

2018-19

Winter Maintenance Report

At a glance

97.2"

State Snowfall
Average

150

Truck Stations

1,814

Full-time and Backup
Snowfighters

800+

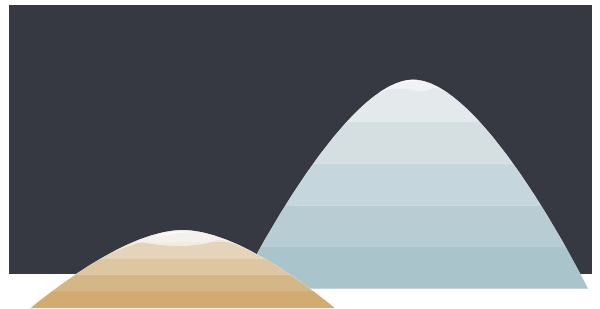
Plow Trucks

30,426

Lane Miles

84%

Frequency
Achieving
Bare Lanes



35,900

Tons of Sand

246,500

Tons of Salt

Total Cost
of Winter

\$133
Million



Introduction

The winter of 2018-19 put MnDOT teams and tools to the test. With record cold temperatures in January and powerful blizzards in February, crews battled some of the most severe winter storms Minnesota has seen this decade. The state received snowfall from October 2018 into mid-May 2019. MnDOT spent \$133 million on its snow and ice operations, which include materials, labor, equipment and other expenditures. This is the most money MnDOT has spent since 2013-14. However, the cost increases are not unusual given the number of winter events and severity of those storms.

Snapshot of winter: two-year comparison

Category	Measure	2017-18	2018-19
Infrastructure	Lane miles	30,585	30,426
Weather	Snowfall, near MSP Airport*	98.4"	92.1"
	Snowfall, statewide across districts*	88.7"	97.2"
	Number of winter events, statewide average	30	31
Materials	Salt used	251,418 tons	246,505 tons
	Average cost of salt per ton	\$60.73	\$68.95
	Salt brine used	4.1 million gallons	4.6 million gallons
	Sand used	39,009 tons	35,948 tons
Costs and Performance	Total plowing, salting and sanding costs	\$124 million**	\$133 million**
	Total plowing, salting and sanding costs per lane mile, statewide average	\$4,050	\$4,361
	Frequency of achieving bare lane after winter event (70% target)	85%	84%
Labor and Services (from Business Intelligence)	Regular labor hours	573,851	620,218
	Overtime winter labor hours	85,007	198,107

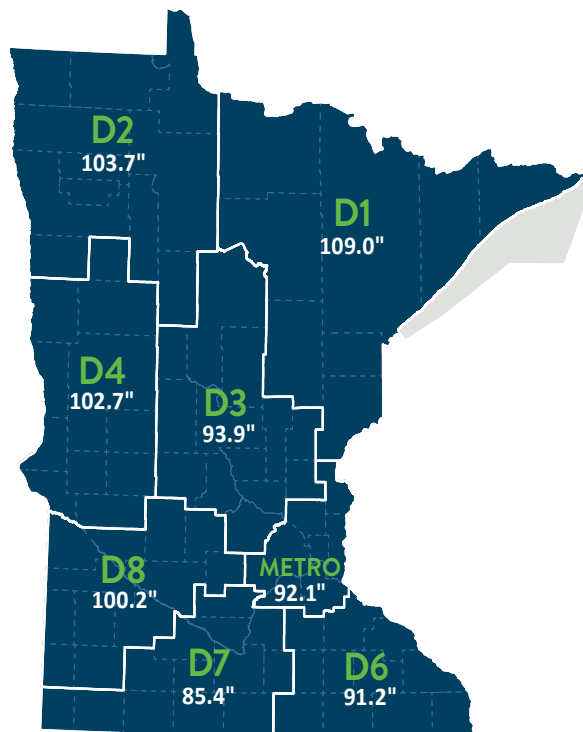
*Based on MnDOT Maintenance Decision Support System

**Based on fiscal year

Weather

The 2018-19 season snowfall reported near the MSP airport was 92.1 inches compared to 98.4 inches in 2017-18. The 10-year average season snowfall in Minnesota is 59.1 inches. District 1 reported the most snowfall with 124.3 inches recorded at Grand Marais and a district average of 109.0 inches. District 2 reported the second highest average with 103.7 inches for the season with 109.1 inches recorded in Crookston. District snowfall levels are determined by averaging measurements from four locations within the district as recorded by the Maintenance Decision Support System.

2018-19 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 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*
2014-15	32.6"	39.4"
2015-16	36.7"	52.6"
2016-17	43.5"	54.0"
2017-18	98.4"	88.7"
2018-19	92.1"	97.2"

*2014-16 reported from districts
2016-19 reported from MDSS

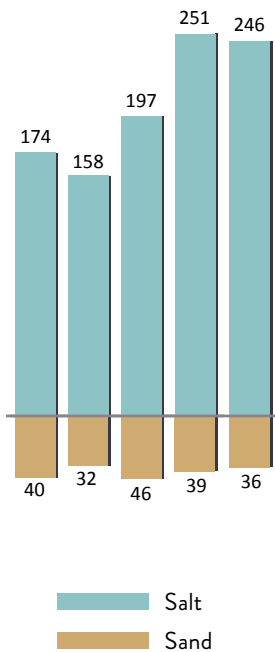


Winter Severity Index by district for past three years

District	2016-17	2017-18	2018-19
1	148	96	154
2	127	124	164
3	107	120	140
4	123	115	157
Metro	89	122	132
6	109	94	144
7	97	109	156
8	96	112	164
Statewide	119	115	154

Materials usage

**Salt and Sand
(in thousands of tons)**



Average salt/sand usage by district for past five years
(in thousands of tons from Business Intelligence)

District	Material	2014-15	2015-16	2016-17	2017-18	2018-19
1	Salt	27.4	34.6	35.5	29.5	34.6
	Sand	11.7	11.2	18.5	10.6	13.0
2	Salt	12.6	14.3	17.5	16.6	12.6
	Sand	8.2	7.7	6.4	7.2	4.3
3	Salt	22.2	20.7	29.5	33.9	33.5
	Sand	1.5	1.1	3.8	2.2	1.2
4	Salt	11.1	9.4	10.2	13.1	10.5
	Sand	5.5	4.4	4.6	3.7	3.7
Metro	Salt	44.9	31.7	45.8	81.8	71.1
	Sand	1.1	0.3	0.9	1.2	1.2
6	Salt	30.5	27.2	34.7	42.6	44.0
	Sand	6.8	3.8	6.8	9.8	8.0
7	Salt	15.0	8.5	14.9	22.9	26.8
	Sand	0.6	0.6	0.8	1.2	1.3
8	Salt	10.3	11.5	9.3	11.0	13.4
	Sand	4.5	2.9	3.9	3.1	3.2
Statewide	Salt	173.9	157.8	197.4	251.4	246.5
	Sand	39.8	32.0	45.8	39.0	35.9

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 7.1 percent, or \$9 million, more than the previous winter. A total of \$133 million was spent on materials, labor and equipment.

Salt costs*

(average per ton)

Year	Cost
2014-15	\$74.36
2015-16	\$75.79
2016-17	\$73.99
2017-18	\$60.73
2018-19	\$68.95

\$8.22/ton
more than in 2017-18

*Based on fiscal year

Historical snow and ice expenditures trend*

(in thousands)

District	2014-15	2015-16	2016-17	2017-18	2018-19	5-Year Average
1	\$10,321	\$13,569	\$12,998	\$13,524	\$14,910	\$13,468
2	\$6,963	\$8,617	\$9,441	\$10,282	\$10,209	\$8,879
3	\$10,259	\$11,207	\$12,110	\$15,261	\$16,179	\$13,063
4	\$7,622	\$7,562	\$8,206	\$10,049	\$11,587	\$8,598
Metro	\$23,880	\$20,150	\$23,507	\$37,141	\$34,821	\$29,448
6	\$12,838	\$12,564	\$14,118	\$16,427	\$18,217	\$14,954
7	\$8,279	\$11,564	\$8,865	\$12,704	\$14,884	\$10,834
8	\$6,281	\$7,399	\$6,443	\$7,106	\$9,905	\$7,296
Other	\$1,479	\$1,522	\$1,346	\$1,389	\$1,975	\$1,266
Statewide	\$87,922	\$94,154	\$97,033	\$123,883	\$132,688	\$107,806

\$24.8 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
2016-17	\$97	119
2017-18	\$124	115
2018-19	\$133	154

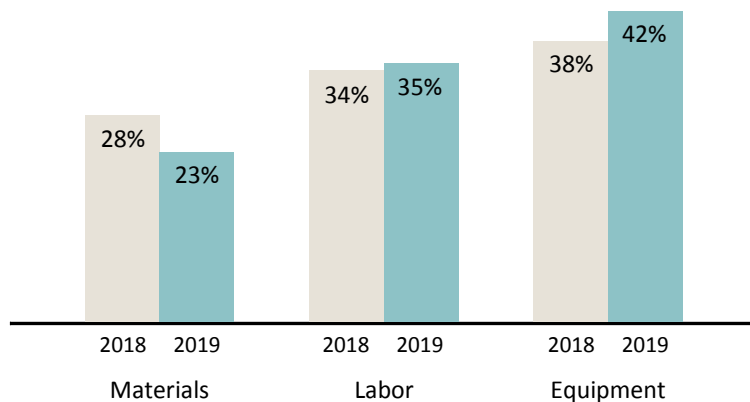
\$9 million
more than 2017-18



Factors affecting winter maintenance costs:

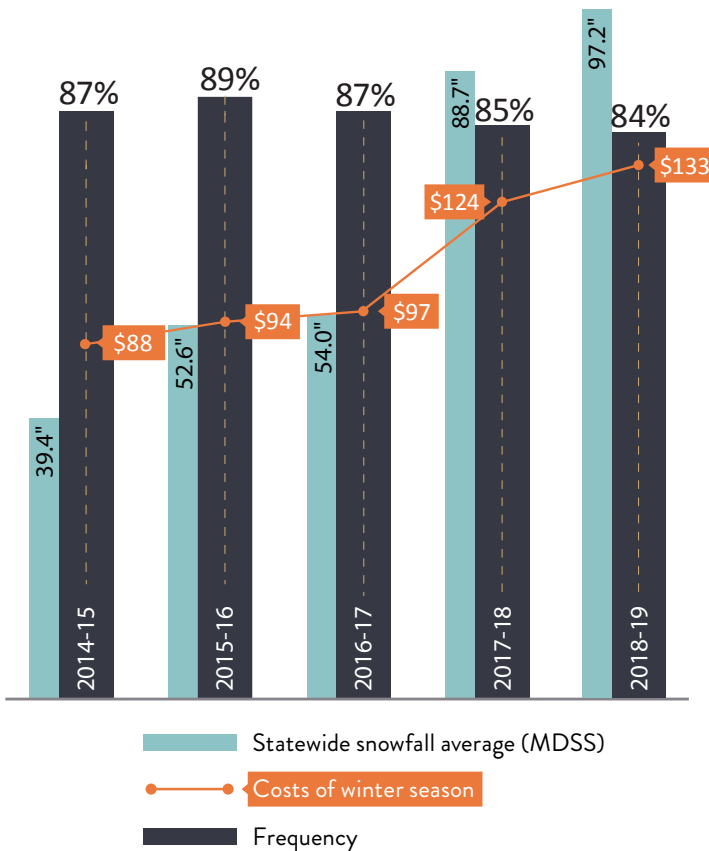
- Timing of storms
- Change in labor costs
- Inflation
- Fuel prices
- Salt, chemical prices
- Winter severity

Winter maintenance costs



Bare lane targets

Frequency of meeting bare lane targets
(cost in millions from Business Intelligence)



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 84 percent. MnDOT met or exceeded the 70 percent target the past 10 of 10 years. MnDOT worked to reduce road salt 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.

Liquid applications improve road salt performance

When Mother Nature put snowplow drivers to the test, MnDOT districts turned to liquid applications to help get the job done. Whether it was a pre-treat solution, additive or compaction attacker, crews found liquids improved the performance of road salt, which led to routes being cleared faster and with less material.

MnDOT has used salt brine for many years. Districts are also exploring different products and combinations of liquids to find the best fit for each condition. Alternate liquids are also playing a role as a salt replacement or enhancement.

All districts are equipped to make and distribute brine, a specific blend of fresh water and road salt. The liquid is often used to pre-treat roads prone to frost. It can also be added to rock salt to create a thicker slurry. This slurry combination helps break up compacted snow and ice more quickly, helping to reduce the total amount of salt used.

District 1 expanded field tests using Potassium Acetate (KAc) on select routes. Results from the 2017-18 winter season show the chemical worked well at lower temperatures and helped reduce the use of road salt. Final results of this year's research is expected later this year.

Districts also found success using BEET HEET, a newer product on the market. This blend of chlorides and sugars is made from the molasses of sugar beets. In addition to enhancing the performance of brine and rock salt, the sticky consistency of this additive helps road salt stay put.

All districts routinely work with chemicals like Apex-C, RG8 and others to enhance the effectiveness of snow and ice efforts.

At the annual winter wrap-up meeting, maintenance supervisors talked about what worked well for their areas. They expect to use more liquid applications next year, which increases the need for additional places to make and store chemicals. Lawmakers approved a budget adjustment to invest in ways to expand brine production and purchase additional storage tanks across the state.



Brine and chemical storage tanks at the Maple Grove Truck Station

- **Potassium Acetate (KAc)**

Non-chloride-based deicer that contains Potassium Acetate, water and a small amount of a corrosion inhibitor. It is a clear to light-straw colored, odorless liquid.

- **BEET HEET**

Organic-based product made from the molasses of sugar beets. It contains calcium chloride, sodium chloride, potassium chloride, Sucrose, Glucose, Fructose, Raffinose and water. Its consistency is a little thicker than syrup and some say it smells like chocolate or coffee.

- **Apex-C**

Made from water, calcium-chloride, magnesium chloride and a proprietary corrosion inhibitor. Apex-C is a clear to amber colored liquid that can be used as a stand-alone product or blended with road salt.

- **RG8**

Road Guard Plus 8 is made from calcium chloride brine and an organic-based corrosion inhibitor. It is a dark brown, odorless liquid.

Conquering winter's worst week with tools and teamwork

The 2018-19 winter season was memorable for many reasons: it produced snow from October to May, a polar vortex in late January and record snowfall amounts by mid-February. But for crews in southern Minnesota, one week stood out from the rest.

It began on Wednesday, Feb. 20, when a storm laid down 8-10 inches of new snow from southwest Minnesota to the Twin Cities and across to Wisconsin. Two days later, a bomb cyclone blizzard hit most of

snow drifts more than a mile long on the interstate and it was worse on many of our two-lane highways.”

Interstate 90 west of Albert Lea was the first major highway to shut down that weekend with I-35 south of Faribault and I-90 east to Dexter soon to follow, a rare triple shutdown. Despite warnings from the weather service, social media and MnDOT's 511 map, many drivers attempted to travel and failed. That left dozens of vehicles stranded across the region.



Three snow blowers work together to clear drifts along I-35 near Ellendale

the same area. This second storm added more than a foot of snow to the region followed by 40-55 mph wind gusts and below freezing wind chills.

“Heavy snow is difficult, but the blowing snow proved to be our biggest challenge,” said Tim Zierden, District 6 maintenance superintendent. “We had 6- to 8-foot

dozers and quadtrac tractors. Even Herman, the oldest truck-mounted snowblower, traveled from the Twin Cities to clear snow drifts along I-35. But to supervisors, the biggest help came in the form of personnel. Snowplow drivers from the Metro District brought equipment and joined additional crews from District 7 to support District 6 in storm clean-up.

“Some roads closed themselves because of that—one car would get stuck and then four or five more would follow,” said Chase Fester, District 7 maintenance superintendent. “Stranded vehicles make everything 100 times worse because it is difficult to plow those areas until the vehicles are towed out. They also create their own snow drifts, which take longer for our snowplow drivers to clear.”

MnDOT pulled out its arsenal to tackle the problem. Crews used ice breakers, SnoGos and motor graders. Some districts brought in

“We haven’t had that many extra people come down to work an event since I became area maintenance engineer in District 6 14 years ago. Their help was a savior to us,” said Mark Panek, District 6 assistant district engineer. “Without those extra crews, highways like 52 and 14 would have stayed in worse shape for a much longer period of time.”

Events like this keep truck stations working seven days a week and require more hands on deck. From the front desk to the repair shops, a lot of people worked extra hours that week to get through both storms.

“Teamwork was key to our success,” said Jed Falgren, District 7 assistant district engineer. “In addition to snow and ice staff, our mechanics kept equipment on the road and our communications staff gave regular updates to the public about road closures and changing conditions. Our partners at the Minnesota State Patrol, the South Dakota and Iowa DOTs also worked with us to get messages out to travelers.”

By Tuesday, Feb. 26, all roads in southern Minnesota were open to traffic again.

“This is what we do,” Falgren said. “Some people may say we survived this winter. Many of us in maintenance feel we conquered it. And we will do it again if we have to.”



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Screen shot from 511 of conditions along Highway 14 near Kasson on Sunday, Feb. 24.



Snowplow view of drifts along two-lane highway in southern Minnesota