

98.4"

Official
State Snowfall

150

Truck Stations

1,813 Full-time
and Backup

Snowfighters

840

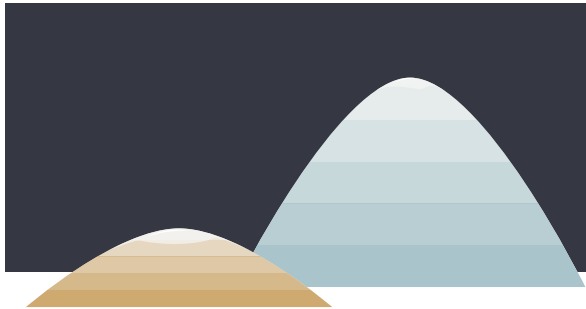
Plow trucks -
includes 47
reserve plows

30,585

Lane Miles

85%

Frequency
Achieving
Bare Lanes



39,000

Tons Sand

251,400

Tons Salt

Total Cost
of Winter

\$124

Million

2017-18

Winter Maintenance Report

At A Glance



Introduction

The winter of 2017-18 was a memorable one. From persistent cold temperatures to five official blizzards on the books, MnDOT responded to 30 winter events, eight more than the previous winter. The state received snowfall from October 2017 into April 2018. The biggest storm of the season waited until April 15 to appear and it became a month of records for snowfall amounts and warm temperatures. MnDOT spent \$124 million on its snow and ice operations, the most spent since 2013-14. The cost increases are expected given the average snowfall in each district was higher and the number of winter events was up from last year. The operations included materials, labor and equipment.

Snapshot of winter: two-year comparison

Category	Measure	2016-17	2017-18
Infrastructure	Lane Miles	30,517	30,585
Weather	Snowfall, MSP Airport	43.5"	98.4"
	Snowfall, statewide across districts**	54.0"	88.7"
	Number of winter events, statewide average	22	30
Materials	Salt used	197,417 tons	251,418 tons
	Average weighted cost of salt per ton	\$73.99	\$60.73
	Salt brine used	3.0 million gallons	4.1 million gallons
	Sand used	46,000 tons	39,009 tons
Costs and Performance	Total plowing, salting and sanding costs	\$97 million*	\$124 million*
	Total plowing, salting and sanding costs per lane mile, statewide average	\$3,180	\$4,050
	Frequency of achieving bare lane after winter event (70% target)	87%	85%
Labor and Services	Regular labor hours	463,798	573,851
	Overtime winter labor hours	54,933	85,007

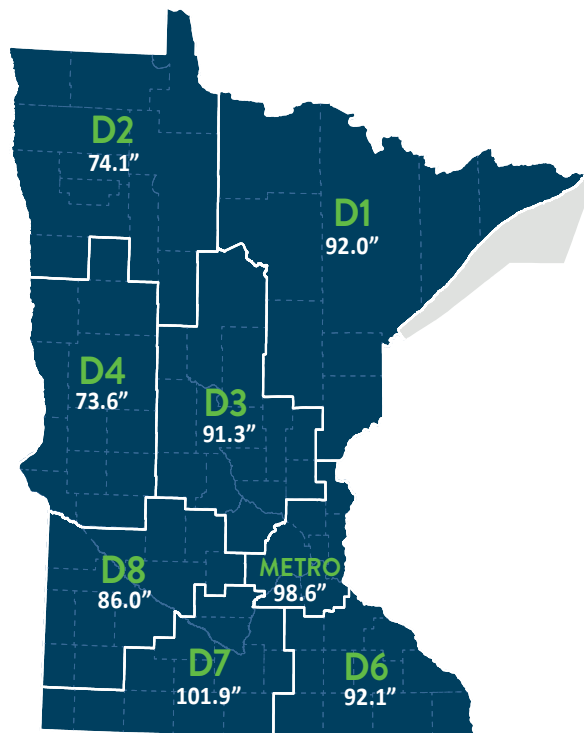
*Based on fiscal year

** Based on Maintenance Decision Support System

Weather

The 2017-18 season snowfall, reported near the MSP airport, was 98.4 inches compared to 43.5 inches in 2016-17. The 10-year average season snowfall is 55.5 inches. District 7 reported the most snowfall with 107.6 inches recorded at St. James and a district average of 101.9 inches. Metro District reported the second highest average with 98.6 inches for the season with 104.3 inches recorded in Harris. District snowfall levels are determined by averaging measurements from four locations within the district as recorded by the Maintenance Decision Support System.

2017-18 Average District Snowfall



A winter event is....

Any winter weather occurrence that consumes resources necessary to prevent, minimize or regain the loss of bare lanes. Winter events can include freezing rain, drizzle/sleet, snow, drifting/blowing snow, frost, ice/black ice, refreeze or any combination of these conditions.

*Snowfall amounts from MnDOT MDSS

Winter Severity Index

MnDOT uses a Winter Severity Index to simplify the comparison of winter severity from year to year. At the end of each season, each district uses these factors to calculate a single relative number:

Dewpoint/
relative
humidity

Wind speed,
gusts,
direction

Frost/
black ice

Precipitation
type, duration
amounts

Air
temperature

Road
temperature

Cloud cover

Blowing snow

Surface
pressure

Official weather reporting station snowfall

	Near MSP Airport	Statewide Average*
2013-14	69.9"	75.6"
2014-15	32.6"	39.4"
2015-16	36.7"	52.6"
2016-17	43.5"	54.0"
2017-18	98.4"	88.7"

*2013-16 reported from districts
2016-18 reported from MDSS

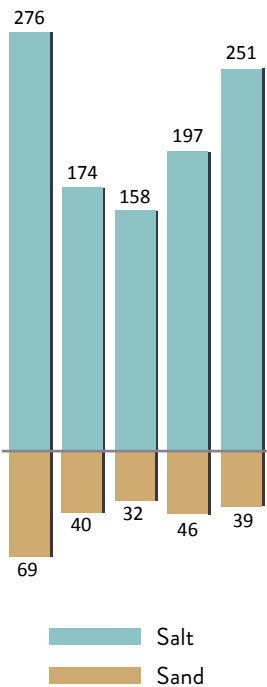


Winter Severity Index by district for past three years

District	2015-16	2016-17	2017-18
1	135	148	96
2	103	127	124
3	92	107	120
4	106	123	115
Metro	71	89	122
6	89	109	94
7	107	97	109
8	97	96	112
Statewide	106	119	115

Materials usage

Salt and Sand (in thousands of tons)



District by district average salt/sand usage for the past five years (in thousands of tons)

District	Material	2013-14	2014-15	2015-16	2016-17	2017-18
1	Salt	40.7	27.4	34.6	35.5	29.5
	Sand	23.4	11.7	11.2	18.5	10.6
2	Salt	9.8	12.6	14.3	17.5	16.6
	Sand	7.4	8.2	7.7	6.4	7.2
3	Salt	35.0	22.2	20.7	29.5	33.9
	Sand	3.9	1.5	1.1	3.8	2.2
4	Salt	11.4	11.1	9.4	10.2	13.1
	Sand	6.4	5.5	4.4	4.6	3.7
Metro	Salt	97.0	44.9	31.7	45.8	81.8
	Sand	7.3	1.1	0.3	0.9	1.2
6	Salt	43.0	30.5	27.2	34.7	42.6
	Sand	12.1	6.8	3.8	6.8	9.8
7	Salt	23.9	15.0	8.5	14.9	22.9
	Sand	1.8	0.6	0.6	0.8	1.2
8	Salt	14.9	10.3	11.5	9.3	11.0
	Sand	6.9	4.5	2.9	3.9	3.1
Statewide	Salt	275.9	173.9	157.8	197.4	251.4
	Sand	69.1	39.8	32.0	45.8	39.0

Factors affecting use of material during winter event:

- Precipitation type
- Air temperature
- Cloud cover
- Blowing snow
- Dew point/relative humidity
- Wind speed
- Road temperature
- Frost/black ice
- Surface pressure

Variation in salt usage from district to district depends on:

- Winter severity
- System size
- Level of service
- Physical environment conditions

Cost and performance of winter operations

Snow and ice expenditures were about 27.8 percent, or \$27 million more than the previous winter. A total of \$124 million was spent on materials, labor and equipment.

Salt costs*

(cost per ton)

Year	Cost
2013-14	\$71.14
2014-15	\$74.36
2015-16	\$75.79
2016-17	\$73.99
2017-18	\$60.73

\$13/ton
less than in 2016-17

*Based on fiscal year

Historical snow and ice expenditures trend*

(costs in thousands)

Office	2013-14	2014-15	2015-16	2016-17	2017-18	5-Year Average
1	\$16,902	\$10,321	\$13,569	\$12,998	\$13,524	\$13,463
2	\$9,051	\$6,963	\$8,617	\$9,441	\$10,282	\$8,871
3	\$16,466	\$10,259	\$11,207	\$12,110	\$15,261	\$13,061
4	\$9,867	\$7,622	\$7,562	\$8,206	\$10,049	\$8,661
6	\$18,790	\$12,838	\$12,564	\$14,118	\$16,427	\$14,947
Metro	\$42,558	\$23,872	\$20,149	\$23,507	\$12,704	\$29,445
7	\$12,760	\$8,279	\$11,564	\$8,865	\$7,106	\$10,834
8	\$9,242	\$6,281	\$7,399	\$6,443	\$37,141	\$7,294
Maintenance	\$495	\$1,346	\$1,249	\$1,209	\$1,256	\$1,111
Other	\$98	\$126	\$97	\$48	\$111	\$96
Statewide	\$136,228	\$87,914	\$94,160	\$97,003	\$123,861	\$107,784

\$16.1 million

more than five-year average

*Based on fiscal year

Total spent for snow and ice control and winter severity

(cost in millions; includes materials, labor and equipment)

	Cost	Severity
2015-16	\$94	106
2016-17	\$97	119
2017-18	\$124	115

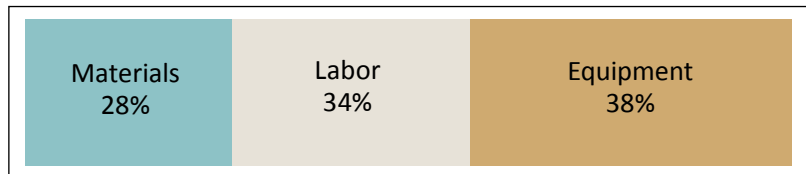
\$27 million
more than 2016-17



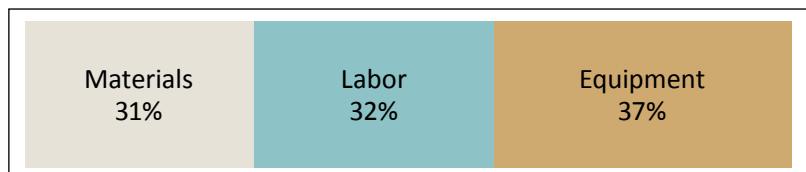
Factors affecting winter maintenance costs:

- Timing of storms
- Change in labor costs
- Inflation
- Fuel prices
- Salt, chemical prices
- Winter severity index

2017-18 winter maintenance costs by category

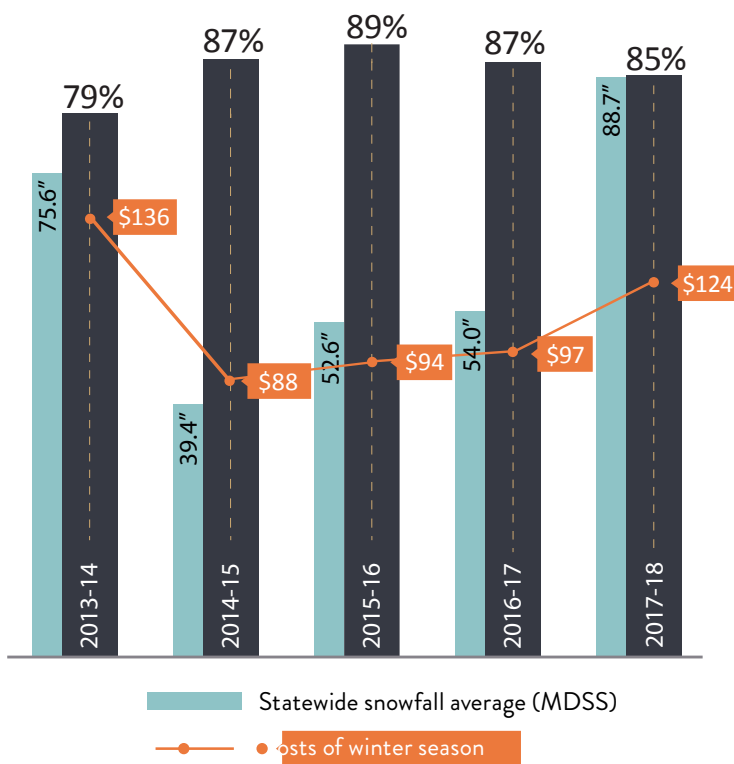


2016-17 winter maintenance costs by category



Bare lane targets

Frequency of meeting bare lane targets
(cost in millions)



Meeting bare lane targets

MnDOT met its overall performance target for the season. The statewide average for meeting this target for all road classifications was 89 percent. MnDOT met or exceeded the 70 percent target the past nine of 10 years. MnDOT worked to reduce chemicals used on roadways and invested in updates to systems and technologies.

Bare lane regain time

This is measured from the time a winter event ends to when MnDOT's snow and ice operations regain bare-lane driving conditions. The target for this measure varies by road classification, ranging from 0 to 3 hours for the state's most heavily traveled roadways to 9 to 36 hours for the least traveled secondary roads.

Frequency of meeting bare lane target

This measure reports how often crews met the bare-lane target over an entire winter season. This target is set at 70 percent.

Snow and ice technology highlights

Pathfinder

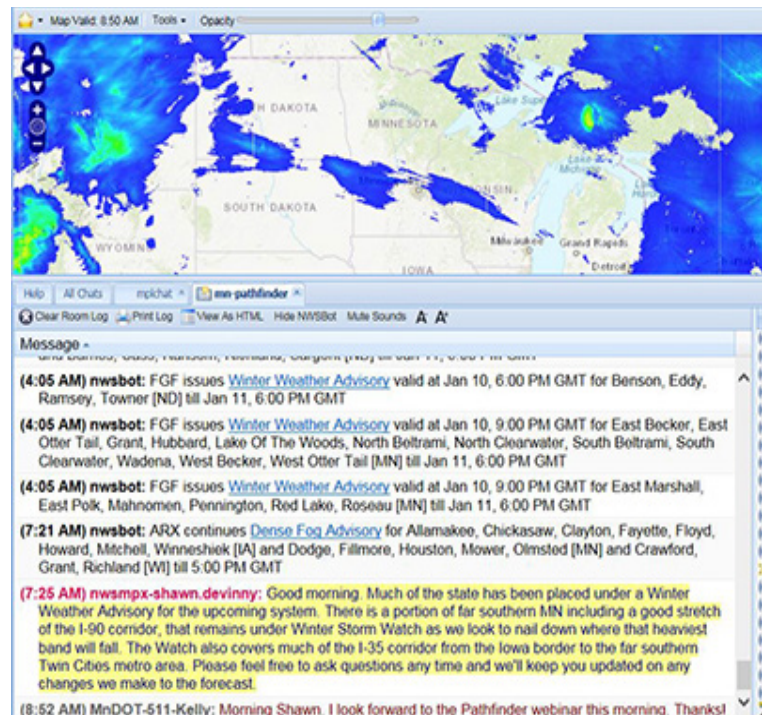
MnDOT launched the Pathfinder strategy to better communicate blizzard warnings to the public. The strategy helps determine clear and consistent messaging to share with the public before, during and after the weather event. Pathfinder is used in more than 17 other states and is a partnership with the National Weather Service. Other partners include Iteris, MnDOT's private sector meteorological service.

Pathfinder launched Jan. 10, 2018, when the first major winter storm of 2018 hit the state. The blizzard conditions were mainly to the north and west and led to road closures in some parts of the state.

District maintenance personnel, NWS and Iteris used an online chat room to exchange details about what the weather conditions were and the impacts of weather on road conditions. It is the central hub of Pathfinder, but other tools include the state's dynamic messaging signs, 511 and Skype briefings before, during and after storms.

MnDOT used Pathfinder in all five of the state's blizzards in the winter of 2017-18. MnDOT maintenance personnel said the first year of Pathfinder was a success and was a learning process in many ways, including how the National Weather Service operates.

MnDOT plans to expand use of Pathfinder to include storms that have the potential to develop into blizzards. Other plans include expanding the use of the dynamic messaging signs.



Salt Sustainability Plan

In early 2018, MnDOT took the next steps in the responsible use of chlorides for winter maintenance. MnDOT will draw from best practices around the state, country and the world to reduce chlorides without sacrificing safety or level of service.

Possible approaches may include better salt stock pile monitoring, improved salt spreader calibration, more accurate salt application, better assessment of road weather conditions for decision making, better practices for solid salt application and alternatives to solid salt application.

The solutions with the most potential will be developed into training materials, along with implementation guidance for using these materials effectively.

A method for measuring salt reduction around the state will help MnDOT track the effectiveness of its salt sustainability plan and continue to improve it.



The maintenance office set a goal to make graduated progress toward meeting the salt use recommendation of the Maintenance Decision Support System, which provides data on how much salt and other materials to use. MDSS has already improved MnDOT's snow and ice operations, but MnDOT is working toward reducing salt usage to within 10 percent of the recommended MDSS usage to further decrease salt usage while finding the balance between public safety and environmental concerns.