



2016-17

Winter Maintenance Report

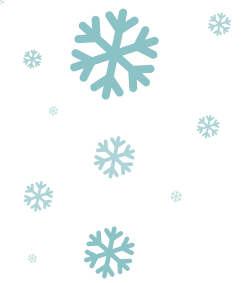
At A Glance

Total Cost of Winter **\$97** Million



30,517
Snow and Ice
Lane Miles

87%
Frequency
Achieving
Bare Lanes

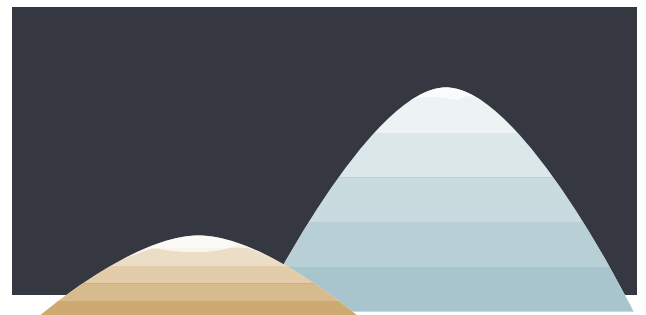


54"
Statewide
Snowfall
Average

150
Truck Stations

1,779 Full-time
and Backup
Drivers

843
Plows



46,000
Tons Sand

197,417
Tons Salt

Introduction

The 2016-17 winter was considered an average one in terms of snow and ice events, but many parts of the state experienced more extreme winter severity, with events having longer durations. MnDOT spent more dollars on snow and ice than 2015-16. Whether the state gets a lot of snow and ice in a season or smaller amounts, resources are still expended to keep roads clear, pay wages and maintain equipment.

Snapshot of winter: 2-year comparison

Category	Measure	2015-16	2016-17
Infrastructure	Lane Miles	30,632	30,517
Weather	Snowfall, near MSP Airport	36.7"	43.5"
	Snowfall, statewide across districts	52.6"	54.0"
	Number of winter events, statewide average	27	22
Materials	Salt used	157,812 tons	197,417 tons
	Average weighted cost of salt per ton	\$75.79	\$73.99
	Salt brine used	2.2 million gallons	3.0 million gallons
Costs and Performance	Total plowing, salting and sanding costs	\$94.2 million*	\$97 million*
	Total plowing, salting and sanding costs per lane mile, statewide average	\$3,074	\$3,180
	Frequency of achieving bare lane after winter event (70% target)	89%	87%
Labor and Services	Regular labor hours	510,147	463,798
	Overtime winter labor hours	78,111	54,933

**Based on fiscal year*

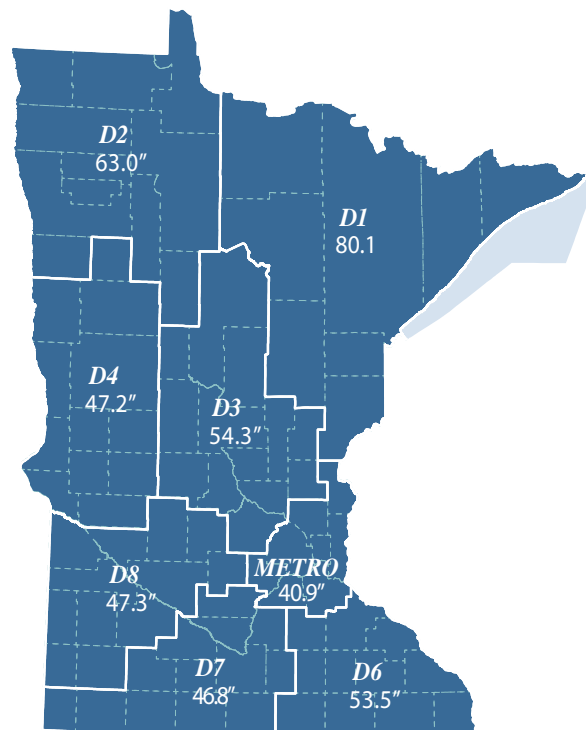
Weather

The 2016-17 season snowfall, reported near the Minneapolis - St. Paul Airport, was 43.5 inches.

That compares to 36.7 inches in 2015-16.

The 10-year average season snowfall is 50.2 inches. District 1 reported the most snowfall in 2016-17 with 87.0 inches at International Falls. The District 1 2016-17 average was 80.1 inches. District 2 reported the second highest 2016-17 average of 63.0 inches, with baudette recording 70.3 inches. District snowfall levels are determined by averaging measurements from four locations within the district as reported by MDSS.

2016-2017 Average District Snowfall



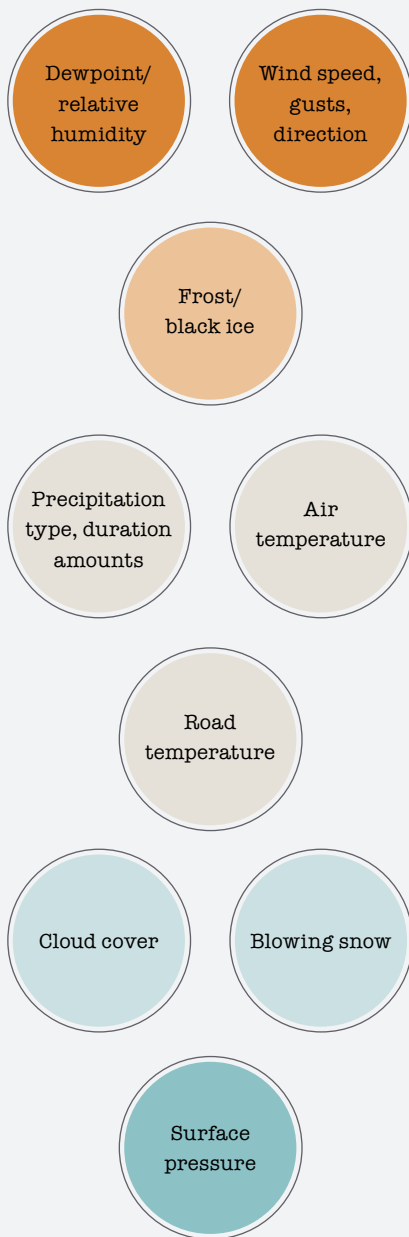
A winter event is....

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:



Official weather reporting station snowfall

	near MSP Airport	*Statewide Average
2012-13	67.7"	72.3"
2013-14	69.9"	75.6"
2014-15	32.6"	39.4"
2015-16	36.7"	52.6"
2016-17	43.5"	54.0"

*2012-2016 reported from Districts
2016-2017 reported from MDSS

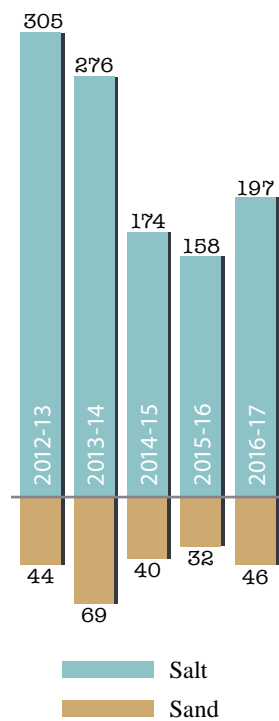


Winter Severity Index by district for past 3 years

District	2014-15	2015-16	2016-17
1	93	135	148
2	85	103	127
3	69	92	107
4	92	106	123
Metro	66	71	89
6	88	89	109
7	97	107	97
8	92	97	96
Statewide	87	106	119

Materials usage

Salt and Sand
(in thousands of tons)



2016-17 district by district average salt/sand usage for the past 5 years
(in thousands of tons)

District	Material	2012-13	2013-14	2014-15	2015-16	2016-17
1	Salt	50.0	40.7	27.4	34.6	35.5
	Sand	14.0	23.4	11.7	11.2	18.5
2	Salt	16.9	9.8	12.6	14.3	17.5
	Sand	7.6	7.4	8.2	7.7	6.4
3	Salt	39.9	35.0	22.2	20.7	29.5
	Sand	3.0	3.9	1.5	1.1	3.8
4	Salt	22.0	11.4	11.1	9.4	10.2
	Sand	3.7	6.4	5.5	4.4	4.6
Metro	Salt	79.9	97	44.9	31.7	45.8
	Sand	1.0	7.3	1.1	0.3	0.9
6	Salt	49.7	43.0	30.5	27.2	34.7
	Sand	8.3	12.1	6.8	3.8	6.8
7	Salt	27.8	23.9	15.0	8.5	14.9
	Sand	1.4	1.8	0.6	0.6	0.8
8	Salt	17.4	14.9	10.3	11.5	9.3
	Sand	5.5	6.9	4.5	2.9	3.9
Statewide	Salt	304.6	275.9	173.9	157.8	197.4
Total	Sand	44.3	69.1	39.8	32.0	45.8

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
- Road classification
- Level of service
- Physical environment conditions

Cost and performance of winter operations

Snow and ice expenditures were about 3.1 percent, or \$2.9 million more than the previous winter. A total of \$97.0 million was spent on materials, labor and equipment.

Salt costs*

(cost per ton 5 year average)

Year	Cost
2012-13	\$69.81
2013-14	\$71.14
2014-15	\$74.36
2015-16	\$75.79
2016-17	\$73.99

2016 - 2017

\$2 /ton

less than in 2015-16

*Based on fiscal year

Historical snow and ice expenditures trend**

(costs in thousands)

Office	2012-13	2013-14	2014-15	2015-16	2016-17	5 Year Average
1	\$14,784	\$16,902	\$10,321	\$13,569	\$12,998	\$13,715
2	\$8,882	\$9,051	\$6,963	\$8,617	\$9,441	\$8,591
3	\$14,300	\$16,466	\$10,259	\$11,207	\$12,110	\$12,868
4	\$11,003	\$9,867	\$7,622	\$7,562	\$8,206	\$8,852
6	\$14,628	\$18,790	\$12,838	\$12,564	\$14,118	\$14,588
7	\$10,027	\$12,760	\$8,279	\$11,564	\$8,865	\$10,299
8	\$7,905	\$9,242	\$6,281	\$7,399	\$6,443	\$7,454
Metro	\$30,253	\$42,558	\$23,872	\$20,149	\$23,507	\$28,068
Maintenance	\$401	\$495	\$1,346	\$1,249	\$1,209	\$940
Other	\$96	\$98	\$126	\$97	\$48	\$93
Statewide	\$112,279	\$136,228	\$87,914	\$94,160	\$97,003	\$105,517

2016 - 2017

\$8.5 million

less than 5 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
2014-15	\$88	87
2015-16	\$94	106
2016-17	\$97	119

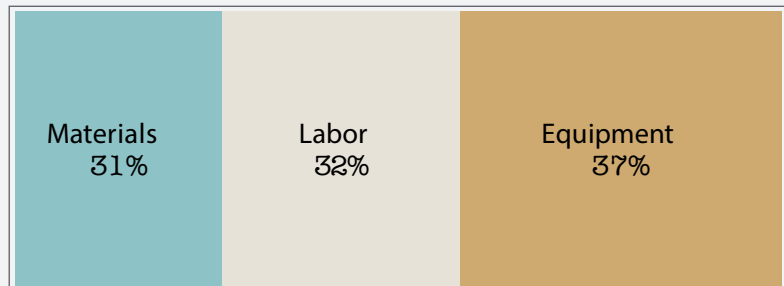
\$3 million
More than 2015-16



Factors affecting winter maintenance costs:

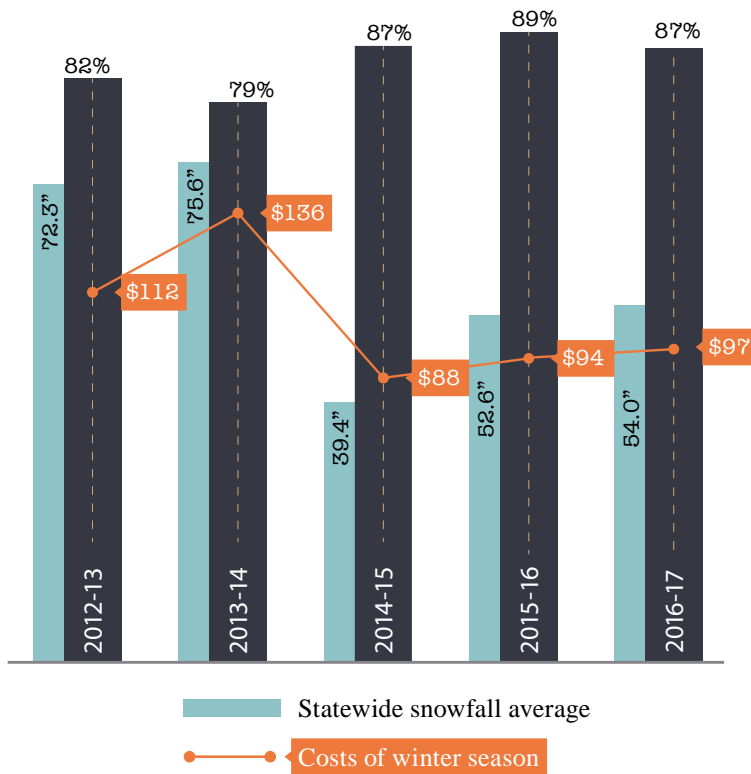
- Timing of storms
- Change in labor costs
- Inflation
- Fuel prices
- Salt, sand prices
- Winter severity index

2016-17 winter 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 87 percent. MnDOT met or exceeded the 70 percent target the past 9 out 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.

2016 – 2017 Snow and Ice Technology Highlights

D6 slurry truck modified

- First used in 2007, employees modified the truck with spray bars that shoot brine directly at the center line and wheel tracks.
- Modification helps reduce salt bounce and the amount of salt used.
- Other modifications include saddle tanks, pumps and flow meters. Slurry is mixed in the sander, not at the spinner disk.
- 35 out of D6 West's 50 trucks are "slurried" with this modification; towplow is also slurried. Cost is \$15,000 or less to convert a truck.
- The employee-designed slurry auger has a patent pending.



Snow Trap Inventory

- Snow trap inventory identifies all areas where MnDOT expends additional resources beyond routine snow plowing. Segment length varies from less than 100 feet to several miles
- All districts have snow traps. Currently there are 71.32 miles of living and structural snow fencing. Last winter, there were 26.9 miles of standing corn rows or temporary fence treatments.
- Inventory identifies all snow traps on plow routes where MnDOT uses additional resources beyond routine snow plowing.
- Each snow trap has a unique segment ID number for tracking purposes that correlates with the University of Minnesota Center for Transportation Snow Control Benefit Cost Tool.
- More information at <http://ihub/livingsnowfence/index.html>



This shows a section of road before and after the planting of a living snow fence.



Snow is captured by this living snow fence, preventing it from reaching the roadway.

Snowplow cameras

- Cameras launched for public viewing in snowplows January 2017
- The public can access cameras on the 511 app and on the full-featured and streamlined pages at www.511mn.org.
- Show real-time road conditions along plow routes, beneficial for the public and maintenance managers and supervisors
- Cameras were placed on 200 of the agency's 843 plows
- This was Phase 2 of the project. The first phase only showed images to MnDOT personnel.



This is a screenshot of the 511 website showing the image from an active snow plow. The webpage shows the location of the plow, date, time and location. The film strip at the bottom shows where the plow has been every five minutes.

Snow plow crashes

In 2016-17, there were 58 crashes between snowplows and the public. Drivers speeding and inattention are the main causes of these crashes each year.

Safe winter driving tips for motorists include:

- Call 511 or visit www.511mn.org before leaving on your trip to get current road conditions.
- Turn on your headlights and wear your seat belt.
- Turn off your cruise control.
- Slow down; allow at least 10 car lengths between your vehicle and a plow.
- Stay behind the snowplow. The road behind a snowplow is safer to drive on.
- Watch for snowplows that turn or exit frequently, and often with little warning.
- Never drive into a snow cloud.

