. 10-year avg.*
A	2.31	0.32	1.21	0.37	0.52	0.48	1.01	0.23	1.15	0.10	**0.77**	***0.39***	***-49%***
B	4.48	1.67	2.4	1.07	1.34	1.16	1.26	1.30	1.13	1.15	**1.70**	***1.21***	***-29%***
C	4.99	2.57	3.19	2.22	2.61	2.16	2.24	2.66	2.29	2.40	**2.73**	***2.76***	***1%***
D	6.23	2.86	3.91	2.06	2.7	2.61	2.90	3.02	2.53	2.37	**3.12**	***3.01***	***-3%***
E	9.36	3.77	6.72	3.94	5.04	4.4	4.29	4.39	3.98	4.73	**5.06**	***4.43***	***-12%***
F	14.81	4.78	8.62	3.64	5.13	3.91	5.27	5.04	4.30	4.58	**6.01**	***4.07***	***-32%***
Statewide average (unweighted)	7.03	2.66	4.34	2.22	2.89	2.45	2.83	2.77	2.56	2.56	**3.23**	***2.65***	***-18%***

Using data from the weekly winter storm reports, Table 4.3 shows the average reaction time to storm events in each Winter Service Group. This winter the average reaction time of 2.65 hours was 18 percent faster than the latest 10-year average. 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.

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 would receive more materials, labor and equipment—and would show a quicker recovery to bare/wet pavement—than a rural, two-lane highway. For more information on these categories, see page 8.

Bare/wet condition is when the lanes of travel are wet and snow is no longer visible in the lane. Some winter levels of service are not expected to achieve a bare/wet condition as quickly as others.

"Time to bare/wet pavement" is measured from the reported end time of a storm. Table 4.4 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.

Table 4.4. Percentage to Bare/Wet Pavement

	Percent of Time the Highway Category Target Time to Bare/Wet Pavement was Met (Target Times: 4 hours for 24-Hour Roads; 6 hours for 18 Hour Roads)										
Highway Category	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
24-Hour Roads	66%	75%	78%	79%	73%	73%	78%	74%	79%	82%	83%
18-Hour Roads	59%	67%	71%	70%	60%	65%	67%	62%	66%	66%	68%
Target	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%

4D. COSTS

The total billed cost of statewide winter operations this winter was $72.3 million, making it 39 percent less costly than 2022-23. A number of factors drive the cost of winter maintenance, including both the nature and severity of the winter (i.e. how much work has to be performed), as well as the unit costs of the component elements of winter maintenance (i.e. cost per lane mile for salt, labor and equipment).

Winter maintenance costs per lane mile decreased in 2023-24 by about 39 percent from 2022-23. See Figure 4.3 for a statewide map of winter cost per lane-mile. Figure 4.1 shows the statewide average winter cost per lane mile and Winter Severity Index since the 1998-99 winter. The average Winter Severity Index was less in all regions compared with the previous winter.

Table 4.5 shows total winter maintenance costs statewide and for each region per lane mile, as well as relative to the region's average Winter Severity Index. The level of service provided in each county affects the total costs, and the mix of counties in a region affects the overall comparative costs.

Figure 4.2 shows in 2023-24 that all regions experienced lower costs compared to 2022-2023. The same is true while looking at comparison to the 5-year average that all regions experienced higher costs.

Table 4.5. Total Winter Costs Relative to Winter Severity, 2023-2024

Region	Average Winter Severity Index	Actual cost per lane mile	Relative cost per severity index point
SW	55.6	$2,151	$38.69
SE	56.7	$2,641	$46.58
NE	59.4	$2,239	$37.69
NC	66.2	$1,809	$27.33
NW	54.7	$1,699	$31.06
Statewide	58.7	$2,080	$35.43

Figure 4.1. Statewide Average Winter Costs per Lane Mile and Winter Severity Index, 2000-01 thru 2023-2024

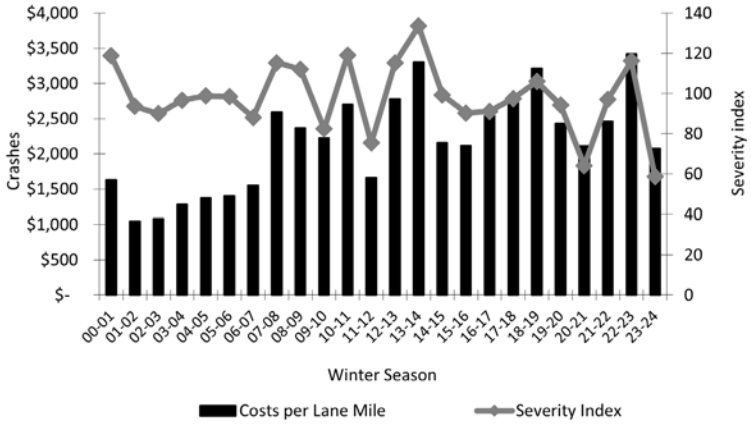


Figure 4.2. Total Winter Maintenance Cost by Region, 2022-23 vs. 2023-24 vs. Previous 5-Year Average

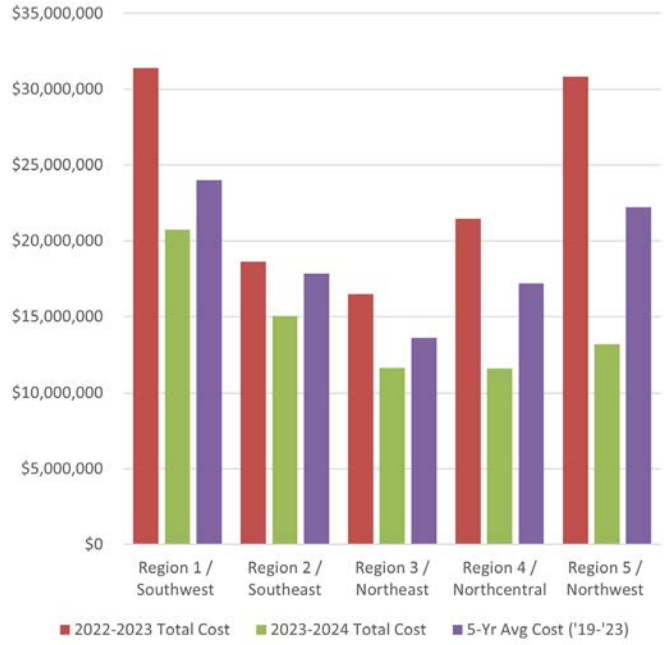
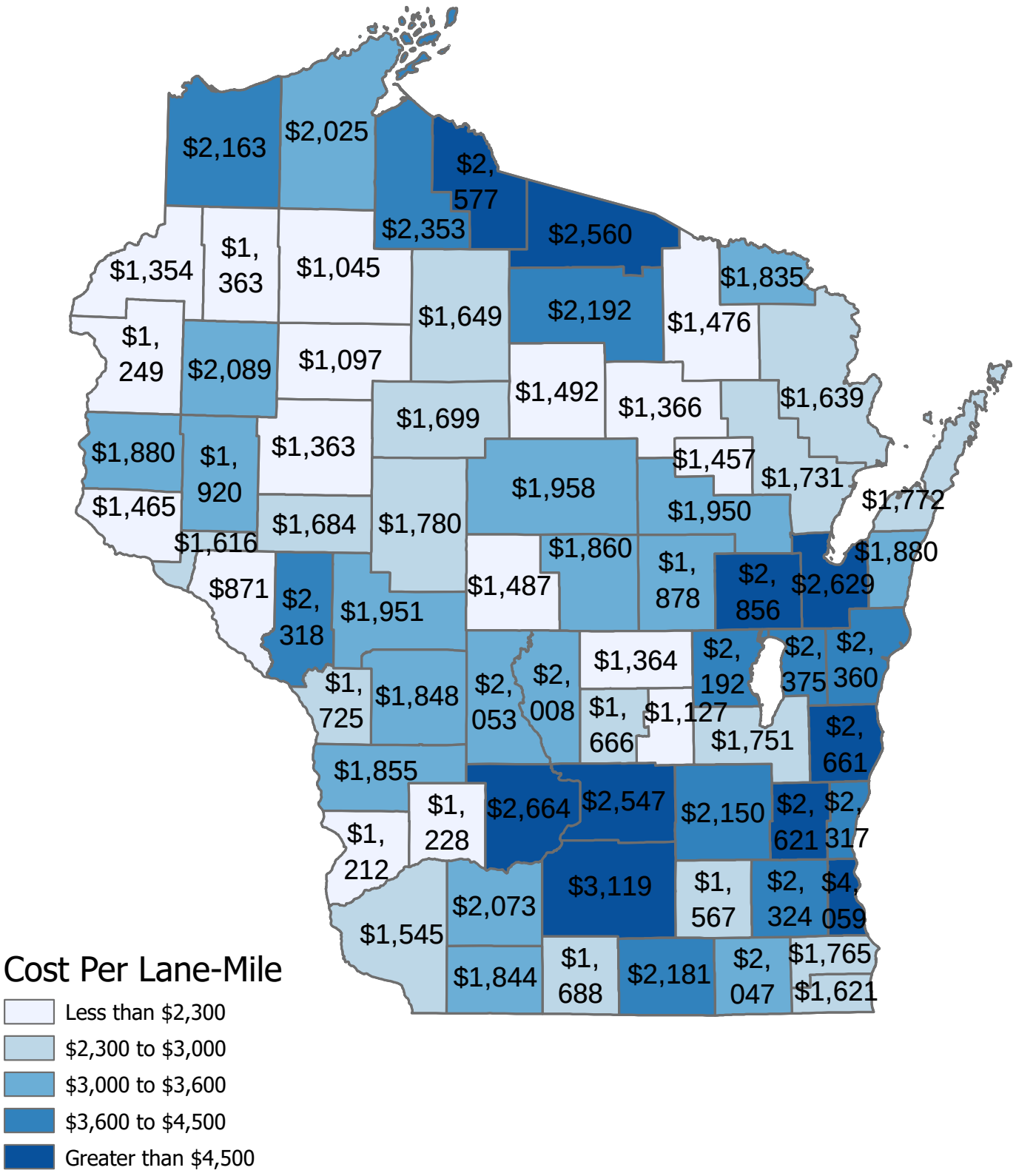


Figure 4.3 Winter Cost/Lane-Mile 2023-2024



Map created: July 2024

There are five major cost categories in the Department's winter maintenance billing system. These include: cost of salt used, labor costs, cost of other materials furnished by the county, and administration costs. Figure 4.4 shows the breakdown of the $72.3 million in 2023-24 statewide winter maintenance costs by these billing categories.

Figure 4.4. Statewide Winter Costs by Category

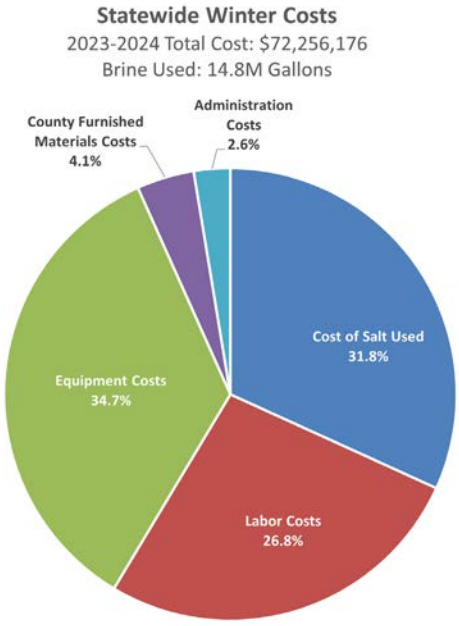


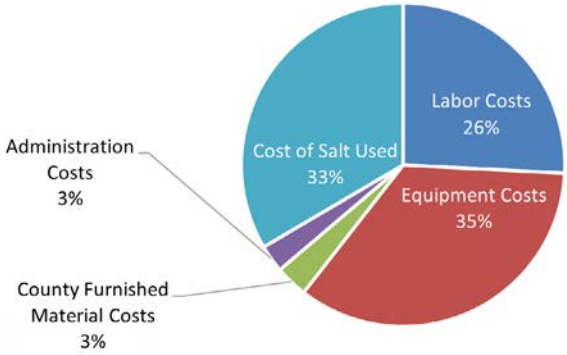
Figure 4.5 shows the breakdown of costs by billing category for each of the five regions. More specific, detailed cost figures by region and for the state as a whole are shown in Table 4.6.

In the five individual winter maintenance expenditure categories for 2023-24 statewide, the following trends were noted:

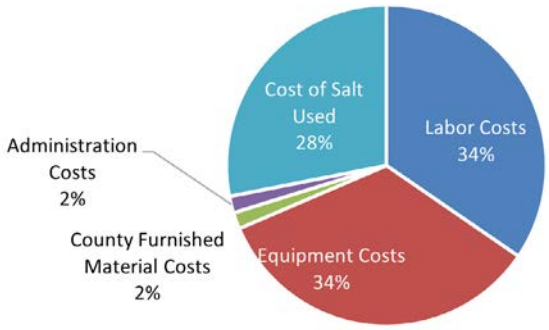
- Salt expenditures were $22.9 million - a 44 percent decrease compared to the previous winter. The Southwest region saw a 40 percent decrease from the previous winter, the Southeast region had a 30 percent decrease, the Northcentral region had a 47 percent decrease from last winter, the Northeast region had a 35 percent decrease from last winter, the Northwest region had a 58 percent decrease from last winter.
- Equipment expenditures were $25.1 million, a decrease of 41 percent compared to the previous winter.
- Labor expenditures were $19.3 million, a decrease of 33 percent from the previous winter.
- County Furnished Material Costs were $3.0 million, an increase of 23 percent compared with the previous winter.

Figure 4.5 Regional Winter Costs by Category, 2023-2024

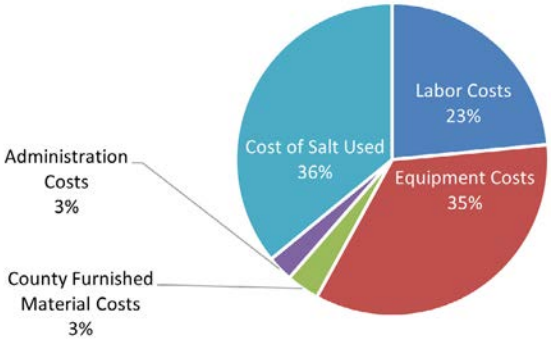
Southwest Region Winter Costs
2023-2024 Total Cost: $20,732,917
Brine Used: 2.8 M Gallons



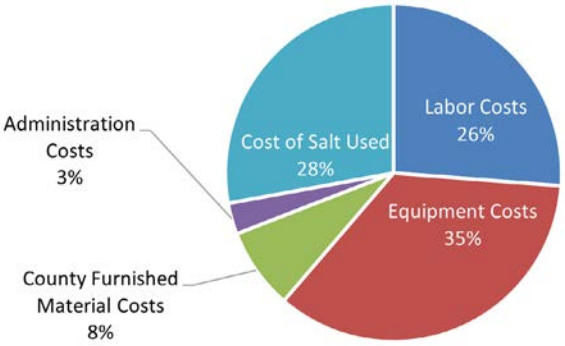
Southeast Region Winter Costs
2023-2024 Total Cost: $15,037,224
Brine Used: 1.7 M Gallons



Northwest Region Winter Costs
2023-2024 Total Cost: $13,224,480
Brine Used: 1.2 M Gallons



Northeast Region Winter Costs
2023-2024 Total Cost: $11,645,384
Brine Used: 4.3 M Gallons



Northcentral Region Winter Costs
2023-2024 Total Cost: $11,616,170
Brine Used: 4.7 M Gallons

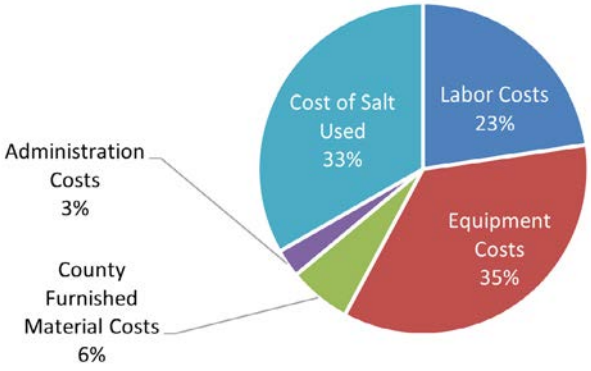
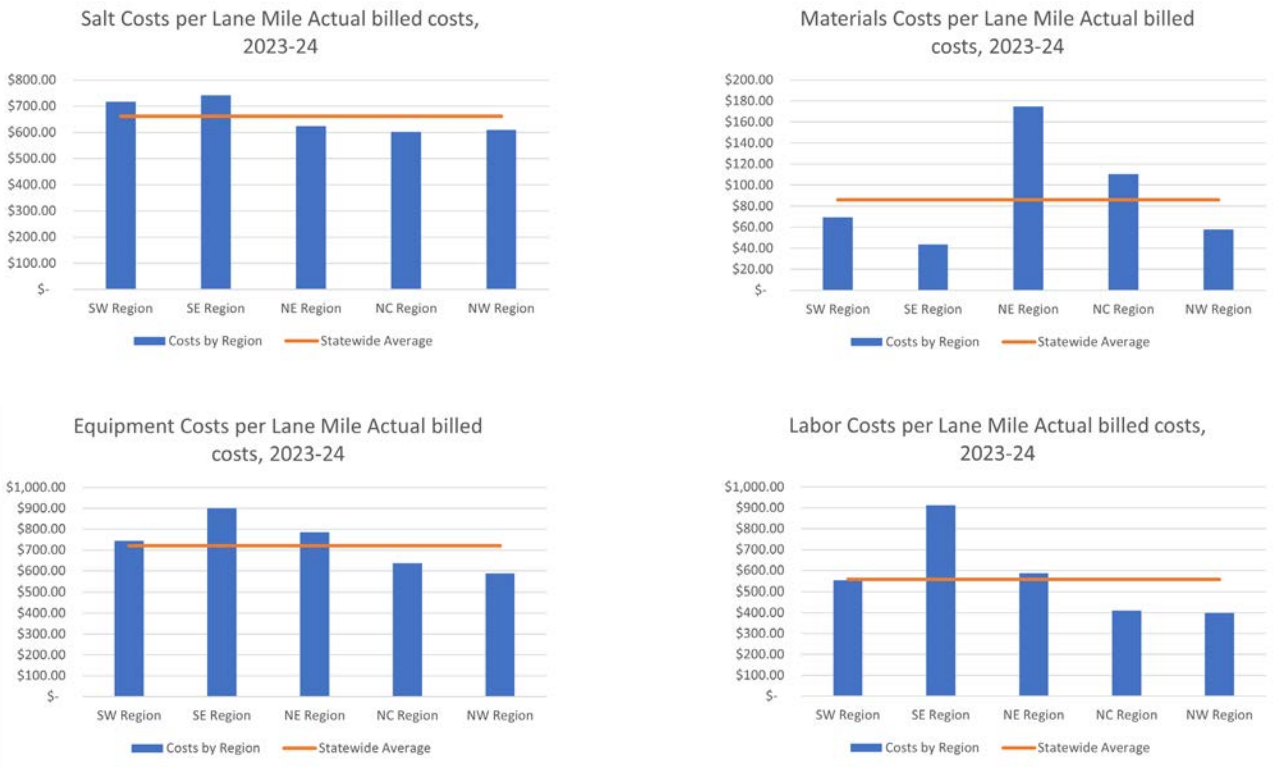


Table 4.6 Winter 2023-24 Expenses for County Services

Region	Labor Costs	Equipment Costs	County Furnished Material Costs	Administration Costs	Cost of Salt Used	Total Costs for Winter	Five Year Average Cost for Winter ('19-'23 avg)	% Total Costs over Five Year Average
Southwest	$5,362,482	$7,218,971	$668,901	$572,677	$6,909,887	$20,732,917	$24,009,000	-14%
Southeast	$5,194,202	$5,119,608	$248,882	$251,695	$4,222,838	$15,037,224	$17,830,600	-16%
Northeast	$3,052,457	$4,088,639	$910,420	$348,013	$3,245,854	$11,645,384	$13,646,700	-15%
North Central	$2,631,489	$4,089,645	$709,674	$321,371	$3,863,991	$11,616,170	$17,181,400	-32%
Northwest	$3,103,727	$4,566,639	$450,455	$351,244	$4,752,415	$13,224,480	$22,239,800	-41%
Totals	**$19,344,357**	**$25,083,501**	**$2,988,332**	**$1,845,000**	**$22,994,985**	**$72,256,176**	**$94,907,500**	**-24%**

Figure 4.6. Costs per Lane Mile by Category



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 3.1 for details on deicing agent costs).
- Administrative costs are calculated at 4.30 percent of each county's combined labor, equipment and materials costs, and cover the overhead costs for office activities.

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 4.6 shows the distribution of costs by category for each region.

County-by-county cost per lane mile data is available in Table 4.10.

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 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 fencing, 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 2023-2024, there were 4,124 reported winter weather crashes (those that occurred on pavements covered with snow, slush or ice), a 47 percent decrease over the previous winter. The statewide average crash rate (number of crashes per 100 million vehicle miles traveled) decreased from 25 to 13, a 48 percent decrease from the previous winter.

Crash rates tend to increase in more severe winters. Figure 4.7 shows the trends in total crashes statewide over the last 20 years overlaid with the Winter Severity Index. This past winter followed the trend that it was a very mild winter so there were not a lot of snow and ice related crashes.

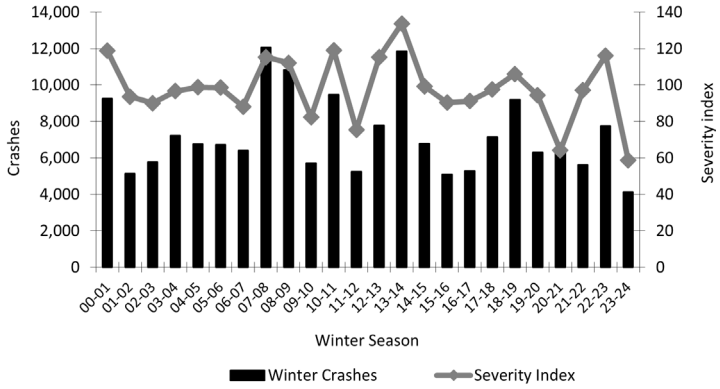
It's important to note that crash rates provide only a portion of the picture of overall winter safety. Crash rates include only "reportable" crashes, which exclude those that cause property damage under $1,000 that aren't required by law to be reported to police. Also, crashes in urban areas are more likely to occur at lower speeds and cause fewer deaths, while crashes on high-speed rural roads are more likely 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 decrease in crash rates, with the Northwest region seeing the greatest percentage decrease in crash rates (a 60 percent decrease), with this year's crash rate at 11 crashes per 100 million VMT (see Table 4.7). Table 4.12 gives the estimated number of vehicle miles traveled in each county this winter (November 2023 to April 2024), and the number of crashes that occurred in each county.

Figure 4.7 Winter Crashes and Winter Severity Index



Source: WisDOT Bureau of Transportation Safety

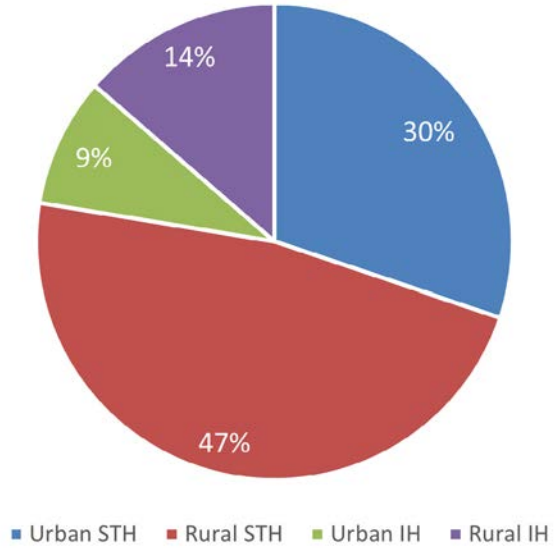
WisDOT tracks crashes according to the type of road where they occurred (urban or rural, and Interstate or other state or U.S. highway), and whether the road was divided or non-divided. Figure 4.8 shows that most winter crashes occur on rural state or U.S. highways, largely because there are more lane miles in this category than in the others. Table 4.13 shows the breakdown of crashes in each county according to highway type.

Photo Credit: Pixabay Commons License

Table 4.7 Crashes and Vehicle Miles of Travel by Region

Region	Winter Severity Index (2023-24)	VMT (100 million) (Nov 2023 - April 2024)	Snow/Slush/Ice Crashes (Nov 2023 - April 2024)	Crashes per 100M VMT (2022–2023)	Crashes per 100M VMT (2023–2024)
NC	66.2	38.7	506	28	13
NW	54.7	51.3	561	28	11
NE	59.4	56.9	837	24	15
SE	56.7	87.3	1,070	21	12
SW	55.6	79.1	1,150	27	15
Statewide	58.7	313.3	4,124	25	13

Figure 4.8. Winter Crashes by Highway Type, Bureau of Transportation Safety Data 2023-2024



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. This winter, total VMT ranged from a low of 15.2 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.

COUNTY-BY-COUNTY TABLES AND FIGURE FOR SECTION 4: PERFORMANCE

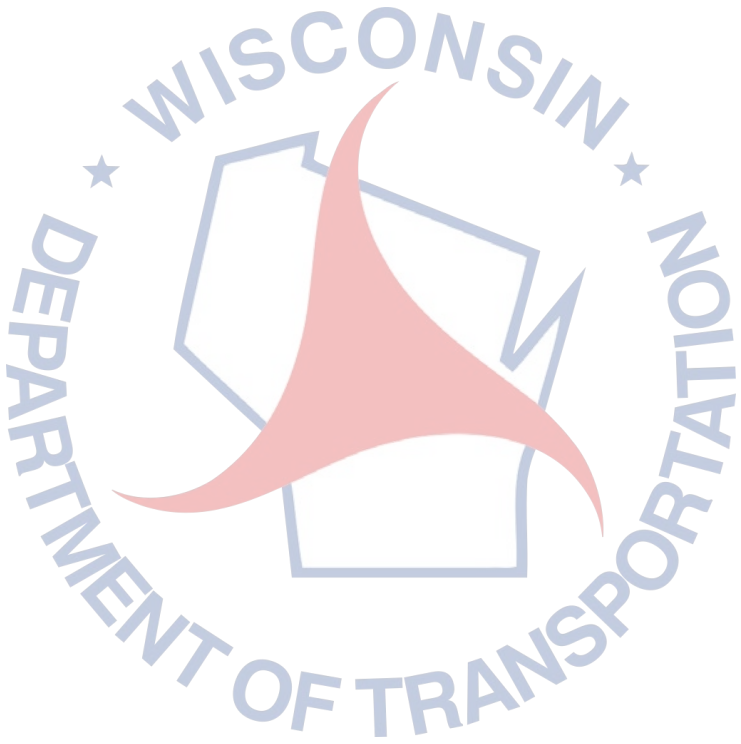

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Table 4.8. Winter Maintenance Sections

NC Region

County	Lane Miles	Winter Patrol Sections 2024	Lane Miles per Patrol Section	Winter Service Group
Adams	202.74	5	40.5	F
Florence	137.43	3	45.8	F
Forest	314.49	6	52.4	E
Green Lake	154.11	3	51.4	E
Iron	240.51	6	40.1	E
Langlade	300.29	6	50.0	E
Lincoln	399.39	10	39.9	C
Marathon	905.42	20	45.3	B
Marquette	246.61	5	49.3	D
Menominee	90.66	2	45.3	F
Oneida	395.39	10	39.5	D
Portage	531.62	15	35.4	B
Price	319.53	6	53.3	E
Shawano	530.27	14	37.9	C
Vilas	307.73	7	44.0	E
Waupaca	556.87	12	46.4	B
Waushara	343.69	6	57.3	D
Wood	443.36	10	44.3	C
Region Average			**45.5**	

NW Region

County	Lane Miles	Winter Patrol Sections 2024	Lane Miles per Patrol Section	Winter Service Group
Ashland	255.69	5	51.1	E
Barron	428.61	14	30.6	C
Bayfield	345.31	6	57.6	D
Buffalo	311.87	7	44.6	D
Burnett	235.35	5	47.1	E
Chippewa	653.17	16	40.8	B
Clark	401.81	10	40.2	C
Douglas	465.66	9	51.7	C
Dunn	521.20	9	57.9	C
Eau Claire	531.32	9	59.0	B
Jackson	520.32	9	57.8	C
Pepin	109.41	3	36.5	E
Pierce	368.08	7	52.6	C
Polk	374.54	6	62.4	D
Rusk	213.10	5	42.6	E
Saint Croix	653.47	12	54.5	B
Sawyer	357.20	6	59.5	E
Taylor	232.44	4	58.1	E
Trempeleau	420.25	11	38.2	D
Washburn	385.68	7	55.1	D
Region Average			**49.9**	

NE Region

County	Lane Miles	Winter Patrol Sections 2024	Lane Miles per Patrol Section	Winter Service Group
Brown	860.16	20	43.0	B
Calumet	219.46	6	36.6	E
Door	267.29	9	29.7	D
Fond du Lac	611.86	15	40.8	B
Kewaunee	126.39	3	42.1	F
Manitowoc	419.96	11	38.2	C
Marinette	414.39	9	46.0	D
Oconto	481.73	10	48.2	C
Outagamie	567.52	16	35.5	B
Sheboygan	543.53	10	54.4	C
Winnebago	688.27	18	38.2	B
Region Average			**41.2**	

SW Region

County	Lane Miles	Winter Patrol Sections 2024	Lane Miles per Patrol Section	Winter Service Group
Columbia	801.13	16	50.1	B
Crawford	398.22	8	49.8	C
Dane	1665.78	33	50.5	A
Dodge	667.73	17	39.3	B
Grant	646.92	11	58.8	B
Green	311.98	7	44.6	D
Iowa	457.10	10	45.7	C
Jefferson	552.87	10	55.3	B
Juneau	500.96	10	50.1	C
LaCrosse	483.56	13	37.2	C
Lafayette	294.51	6	49.1	D
Monroe	679.49	13	52.3	B
Richland	321.78	7	46.0	D
Rock	791.89	14	56.6	B
Sauk	594.09	12	49.5	B
Vernon	469.79	11	42.7	C
Region Average			**48.6**	

SE Region

County	Lane Miles	Winter Patrol Sections 2024	Lane Miles per Patrol Section	Winter Service Group
Kenosha	674.40	17	39.7	B
Milwaukee	1574.67	33	47.7	A
Ozaukee	321.10	6	53.5	D
Racine	774.85	13	59.6	B
Walworth	697.33	14	49.8	B
Washington	591.04	14	42.2	B
Waukesha	1059.84	26	40.8	A
Region Average			**47.6**	

	Lane Miles	Winter Patrol Sections 2024	Lane Miles per Patrol Section
Statewide Totals	34,736.2	754.0	46.1
Statewide Averages	482.4	10.5	46.1
Group A Averages	1,433.4	30.7	46.3
Group B Averages	668.2	14.5	47.2
Group C Averages	460.8	10.3	45.8
Group D Averages	339.6	7.3	48.1
Group E Averages	250.7	5.2	47.9
Group F Averages	139.3	3.3	43.5

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

From Winter Storm Reports, 2023-2024

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 precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
MILWAUKEE	SE	0.00	0.00	0.00	0.00	0.00	54.75	1.35
WAUKESHA	SE	2.67	0.65	-0.17	-0.17	1.18	53.09	1.34
DANE	SW	-1.33	0.46	-0.38		0.00	60.21	1.18
Group A Averages		0.44	0.37	-0.18	-0.08	0.39	56.02	1.29

Final totals as of Monday, July 1, 2024 **Page 1 of 1**

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

From Winter Storm Reports, 2023-2024

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 precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
OUTAGAMIE	NE	2.00	1.75	4.50		2.03	64.45	3.39
WASHINGTON	SE	0.30	0.25	0.70	0.50	0.36	75.45	2.91
SAUK	SW	0.87	0.14	0.50	0.75	0.50	50.63	2.89
WALWORTH	SE	0.10	1.23	0.75	0.00	0.93	64.79	2.27
PORTAGE	NC	3.57	4.12	2.00	1.25	3.63	73.22	2.20
EAU CLAIRE	NW	0.50	0.69	0.00		0.56	46.79	2.09
JEFFERSON	SW	0.00	0.19	-0.17	-1.50	0.20	62.30	2.00
FOND DU LAC	NE	4.00	2.53	1.50		2.50	54.84	1.98
BROWN	NE	0.00	1.11	0.62	0.50	0.70	59.76	1.97
WAUPACA	NC	1.50	1.19	1.00		1.17	57.46	1.95
WINNEBAGO	NE	0.50	1.50	7.00		1.33	49.39	1.81
ROCK	SW	0.10	0.61	1.00		0.52	50.66	1.78
GRANT	SW	0.17	0.44	0.00		0.32	50.39	1.68
KENOSHA	SE	1.00	0.82	0.75		0.76	54.09	1.60
RACINE	SE	1.00	0.81	2.08	1.13	0.84	61.74	1.55
SAINT CROIX	NW	1.25	1.78	1.25	1.25	1.71	31.17	1.20
CHIPPEWA	NW	2.50	3.10	3.50	1.00	2.47	48.57	1.16
Group B Averages		1.14	1.31	1.59	0.54	1.21	56.22	2.03

Final totals as of Monday, July 1, 2024 **Page 1 of 1**

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

From Winter Storm Reports, 2023-2024

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 precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
MANITOWOC		0.83	1.25			1.17	34.16	3.69
IOWA	SW	1.37	1.90	1.67	0.00	1.79	54.55	3.28
JUNEAU	SW	1.42	0.54	1.50	1.25	0.82	52.69	3.10
DOUGLAS	NW	2.28	2.91	1.70	2.00	2.18	87.46	3.05
SHEBOYGAN	NE	0.00	-0.64	1.00	0.50	-0.19	70.51	3.02
CLARK	NW	3.87	5.50	9.00	4.50	4.63	39.00	2.99
LINCOLN	NC	9.58	6.56	6.03	5.75	6.22	79.32	2.92
JACKSON	NW	0.62	2.10	2.03	2.29	1.63	60.10	2.90
BARRON	NW	5.50	5.82	3.59	3.00	4.22	62.07	2.77
VERNON	SW	2.00	1.00	1.14	2.70	1.80	88.46	2.66
DUNN	NW	1.69	2.50	0.17		1.93	57.34	2.48
SHAWANO	NC	2.00	2.53	6.60		3.45	85.33	2.32
OCONTO	NE	2.30	3.54	2.87		3.39	74.62	2.31
PIERCE	NW	-1.50	4.45	3.75		3.46	35.40	2.29
WOOD	NC	2.75	3.24	1.58	1.40	2.68	82.08	2.20
CRAWFORD	SW	3.92	5.50	4.00	3.25	5.00	74.48	2.18
Group C Averages		2.42	3.04	3.11	2.42	2.76	64.85	2.76

Final totals as of Monday, July 1, 2024 **Page 1 of 1**

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

From Winter Storm Reports, 2023-2024

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 precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
MARQUETTE	NC	1.94	2.10	1.25	0.64	1.88	65.94	4.40
TREMPEALEAU		0.25	2.50			1.43	54.83	4.21
DOOR	NE	4.00	2.05	4.00	14.50	3.02	68.64	4.02
BAYFIELD	NW	8.00	8.00	1.00		7.59	99.05	3.66
LAFAYETTE	SW	1.80	1.91	1.88		1.88	71.67	3.61
GREEN	SW	4.90	3.04	0.67	1.00	3.20	61.51	3.45
OZAUKEE	SE	1.50	1.42	0.88	1.40	1.44	44.04	3.30
MARINETTE	NE	-0.14	0.00	0.00		-0.03	95.04	3.05
RICHLAND	SW	3.50	2.60	5.50	5.50	2.86	34.68	2.77
ONEIDA	NC	7.33	9.06	8.04	2.00	7.69	93.73	2.70
WAUSHARA	NC	1.00	3.50	1.33	4.50	3.05	60.22	2.57
POLK		2.33	3.08			2.83	60.71	2.41
WASHBURN	NW	4.50	6.12	3.33	3.50	5.35	57.29	2.30
BUFFALO	NW	0.00	0.00	0.00	0.00	0.00	73.17	2.13
Group D Averages		2.92	3.24	2.32	3.67	3.01	67.18	3.18

Final totals as of Monday, July 1, 2024 **Page 1 of 1**

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

From Winter Storm Reports, 2023-2024

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 precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
PEPIN	NW	6.50	9.75	10.33	6.00	6.47	45.20	9.12
IRON	NC	4.37	2.89	0.92	1.14	3.11	103.24	7.06
CALUMET	NE	4.17	3.33	6.00		3.39	67.63	6.22
ASHLAND	NW	5.00	2.78	4.40		4.47	90.08	5.92
VILAS	NC	5.88	5.52	5.09	6.17	5.37	129.77	5.42
RUSK	NW	7.00	3.69	2.00		4.66	83.19	4.30
GREEN LAKE	NC	4.00	2.55	2.50		2.59	49.59	4.17
TAYLOR	NW	5.30	5.85	2.17		4.84	55.28	3.89
BURNETT	NW	8.25	4.25	4.08	5.72	5.44	48.94	3.84
PRICE	NC	2.92	3.03	3.34	3.00	3.12	79.29	3.58
FOREST	NC	6.00	5.74	5.10		5.61	101.61	3.01
LANGLADE	NC	6.14	4.30	3.81		4.62	84.91	2.65
SAWYER	NW	4.43	3.50	2.50	0.00	3.85	71.69	2.06
Group E Averages		5.38	4.40	4.02	3.67	4.43	77.73	4.71

Final totals as of Monday, July 1, 2024 **Page 1 of 1**

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

From Winter Storm Reports, 2023-2024

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 precipitation types but when calculating the average time difference for a particular precipitation type this is not taken into account.

County	Region	Precipitation Type (Average Time in Hours)					Severity Index	Cost per LM per Severity Index
		Dry Snow	Wet Snow	Freezing Rain	Sleet	All Precip. Types		
MENOMINEE	NC	4.00	3.25	3.62		3.24	62.34	12.89
FLORENCE	NC	4.50	5.29	2.00	1.25	4.67	77.24	9.29
KEWAUNEE	NE	3.50	3.44	3.92	3.93	3.44	67.52	9.19
ADAMS	NC	4.71	5.33	4.67	5.50	4.92	65.34	8.24
Group F Averages		4.18	4.33	3.55	3.56	4.07	68.11	9.90

Final totals as of Monday, July 1, 2024 **Page 1 of 1**

Table 4.10 Winter Maintenance Costs Per Lane Mile, 2024 Fiscal Year

County #		Total Labor	Labor $'s per Lane Mile	Total Equipment	Equip $'s per Lane Mile	Total Materials	Materials $'s Lane Mile	Total Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2024 Winter Costs	2024 LOS Lane Miles	Winter Costs Per Lane Mile
	Southwest Region												
11	Columbia	$465,169	$581	$621,442	$776	$68,245	$85	$49,900	$835,961	8,171	$2,040,717	801.13	$2,547
12	Crawford	$117,791	$296	$170,838	$429	$9,622	$24	$12,891	$171,353	1,792	$482,495	398.22	$1,212
13	Dane	$1,763,794	$1,059	$1,860,492	$1,117	$158,401	$95	$163,465	$1,249,478	13,894	$5,195,630	1,665.78	$3,119
14	Dodge	$287,787	$431	$535,653	$802	$56,983	$85	$38,027	$517,287	6,245	$1,435,736	667.73	$2,150
22	Grant	$259,113	$401	$331,241	$512	$20,153	$31	$26,393	$362,837	4,041	$999,738	646.92	$1,545
23	Green	$157,636	$505	$192,101	$616	$11,952	$38	$15,650	$149,261	1,386	$526,600	311.98	$1,688
25	Iowa	$259,211	$567	$323,231	$707	$6,005	$13	$25,455	$333,549	3,593	$947,451	457.10	$2,073
28	Jefferson	$228,134	$413	$392,380	$710	$37,299	$67	$28,381	$180,235	2,012	$866,429	552.87	$1,567
29	Juneau	$189,125	$378	$330,697	$660	$35,529	$71	$24,005	$449,334	4,387	$1,028,691	500.96	$2,053
32	La Crosse	$193,540	$400	$322,889	$668	$65,272	$135	$25,173	$227,502	2,603	$834,376	483.56	$1,725
33	Lafayette	$128,185	$435	$172,176	$585	$77,768	$264	$16,356	$148,574	1,599	$543,059	294.51	$1,844
41	Monroe	$225,113	$331	$370,252	$545	$6,629	$10	$26,030	$627,619	6,452	$1,255,643	679.49	$1,848
52	Richland	$85,566	$266	$148,245	$461	$457	$1	$10,114	$150,887	1,496	$395,269	321.78	$1,228
53	Rock	$477,831	$603	$677,348	$855	$55,130	$70	$52,328	$464,361	5,224	$1,726,998	791.89	$2,181
56	Sauk	$343,454	$578	$439,493	$740	$28,354	$48	$35,055	$736,208	6,930	$1,582,564	594.09	$2,664
62	Vernon	$181,033	$385	$330,493	$703	$31,103	$66	$23,453	$305,441	3,342	$871,522	469.79	$1,855
	SWR Totals	**$5,362,482**	**$556**	**$7,218,971**	**$749**	**$668,901**	**$69**	**$572,677**	**$6,909,887**	**73,167**	**$20,732,917**	**9,637.80**	**$2,151**

Table 4.10 Winter Maintenance Costs Per Lane Mile, 2024 Fiscal Year

County #		Total Labor	Labor $'s per Lane Mile	Total Equipment	Equip $'s per Lane Mile	Total Materials	Materials $'s Lane Mile	Total Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2024 Winter Costs	2024 LOS Lane Miles	Winter Costs Per Lane Mile
	Southeast Region												
30	**Kenosha**	$365,626	$542	$468,058	$694	$13,249	$20	$36,530	$210,047	2,624	$1,093,510	674.40	$1,621
40	**Milwaukee**	$2,882,363	$1,830	$1,822,658	$1,157	$27,960	$18	$0	$1,659,134	21,776	$6,392,115	1,574.67	$4,059
45	**Ozaukee**	$288,460	$898	$219,250	$683	$44,876	$140	$23,881	$167,617	2,194	$744,084	321.10	$2,317
51	**Racine**	$394,601	$509	$459,069	$592	$14,447	$19	$37,486	$461,892	5,497	$1,367,495	774.85	$1,765
64	**Walworth**	$323,084	$463	$581,675	$834	$39,145	$56	$40,792	$442,975	5,594	$1,427,672	697.33	$2,047
66	**Washington**	$372,659	$631	$585,413	$990	$28,274	$48	$42,621	$520,219	5,974	$1,549,186	591.04	$2,621
67	**Waukesha**	$567,409	$535	$983,484	$928	$80,931	$76	$70,386	$760,954	9,787	$2,463,163	1,059.84	$2,324
	SER Totals	**$5,194,202**	**$912**	**$5,119,608**	**$899**	**$248,882**	**$44**	**$251,695**	**$4,222,838**	**53,446**	**$15,037,224**	**5,693.23**	**$2,641**
		$0.345											

County #		Total Labor	Labor $'s per Lane Mile	Total Equipment	Equip $'s per Lane Mile	Total Materials	Materials $'s Lane Mile	Total Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2024 Winter Costs	2024 LOS Lane Miles	Winter Costs Per Lane Mile
	Northeast Region												
5	**Brown**	$479,851	$558	$952,721	$1,108	$117,226	$136	$66,961	$644,677	8,929	$2,261,437	860.16	$2,629
8	**Calumet**	$162,496	$740	$177,182	$807	$49,703	$226	$16,828	$114,967	1,292	$521,176	219.46	$2,375
15	**Door**	$162,299	$607	$169,180	$633	$24,339	$91	$15,377	$102,574	1,128	$473,769	267.29	$1,772
20	**Fond du Lac**	$315,216	$515	$406,232	$664	$41,822	$68	$32,945	$274,909	3,148	$1,071,124	611.86	$1,751
31	**Kewaunee**	$54,517	$431	$74,925	$593	$29,168	$231	$6,854	$72,096	789	$237,560	126.39	$1,880
36	**Manitowoc**	$280,119	$667	$319,479	$761	$46,965	$112	$27,924	$316,541	3,788	$991,028	419.96	$2,360
38	**Marinette**	$167,124	$403	$257,366	$621	$18,178	$44	$19,109	$217,421	2,817	$679,197	414.39	$1,639
42	**Oconto**	$232,531	$483	$275,325	$572	$34,260	$71	$23,459	$268,108	3,389	$833,684	481.73	$1,731
44	**Outagamie**	$475,281	$837	$484,165	$853	$96,318	$170	$45,637	$519,635	6,467	$1,621,036	567.52	$2,856
59	**Sheboygan**	$392,767	$723	$453,961	$835	$255,397	$470	$47,665	$296,580	3,101	$1,446,369	543.53	$2,661
70	**Winnebago**	$330,256	$480	$518,102	$753	$197,045	$286	$45,254	$418,347	4,997	$1,509,004	688.27	$2,192
	NER Totals	**$3,052,457**	**$587**	**$4,088,639**	**$786**	**$910,420**	**$175**	**$348,013**	**$3,245,854**	**39,847**	**$11,645,384**	**5,200.56**	**$2,239**

Table 4.10 Winter Maintenance Costs Per Lane Mile, 2024 Fiscal Year

County #		Total Labor	Labor $'s per Lane Mile	Total Equipment	Equip $'s per Lane Mile	Total Materials	Materials $'s Lane Mile	Total Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2024 Winter Costs	2024 LOS Lane Miles	Winter Costs Per Lane Mile
	North Central Region												
1	Adams	$61,525	$303	$107,884	$532	$6,470	$32	$7,611	$223,578	2,054	$407,068	202.74	$2,008
19	Florence	$40,049	$291	$81,327	$592	$14,861	$108	$5,885	$110,127	1,121	$252,249	137.43	$1,835
21	Forest	$84,920	$270	$189,666	$603	$14,086	$45	$12,480	$162,969	1,682	$464,120	314.49	$1,476
24	Green Lake	$57,637	$374	$69,623	$452	$2,405	$16	$5,608	$38,460	373	$173,733	154.11	$1,127
26	Iron	$150,076	$624	$218,851	$910	$9,423	$39	$16,361	$225,097	2,085	$619,807	240.51	$2,577
34	Langlade	$119,775	$399	$157,692	$525	$32,362	$108	$13,413	$86,937	881	$410,178	300.29	$1,366
35	Lincoln	$144,123	$361	$183,325	$459	$13,380	$34	$14,752	$240,392	2,333	$595,972	399.39	$1,492
37	Marathon	$322,718	$356	$528,378	$584	$167,292	$185	$44,043	$710,029	7,072	$1,772,460	905.42	$1,958
39	Marquette	$78,579	$319	$141,883	$575	$71,480	$290	$12,629	$106,302	1,050	$410,873	246.61	$1,666
73	Menominee	$19,804	$218	$40,149	$443	$3,323	$37	$2,734	$66,115	691	$132,125	90.66	$1,457
43	Oneida	$212,895	$538	$312,663	$791	$136,246	$345	$28,643	$176,069	1,769	$866,515	395.39	$2,192
49	Portage	$301,113	$566	$419,977	$790	$30,073	$57	$32,477	$205,013	2,195	$988,653	531.62	$1,860
50	Price	$122,401	$383	$190,931	$598	$21,777	$68	$14,507	$177,364	1,713	$526,980	319.53	$1,649
58	Shawano	$257,563	$486	$378,240	$713	$47,596	$90	$29,519	$321,250	3,767	$1,034,169	530.27	$1,950
63	Vilas	$113,393	$368	$285,724	$928	$74,744	$243	$20,506	$293,291	2,690	$787,657	307.73	$2,560
68	Waupaca	$245,776	$441	$358,807	$644	$46,465	$83	$28,146	$366,353	4,307	$1,045,547	556.87	$1,878
69	Waushara	$142,709	$415	$165,311	$481	$496	$1	$13,337	$146,788	1,404	$468,642	343.69	$1,364
71	Wood	$156,434	$353	$259,215	$585	$17,194	$39	$18,720	$207,858	2,084	$659,422	443.36	$1,487
	NCR Totals	**$2,631,489**	**$410**	**$4,089,645**	**$637**	**$709,674**	**$111**	**$321,371**	**$3,863,991**	**39,271**	**$11,616,170**	**6,420.11**	**$1,809**

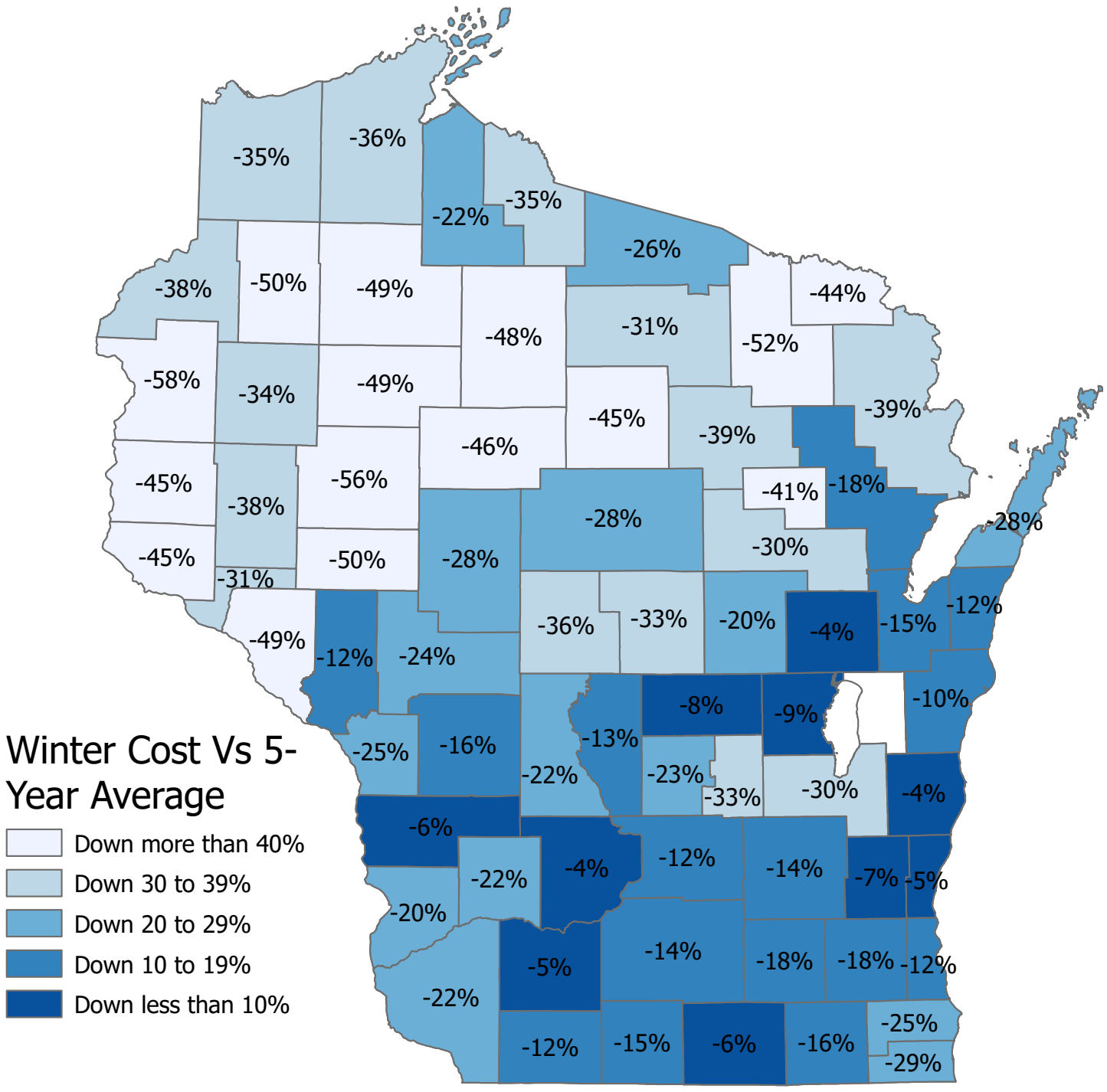
Table 4.10 Winter Maintenance Costs Per Lane Mile, 2024 Fiscal Year

County #		Total Labor	Labor $'s per Lane Mile	Total Equipment	Equip $'s per Lane Mile	Total Materials	Materials $'s Lane Mile	Total Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2024 Winter Costs	2024 LOS Lane Miles	Winter Costs Per Lane Mile
	Northwest Region												
2	Ashland	$92,543	$362	$209,950	$821	$69,864	$273	$16,105	$213,247	2,096	$601,709	255.69	$2,353
3	Barron	$295,866	$690	$289,170	$675	$9,147	$21	$25,687	$275,602	3,046	$895,471	428.61	$2,089
4	Bayfield	$170,728	$494	$276,053	$799	$31,642	$92	$20,689	$200,089	2,220	$699,199	345.31	$2,025
6	Buffalo	$62,446	$200	$106,541	$342	$0	$0	$7,305	$95,500	982	$271,791	311.87	$871
7	Burnett	$61,631	$262	$85,075	$361	$33,251	$141	$7,791	$130,863	1,365	$318,611	235.35	$1,354
9	Chippewa	$314,828	$482	$352,999	$540	$12,004	$18	$29,367	$181,382	1,818	$890,580	653.17	$1,363
10	Clark	$162,717	$405	$201,678	$502	$24	$0	$15,753	$334,919	2,961	$715,091	401.81	$1,780
16	Douglas	$180,999	$389	$358,414	$770	$83,381	$179	$26,941	$357,254	4,416	$1,006,990	465.66	$2,163
17	Dunn	$211,481	$406	$331,865	$637	$17,681	$34	$24,255	$415,601	4,313	$1,000,882	521.20	$1,920
18	Eau Claire	$218,440	$411	$374,318	$705	$407	$1	$25,657	$275,884	2,664	$894,706	531.32	$1,684
27	Jackson	$152,455	$293	$297,067	$571	$29,456	$57	$20,727	$515,339	5,139	$1,015,044	520.32	$1,951
46	Pepin	$72,728	$665	$56,486	$516	$4,309	$39	$5,781	$37,526	375	$176,830	109.41	$1,616
47	Pierce	$120,096	$326	$189,511	$515	$7,652	$21	$13,726	$208,208	2,207	$539,193	368.08	$1,465
48	Polk	$89,141	$238	$179,185	$478	$15,768	$42	$12,297	$171,472	1,881	$467,863	374.54	$1,249
54	Rusk	$40,334	$189	$71,966	$338	$6,870	$32	$5,156	$109,502	1,083	$233,829	213.10	$1,097
57	Sawyer	$74,235	$208	$131,395	$368	$6,403	$18	$9,170	$151,920	1,616	$373,122	357.20	$1,045
55	St. Croix	$357,200	$547	$450,505	$689	$83,433	$128	$38,576	$299,120	3,299	$1,228,834	653.47	$1,880
60	Taylor	$125,882	$542	$142,657	$614	$6,376	$27	$11,894	$108,137	946	$394,945	232.44	$1,699
61	Trempealeau	$189,380	$451	$288,009	$685	$895	$2	$20,683	$475,007	4,848	$973,974	420.25	$2,318
65	Washburn	$110,598	$287	$173,795	$451	$31,892	$83	$13,685	$195,844	2,150	$525,814	385.68	$1,363
	NWR Totals	**$3,103,727**	**$399**	**$4,566,639**	**$587**	**$450,455**	**$58**	**$351,244**	**$4,752,415**	**49,425**	**$13,224,480**	**7,784.48**	**$1,699**

Table 4.10 Winter Maintenance Costs Per Lane Mile, 2024 Fiscal Year

	Total Labor	Labor $'s per Lane Mile	Total Equipment	Equip $'s per Lane Mile	Total Materials	Materials $'s Lane Mile	Total Admin	Cost of Salt Used	Tons of Salt Used	Total FY 2024 Winter Costs	2024 LOS Lane Miles	Winter Costs Per Lane Mile
STATEWIDE SUMMARY												
SW Region	$5,362,482	$556	$7,218,971	$749	$668,901	$69	$572,677	$6,909,887	73,167	$20,732,917	9,637.80	$2,151
SE Region	$5,194,202	$912	$5,119,608	$899	$248,882	$44	$251,695	$4,222,838	53,446	$15,037,224	5,693.23	$2,641
NE Region	$3,052,457	$587	$4,088,639	$786	$910,420	$175	$348,013	$3,245,854	39,847	$11,645,384	5,200.56	$2,239
NC Region	$2,631,489	$410	$4,089,645	$637	$709,674	$111	$321,371	$3,863,991	39,271	$11,616,170	6,420.11	$1,809
NW Region	$3,103,727	$399	$4,566,639	$587	$450,455	$58	$351,244	$4,752,415	49,425	$13,224,480	7,784.48	$1,699
Statewide Totals	$19,344,357	$557	$25,083,501	$722	$2,988,332	$86	$1,845,000	$22,994,986	255,155	$72,256,176	34,736.18	$2,080

Figure 4.10. 2023-2024 Winter Costs vs. 5-Year Average



Map created: October 2024

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

From Winter Storm Reports, 2023-2024

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
MILWAUKEE	SE	1,574.67	54.75	37.1	21776	13.83	0.25	$3,327,000	$2,128	1.35
WAUKESHA	SE	1,059.84	53.09	45.7	9787	9.23	0.17	$1,497,000	$1,423	1.34
DANE	SW	1,665.78	60.21	42.7	13894	8.34	0.14	$3,239,000	$1,964	1.18
Group A Averages		1,433.43	56.02	41.8	15152	10.47	0.19	$2,687,667	$1,839	1.29

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

From Winter Storm Reports, 2023-2024

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
OUTAGAMIE	NE	567.52	64.45	47.5	6467	11.40	0.18	$992,000	$1,927	3.39
WASHINGTON	SE	591.04	75.45	57.3	5974	10.11	0.13	$1,003,000	$1,721	2.91
SAUK	SW	594.09	50.63	20.5	6930	11.66	0.23	$1,014,000	$1,715	2.89
DODGE	SW	667.73	53.30	59.0	6245	9.35	0.18	$1,032,000	$1,555	2.33
COLUMBIA	SW	801.13	67.74	50.1	8171	10.20	0.15	$1,441,000	$1,842	2.30
WALWORTH	SE	697.33	64.79	51.8	5594	8.02	0.12	$1,044,000	$1,584	2.27
MONROE	SW	679.49	61.43	41.8	6452	9.50	0.15	$1,015,000	$1,497	2.20
PORTAGE	NC	531.62	73.22	47.8	2195	4.13	0.06	$614,000	$1,167	2.20
EAU CLAIRE	NW	531.32	46.79	28.1	2664	5.01	0.11	$585,000	$1,112	2.09
JEFFERSON	SW	552.87	62.30	50.5	2012	3.64	0.06	$612,000	$1,107	2.00
FOND DU LAC	NE	611.86	54.84	47.0	3148	5.14	0.09	$708,000	$1,209	1.98
BROWN	NE	860.16	59.76	64.6	8929	10.38	0.17	$1,439,000	$1,691	1.97
WAUPACA	NC	556.87	57.46	48.7	4307	7.73	0.13	$600,000	$1,085	1.95
WINNEBAGO	NE	688.27	49.39	45.8	4997	7.26	0.15	$852,000	$1,243	1.81
ROCK	SW	791.89	50.66	42.0	5224	6.60	0.13	$1,111,000	$1,410	1.78
GRANT	SW	646.92	50.39	51.7	4041	6.25	0.12	$687,000	$1,089	1.68
MARATHON	NC	905.42	82.52	40.3	7072	7.81	0.09	$1,288,000	$1,458	1.61
KENOSHA	SE	674.40	54.09	4.5	2624	3.89	0.07	$726,000	$1,077	1.60

Final totals as of Monday, July 1, 2024

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

From Winter Storm Reports, 2023-2024

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
RACINE	SE	774.85	61.74	39.0	5497	7.09	0.11	$928,000	$1,205	1.55
SAINT CROIX	NW	653.47	31.17	19.4	3299	5.05	0.16	$502,000	$783	1.20
CHIPPEWA	NW	653.17	48.57	32.6	1818	2.78	0.06	$490,000	$760	1.16
Group B Averages		668.16	58.13	42.4	4936	7.29	0.13	$889,667	$1,345	2.04

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

From Winter Storm Reports, 2023-2024

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
MANITOWOC	NE	419.96	34.16	30.8	3788	9.02	0.26	$647,000	$1,551	3.69
IOWA	SW	457.10	54.55	46.3	3593	7.86	0.14	$680,000	$1,498	3.28
JUNEAU	SW	500.96	52.69	40.7	4387	8.76	0.17	$775,000	$1,555	3.10
DOUGLAS	NW	465.66	87.46	57.1	4416	9.48	0.11	$655,000	$1,418	3.05
SHEBOYGAN	NE	543.53	70.51	54.4	3101	5.71	0.08	$814,000	$1,640	3.02
CLARK	NW	401.81	39.00	29.6	2961	7.37	0.19	$481,000	$1,203	2.99
LINCOLN	NC	399.39	79.32	47.7	2333	5.84	0.07	$449,000	$1,167	2.92
JACKSON	NW	520.32	60.10	39.7	5139	9.88	0.16	$784,000	$1,509	2.90
BARRON	NW	428.61	62.07	34.1	3046	7.11	0.11	$507,000	$1,187	2.77
VERNON	SW	469.79	88.46	35.3	3342	7.11	0.08	$575,000	$1,251	2.66
DUNN	NW	521.20	57.34	37.8	4313	8.27	0.14	$668,000	$1,293	2.48
SHAWANO	NC	530.27	85.33	70.5	3767	7.10	0.08	$652,000	$1,232	2.32
OCONTO	NE	481.73	74.62	49.2	3389	7.04	0.09	$526,000	$1,111	2.31
PIERCE	NW	368.08	35.40	26.6	2207	6.00	0.17	$309,000	$843	2.29
WOOD	NC	443.36	82.08	42.0	2084	4.70	0.06	$431,000	$976	2.20
CRAWFORD	SW	398.22	74.48	41.1	1792	4.50	0.06	$344,000	$868	2.18
LA CROSSE	SW	483.56	27.54	43.0	2603	5.38	0.20	$378,000	$806	1.67

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

From Winter Storm Reports, 2023-2024

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 C Averages		460.80	62.65	42.7	3309	7.13	0.13	$569,118	$1,242	2.70

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

From Winter Storm Reports, 2023-2024

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
MARQUETTE	NC	246.61	65.94	49.5	1050	4.26	0.06	$263,000	$1,084	4.40
TREMPEALEAU	NW	420.25	54.83	35.1	4848	11.54	0.21	$741,000	$1,770	4.21
DOOR	NE	267.29	68.64	56.0	1128	4.22	0.06	$283,000	$1,074	4.02
BAYFIELD	NW	345.31	99.05	61.7	2220	6.43	0.06	$429,000	$1,264	3.66
LAFAYETTE	SW	294.51	71.67	46.2	1599	5.43	0.08	$312,000	$1,063	3.61
GREEN	SW	311.98	61.51	40.9	1386	4.44	0.07	$328,000	$1,077	3.45
OZAUKEE	SE	321.10	44.04	37.1	2194	6.83	0.16	$336,000	$1,059	3.30
MARINETTE	NE	414.39	95.04	63.7	2817	6.80	0.07	$515,000	$1,262	3.05
RICHLAND	SW	321.78	34.68	25.0	1496	4.65	0.13	$282,000	$892	2.77
ONEIDA	NC	395.39	93.73	55.4	1769	4.47	0.05	$421,000	$1,069	2.70
WAUSHARA	NC	343.69	60.22	52.8	1404	4.09	0.07	$299,000	$883	2.57
POLK	NW	374.54	60.71	43.0	1881	5.02	0.08	$335,000	$902	2.41
WASHBURN	NW	385.68	57.29	18.9	2150	5.57	0.10	$341,000	$888	2.30
BUFFALO	NW	311.87	73.17	35.2	982	3.15	0.04	$206,000	$663	2.13
Group D Averages		339.60	67.18	44.3	1923	5.49	0.09	$363,643	$1,068	3.18

Final totals as of Monday, July 1, 2024

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

From Winter Storm Reports, 2023-2024

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
PEPIN	NW	109.41	45.20	28.9	375	3.43	0.08	$109,000	$998	9.12
IRON	NC	240.51	103.24	93.1	2085	8.67	0.08	$404,000	$1,699	7.06
CALUMET	NE	219.46	67.63	53.1	1292	5.89	0.09	$298,000	$1,364	6.22
ASHLAND	NW	255.69	90.08	65.4	2096	8.20	0.09	$376,000	$1,513	5.92
VILAS	NC	307.73	129.77	71.6	2690	8.74	0.07	$511,000	$1,668	5.42
RUSK	NW	213.10	83.19	39.2	1083	5.08	0.06	$195,000	$916	4.30
GREEN LAKE	NC	154.11	49.59	47.3	373	2.42	0.05	$98,000	$642	4.17
TAYLOR	NW	232.44	55.28	36.1	946	4.07	0.07	$195,000	$904	3.89
BURNETT	NW	235.35	48.94	34.1	1365	5.80	0.12	$210,000	$904	3.84
PRICE	NC	319.53	79.29	35.0	1713	5.36	0.07	$359,000	$1,144	3.58
FOREST	NC	314.49	101.61	67.3	1682	5.35	0.05	$296,000	$948	3.01
LANGLADE	NC	300.29	84.91	59.1	881	2.93	0.03	$237,000	$797	2.65
SAWYER	NW	357.20	71.69	32.7	1616	4.52	0.06	$262,000	$734	2.06
Group E Averages		250.72	77.73	51.0	1400	5.42	0.07	$273,077	$1,095	4.71

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

From Winter Storm Reports, 2023-2024

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
MENOMINEE	NC	90.66	62.34	48.2	691	7.62	0.12	$105,000	$1,169	12.89
FLORENCE	NC	137.43	77.24	52.6	1121	8.16	0.11	$173,000	$1,277	9.29
KEWAUNEE	NE	126.39	67.52	60.1	789	6.24	0.09	$142,000	$1,162	9.19
ADAMS	NC	202.74	65.34	45.6	2054	10.13	0.16	$326,000	$1,671	8.24
Group F Averages		139.31	68.11	51.6	1164	8.04	0.12	$186,500	$1,320	9.90

Table 4.12. Winter Crashes per 100 Million Vehicle Miles of Travel

Bureau of transportation Safety data, Nov. 1, 2023 - April 30, 2024 State, U.S. and Interstate Highways only

WisDOT REGION / COUNTY	2023-24 WINTER VEHICLE MILES OF TRAVEL (VMT)	2023-24 WINTER CRASHES	CRASH RATE PER 100M VMT
NORTH CENTRAL			
ADAMS	111,800,000	15	13
FLORENCE	41,800,000	4	10
FOREST	73,700,000	13	18
GREEN LAKE	102,600,000	7	7
IRON	59,700,000	13	22
LANGLADE	107,500,000	17	16
LINCOLN	271,400,000	18	7
MARATHON	843,000,000	112	13
MARQUETTE	144,200,000	31	21
MENOMINEE	15,200,000	3	20
ONEIDA	256,900,000	43	17
PORTAGE	456,400,000	60	13
PRICE	96,500,000	10	10
SHAWANO	320,300,000	17	5
VILAS	165,100,000	20	12
WAUPACA	293,100,000	45	15
WAUSHARA	182,300,000	32	18
WOOD	328,500,000	46	14
Region Total	**3,870,000,000**	**506**	**13**
NORTHEAST			
BROWN	1,166,000,000	143	12
CALUMET	209,500,000	46	22
DOOR	254,300,000	21	8
FOND DU LAC	599,000,000	95	16
KEWAUNEE	105,400,000	14	13
MANITOWOC	394,400,000	89	23
MARINETTE	448,200,000	19	4
OCONTO	316,300,000	18	6
OUTAGAMIE	789,200,000	99	13
SHEBOYGAN	506,800,000	125	25
WINNEBAGO	901,100,000	168	19
Region Total	**5,690,200,000**	**837**	**15**

Table 4.12. Winter Crashes per 100 Million Vehicle Miles of Travel

Bureau of transportation Safety data, Nov. 1, 2023 - April 30, 2024 State, U.S. and Interstate Highways only

WisDOT REGION / COUNTY	2023-24 WINTER VEHICLE MILES OF TRAVEL (VMT)	2023-24 WINTER CRASHES	CRASH RATE PER 100M VMT
NORTHWEST			
ASHLAND	109,000,000	6	6
BARRON	340,500,000	22	6
BAYFIELD	189,600,000	9	5
BUFFALO	119,000,000	7	6
BURNETT	128,800,000	8	6
CHIPPEWA	500,600,000	55	11
CLARK	266,300,000	38	14
DOUGLAS	295,900,000	38	13
DUNN	365,300,000	56	15
EAU CLAIRE	537,200,000	69	13
JACKSON	326,100,000	27	8
PEPIN	47,700,000	4	8
PIERCE	185,600,000	29	16
POLK	258,700,000	32	12
RUSK	129,000,000	6	5
ST.CROIX	641,000,000	81	13
SAWYER	155,100,000	11	7
TAYLOR	117,700,000	10	8
TREMPEALEAU	238,900,000	30	13
WASHBURN	176,300,000	23	13
Region Total	**5,128,300,000**	**561**	**11**
SOUTHEAST			
KENOSHA	789,300,000	69	9
MILWAUKEE	3,233,700,000	396	12
OZAUKEE	498,900,000	49	10
RACINE	822,200,000	63	8
WALWORTH	600,700,000	88	15
WASHINGTON	760,700,000	163	21
WAUKESHA	2,026,400,000	242	12
Region Total	**8,731,900,000**	**1,070**	**12**

Table 4.12. Winter Crashes per 100 Million Vehicle Miles of Travel

Bureau of transportation Safety data, Nov. 1, 2023 - April 30, 2024 State, U.S. and Interstate Highways only

WisDOT REGION / COUNTY	2023-24 WINTER VEHICLE MILES OF TRAVEL (VMT)	2023-24 WINTER CRASHES	CRASH RATE PER 100M VMT
SOUTHWEST			
COLUMBIA	516,900,000	93	18
CRAWFORD	137,800,000	17	12
DANE	2,467,500,000	257	10
DODGE	509,700,000	102	20
GRANT	310,600,000	45	14
GREEN	182,500,000	22	12
IOWA	204,800,000	46	22
JEFFERSON	509,600,000	93	18
JUNEAU	366,200,000	41	11
LA CROSSE	544,500,000	82	15
LAFAYETTE	146,700,000	22	15
MONROE	431,800,000	64	15
RICHLAND	129,500,000	8	6
ROCK	810,300,000	173	21
SAUK	444,100,000	59	13
VERNON	197,400,000	26	13
Region Total	**7,909,900,000**	**1,150**	**15**
STATEWIDE TOTAL	**31,330,300,000**	**4,124**	**13**

Table 4.13 Motor Vehicle Crashes on Roads with Snow/Ice/Slush

Bureau of transportation Safety data, Nov. 1, 2023 - April 30, 2024 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	15	0	15	0	0	0	0	0	14	1	0
FLORENCE	4	0	4	0	0	0	0	0	4	0	0
FOREST	13	0	13	0	0	0	0	0	11	1	1
GREEN LAKE	7	1	6	0	0	1	0	0	5	0	1
IRON	13	0	13	0	0	0	0	0	13	0	0
LANGLADE	17	1	16	0	0	1	0	0	16	0	0
LINCOLN	18	4	14	0	0	4	0	0	7	7	0
MARATHON	112	32	63	7	10	20	11	1	34	29	0
MARQUETTE	31	0	5	0	26	0	0	0	5	0	0
MENOMINEE	3	0	3	0	0	0	0	0	3	0	0
ONEIDA	43	3	40	0	0	1	2	0	35	3	2
PORTAGE	60	11	24	9	16	6	4	1	10	14	0
PRICE	10	0	10	0	0	0	0	0	10	0	0
SHAWANO	17	1	16	0	0	0	0	1	5	11	0
VILAS	20	0	20	0	0	0	0	0	18	1	1
WAUPACA	45	1	44	0	0	0	1	0	19	25	0
WAUSHARA	32	0	18	0	14	0	0	0	17	1	0
WOOD	46	20	26	0	0	8	12	0	15	10	1
TOTAL	506	74	350	16	66	41	30	3	241	103	6

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	143	92	32	13	6	23	67	2	11	21	0
CALUMET	46	11	31	4	0	4	7	0	30	0	1
DOOR	21	2	19	0	0	2	0	0	15	4	0
FOND DU LAC	95	23	69	1	2	12	8	3	38	30	1
KEWAUNEE	14	0	14	0	0	0	0	0	13	1	0
MANITOWOC	89	34	29	2	24	20	12	2	25	1	3
MARINETTE	19	0	19	0	0	0	0	0	14	2	3
OCONTO	18	0	18	0	0	0	0	0	4	14	0
OUTAGAMIE	99	56	42	0	1	23	30	3	19	21	2
SHEBOYGAN	125	41	51	1	32	24	15	2	26	25	0
WINNEBAGO	168	78	59	30	1	39	35	4	19	40	0
TOTAL	837	337	383	51	66	147	174	16	214	159	10

Table 4.13 Motor Vehicle Crashes on Roads with Snow/Ice/Slush

Bureau of transportation Safety data, Nov. 1, 2023 - April 30, 2024 State, U.S. and Interstate Highways only

NW 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
ASHLAND	6	3	3	0	0	3	0	0	3	0	0
BARRON	22	2	20	0	0	0	2	0	17	3	0
BAYFIELD	9	0	9	0	0	0	0	0	9	0	0
BUFFALO	7	0	7	0	0	0	0	0	7	0	0
BURNETT	8	0	8	0	0	0	0	0	8	0	0
CHIPPEWA	55	4	51	0	0	1	3	0	9	40	2
CLARK	38	0	38	0	0	0	0	0	10	28	0
DOUGLAS	38	20	16	2	0	11	8	1	10	6	0
DUNN	56	10	20	3	23	5	5	0	19	1	0
EAU CLAIRE	69	24	15	7	23	8	15	1	10	5	0
JACKSON	27	0	16	0	11	0	0	0	13	2	1
PEPIN	4	0	4	0	0	0	0	0	4	0	0
PIERCE	29	3	26	0	0	2	1	0	25	1	0
POLK	32	0	32	0	0	0	0	0	28	4	0
RUSK	6	0	6	0	0	0	0	0	6	0	0
ST. CROIX	81	5	40	0	36	2	3	0	20	19	1
SAWYER	11	0	11	0	0	0	0	0	10	1	0
TAYLOR	10	0	10	0	0	0	0	0	8	1	1
TREMPEALEAU	30	0	27	0	3	0	0	0	26	1	0
WASHBURN	23	0	23	0	0	0	0	0	10	11	2
TOTAL	561	71	382	12	96	32	37	2	252	123	7

SE 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
KENOSHA	69	33	22	11	3	16	17	0	14	8	0
MILWAUKEE	396	276	0	120	0	74	185	17	0	0	0
OZAUKEE	49	9	11	8	21	4	5	0	2	9	0
RACINE	63	49	12	0	2	12	35	2	6	6	0
WALWORTH	88	19	61	0	8	10	8	1	36	21	4
WASHINGTON	163	69	82	2	10	26	43	0	30	51	1
WAUKESHA	242	87	49	71	35	18	64	5	23	26	0
TOTAL	1,070	542	237	212	79	160	357	25	111	121	5

SW 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
COLUMBIA	93	3	49	5	36	2	0	1	40	9	0
CRAWFORD	17	5	12	0	0	3	2	0	10	2	0
DANE	257	100	87	23	47	11	85	4	54	32	1
DODGE	102	4	89	0	9	1	3	0	47	42	0
GRANT	45	3	42	0	0	2	0	1	36	6	0
GREEN	22	1	21	0	0	0	1	0	19	2	0
IOWA	46	0	46	0	0	0	0	0	23	22	1
JEFFERSON	93	10	42	0	41	6	4	0	29	13	0
JUNEAU	41	0	21	0	20	0	0	0	20	1	0
LA CROSSE	82	48	19	4	11	21	20	7	12	7	0
LAFAYETTE	22	0	22	0	0	0	0	0	19	3	0
MONROE	64	12	20	3	29	6	6	0	20	0	0
RICHLAND	8	0	8	0	0	0	0	0	7	1	0
ROCK	173	32	58	36	47	15	13	4	45	13	0
SAUK	59	2	42	0	15	2	0	0	27	15	0
VERNON	26	0	26	0	0	0	0	0	23	2	1
TOTAL	1,150	220	604	71	255	69	134	17	431	170	3

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.

*2024 figures are preliminary at this time.
**Does not include deer or other animal crashes

5 Looking Ahead

Photo credit: Pixabay Creative Commons License

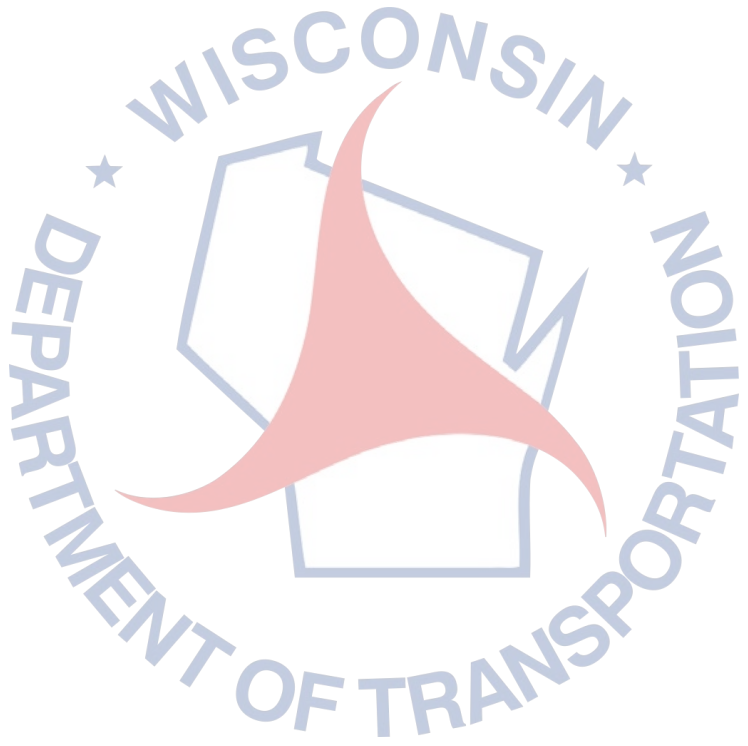
The WisDOT Bureau of Highway Maintenance continues to look for efficiencies that reduce winter maintenance costs. For example, using brine during winter storm events helps reduce salt use and can result in a significant reduction in cost of materials. Additionally, reducing salt use can lessen negative impacts to roadside vegetation and the state's water resources.

WisDOT will continue to work together with the counties to move towards the use of more liquids in place of rock salt. WisDOT has looked back at the five-year averages of salt use and of winter severity in each county. In the 2023-2024 winter season, 59 out of 72 counties improved their salt use based on those calculations. It was also estimated that the state saved $8.8 million due to the use of liquids that improve the efficiency of rock salt use. This comparison also shows an estimated 97,000 tons of salt saved.

WisDOT will also continue with winter tech talks, which brings WisDOT staff and county staff together to discuss brine liquid use, better salt management practices, and learn from successes and failures. Due in part to this education effort, brine use increased drastically over the last few years, which the hope is in turn that we see salt use decrease as well.

A study focusing on liquid application was completed in 2022 by the University of Wisconsin Madison Traffic Operations and Safety (TOPS) Laboratory in collaboration with several Wisconsin counties. The result from this study showed the benefits, in cost and materials, of using a mostly liquid model for fighting winter storms. TOPS Lab is also currently in the early phase of another winter maintenance study funded through the Clear Roads group that will show further insight into the benefits of using brine. So far, several performance measures of liquid application were collected in a survey of practice of 23 state, county, and city agencies. Field testing protocols have been established, with field data collection scheduled to be conducted in winter 2024-2025 season. This study focuses on the various performance measures of liquid operations in comparison to rock salt, including friction and speed recovery. The result of this study will give a thorough understanding of how direct liquid application benefits road users, and hopefully will be a turning point in changing how liquid application is perceived by the traveling public.

The Maintenance Decision Support System (MDSS) continues to be refined, including the option of having treatment recommendations sent directly to plow drivers. WisDOT will continue to work with MDSS to come up with better and more precise application recommendations for specific weather conditions and direct liquid application rates. Through the Wisconsin County Highway Association, winter maintenance training at all levels will be implemented using materials and methods created by Clear Roads and other expert sources. The data from MDSS has also been integrated into the Wisconsin 511 system to show road conditions across all the state highway network and will continue to be improved upon. These many efforts are aimed at providing users of Wisconsin's highways the safest possible experience despite harsh winter weather while also safeguarding the state's natural environment.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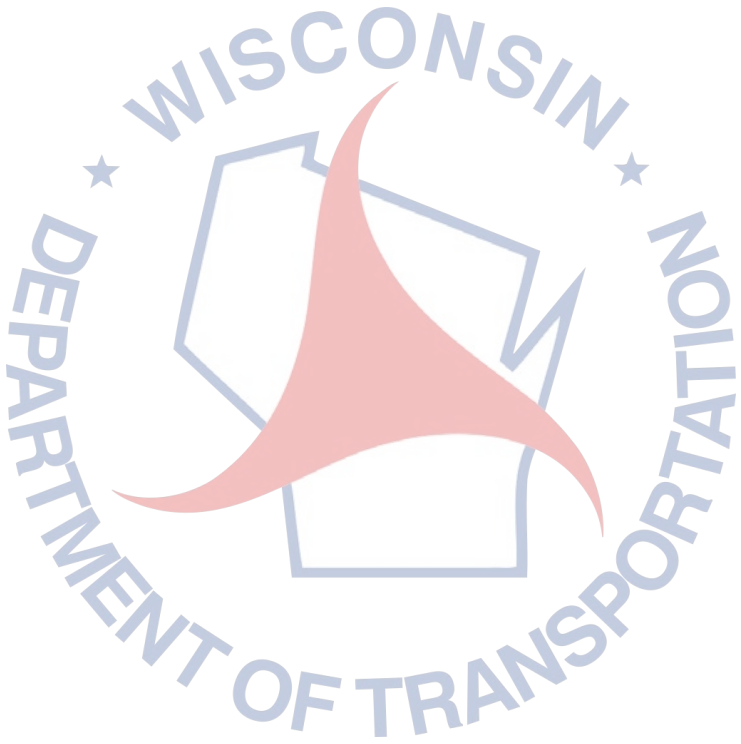
Appendix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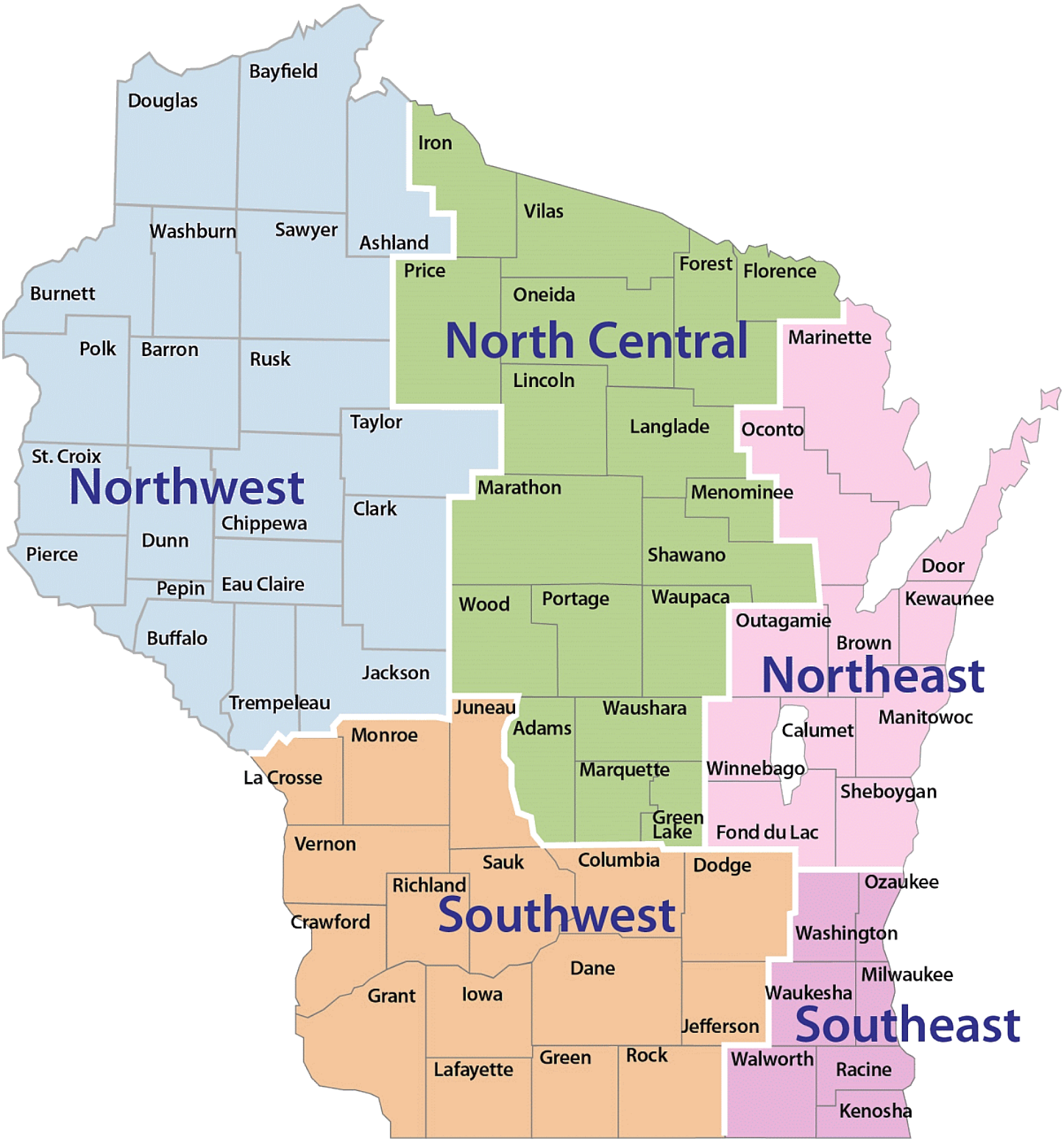
Wisconsin Department of Transportation
Region Map
October 2024



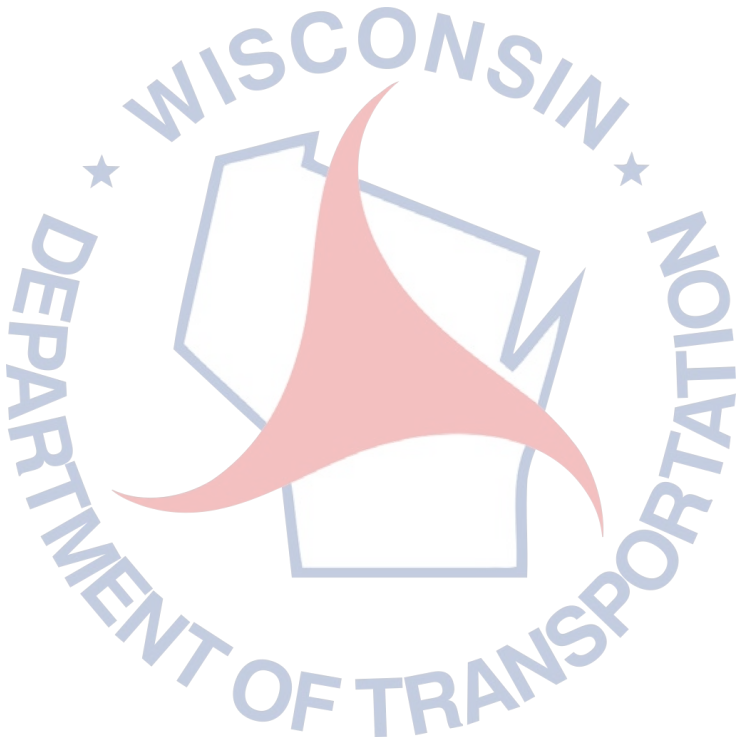

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Table A-1. Storm Report Summary, 2023-2024

Storm Report Summary - End of Season

From Winter Storm Reports, 2023-2024

General Notes: 1) Costs shown in table are estimated and do not include the Administrative Costs; 2) Material Costs includes Brine, Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on an estimated $90 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds plus "early fill" plus "seasonal fill" plus "vendor reserve" available. 6) Some Material Costs are estimated. 7) Severity Indices in this table are not the official MDSS severity index used by WisDOT in other reports. 8) This report is sorted by TOTAL Cost per Lane Mile.

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 Thaw-Rox (tons)	Total Clear-Lane (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		
IRON	240.51	103.24	93.1	0	32	13	12	6,813	2,085	4,728	8.7	0	0	34	784.0	685.0	$957	$555	$351	$1,863	$448,165	0.08
VILAS	307.73	129.77	71.6	5	46	16	23	8,775	2,690	6,085	8.7	0	0	395	1815.0	170.0	$1,004	$569	$281	$1,854	$569,045	0.07
ADAMS	202.74	65.34	45.6	10	20	5	8	4,280	2,054	2,226	10.1	0	0	16	602.0	129.0	$1,236	$294	$178	$1,708	$346,350	0.16
MARATHON	905.42	82.52	40.3	16	24	14	9	14,350	7,072	7,278	7.8	0	0	43	2100.0	2556.0	$858	$440	$271	$1,569	$1,420,414	0.09
SHAWANO	530.27	85.33	70.5	6	22	16	7	9,381	3,767	5,614	7.1	0	0	8	1647.0	1106.0	$631	$479	$279	$1,389	$736,686	0.08
FLORENCE	137.43	77.24	52.6	4	27	10	5	3,735	1,121	2,614	8.2	0	0	13	418.0	161.0	$846	$327	$195	$1,368	$188,061	0.11
PORTAGE	531.62	73.22	47.8	14	23	10	10	9,000	2,195	6,805	4.1	0	0	33	2273.0	1157.0	$426	$578	$343	$1,347	$716,128	0.06
MENOMINEE	90.66	62.34	48.2	2	23	6	8	2,365	691	1,674	7.6	0	0	9	252.0	96.0	$752	$346	$171	$1,269	$115,091	0.12
PRICE	319.53	79.29	35.0	13	30	4	16	5,925	1,713	4,212	5.4	0	0	0	866.0	552.0	$630	$399	$227	$1,257	$401,547	0.07
LINCOLN	399.39	79.32	47.7	12	25	7	15	6,729	2,333	4,396	5.8	0	0	335	1087.0	502.0	$707	$313	$209	$1,229	$490,996	0.07
MARQUETTE	246.61	65.94	49.5	13	24	3	6	4,857	1,050	3,807	4.3	0	0	16	535.0	548.0	$534	$412	$261	$1,207	$297,164	0.06
ONEIDA	395.39	93.73	55.4	7	26	13	19	10,347	1,769	8,578	4.5	0	0	156	1786.0	537.0	$479	$423	$303	$1,205	$476,319	0.05
WAUPACA	556.87	57.46	48.7	2	15	13	3	11,200	4,307	6,893	7.7	0	0	0	974.0	1000.0	$666	$311	$205	$1,181	$657,784	0.13
WOOD	443.36	82.08	42.0	18	28	8	13	7,100	2,084	5,016	4.7	0	0	89	1045.0	978.0	$485	$357	$248	$1,091	$483,602	0.06
FOREST	314.49	101.61	67.3	1	37	6	11	7,614	1,682	5,932	5.3	0	0	0	712.0	516.0	$527	$325	$199	$1,051	$330,409	0.05
WAUSHARA	343.69	60.22	52.8	2	20	6	3	4,086	1,404	2,682	4.1	0	0	49	805.0	478.0	$452	$330	$199	$981	$337,120	0.07
LANGLADE	300.29	84.91	59.1	11	28	8	10	5,257	881	4,376	2.9	0	0	1	813.0	417.0	$347	$345	$211	$903	$271,250	0.03
GREEN LAKE	154.11	49.59	47.3	1	16	7	4	1,830	373	1,457	2.4	0	0	0	269.0	254.0	$258	$279	$194	$730	$112,557	0.05
Region Total		--	--	--	--	--	--	123,644	39,271	84,373	--	0	0	1197	--	--	--	--	--	--	$8,398,687	
Region Average		79.62	54.1	7.6	25.9	9.2	10.1	6,869	2,182	4,687	6.1	0	0	67	1043.5	657.9	$655	$394	$240	$1,289	$466,594	0.08

Final totals as of Thursday, June 20, 2024

Table A-1. Storm Report Summary, 2023-2024

Storm Report Summary - End of Season

From Winter Storm Reports, 2023-2024

General Notes: 1) Costs shown in table are estimated and do not include the Administrative Costs; 2) Material Costs includes Brine, Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on an estimated $90 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds plus "early fill" plus "seasonal fill" plus "vendor reserve" available. 6) Some Material Costs are estimated. 7) Severity Indices in this table are not the official MDSS severity index used by WisDOT in other reports. 8) This report is sorted by TOTAL Cost per Lane Mile.

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 Thaw-Rox (tons)	Total Clear-Lane (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	860.16	59.76	64.6	49	22	4	4	20,338	8,929	11,409	10.4	0	0	26	2279.0	3371.0	$818	$683	$401	$1,902	$1,635,180	0.17
OUTAGAMIE	567.52	64.45	47.5	1	17	19	1	11,682	6,467	5,215	11.4	0	0	0	2020.0	1410.0	$1,100	$395	$383	$1,879	$1,066,236	0.18
MANITOWOC	419.96	34.16	30.8	26	15	2	0	8,700	3,788	4,912	9.0	0	0	140	1896.0	775.0	$855	$572	$305	$1,732	$727,266	0.26
SHEBOYGAN	543.53	70.51	54.4	18	21	24	4	10,434	3,101	7,333	5.7	0	0	52	1650.0	1739.0	$719	$535	$421	$1,675	$910,533	0.08
CALUMET	219.46	67.63	53.1	18	19	19	3	2,625	1,292	1,333	5.9	0	0	0	1044.0	488.0	$600	$547	$393	$1,540	$337,928	0.09
MARINETTE	414.39	95.04	63.7	32	32	15	10	9,050	2,817	6,233	6.8	0	0	0	1243.0	902.0	$627	$440	$322	$1,388	$575,356	0.07
WINNEBAGO	688.27	49.39	45.8	13	15	12	2	11,886	4,997	6,889	7.3	0	18	10	1689.0	1796.0	$662	$384	$320	$1,367	$940,637	0.15
FOND DU LAC	611.86	54.84	47.0	4	19	7	4	11,240	3,148	8,092	5.1	0	0	142	1331.0	1844.0	$525	$415	$356	$1,296	$792,854	0.09
KEWAUNEE	126.39	67.52	60.1	3	18	15	8	1,770	789	981	6.2	0	0	210	285.0	198.0	$665	$343	$230	$1,238	$156,256	0.09
OCONTO	481.73	74.62	49.2	16	19	13	9	7,241	3,389	3,852	7.0	0	0	0	1108.0	864.0	$627	$337	$241	$1,205	$580,420	0.09
DOOR	267.29	68.64	56.0	8	22	20	1	4,988	1,128	3,860	4.2	0	0	48	450.0	848.0	$428	$437	$340	$1,204	$321,904	0.06
Region Total		--	--	--	--	--	--	99,954	39,845	60,109	--	0	18	628	--	--	--	--	--	--	$8,044,568	
Region Average		64.23	52.0	17.1	19.9	13.6	4.2	9,087	3,622	5,464	7.2	0	2	57	1363.2	1294.1	$693	$462	$337	$1,493	$731,324	0.12

Table A-1. Storm Report Summary, 2023-2024

Storm Report Summary - End of Season

From Winter Storm Reports, 2023-2024

General Notes: 1) Costs shown in table are estimated and do not include the Administrative Costs; 2) Material Costs includes Brine, Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on an estimated $90 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds plus "early fill" plus "seasonal fill" plus "vendor reserve" available. 6) Some Material Costs are estimated. 7) Severity Indices in this table are not the official MDSS severity index used by WisDOT in other reports. 8) This report is sorted by TOTAL Cost per Lane Mile.

Region / NW County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season: Anti-Icing	Storms	Incident	Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Thaw-Rox (tons)	Total Clear-Lane (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
TREMPEALEAU	420.25	54.83	35.1	10	15	18	0	9,261	4,848	4,413	11.5	0	0	0	1188.0	1003.0	$1,159	$421	$324	$1,904	$800,304	0.21
JACKSON	520.32	60.10	39.7	23	20	15	16	11,703	5,139	6,564	9.9	0	0	0	1158.0	1055.0	$1,040	$369	$221	$1,630	$847,925	0.16
ASHLAND	255.69	90.08	65.4	9	30	8	10	4,475	2,096	2,379	8.2	0	0	7	905.0	403.0	$896	$445	$278	$1,619	$413,837	0.09
DOUGLAS	465.66	87.46	57.1	41	33	15	10	10,432	4,416	6,016	9.5	0	0	0	2379.0	587.0	$784	$512	$281	$1,578	$734,732	0.11
BAYFIELD	345.31	99.05	61.7	5	34	17	3	7,541	2,220	5,321	6.4	0	0	18	1420.0	537.0	$604	$508	$299	$1,411	$487,194	0.06
DUNN	521.2	57.34	37.8	7	22	6	3	13,635	4,313	9,323	8.3	0	0	0	917.0	1080.0	$815	$322	$252	$1,390	$724,492	0.14
BARRON	428.61	62.07	34.1	3	18	15	11	7,000	3,046	3,954	7.1	0	2	205	1284.0	686.0	$653	$385	$274	$1,311	$561,962	0.11
CLARK	401.81	39.00	29.6	5	15	10	4	7,260	2,961	4,299	7.4	0	0	3	520.0	731.0	$842	$279	$171	$1,291	$518,733	0.19
EAU CLAIRE	531.32	46.79	28.1	8	18	1	4	11,842	2,664	9,178	5.0	0	0	0	2209.0	500.0	$560	$402	$272	$1,235	$655,983	0.11
PEPIN	109.41	45.20	28.9	10	15	4	6	1,202	375	827	3.4	0	0	0	362.0	282.0	$362	$478	$315	$1,154	$126,275	0.08
RUSK	213.1	83.19	39.2	8	22	7	16	3,249	1,083	2,166	5.1	0	0	0	396.0	352.0	$516	$291	$206	$1,013	$215,786	0.06
POLK	374.54	60.71	43.0	16	18	19	0	9,074	1,881	7,193	5.0	0	0	3	807.0	628.0	$472	$317	$211	$1,001	$374,758	0.08
BURNETT	235.35	48.94	34.1	8	17	4	13	3,715	1,365	2,350	5.8	0	0	6	357.0	314.0	$574	$255	$149	$979	$230,318	0.12
WASHBURN	385.68	57.29	18.9	18	20	5	9	7,845	2,150	5,695	5.6	0	0	0	622.0	531.0	$521	$268	$185	$973	$375,441	0.10
TAYLOR	232.44	55.28	36.1	5	22	5	7	4,338	946	3,392	4.1	0	0	0	329.0	314.0	$535	$232	$148	$915	$212,717	0.07
PIERCE	368.08	35.40	26.6	4	12	6	2	6,425	2,207	4,218	6.0	0	0	0	495.0	425.0	$572	$180	$146	$899	$330,756	0.17
CHIPPEWA	653.17	48.57	32.6	6	16	6	5	13,874	1,818	12,056	2.8	0	0	47	870.0	1729.0	$290	$324	$244	$859	$560,831	0.06
SAINT CROIX	653.47	31.17	19.4	1	12	2	2	16,486	3,299	13,187	5.0	0	0	2	406.0	1023.0	$473	$197	$164	$834	$544,888	0.16
SAWYER	357.2	71.69	32.7	0	26	13	6	5,750	1,616	4,134	4.5	0	0	0	617.0	441.0	$425	$231	$155	$811	$289,694	0.06
BUFFALO	311.87	73.17	35.2	8	27	7	10	3,478	982	2,496	3.1	0	0	0	624.0	406.0	$324	$261	$162	$746	$232,717	0.04
Region Total		--	--	--	--	--	--	158,585	49,425	109,161	--	0	2	291	--	--	--	--	--	--	$9,239,343	
Region Average		60.37	36.8	9.8	20.6	9.2	6.9	7,929	2,471	5,458	6.2	0	0	15	893.3	651.4	$621	$334	$223	$1,178	$461,967	0.11

Final totals as of Thursday, June 20, 2024

Table A-1. Storm Report Summary, 2023-2024

Storm Report Summary - End of Season

From Winter Storm Reports, 2023-2024

General Notes: 1) Costs shown in table are estimated and do not include the Administrative Costs; 2) Material Costs includes Brine, Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on an estimated $90 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds plus "early fill" plus "seasonal fill" plus "vendor reserve" available. 6) Some Material Costs are estimated. 7) Severity Indices in this table are not the official MDSS severity index used by WisDOT in other reports. 8) This report is sorted by TOTAL Cost per Lane Mile.

Region / SE / County	Lane Miles	Severity Index	Snow Amount (inches)	Events this Season: Anti-Icing	Storms	Incident	Freez. Rain Events	Total Salt Avail. (tons)	Total Salt Used (tons)	Total Salt Remain. (tons)	Salt Used per LM (tons)	Total Thaw-Rox (tons)	Total Clear-Lane (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
MILWAUKEE	1574.67	54.75	37.1	5	15	0	5	55,265	21,776	33,489	13.8	0	0	0	5771.0	5724.0	$1,083	$566	$653	$2,302	$3,624,497	0.25
WASHINGTON	591.04	75.45	57.3	19	22	13	6	16,230	5,974	10,256	10.1	0	0	0	1859.0	2027.0	$919	$550	$412	$1,881	$1,111,745	0.13
WALWORTH	697.33	64.79	51.8	23	22	10	4	19,050	5,594	13,456	8.0	0	0	12	2213.0	2143.0	$767	$469	$417	$1,653	$1,152,434	0.12
WAUKESHA	1059.84	53.09	45.7	12	14	3	4	41,600	9,787	31,813	9.2	0	0	14	3847.0	2119.0	$739	$464	$364	$1,567	$1,660,556	0.17
RACINE	774.85	61.74	39.0	22	25	0	6	18,000	5,497	12,503	7.1	0	0	0	1970.0	1623.0	$612	$379	$332	$1,324	$1,025,786	0.11
KENOSHA	674.4	54.09	4.5	3	17	7	4	13,300	2,624	10,676	3.9	0	0	9	2295.0	1840.0	$312	$517	$421	$1,249	$842,473	0.07
OZAUKEE	321.1	44.04	37.1	11	16	5	5	9,951	2,194	7,757	6.8	0	0	0	702.0	573.0	$555	$343	$263	$1,160	$372,386	0.16
Region Total		--	--	--	--	--	--	173,396	53,446	119,950	--	0	0	35	--	--	--	--	--	--	$9,789,877	
Region Average		58.28	38.9	13.6	18.7	5.4	4.9	24,771	7,635	17,136	8.4	0	0	5	2665.3	2292.7	$712	$470	$409	$1,591	$1,398,554	0.15

Table A-1. Storm Report Summary, 2023-2024

Storm Report Summary - End of Season

From Winter Storm Reports, 2023-2024

General Notes: 1) Costs shown in table are estimated and do not include the Administrative Costs; 2) Material Costs includes Brine, Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on an estimated $90 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds plus "early fill" plus "seasonal fill" plus "vendor reserve" available. 6) Some Material Costs are estimated. 7) Severity Indices in this table are not the official MDSS severity index used by WisDOT in other reports. 8) This report is sorted by TOTAL Cost per Lane Mile.

Region SW 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 Thaw-Rox (tons)	Total Clear-Lane (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		
DANE	1665.78	60.21	42.7	17	19	0	5	53,583	13,894	39,689	8.3	0	0	171	3664.0	8574.0	$781	$631	$743	$2,155	$3,589,746	0.14
COLUMBIA	801.13	67.74	50.1	25	16	19	9	24,992	8,171	16,821	10.2	0	0	156	2682.0	2000.0	$1,114	$515	$342	$1,970	$1,578,329	0.15
SAUK	594.09	50.63	20.5	3	14	3	7	16,268	6,930	9,338	11.7	0	0	0	1067.0	1428.0	$1,250	$313	$249	$1,812	$1,076,129	0.23
DODGE	667.73	53.30	59.0	23	18	8	2	19,970	6,245	13,725	9.4	0	0	110	1885.0	2161.0	$801	$545	$382	$1,728	$1,153,436	0.18
JUNEAU	500.96	52.69	40.7	9	19	12	1	10,569	4,387	6,182	8.8	0	0	0	1127.0	1386.0	$954	$432	$304	$1,690	$846,773	0.17
IOWA	457.1	54.55	46.3	13	19	4	6	8,478	3,593	4,885	7.9	0	0	19	1470.0	1364.0	$770	$481	$396	$1,647	$752,914	0.14
MONROE	679.49	61.43	41.8	8	19	8	7	13,755	6,452	7,303	9.5	0	0	0	1275.0	1943.0	$958	$408	$264	$1,630	$1,107,486	0.15
ROCK	791.89	50.66	42.0	11	21	2	3	15,286	5,224	10,062	6.6	0	0	16	1833.0	2745.0	$615	$463	$480	$1,558	$1,233,550	0.13
VERNON	469.79	88.46	35.3	12	28	15	7	6,988	3,342	3,646	7.1	0	0	0	1015.0	1313.0	$689	$412	$261	$1,362	$639,734	0.08
JEFFERSON	552.87	62.30	50.5	14	20	11	4	16,157	2,012	14,145	3.6	0	0	231	1493.0	1903.0	$345	$552	$394	$1,291	$713,822	0.06
LAFAYETTE	294.51	71.67	46.2	5	26	8	4	3,507	1,599	1,908	5.4	0	0	1030	780.0	656.0	$547	$384	$255	$1,186	$349,214	0.08
GREEN	311.98	61.51	40.9	9	20	9	3	3,846	1,386	2,460	4.4	0	0	7	757.0	725.0	$523	$401	$260	$1,184	$369,370	0.07
GRANT	646.92	50.39	51.7	1	14	12	2	10,132	4,041	6,091	6.2	0	0	1133	1273.0	1348.0	$606	$346	$226	$1,178	$761,794	0.12
RICHLAND	321.78	34.68	25.0	6	7	21	3	3,652	1,496	2,156	4.6	0	0	94	647.0	514.0	$506	$296	$174	$975	$313,743	0.13
CRAWFORD	398.22	74.48	41.1	7	18	21	8	5,072	1,792	3,280	4.5	0	0	107	858.0	664.0	$445	$305	$215	$965	$384,272	0.06
LA CROSSE	483.56	27.54	43.0	0	8	4	1	10,461	2,603	7,858	5.4	0	0	0	367.0	732.0	$495	$192	$158	$846	$408,861	0.20
Region Total		--	--	--	--	--	--	222,716	73,167	149,549	--	0	0	3074	--	--	--	--	--	--	$15,279,172	
Region Average		57.64	42.3	10.2	17.9	9.8	4.5	13,920	4,573	9,347	7.1	0	0	192	1387.1	1841.0	$712	$417	$319	$1,448	$954,948	0.13

Final totals as of Thursday, June 20, 2024

Table A-1. Storm Report Summary, 2023-2024

Storm Report Summary - End of Season

From Winter Storm Reports, 2023-2024

General Notes: 1) Costs shown in table are estimated and do not include the Administrative Costs; 2) Material Costs includes Brine, Salt, Sand, and other Deicing and Anti-icing Agents; 3) Equipment Costs are based on an estimated $90 per hour per unit; 4) Labor Costs are based on each County's average labor rate; 5) Total Salt Available = salt in sheds plus "early fill" plus "seasonal fill" plus "vendor reserve" available. 6) Some Material Costs are estimated. 7) Severity Indices in this table are not the official MDSS severity index used by WisDOT in other reports. 8) This report is sorted by TOTAL Cost per Lane Mile.

	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 Thaw-Rox (tons)	Total Clear-Lane (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		
Statewide Total	--	--	--	--	--	--	--	778,295	255,154	523,142	--	0	20	5225.0	--	--	--	--	--	--	$50,751,648	--
Statewide Average	64.96	44.9	10.8	21.0	9.6	6.5	10,810	3,544	7,266	6.7	0.0	0.3	72.6	1284.6	1175.1	$670	$400	$284	$1,354	$704,884	0.11	

Table A-2. Anti-Icing Usage (Gallons)

From Winter Storm Reports, 2023-2024

Region	County	# Applications	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NC	ADAMS	10	0	97,491	0	0	0	0	0	0
	FLORENCE	4	0	24,000	0	0	0	0	0	0
	FOREST	1	0	6,900	0	0	0	0	0	0
	GREEN LAKE	1	0	3,300	0	0	0	0	0	0
	IRON	0	0	0	0	0	0	0	0	0
	LANGLADE	11	0	98,247	0	0	0	0	0	0
	LINCOLN	12	0	144,800	0	200	0	0	0	0
	MARATHON	16	0	226,326	0	0	0	0	10,727	0
	MARQUETTE	13	0	137,491	0	0	0	0	0	0
	MENOMINEE	2	0	4,550	0	0	0	0	0	0
	ONEIDA	7	0	63,370	0	0	0	0	0	3,449
	PORTAGE	14	0	93,222	0	0	0	0	0	0
	PRICE	13	0	116,956	0	0	0	0	0	0
	SHAWANO	6	0	80,172	0	0	0	0	0	0
	VILAS	5	0	50,057	0	0	0	0	0	0
	WAUPACA	2	0	3,550	0	0	0	0	0	0
	WAUSHARA	2	0	24,775	0	0	0	0	0	0
	WOOD	18	0	31,593	0	0	0	0	0	0
	Region Totals	**137**	**0**	**1,206,800**	**0**	**200**	**0**	**0**	**10,727**	**3,449**

Region	County	# Applications	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NE	BROWN	49	0	290,151	0	0	11,974	0	0	0
	CALUMET	18	0	101,924	0	0	0	0	0	0
	DOOR	8	0	47,350	0	0	0	0	0	0
	FOND DU LAC	4	0	86,898	0	0	0	0	0	0
	KEWAUNEE	3	0	31,000	0	0	0	0	0	0
	MANITOWOC	26	0	246,050	0	0	0	0	0	0
	MARINETTE	32	0	228,300	0	0	0	0	0	0
	OCONTO	16	0	167,788	0	0	0	0	0	0
	OUTAGAMIE	1	0	20,500	0	0	0	0	0	0
	SHEBOYGAN	18	0	106,552	0	0	0	0	0	0
	WINNEBAGO	13	0	229,094	0	0	0	0	0	0
	Region Totals	**188**	**0**	**1,555,607**	**0**	**0**	**11,974**	**0**	**0**	**0**

Table A-2. Anti-Icing Usage (Gallons)

From Winter Storm Reports, 2023-2024

Region	County	# Applications	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NW	ASHLAND	9	0	31,005	3,445	0	0	0	0	0
	BARRON	3	0	840	0	0	0	0	0	0
	BAYFIELD	5	0	4,905	0	0	0	0	0	0
	BUFFALO	8	0	28,166	0	0	0	0	0	0
	BURNETT	8	0	10,253	0	0	0	0	0	490
	CHIPPEWA	6	0	8,702	0	0	0	0	0	0
	CLARK	5	0	6,985	0	0	0	0	0	0
	DOUGLAS	41	0	19,626	0	0	0	334	0	12,610
	DUNN	7	0	25,014	0	0	0	0	0	49
	EAU CLAIRE	8	0	105,245	0	0	0	0	0	0
	JACKSON	23	0	161,050	0	0	0	0	0	0
	PEPIN	10	0	11,162	0	0	0	0	0	0
	PIERCE	4	0	4,250	0	0	0	0	0	0
	POLK	16	0	17,960	0	0	0	0	0	1,740
	RUSK	8	0	2,621	0	0	0	0	0	917
	ST. CROIX	1	0	1,574	0	0	0	0	0	510
	SAWYER	0	0	0	0	0	0	0	0	0
	TAYLOR	5	0	6,695	0	0	0	0	0	0
	TREMPEALEAU	10	0	63,825	0	0	0	0	0	0
	WASHBURN	18	0	21,239	0	0	0	0	0	4,917
	Region Totals	**195**	**0**	**531,117**	**3,445**	**0**	**0**	**334**	**0**	**21,233**

Region	County	# Applications	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
SE	KENOSHA	3	600	0	0	0	0	0	0	0
	MILWAUKEE	5	0	142,838	0	0	0	0	0	0
	OZAUKEE	11	0	41,979	0	0	0	0	0	0
	RACINE	22	0	45,900	0	0	0	0	0	0
	WALWORTH	23	335	201,193	0	0	0	0	0	0
	WASHINGTON	19	0	60,410	0	0	0	0	0	0
	WAUKESHA	12	0	68,325	0	0	0	0	0	0
	Region Totals	**95**	**935**	**560,645**	**0**	**0**	**0**	**0**	**0**	**0**

Table A-2. Anti-Icing Usage (Gallons)

From Winter Storm Reports, 2023-2024

Region	County	# Applications	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
SW	COLUMBIA	25	0	131,607	0	0	0	0	0	0
	CRAWFORD	7	0	18,600	0	0	0	0	0	0
	DANE	17	0	109,589	0	0	0	0	0	0
	DODGE	23	0	66,086	0	0	0	0	0	6,794
	GRANT	1	0	4,000	0	0	0	0	0	0
	GREEN	9	0	37,140	0	0	0	0	0	0
	IOWA	13	0	87,164	0	0	0	0	0	0
	JEFFERSON	14	0	53,422	0	0	0	0	0	0
	JUNEAU	9	0	162,044	0	0	0	0	0	0
	LA CROSSE	0	0	0	0	0	0	0	0	0
	LAFAYETTE	5	0	6,200	0	0	0	0	0	0
	MONROE	8	0	142,859	0	0	0	0	0	0
	RICHLAND	6	0	39,550	0	0	0	0	0	0
	ROCK	11	0	115,518	0	0	0	0	0	0
	SAUK	3	0	7,835	0	0	0	0	0	0
	VERNON	12	0	38,338	0	0	0	0	0	0
	Region Totals	**163**	**0**	**1,019,952**	**0**	**0**	**0**	**0**	**0**	**6,794**

Region	# Applications	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NC	137	0	1,206,800	0	200	0	0	10,727	3,449
NE	188	0	1,555,607	0	0	11,974	0	0	0
NW	195	0	531,117	3,445	0	0	334	0	21,233
SE	95	935	560,645	0	0	0	0	0	0
SW	163	0	1,019,952	0	0	0	0	0	6,794
Statewide Totals	**778**	**935**	**4,874,121**	**3,445**	**200**	**11,974**	**334**	**10,727**	**31,476**

Total Anti-Icing Liquid Used	**4,933,212**

Table A-3. Actual Anti-Icing Costs, 2023-2024

	Cost to Apply Liquid Anti-Icing Chemicals	Total Winter Maintenance Costs	Anti-Icing as a % of Total Winter Costs
Southwest Region			
Columbia	$76,690	$2,040,717	3.76%
Crawford	$10,716	$482,495	2.22%
Dane	$113,030	$5,195,630	2.18%
Dodge	$67,706	$1,435,736	4.72%
Grant	$8,303	$999,738	0.83%
Green	$18,394	$526,600	3.49%
Iowa	$20,856	$947,451	2.20%
Jefferson	$31,898	$866,429	3.68%
Juneau	$45,184	$1,028,691	4.39%
La Crosse	$52,528	$834,376	6.30%
Lafayette	$5,558	$543,059	1.02%
Monroe	$25,371	$1,255,643	2.02%
Richland	$12,241	$395,269	3.10%
Rock	$52,490	$1,726,998	3.04%
Sauk	$18,020	$1,582,564	1.14%
Vernon	$20,583	$871,522	2.36%
Region Totals	**$579,568**	**$20,732,917**	**2.80%**
Southeast Region			
Kenosha	$8,531	$1,093,510	0.78%
Milwaukee	$36,462	$6,392,115	0.57%
Ozaukee	$17,234	$744,084	2.32%
Racine	$26,563	$1,367,495	1.94%
Walworth	$96,665	$1,427,672	6.77%
Washington	$28,251	$1,549,186	1.82%
Waukesha	$63,665	$2,463,163	2.58%
Region Totals	**$277,372**	**$15,037,224**	**1.84%**

Table A-3. Actual Anti-Icing Costs, 2023-2024

	Cost to Apply Liquid Anti-Icing Chemicals	Total Winter Maintenance Costs	Anti-Icing as a % of Total Winter Costs
Northeast Region			
Brown	$182,005	$2,261,437	8.05%
Calumet	$23,265	$521,176	4.46%
Door	$25,330	$473,769	5.35%
Fond du Lac	$27,401	$1,071,124	2.56%
Kewanee	$5,092	$237,560	2.14%
Manitowoc	$48,499	$991,028	4.89%
Marinette	$63,695	$679,197	9.38%
Oconto	$37,428	$833,684	4.49%
Outagamie	$0	$1,621,036	0.00%
Sheboygan	$107,093	$1,446,369	7.40%
Winnebago	$76,147	$1,509,004	5.05%
Region Totals	**$595,956**	**$11,645,384**	**5.12%**
North Central Region			
Adams	$16,574	$407,068	4.07%
Florence	$20,468	$252,249	8.11%
Forest	$1,236	$464,120	0.27%
Green Lake	$1,258	$173,733	0.72%
Iron	$0	$619,807	0.00%
Langlade	$31,689	$410,178	7.73%
Lincoln	$10,610	$595,972	1.78%
Marathon	$160,586	$1,772,460	9.06%
Marquette	$37,232	$410,873	9.06%
Menominee	$0	$132,125	0.00%
Oneida	$107,454	$866,515	12.40%
Portage	$42,144	$988,653	4.26%
Price	$44,889	$526,980	8.52%
Shawano	$22,496	$1,034,169	2.18%
Vilas	$14,988	$787,657	1.90%
Waupaca	$2,320	$1,045,547	0.22%
Waushara	$2,306	$468,642	0.49%
Wood	$36,521	$659,422	5.54%
Region Totals	**$552,771**	**$11,616,170**	**4.76%**

Table A-3. Actual Anti-Icing Costs, 2023-2024

	Cost to Apply Liquid Anti-Icing Chemicals	Total Winter Maintenance Costs	Anti-Icing as a % of Total Winter Costs
Northwest Region			
Ashland	$31,143	$601,709	5.18%
Barron	$0	$895,471	0.00%
Bayfield	$5,087	$699,199	0.73%
Buffalo	$8,070	$271,791	2.97%
Burnett	$20,165	$318,611	6.33%
Chippewa	$13,289	$890,580	1.49%
Clark	$6,269	$715,091	0.88%
Douglas	$17,128	$1,006,990	1.70%
Dunn	$19,843	$1,000,882	1.98%
Eau Claire	$18,925	$894,706	2.12%
Jackson	$35,995	$1,015,044	3.55%
Pepin	$11,576	$176,830	6.55%
Pierce	$8,731	$539,193	1.62%
Polk	$21,486	$467,863	4.59%
Rusk	$8,912	$233,829	3.81%
Saint Croix	$27,465	$1,228,834	2.24%
Sawyer	$0	$373,122	0.00%
Taylor	$7,412	$394,945	1.88%
Trempealeau	$49,295	$973,974	5.06%
Washburn	$28,937	$525,814	5.50%
Region Totals	**$339,728**	**$13,224,480**	**2.57%**

STATEWIDE SUMMARY

SW Region	**$579,568**	**$20,732,917**	2.80%
SE Region	**$277,372**	**$15,037,224**	1.84%
NE Region	**$595,956**	**$11,645,384**	5.12%
NC Region	**$552,771**	**$11,616,170**	4.76%
NW Region	**$339,728**	**$13,224,480**	2.57%
Statewide Totals	**$2,345,395**	**$72,256,176**	**3.25%**

Table A-4. Salt Brine Used

From Winter Storm Reports, 2023-2024

Region	County	PreWetting (Gal)	Anti-Icing (Gal)	Direct Liquid (Gal)	Total (Gal)
North Central	ADAMS	81,999	97,491	0	179,490
	FLORENCE	16,401	24,000	4,300	44,701
	FOREST	11,553	6,900	84,898	103,351
	GREEN LAKE	4,930	3,300	0	8,230
	IRON	32,200	0	0	32,200
	LANGLADE	17,276	98,247	194,571	310,094
	LINCOLN	115,448	145,000	0	260,448
	MARATHON	220,028	237,053	30,331	487,412
	MARQUETTE	25,544	137,491	207,583	370,618
	MENOMINEE	8,810	4,550	0	13,360
	ONEIDA	17,173	66,819	445,107	529,099
	PORTAGE	45,523	93,222	2,200	140,945
	PRICE	43,667	116,956	0	160,623
	SHAWANO	9,658	80,172	425,053	514,883
	VILAS	7,129	50,057	730,530	787,716
	WAUPACA	25,969	3,550	213,049	242,568
	WAUSHARA	28,645	24,775	0	53,420
	WOOD	11,665	31,593	387,841	431,099
	Region Totals	**723,618**	**1,221,176**	**2,725,463**	**4,670,257**

Region	County	PreWetting (Gal)	Anti-Icing (Gal)	Direct Liquid (Gal)	Total (Gal)
Northeast	BROWN	95,440	302,125	304,044	701,609
	CALUMET	10,204	101,924	7,206	119,334
	DOOR	27,957	47,350	45,570	120,877
	FOND DU LAC	211,236	86,898	0	298,134
	KEWAUNEE	32,330	31,000	73,700	137,030
	MANITOWOC	26,943	246,050	0	272,993
	MARINETTE	66,460	228,300	0	294,760
	OCONTO	58,508	167,788	53,696	279,992
	OUTAGAMIE	339,352	20,500	349,852	709,703
	SHEBOYGAN	259,595	106,552	259,595	625,742
	WINNEBAGO	19,241	229,094	536,141	784,476
	Region Totals	**1,147,266**	**1,567,581**	**1,629,804**	**4,344,650**

Table A-4. Salt Brine Used

From Winter Storm Reports, 2023-2024

Region	County	PreWetting (Gal)	Anti-Icing (Gal)	Direct Liquid (Gal)	Total (Gal)
Northwest	ASHLAND	81,792	34,450	0	116,242
	BARRON	11,458	840	0	12,298
	BAYFIELD	50,411	4,905	0	55,316
	BUFFALO	8,454	28,166	28,433	65,053
	BURNETT	17,507	10,743	0	28,250
	CHIPPEWA	46,657	8,702	0	55,359
	CLARK	14,182	6,985	0	21,167
	DOUGLAS	48,630	32,570	0	81,200
	DUNN	40,928	25,063	0	65,991
	EAU CLAIRE	40,186	105,245	0	145,431
	JACKSON	14,733	161,050	4,010	179,793
	PEPIN	2,406	11,162	0	13,568
	PIERCE	11,369	4,250	0	15,619
	POLK	20,131	19,700	0	39,831
	RUSK	857	3,538	0	4,395
	SAINT CROIX	82,395	2,084	0	84,479
	SAWYER	1,849	0	0	1,849
	TAYLOR	101,768	6,695	0	108,463
	TREMPEALEA	17,907	63,825	0	81,732
	WASHBURN	14,424	26,156	0	40,580
	Region Totals	**628,044**	**556,129**	**32,443**	**1,216,616**

Region	County	PreWetting (Gal)	Anti-Icing (Gal)	Direct Liquid (Gal)	Total (Gal)
Southeast	KENOSHA	7,224	600	0	7,824
	MILWAUKEE	168,710	142,838	152	311,700
	OZAUKEE	28,135	41,979	88,597	158,711
	RACINE	39,655	45,900	0	85,555
	WALWORTH	423,709	201,528	167,567	792,804
	WASHINGTO	91,296	60,410	30,150	181,856
	WAUKESHA	103,942	68,325	0	172,267
	Region Totals	**862,671**	**561,580**	**286,466**	**1,710,717**

Table A-4. Salt Brine Used

From Winter Storm Reports, 2023-2024

Region	County	PreWetting (Gal)	Anti-Icing (Gal)	Direct Liquid (Gal)	Total (Gal)
Southwest	COLUMBIA	233,520	131,607	0	365,127
	CRAWFORD	11,654	18,600	0	30,254
	DANE	217,649	109,589	0	327,238
	DODGE	41,121	72,880	133,327	247,328
	GRANT	113,515	4,000	0	117,515
	GREEN	55,417	37,140	0	92,557
	IOWA	35,204	87,164	95,542	217,910
	JEFFERSON	20	53,422	287,488	340,930
	JUNEAU	29,426	162,044	0	191,470
	LA CROSSE	79,815	0	43,110	122,925
	LAFAYETTE	9,610	6,200	0	15,810
	MONROE	13,406	142,859	4,000	160,265
	RICHLAND	32,855	39,550	0	72,405
	ROCK	33,531	115,518	231,908	380,957
	SAUK	30,097	7,835	1,498	39,430
	VERNON	86,156	38,338	0	124,494
	Region Totals	**1,022,996**	**1,026,746**	**796,873**	**2,846,615**
Totals		**4,384,595**	**4,933,212**	**5,471,049**	**14,788,855**

Table A-5. Annual Prewetting Agent Usage for Salt (Gallons)

From Winter Storm Reports, 2023-2024

Region	County	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NC	ADAMS	0	81,999	0	0	0	0	0	0
	FLORENCE	0	16,401	0	0	0	0	0	0
	FOREST	0	11,266	0	47	0	0	240	0
	GREEN LAKE	0	4,930	0	0	0	0	0	0
	IRON	0	32,160	0	40	0	0	0	0
	LANGLADE	0	17,276	0	0	0	0	0	0
	LINCOLN	0	112,158	0	3,290	0	0	0	0
	MARATHON	0	212,846	0	0	0	0	7,182	0
	MARQUETTE	0	24,744	0	800	0	0	0	0
	MENOMINEE	0	8,810	0	0	0	0	0	0
	ONEIDA	0	13,542	0	0	0	0	0	3,631
	PORTAGE	0	45,523	0	0	0	0	0	0
	PRICE	0	43,667	0	0	0	0	0	0
	SHAWANO	0	9,658	0	0	0	0	0	0
	VILAS	0	7,129	0	0	0	0	0	0
	WAUPACA	0	25,969	0	0	0	0	0	0
	WAUSHARA	0	28,645	0	0	0	0	0	0
	WOOD	0	11,665	0	0	0	0	0	0
	Region Totals	**0**	**708,388**	**0**	**4,177**	**0**	**0**	**7,422**	**3,631**

Region	County	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NE	BROWN	1,040	94,400	0	0	0	0	0	0
	CALUMET	0	9,592	0	0	0	0	0	612
	DOOR	0	27,957	0	0	0	0	0	0
	FOND DU LAC	834	210,402	0	0	0	0	0	0
	KEWAUNEE	0	32,330	0	0	0	0	0	0
	MANITOWOC	0	26,943	0	0	0	0	0	0
	MARINETTE	0	55,575	0	10,885	0	0	0	0
	OCONTO	0	58,508	0	0	0	0	0	0
	OUTAGAMIE	0	339,352	0	0	0	0	0	0
	SHEBOYGAN	0	259,595	0	0	0	0	0	0
	WINNEBAGO	0	19,241	0	0	0	0	0	0
	Region Totals	**1,874**	**1,133,895**	**0**	**10,885**	**0**	**0**	**0**	**612**

Table A-5. Annual Prewetting Agent Usage for Salt (Gallons)

From Winter Storm Reports, 2023-2024

Region	County	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NW	ASHLAND	0	73,612	8,180	0	0	0	0	0
	BARRON	0	11,458	0	0	0	0	0	0
	BAYFIELD	0	50,411	0	0	0	0	0	0
	BUFFALO	0	8,454	0	0	0	0	0	0
	BURNETT	0	17,026	0	0	0	0	0	481
	CHIPPEWA	966	41,476	0	0	0	0	0	4,215
	CLARK	0	14,182	0	0	0	0	0	0
	DOUGLAS	0	33,710	0	0	0	163	0	14,757
	DUNN	0	37,598	0	0	0	0	0	3,330
	EAU CLAIRE	85	40,101	0	0	0	0	0	0
	JACKSON	0	9,300	2,373	0	0	2,960	0	100
	PEPIN	0	2,406	0	0	0	0	0	0
	PIERCE	0	11,369	0	0	0	0	0	0
	POLK	0	17,780	2,351	0	0	0	0	0
	RUSK	0	466	0	0	0	0	0	391
	ST. CROIX	863	62,912	0	0	0	0	0	18,620
	SAWYER	0	0	0	0	0	0	0	1,849
	TAYLOR	0	101,768	0	0	0	0	0	0
	TREMPEALEAU	0	17,907	0	0	0	0	0	0
	WASHBURN	0	11,539	0	0	0	0	0	2,885
	Region Totals	**1,914**	**563,475**	**12,904**	**0**	**0**	**3,123**	**0**	**46,628**

Region	County	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
SE	KENOSHA	7,224	0	0	0	0	0	0	0
	MILWAUKEE	7,577	161,133	0	0	0	0	0	0
	OZAUKEE	150	27,985	0	0	0	0	0	0
	RACINE	1,987	37,668	0	0	0	0	0	0
	WALWORTH	14,820	408,888	0	0	0	0	0	0
	WASHINGTON	0	91,296	0	0	0	0	0	0
	WAUKESHA	26,016	77,926	0	0	0	0	0	0
	Region Totals	**57,774**	**804,896**	**0**	**0**	**0**	**0**	**0**	**0**

Table A-5. Annual Prewetting Agent Usage for Salt (Gallons)

From Winter Storm Reports, 2023-2024

Region	County	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
SW	COLUMBIA	0	233,520	0	0	0	0	0	0
	CRAWFORD	0	11,654	0	0	0	0	0	0
	DANE	0	217,649	0	0	0	0	0	0
	DODGE	0	37,513	0	0	0	0	0	3,608
	GRANT	0	113,515	0	0	0	0	0	0
	GREEN	0	55,417	0	0	0	0	0	0
	IOWA	0	35,204	0	0	0	0	0	0
	JEFFERSON	0	20	0	0	0	0	0	0
	JUNEAU	0	29,426	0	0	0	0	0	0
	LA CROSSE	0	79,815	0	0	0	0	0	0
	LAFAYETTE	0	9,310	0	300	0	0	0	0
	MONROE	0	13,406	0	0	0	0	0	0
	RICHLAND	0	32,855	0	0	0	0	0	0
	ROCK	0	33,531	0	0	0	0	0	0
	SAUK	0	30,097	0	0	0	0	0	0
	VERNON	0	83,361	0	0	0	0	0	2,795
	Region Totals	**0**	**1,016,293**	**0**	**300**	**0**	**0**	**0**	**6,403**

Region	$CaCl_2$	Salt Brine	$MgCl_2$	FreezeGard	GeoMelt	Beet 55	AMP	Beet Heet
NC	0	708,388	0	4,177	0	0	7,422	3,631
NE	1,874	1,133,895	0	10,885	0	0	0	612
NW	1,914	563,475	12,904	0	0	3,123	0	46,628
SE	57,774	804,896	0	0	0	0	0	0
SW	0	1,016,293	0	300	0	0	0	6,403
Statewide Totals	**61,562**	**4,226,947**	**12,904**	**15,362**	**0**	**3,123**	**7,422**	**57,274**

4,384,594

Table A-6. 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
2010/11	573,253	33,776	17.0	26,998
2011/12	355,519	33,944	10.5	25,669
2012/13	621,207	34,192	18.2	26,512
2013/14	669,807	34,339	19.5	26,774
2014/15	388,797	34,435	11.3	28,218
2015/16	399,046	34,486	11.6	28,518
2016/17	526,198	34,621	15.2	29,350
2017/18	567,600	34,678	16.4	30,095
2018/19	553,443	34,774	15.9	30,022
2019/20	425,558	34,859	12.2	30,525
2020/21	324,265	35,177	9.2	27,764
2021/22	387,600	34,736	11.2	28,773
2022/23	483,874	34,723	13.9	30,785
2023/24	255,155	34,736	7.3	31,330

* Quantities adjusted