Smart Salting for Property Management Manual

December 2020

Written and published by:

Minnesota Pollution Control Agency
and Fortin Consulting, Inc.

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Acknowledgements

This manual was written by Fortin Consulting for the Minnesota Pollution Control Agency's (MPCA) Smart Salting for Property Management certification training. Thank you to the following people and organizations for their input and support for this manual.

Funding:

Riley Purgatory Bluff Creek Watershed District

Lower Minnesota River Watershed District

Nine Mile Creek Watershed District

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1. Introduction

Deicing salt is an important and widely used public safety tool in winter maintenance. All MPCA Smart Salting certification trainings advocate for smart salting best practices that reduce chloride pollution in Minnesota, based on the best science to inform decisions. The goal of the program is to get everyone on the path to safe and smart salt use. It is possible.

This manual accompanies the MPCA "Smart Salting for Property Management" certification training. Participants learn the environmental impacts and true cost of salting as well as valuable methods for managing maintenance on their properties more efficiently; that still ensure safety, reduce infrastructure costs, and lessen environmental impacts.

Targeted audiences include:

- Private or public management-level property and building owners and managers
- Outdoor maintenance leadership directing snow and ice control
- Building and grounds maintenance managers
- Local government management and employees
- Environmental professionals who influence winter maintenance operations

MPCA Smart Salting Certification Training Program

The MPCA and Fortin Consulting created and continues to manage the Smart Salting Certification Training program. Additional trainings offered:

- **Smart Salting for Roads:** For those who maintain high and low speed roads
- **Smart Salting for Parking Lots and Sidewalks:** For those who maintain or contract with private or public professionals that manage parking lots, walkways, sidewalks, service roads and more
- **Smart Salting Assessment tool (SSAt) Level 2::** Organizational certifiication for public and private organizations looking to assess salt use to find projected annual salt savings and recommended best practices for their organization using the Smart Salting Assessment tool.

To earn or renew your MPCA Smart Salting for Property Management certification, attend the training and pass the certification test (>70% score). The MPCA issues certificates good for 3 years and lists certified individuals and their contact information on the MPCA Smart Salting training website.

Those certified pledge to:

1. Reduce salt use on their properties
2. Hire certified contractors
3. Require maintenance staff to get certified
4. Educate property users and occupants

Find future trainings on the MPCA Smart Salting training calendar. You may find it more convenient to host a private training for your employees or targeted audience. To inquire about trainings and certifications email: smartsalting.pca@state.mn.us.

Using the manual

This manual should accompany the MPCA Smart Salting for Property Management Certification Training. It is a high-level reference for understanding the threat chloride products pose to our vegetation, drinking water, lakes, rivers and wetlands of Minnesota. It further guides users through the hidden cost of salt use, infrastructure damage, liability and regulatory issues, product and deicer use, snow and ice removal best management practices, alternative products. other chloride sources like water softeners and fertilizers and customer education. It is not a detailed guide providing the technical aspects of snow and ice removal used by winter maintenance professionals.To find detailed operation improvements attend the MPCA Smart Salting for Roads or the Parking Lots & Sidewalks Training and manual.

Throughout the manual environmental tips will be shown with a fish symbol.

Throughout the manual cost-saving tips will be shown with a dollar symbol.

Disclaimer

The MPCA provides instruction and guidance about the most current best management practices and technologies intended to provide safe surfaces while minimizing negative impacts on the environment and infrastructure. Clear policies that include maintenance considerations such as service level, reasonable professional care, and appropriate use and documentation of best practices may help to reduce potential liability risk. The class instruction or other MPCA resources provided in the Smart Salting trainings is not a substitute for professional legal advice. Always consult a legal professional before implementing a comprehensive liability risk reduction plan.

Evaluation 1: Identification of salt problems and solutions

Select a property _____**Date**_____

Answer at beginning of class	**Answer at end of class**
List 2 winter maintenance challenges at this property	**Remedies for these challenges**
1.	1.
2.	2.
List 2 problems you see that are caused by salt (e.g. ruined rugs, dead grass…)	**List 2 ideas for reducing your damages**
1.	1.
2.	2.
What area uses the most salt? (e.g. Church front steps, top level of parking ramp …)	**Ideas for reducing salt**

2. Environmental impacts of chloride

Minnesota has a growing salty water problem. Chloride is a permanent pollutant. It does not breakdown or degrade over time and will persist in our waters. Chloride is a pollutant of concern because it is toxic to freshwater fish, amphibians, insects, and plants. Once used, it seeps into lakes, streams and groundwater. It is far too expensive and difficult to remove with current technologies (such as reverse osmosis). Salt is used widely and is an important public safety tool in winter conditions. The Smart Salting program is not about decreasing public safety, but instead is advocating for smart salt use practices, based on the best science to inform decisions.

Did you know? Chloride is a permanent pollutant.

Salt vs. chloride

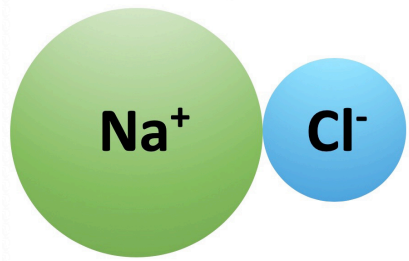


Figure 2-1 Depiction of a sodium chloride (NaCl) compound

When referring to salt in this manual, we are talking about chemical compounds that contain a chloride ion (Figure 2-1). These compounds include sodium chloride (NaCl or rock salt), calcium chloride (CaCl2), magnesium chloride (MgCl2) and potassium chloride (KCl or potash).

"Salt" and "chloride" are often used interchangeably when referring to this type of pollution.

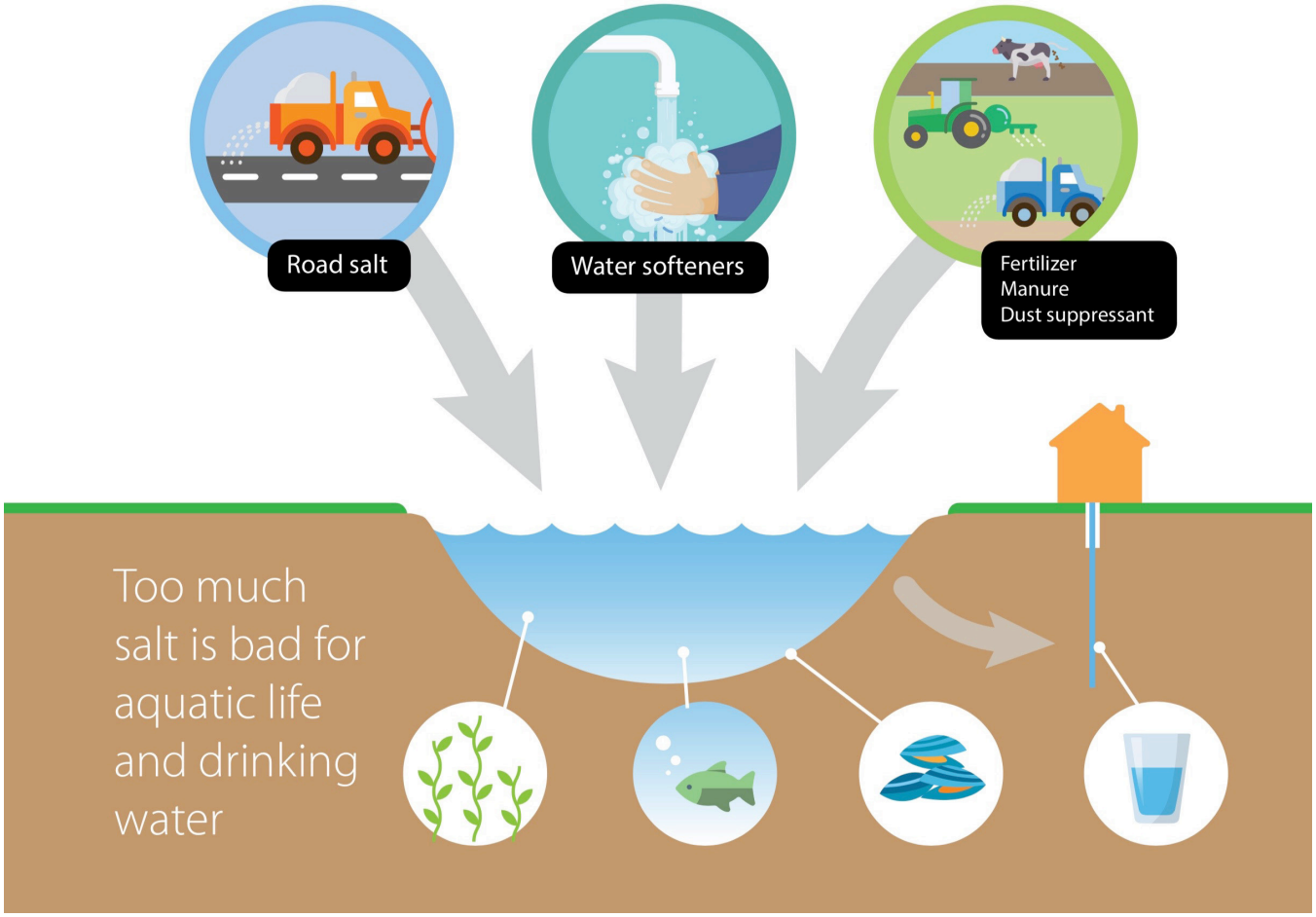


Figure 2-2 Sources of chloride in Minnesota

Sources of chloride

Chloride pollution to Minnesota water resources comes from several sources: Deicing salt, water softeners, dust suppressants, and in fertilizers/manure. Salt applied to roads, parking lots, and sidewalks and water softener brine discharges to municipal wastewater treatment plants, are large sources of chloride pollution that have created visible problems to date, particularly in more populated areas.

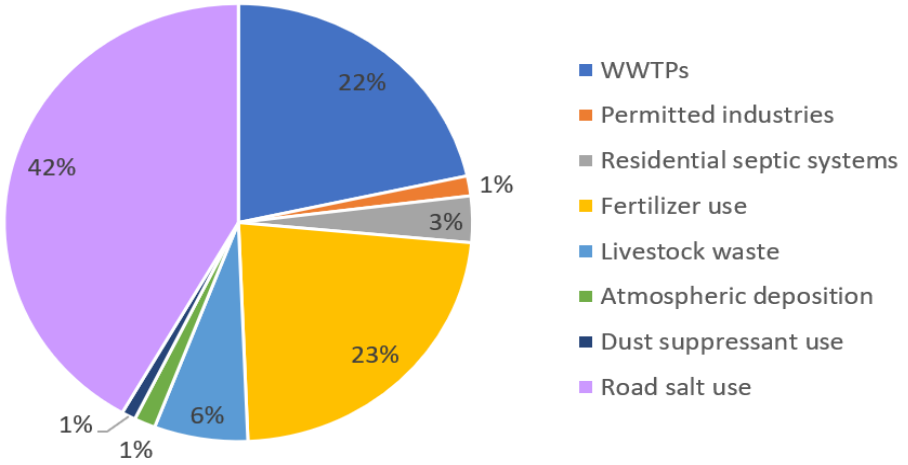


Figure 2-3 Annual chloride contributions from major point and nonpoint sources for Minnesota

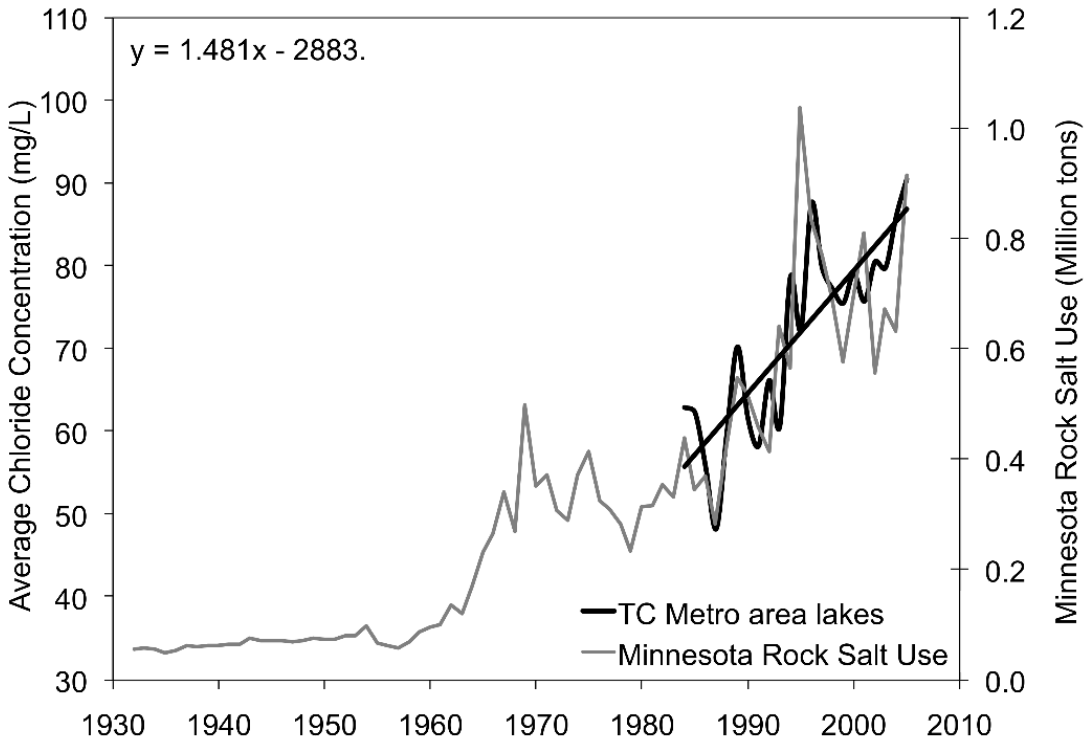


Figure 2-4 Comparison of lake chloride concentrations in 39 Twin Cities' area lakes and rock salt purchases by the State of Minnesota. (Sander et al. 2007).

How much de-icing salt do we apply?

De-icing salt salt is the #1 source of chloride use in Minnesota. An estimated 403,600 tons of road salt is applied in Minnesota and 249,100 tons just in the Twin Cities metro area each year (Overbo et al., 2019). A University of Minnesota study found about 78% of salt applied in the Twin Cities for winter maintenance is either transported to groundwater or remains in the local lakes and wetlands (Stefan et al., 2008).

Deicing salt is the top source of chloride pollution in MN

Water softener salt

There are currently nearly 100 communities in Minnesota that have high chloride in their discharge from municipal wastewater treatment plants that do not have the technology to remove salt from that wastewater. About 75% of Minnesotan's receive their drinking water from groundwater, which most of Minnesota has hard to very hard groundwater. Because of this people soften their water to make water heaters operate more efficiently, prevent hard water spots on dishes, and make soaps lather more. In most communities, salty brine from water softeners drains to the local wastewater treatment plant, and the salt passes directly through the plant to a local water body. Septic systems also do not remove salt; it likely ends up traveling toward private wells or through the soil to nearby lakes, streams and wetlands.

Fertilizer/manure application and dust suppressants

Agricultural fertilizer is a large chloride pollution source in Minnesota (Overbo et al., 2019). Chloride land-applied for agriculture, is likely transported to lakes and streams through runoff and shallow groundwater infiltration (MPCA, 2020b). The chloride from potassium chloride, or potash, is a common fertilizer ingredient. Potash applied on turfgrass and ornamental plants also makes its way to surface and groundwater. Chloride concentrations can be very high in animal manure (Overbo et al., 2019). Surface and groundwater near feedlots, or where manure is applied, may be at risk of chloride pollution.

Chloride in Minnesota's water resources

Deicing salt runoff is creating water quality problems, especially in developed areas with many paved surfaces. Overall, chloride concentrations are increasing in many surface waters and groundwater across Minnesota.

Chloride in lakes and streams

Figure 2-5 Water and teaspoon salt.

There are 50 impaired water bodies in Minnesota that exceed the chloride standard designed to protect fish and other aquatic life on the 2020 draft impaired waters list, (MPCA, May 2020a). Minnesota follows federal water quality standards of 230 mg/L (chronic) and 860 mg/L (acute), to protect fish and other aquatic life from chloride pollution (EPA, n.d.a). When con centrations exceed that, the water is called 'impaired'. There are another 75 water bodies classified as 'high risk' for exceeding the chloride standards (within 10%). Minnesota has many lakes and streams in Minnesota that are testing for chloride (Figure 2-6). However many of our waters have never been tested for chloride.

It only takes 1 teaspoon of salt to permanently pollute 5 gallons of water.

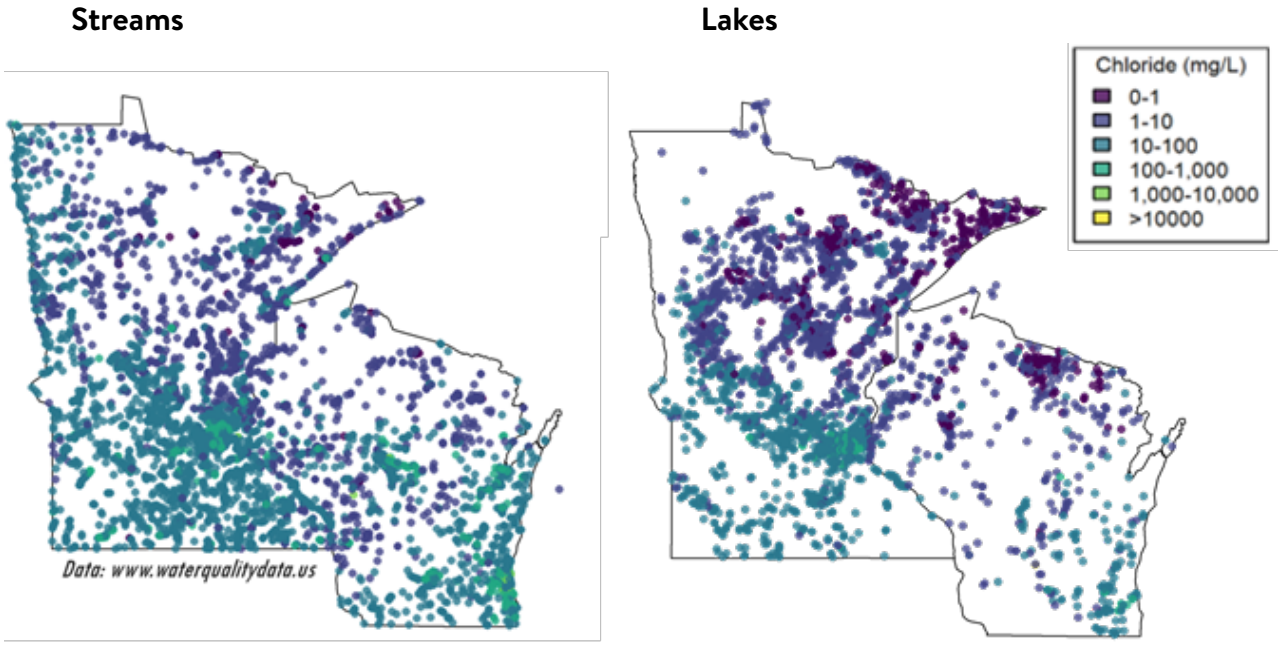


Figure 2-6 Chloride levels in Streams (left) and Lakes (right) in Minnesota and Wisconsin.

The lighter the dots, the saltier the water. Data from these maps comes from www.waterqualitydata.us (Dugan, 2018)

Chloride in groundwater

The MPCA's updated trend analysis found that chloride concentrations had a statistically significant upward trend in 40 percent of the tested wells, and most of these were installed in the state's bedrock aquifers.

The most recent assessment of chloride concentrations in the state's groundwater used information from 2013-2017. Twenty-four of the monitoring wells contained water in which the chloride concentration exceeded the secondary maximum contaminant level (SMCL) of 250 mg/L set by the USEPA for drinking water. Most of these were shallow monitoring wells, with a median depth of 26 feet. Two-thirds of the wells with chloride concentrations exceeding the SMCL were located in the TCMA, and the remaining wells were located in other urban areas such as Cloquet or Moose Lake. That's generally the point at which one can taste salt in drinking water.

Forty percent of the 35 wells analyzed by the MPCA had an upward trend in chloride concentrations from 2005-2017. The upward trends were mostly in shallow drinking water wells. The highest groundwater concentrations were near commercial/industrial areas receiving high concentrations of deicing salt near roads, such as gas stations.

When snow and ice melt, the salt has to go somewhere. It flows directly into ditches and storm drains and on to lakes, streams, wetlands, and groundwater.

The environmental costs of chloride

Aquatic life

Elevated chloride levels are toxic to fish, aquatic bugs, amphibians, and plants. Chloride reduces fish and insect community structure, diversity and productivity. High levels of salt exposure can compromise the immune response of dragonfly larvae (Mangahas et al 2019). Amphibians have been shown to be more sensitive to salt-induced mortality and deformities (Tiwari and Rachlin 2018). In particular, amphibian eggs are permeable, making them especially sensitive to salt exposure. In other words they dry out and often die. (Jones 2015). Even as low levels of chloride are toxic to fish eggs, wood frog tadpole's survivability drops (Tiwari and Rachlin 2018). It lowers invertebrate resiliency to outside biotic stressors. Developmental delays, physiology changes, resistance to disease, altered food webs, and predation pressures, further impact native species ability to survive and thrive. Chloride in streams, lakes, and wetlands harms aquatic vegetation and can change the plant community structure (MPCA, 2016).

This is allowing non-native species to make their way into Minnesota waters. Non-native species have been shown to have a greater tolerance for chloride pollution and are destined to survive and overrun native species. This is likely to have a long-term impact on recreational fishing in Minnesota.

Lakes

Only 2.5% of all the water on Earth is freshwater. Of that, less than 1% is available for use. Most freshwater is frozen in glaciers (Freshwater Crisis n.d.). Chloride pollution is slowly and irreversibly turning Minnesota's lakes from freshwater into saltwater. We need to prevent impaired waters from getting worse, and preserving the water bodies that are not.

Chloride concentrations have been going up in North America's lakes region since 1985. Impervious land cover and road density surrounding lakes is a contributing factor. Dissolved chloride increases water density, which can prevent the natural, seasonal mixing of lake waters (Novotny et al. 2008). Chemical stratification is when salt water is heavier than freshwater and sinks to the bottom of lakes. This changes the lakes natural mixing process. (Stefan et al. 2008). The natural mixing of lakes increases oxygen levels required by aquatic life to survive; thus oxygen is low when it does not mix. Denser chloride- impacted water locates below less dense fresher water toward the surface above. The impact of persistent stratification in lakes may be leaving the deepest parts oxygen-deprived. This could result in increased phosphorus release into the water (Novotney and Stefan 2012).

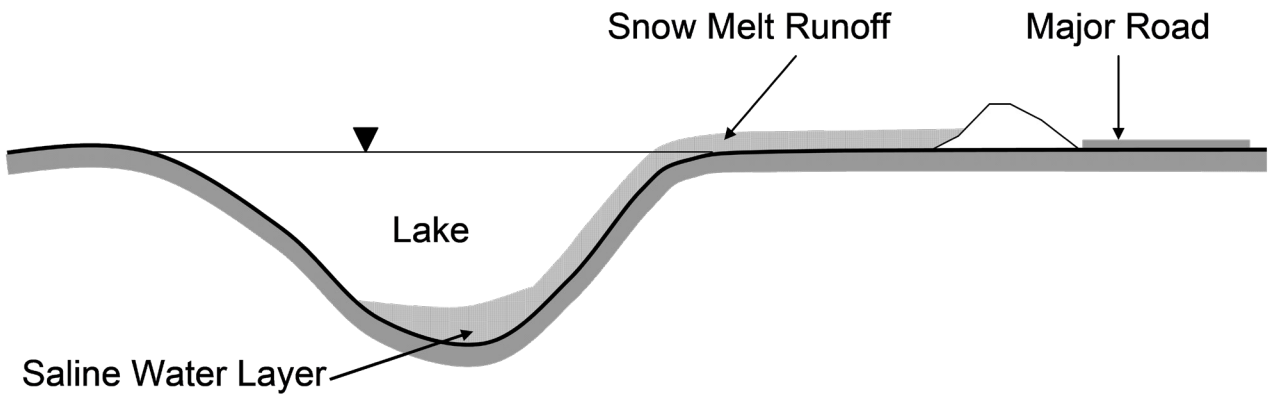


Figure 2-7 Schematic of a saline water intrusion into a lake Minnesota chloride groundwater situation highlights: "The Condition of MN groundwater quality 2013-2017, published July 2019"

Stormwater pond function

Chloride cannot be removed by stormwater ponds. The same stratification has been observed in stormwater ponds, where persistent layers of high chloride were found (Herb et al 2017). Research suggests stormwater ponds release heavy metals and phosphorus stored in sediment in the presence of high chloride levels. (Finlay, 2018). The presence of increased phosphorus is known to cause increased algae blooms. There is ongoing research to determine the potential impacts of chloride loading and phosphorus release from stormwater ponds specifically.

Vegetation

Road salt spray and run-off can damages or kill vegetation near salted surfaces. Many plants suffer that take up salty water through their roots (University of Massachusetts Amherst, 2016; Gould, 2013). Stunted tree growth indicators, like witches brooms, show an increase in chloride in the soil. Trees can die from too much chloride runoff in their soil. Trees and plants located in highly paved areas such as downtowns, have early die-off in part from nearby salt run-off.

Along with the familiar annual vegetation burn, salt spray and run-off causes tree damage known as 'Witch's broom'.

Figure 2-8 Left: "Witch's broom" branching. Right: Vegetation burn. Photo credit: FCI

Many are familiar with the perennial 'vegetation burn' common along sidewalks, parking partitions, even in rain gardens. The cost to replace dead grass, plants, and trees can add up quickly in maintenance costs, particularly if it's an annual habit. Unfortunately, rain gardens have seen increased maintenance and replacement costs, as they tend to be a common snow storage area.

Excess salt can damage trees and burn vegetation. Reduce salt use first, then consider salt tolerant plants in damage-prone areas.

Our goal is to reduce salt, but there may be unavoidable impacts in certain areas. One way to save time and money is to choose plants with higher salt tolerance. Resources for selecting salt tolerant plants:

- MNDOT Plant Selector https://plantp.dot.state.mn.us/plant/
- MPCA Stormwater Manual salt tolerant plant list: https://stormwater.pca.state.mn.us/index.php/Minnesota_plant_lists.
- Best management practices for establishment of salt-tolerant grasses on roadsides (Eric Watkins 2017) http://dot.state.mn.us/research/reports/2017/201731.pdf

Pets and wildlife

Salt may irritate pet paws depending on the type and concentration of salt exposure. It may also be harmful if ingested. There are no standards for deicer packaging, thus any company could label their salt “pet friendly”. It is best to keep deicers away from pets. Some birds (e.g. finches and house sparrows) can die from ingesting deicing salt. Deicing salt may also cause a decline among populations of salt sensitive species on land, reducing natural diversity (MPCA, 2020b). There is anecdotal evidence wildlife is attracted to the taste of salt on roadways, exposing them and humans, to unsafe conditions.

Soil

Salt-laden soil can lose its ability to retain water and store nutrients and be more prone to erosion and sediment runoff (which also harms water quality). Soil near roads and parking lots exposed to de-icing salt have exhibited soil structure change, nutrient imbalance, accelerated colloidal transport, mobilization of heavy metals, and more (Amundsen 2010; Michigan DOT 1993). These changes cause reduced plant growth and increased erosion of sediment to surface waters (Kelting and Laxson 2010).

Statewide Chloride Management Plan

The MPCA released a Statewide Minnesota Chloride Management Plan (CMP) in 2020, designed specifically to minimize chloride use state-wide. The CMP is useful to understand the many sources of chloride pollution statewide and how to actively reduce it, laying the foundation for everyone in Minnesota to responsibly reduce salt use and protect water quality. This manual and the accompanying Smart Salting training help property owners and managers understand how to meet the goals of the CMP.

Minnesota is the first state to issue a statewide Chloride Management Plan. It asks us all to reduce salt use. Source reduction begins with you!

Alternative deicing materials

Chloride is not the only material in winter maintenance chemicals. All chemicals applied in winter maintenance have some an impact on the environment.

Organic deicers

Acetates, formates, urea and organic (e.g. beet, corn) additives do not contain chloride, but do have some environmental effects. While these non-chloride deicers typically are generally shorter-lived and biodegrade, some short term effects can still be serious. They can deplete oxygen in water and soil, and add nutrients, potentially causing algal blooms or fish kills.

Non-chloride materials are typically less corrosive and safer for vegetation. The environmental effects from these products may potentially be remediated by holding ponds, rain gardens and other nutrient traps.

Deicer additives

Anti-caking additives and other contaminants in deicing products such as phosphorus, ferrocyanide, copper, and zinc cause additional stress and can accumulate in the environment to a potentially toxic level (Wenck 2009). Some deicers have corrosion inhibitors which typically add nutrients to where they run-off.

Sand

Sand is a useful winter maintenance tool. It provides temporary traction. Once sand is no longer needed, it should be cleaned up. Sand will run off into the nearest storm drain where it can clog drain systems, because fill in or cover habitat in nearby surface waters. Sand also transports other pollutants, such as oil or grease from cars, into the storm drain.

Truth in labeling

There are no requirements or standards for deicer packaging claims or for full ingredient disclosure. Beware of labeling claims such as 'environmentally or pet friendly'. No deicers are truly environmentally safe nor will work in all conditions. It is the buyers responsibility to fully research products and make decisions accordingly. Request vendors to provide detailed ingredient lists and quantities, written guidance on the temperature range for optimal product use, and proper storage and handling.

Know what you're buying. Many labels don't list ingredients or exaggerate practical melting ranges. No deicer works in all conditions.

The business cost of salt

The total cost of infrastructure damage from one ton of salt is estimated to be $800–$3,300 annually.

Infrastructure damage

Salt costs much more than the initial purchase and application. Salt damages ground-level building interiors and exteriors, walkway and sidewalks, steps, handrails, curbs, parking lots, vehicles, and vegetation. Salt tracked indoors ruins entrance carpets and flooring. For property managers, this means costly, and often unanticipated maintenance and repairs. On a larger scale, it damages concrete, roads, bridge surfaces and parking garages. The total cost of infrastructure damage from one ton of salt is estimated to be between $800–$3,300 (Fortin Consulting, 2014).

Business reputation

Winter maintenance professionals and businesses often field complaints from those that hold to the notion that the crunch of salt equates to a safer surface. Yet more and more people are expecting you to use less, and want clean and neat parking lots and sidewalks. Chloride pollution is gaining more local news attention. Along with increased education efforts, people are starting to associate over-salting with environmental damage. The perception is shifting. More people now believe excess salt on your sidewalks or parking lot looks unprofessional and reflects poorly on your business. Educating customers on your sustainable winter maintenance approach will allow them to have a hand in protecting Minnesota's valuable water resources. Customers are now searching for, or requiring the use of, Smart Salting certified winter maintenance professionals.

Customers and the public want safe parking lots and sidewalks. We understand that customer service is the key to success.

Customers want affordable and reliable snow and ice control. Creating a well-planned and well-executed winter maintenance program, accompanied by appropriate material use, the latest technologies, and customized application rates for the weather conditions, allows you to efficiently give customers the reliable service they need on your properties.

Education on best practices and managing customer expectations is key. There are many educational resources to help manage customer expectations. "Appendix B: Resources".

The use of sophisticated chemicals, equipment and improved strategies may require education and a larger budget up-front; however, these costs are quickly recovered by reduced operation and maintenace costs. There are MPCA 0% interest loan programs to help small businesses and local governments purchase equipment or provide education. Email smartsalting.pca@state.mn.us for more on loan programs.

Earning the MPCA Smart Salting Certification reflects positively on you and your organization.

Evaluation 2: Side effects of deicers

1. How many teaspoons of salt does it take to pollute 5 gallons of water?

If you used one less 50-pound bag of salt this season you will protect over 10,000 gallons of water!

2. Do you know if the lakes and rivers near your property have high chloride levels?

Yes

No

In the state of Minnesota, 50 bodies of water exceed the chronic chloride standard and 120 more are at risk. View this map on the MPCA Chloride 101 page to see the condition of water bodies near you.

3. Do you see damage to concrete, plants or turfgrass, indoor flooring or elsewhere on your properties? Yes No

List out all known infrastructure damage to your property(s):

Reducing salt not only protects our water but it also reduces damages to infrastructure and plants and saves money.

4. Other thoughts on the side effects of deicers? What new information will help your future planning?

5. Who might you to share this information with such as co-workers, building users, sub-contractors, customers, friends/family? What will you tell them?

a. Co-workers:

b. Building users:

c. Sub-contractors:

d. Customers:

e. Friends/family:

3. Success stories

Precision Landscaping

Precision Landscaping is making a move into using liquids. The company began with one liquid capable truck at one site in 2018. In 2019 because of the success Precision Landscaping had with reducing the amount of product needed, the company added two more trucks with liquid capabilities to be able to use the technology on more sites. The company also added 3 offsite reloading locations to increase the number of properties treated with liquids.

Additionally, the company is working to educate their clients about the effects of salt as part of their push to reduce their overall salt use for winter maintenance.

In September of 2018 Precision Landscaping held a Smart Salting for Parking Lots and Sidewalks training at their office for their entire staff. This has led to a team effort on salt awareness and reduction. Salt impact and reduction is now a significant part of training and discussion for their team both when preparing for and throughout the season. The company involves the majority of staff in calibrating salters (instead of just a few people) so that everyone is aware of the process and how the equipment works.

In addition to regular reminders to try to use less salt, Precision Landscaping bought fewer pallets at the beginning of the season with the goal to meet site safety needs while reducing salt and without needing to make another salt purchase. Having a smaller supply has made staff more conscious about how they are using product. The discussions helped create plans identifying areas on sites that may not need to be salted each time it snows. From the changes made during the 2018 season, Precision was able to cut back 20 percent on salt per event from the previous season while still maintaining the same amount of pavement and quality standards. On one 14-acre site, their salt usage last season was down by about 60 percent, and they saw less vegetation and landscape damages to the property when the snow melted.

Precision Landscaping will continue to look for ways to offer great service to their customers and reduce salt use in the years to come.

Edina Public Schools

Edina Public Schools serves 8,000 students and over 205 acres of property. Its 10 sites include 6 elementary schools, 2 middle schools, the Edina High School & the Edina Transportation Center. Buildings are often open 7 days a week.

Edina Public Schools estimates they have reduced their salt use 60% since 2014. It has been a districtwide effort to minimize the harmful effects salt has on our groundwater and the environment. The school district has made several changes to their snow and ice practices. This includes purchasing less product, educating staff, researching and purchasing more efficient equipment, and being more conscious of the weather.

The salt reduction began in 2014 as the District began the purchase of snow removal equipment such as brooms and drop spreaders that could clean more efficiently and better control salt distribution. Prior to 2014, the District was purchasing and utilizing 45 pallets of salt. Salt was freely applied throughout the winter with little or no regard to the changing weather conditions or current condition of the walkways and parking lots.

In 2016, the grounds crew began attending the MPCA's Smart Salting training. This led to discussion and planning for how they could reduce salt use on the grounds. Currently all grounds crew, along with several building staff, are certified in Smart Salting.

This winter, the District purchased 16 pallets of salt, and have used only a small portion of it. The grounds crew, transportation, building staff, and administration are all tuned into the weather and are quick to respond when steps can be taken to prepare walkways and parking lots prior to inclement weather. Two years ago, the crew created their own salt-brining system that has been used throughout the district especially on high traffic walkways. Many areas prone to refreeze and several unsafe walkways/stairways are completely closed during the season to reduce salt and risk. The building staff has been equipped with small hand spreaders that distribute salt in entryways and stairs in a responsible manner.

It is the Edina Public School District's hope that they can continue to improve and minimize the negative effects their district has, on the groundwater and on the environment.

Mayo Clinic

Graphic credit: Mayo Clinic

At the conclusion of his first two winters as Grounds Maintenance Supervisor for Mayo Clinic, Nick Queensland was proud of what his crews had accomplished in terms of productivity and safety. However, he was bothered by the amount of salt applied to their paved surfaces in order to obtain these results. Immediately following winter 2017-2018 he went to work determined to maintain Mayo Clinic's excellent level of service while prioritizing salt reduction.

While doing research on salt reduction methods, Queensland continued to see the MPCA's Smart Salt Training. He committed to have all his in-house grounds maintenance staff attend the Smart Salting for Parking Lots and Sidewalks training together, including leadership. This was an excellent decision! His crew was energized about reducing salt use after learning facts about the negative environmental impacts of salt and fresh alternatives to current practices.

The day after the Smart Salting training, Queensland gathered his crew and they made a list of methods they could implement to reduce salt use on Mayo's campus, which consists of 15 miles of sidewalk, 300 doorways, and 120 acres of parking lot and roadways. Queensland focused on parking lot and roadway salting, as he felt he could get the greatest tonnage reduction there and had the most room for improvement.

They began with calibrating the salt application equipment used on the property. Mayo Clinic had never done this in the past ,and was surprised that nobody knew what rate of salt was being applied. Knowing the rates of the spreaders was important to lowering salt use. When the clinic directed the contractors to apply salt, they could specify a rate instead of the contractor applying a moderately heavy blanket of salt every time.

The other significant change was to incorporate liquid salt brine into their ice control toolkit. They had experimented with liquid salts in the past with limited success and had abandoned this method. The salt brine applied correctly allowed them to plow snow and not have to apply rock salt at all for several storms. Public education, such as the sign above, prevented injuries.

Calibrating contractor equipment and incorporating liquids in practice along with Smart Salting for Parking Lots Training resulted in a 60% salt reduction for Mayo Clinic in a winter where they received a record amount of snow and a normal amount of ice. This number exceeded expectations. This was not easy, change never is, but Queensland found it was well worth efforts both in environmental impact reduction and budget savings.

An 'Epic' success story

Epic is a healthcare software company with a 1,100-acre campus headquartered in Verona, Wisconsin.

Epic's salt diet began in the winter of 2016-2017 after key staff attended a training held by Wisconsin Saltwise. Starting that winter, Epic implemented anti-icing on some of the main roadways, tracked the amount of salt used for each event, calibrated all equipment, and equipped each operator with application charts for each piece of equipment.

Table 3-1 Epic's salt savings

Salt Savings at Epic

Year	Bulk salt total (tons)	Bag salt total (tons)
2014-15	224	22
2015-16	134	22
2016-17	94.4	12
2017-18	62.4	8.4
2018-19	87.7	9.1

Before making all of these changes, operators would go out and put down salt 'by eye'. Now they follow application rate charts. They've made some challenges with modified equipment to put down less salt, but have gotten some spreaders close to the low rates they are looking for.

Each year Epic has a team meeting at the beginning of the season to go through any changes to the program, and share any new information with the team. The company has also reached out to their nearly 10,000 employees letting them know that the maintenance team is not compromising safety, but reducing salt output, and it might take a little time for salt to work.

Despite having more challenging winters recently, the salt use has continued to stay low! They hope to continue to educate our staff and keep making reductions where they can.

Conclusion

By educating ourselves and using innovative techniques, proper equipment and materials we can lower our salt use!

Share your success! We want to promote those who have realized the benefits of smart salting. Contact Angela Bourdaghs at angela.bourdaghs@state.mn.us**.**

4. Winter maintenance

4.1 Winter policy and planning

As with all aspects of property management, developing a strategy, communicating the strategy, following the strategy and documenting actions produces better results and allows you to evaluate and improve performance. Winter maintenance operations can benefit from this same level of planning and preparedness but it is a frequently overlooked area. Especially with contractors or sub-contractors where disconnects happen easily. Winter maintenance suffers from inconsistent and inefficient practices.

Afraid of lawsuits?

Costly over-application of salt does not always equal a safer surface

Fear of lawsuits is usually the reason salt is over-applied. It's important to realize that over application of salt does not necessarily provide more safety (Figure 4-1). Develop a snow and ice maintenance policy or plan that guides winter operations and decisions. Solicit and incorporate input from maintenance staff, building users, or others affected by changes. The winter maintenance policy template can be helpful. This model policy was created by winter maintenance professionals and written by the attorneys from Smith and Associates LLC.

These pre-season planning steps for property managers can lead to more efficient winter maintenance operations and reduce risk:

- Review the maintenance policy/plan with staff and inform customers of your high-level plan
- Establish clear level of service expectations and education to staff and building users
- ncorporate certification training into contracts and/or require it of their staff
- Follow the plan
- Fully document maintenance activities to prove you followed the plan
- Review and update the maintenance policy and plan each year
- Understand your regulatory obligations and the effects of over-salting on the environment

Reasonable care and liability

Figure 4-1 The sidewalk on the left with excess salt is no safer than the stairs on the right cleared of snow and ice without excess salt.

To reduce liability from any source including winter maintenance, property managers should use reasonable care to prevent a person from being injured by conditions on the property, so long as those conditions present a foreseeable risk of harm. Reasonable care is defined as the degree of caution and concern for the safety of others that an ordinarily prudent and rational person would use in the circumstances. Liability may be created when there is failure to show reasonable care.

Snow and ice policy

Create a snow and ice policy for your organization that directs winter maintenance decisions. A model snow and ice policy was created for municipalities, it cannot be used, as is, for most organizations such as private companies, but it does give many good ideas for creating your own snow and ice policy.

Once your policy is created share it with your maintenance staff and contractors and ask that they follow the policy. It may also be useful to provide a high-level summary of the policy to residents or employees who visit your site frequently. Your snow and ice policy should be reviewed and updated yearly.

Documentation

After creating and implementing a snow and ice policy, don't overlook the last element of responsible winter maintenance: documentation (Figure 4-2). Require staff and contractors to document their actions. Documentation of good practices that follow your snow and ice policy can provide a great defense. It is also a powerful tool to help understand the effectiveness of strategies and provide information to help refine practices. Without a record of what practices have been performed, it is difficult to improve effectiveness and efficiency. Useful information to record includes but is not limited to:

- Site, time, date, weather conditions, operator
- Pavement conditions
- Maintenance actions performed
- Type and amount of material applied
- Results

Figure 4-2 Plan for responsible winter maintenance.

Winter maintenance contracts

Create a winter maintenance contract that encourages best practices. Never use a contract that bills by the ton, gallon or pound of salt applied because it encourages over-application.

When soliciting bids for winter services, add a requirement for Smart Salting certification for anyone applying salt on your property. If a potential contractor's crew is not certified they are not eligible to bid.

Contracts often have set language for all winter events, with little flexibilty (e.g. paying by ton used and not service). This often results in salt overuse.

You are encouraged to review and implement the model contract on MPCA's statewide chloride resources page. This is a template for a lower salt but not lower level of service or safety agreement. It showcases other strategies to bill for services instead of billing by the ton or gallon of materials applied. This contract was created by winter maintenance professionals and property managers and written by the attorneys from Smith and Associates LLC.

For contractors, if your profit center is based on the amount of material you use, you will likely have less profits in the future as Minnesota moves to protect water resources and reduce salt use. Consider adjusting your billing or payment strategy to bill for services not materials.

Smart Salting certification

Individuals that perform winter maintenance, in-house staff or contractors, can learn industry best practices from the Smart Salting for Parking Lots and Sidewalks Certification. Training can improve winter maintenance effectiveness. If looking for contractors, you can see who is certified on the MPCA Smart Salting training webpage.

Figure 4-3 Smart Salting certificate

Laws and ordinances

State and local laws and ordinances may restrict or influence winter maintenance strategies. As chloride reduction efforts continue, it is likely more rules and ordinances will be established. Being aware of your requirements is important, don't let it take you by surprise. For example there are some MPCA permit programs that include chloride specific requirements that may impact your property.

A detailed list of Minnesota laws and ordinances can be found in "Appendix A: Laws and ordinances".

For questions on Minnesota rules and regulations email: smartsalting.pca@state.mn.us.

Do you know what regulations apply to your winter maintenance operations?

Evaluation 3: Evaluate your contract

Does your contractor bill you based on the amount of salt applied?

Yes

Time to change to a contract that bills by time or a fixed price.

No

Congratulations, your contract does not encourage using excess salt!

Do you require contractors to be Smart Salting certified to perform winter maintenance on your site?

Yes

Congratulations, your contractors are trained in the best practices in the industry!

No

Adding a requirement for Smart Salting certification will ensure that your contractors have been trained in the best practices in the industry.

Other thoughts on improving your contracts?

Other thoughts on talking to your contractors?

Evaluation 4: Evaluate your winter maintenance plan

Does your organization have a snow and ice policy?

_____No

The first step to responsible winter maintenance is to create a snow and ice policy.

_____Yes

Have you communicated the policy to managers and individuals that perform winter maintenance on your site?

_____No

Communicate the policy to all staff and contractors who perform winter maintenance and ensure they understand the policy.

_____Yes

Is the snow and ice followed by managers and individuals that perform winter maintenance on your site?

_____No

Make sure the staff and contractors understand the policy. Ensure they also have the tools and resources they need to enact the policy.

_____Yes

Does your winter maintenance staff and contractors record their actions?

_____No

Require that they document all practices, without documentation it is difficult to improve practices.

_____Yes

Congratulations, your organization is likely reducing risks and improving winter maintenance performance.

4.2 Preparing properties for winter operations

Winter maintenance is a year around process. Good planning and preparation ahead of the winter season are key for successful winter operations.

Property evaluation

Following this chapter are several exercises designed to evaluate a property for improved winter maintenance. The property assessment should be completed for each property you maintain.

Integrating maintenance into design

Involve a maintenance professional in the design or redesign process of properties. Maintenance professionals will save you time and money by pointing out subtle design changes to the parking lots, sidewalks, steps and adjacent areas that will make their work more efficient. For example, a storm drain located at the handicap parking spot will make it the most dangerous parking spot in the lot during the winter months. Raised islands make plowing difficult. Snow storage area on the bottom of the slope will cause less melt and refreeze problems than snow storage areas on the top of the slope. Decks that overhang the sidewalk will drip on the sidewalk during melt and re-freeze times. Heated pavements connecting to unheated pavements need a drain interface. Make properties easier to manage by integrating maintenance into design!

Measuring and mapping properties

Document the size of maintenance areas on each property and share that information with the maintenance crew. Each area that involves a different physical location, maintenance crew, and maintenance goal or maintenance strategy should be listed separately.

Table 4-1 Example maintenance area measurements

Maintenance areas **Location:** Joe's Shoe Shop	**Area (Sq. ft)**
Sidewalks from parking lot to front door	7,935
Service road and handicap parking	16,082
Main parking lot	21,229
Overflow parking lot	46,477
Exit drive	10,271

A spreadsheet (Table 4-1) is great for organizing information but a map (Figure 4-4) is quicker for maintenance staff to interpret. Delivering information to maintenance staff in an easier and quicker to understand format may give better results. Provide a map of the property with measurements to the contractor or staff member performing maintenance.

Figure 4-4 Example maintenance area map.

Level of service

A level of service (LOS) goal is the target the maintenance team will aim for when performing winter maintenance. It is defined by how clear a surface needs to be in a given time frame.

When and how are your maintenance areas used? What level of service is needed?

For each area defined on a property, associate a level of service target, time frame to meet that target and the time period the area needs to be maintained. Communicate the level of service goals to the maintenance staff. A good way to communicate LOS goals simply is to color code a map as shown below in Figure 4-5.

By understanding and communicating the level of service goal, the cost, amount of salt and amount of work will adjust to meet the goal in the most efficient manner. Much of the strategies used to meet LOS goals are covered in the Smart Salting for Parking Lots and Sidewalks class. *Understand that LOS targets cannot always be met in the time frame desired. The faster the time frame the more salt and effort typically required.*

Table 4-2 Example maintenance areas and level of service goals

Maintenance areas and level of service goals

Location: Joe's Shoe Shop	Area (Sq. ft)	Target	How fast	Time Period
Sidewalks from parking lot to front door	7,935	Bare pavement	24 hours after snow	Same for all days
Service road and handicap parking	16,082	Bare pavement	48 hours after snow	Same for all days
Main parking lot	21,229	Patches of bare		Weekends Wednesday
Overflow parking lot	46,477	Compacted snow		Can wait to morning
Exit drive	10,271	Patches of bare		

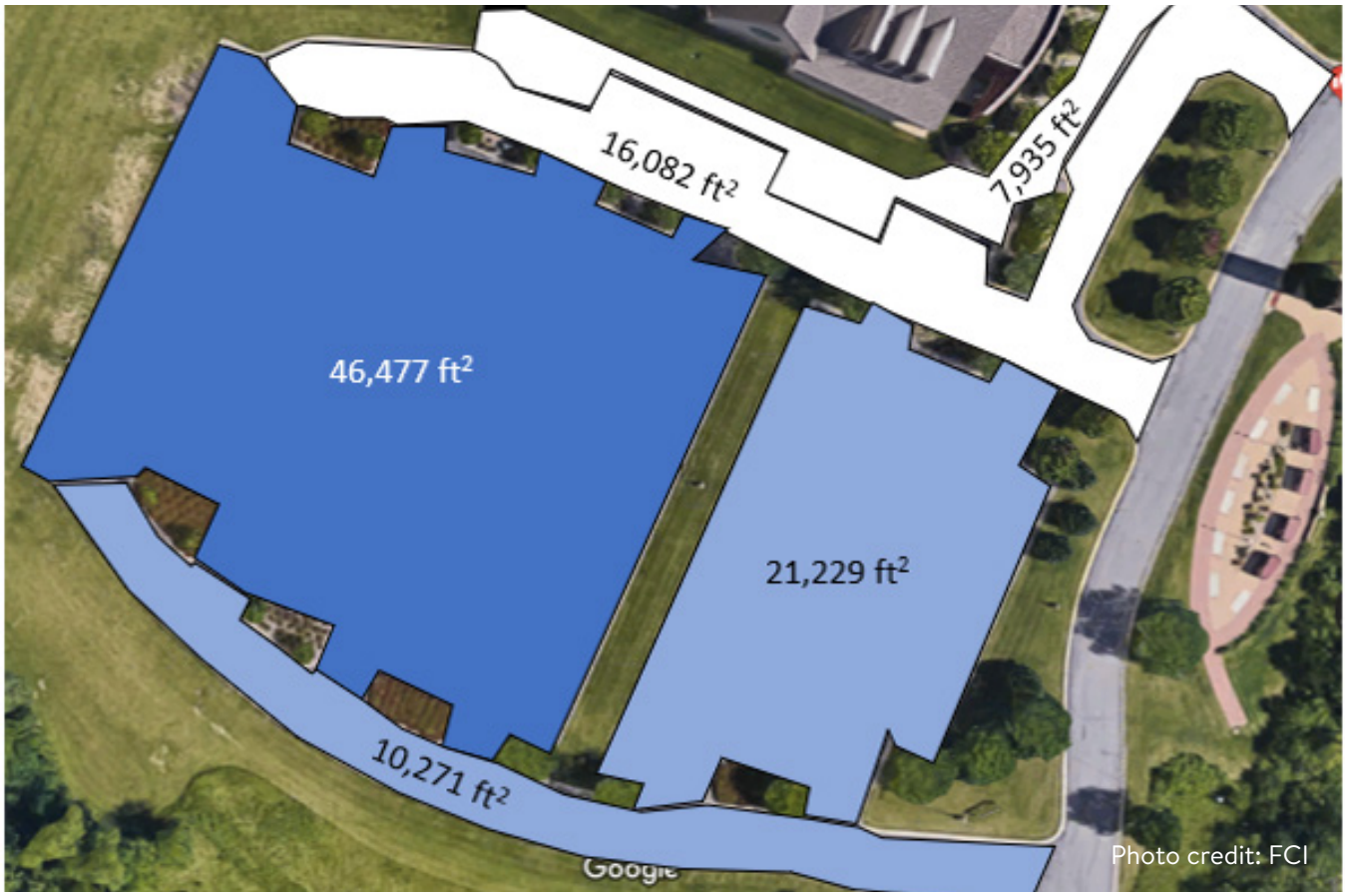


Figure 4-5 Example maintenance area map with LOS goals.

Review and revise information

Before each winter, review and revise measurements and level of service goals. As the winter progresses, look at how properties are used and compare it to level of service goals. Make adjustments as needed and make sure the crew is informed.

To reduce the damages from salt, a lot can be done to improve tools, techniques and strategies for winter maintenance without changing level of service. In addition, there may be areas where the level of service can be reduced or the time required to reach that level of service can be increased.

Review how a property is used compared to the level of service goal. For example, is there an area with a bare pavement level of service goal is rarely used? Why not lower the level of service and work and time used to maintain that area. Consider if salt storage or other parking lot updates mean fewer parking spaces to be maintained? Update the area calculations. Staying on top of the use of properties and adjusting practices accordingly affords the potential to save salt, reduce infrastructure and vegetation damages and creates a workable management plan with little waste.

Drainage

Poor drainage creates icy surfaces in the winter. Drainage problems can stem from poor design, broken or degraded infrastructure, or poor decision making in winter maintenance (example shown in Figure 4-6). Icy spots caused by melt and refreeze can be managed with salt but that is a high risk, high labor and high cost approach. A much better approach is to address the drainage problem that causes the ice. Staff and subcontractors should be encouraged to report drainage concerns so they can be properly diagnosed and corrected.

To identify drainage problems before winter, look for spots that collect water when it rains. In the winter, keep a list of persistent icy spots, figure out what is causing the ice and put together a plan to fix the problem.

Poor drainage is a winter maintenance liability

Figure 4-6 This downspout is an example of poor drainage causing ice.

Table 4-3 Example drainage problems and solutions

Drainage problems and solutions

Joe's Shoe Shop	Problem	Solutions
Front steps	Roof drips onto steps making ice.	• Add gutter to roof over steps
Sidewalk	Discharge from downspout onto sidewalk. Constant slippery area.	• Divert downspout to grass area • Dig downspout under sidewalk • Close this part of sidewalk in winter
Parking lot	Water ponds in handicap spot. Use most of our salt here.	• Change location of handicap spot to other side of door • Change location of snow pile

Winter closures

It is not necessary to maintain all surfaces for winter use. Often times closing select areas on a property during the winter can reduce cost and risk. Factors to consider when deciding on winter closures include the maintenance cost, risk and frequency of use. Consider closings areas such as low use sidewalks, duplicate staircases or remote parking lots (Figure 4-7). When closing an entrance for everyday use, it is important to maintain the area enough for the door to open for emergency exit. Check local fire code and city ordinances before closing an exit or sidewalk.

Figure 4-7 A duplicate staircase closed for the winter.

Closing low use areas with high maintenance cost can save money and salt.

Table 4-4 Example low use maintenance areas and solutions

Low use maintenance areas and solutions

Maintenance areas	Solutions
Back spiral stairs	Close for winter. Maintain for emergency exit only. Post sign
Sidewalk to the dumpster	Clear 3 foot wide path, not 8 foot wide path
Visitor parking by pond	Close and use for snow storage

Table 4-5 Example high risk maintenance areas and solutions

High risk maintenance areas and solutions

Maintenance areas	Solutions
Sidewalk under deck	Put gutters around deck to direct meltwater on lawn Move sidewalk section around deck not under deck Put winter awnings on over strectch of sidewalk Put permeable pavers in that stretch of sidewalk
Parking spot by storm drain	Close that parking spot during winter Put permeable asphalt in that parking spot
North facing steps	Put sign at top and bottom of steps warning of icy conditions Close for winter, maintain for emergency exit only Install high friction concrete overlay

Storage

Snow storage

If storing snow on a property, have designated areas for storage. The ideal area is one where the snow can melt and not cause an icy refreeze problem on maintained surfaces. It is also important to choose an area where debris can be recovered after the snow has melted. While it is not illegal to push snow into holding ponds and rain gardens it is not advised. The snow storage will increase the maintenance cost for these important and expensive stormwater treatment devices. The salt, sand and debris mixed into the snow will shorten the life span and increase the maintenance cost of these engineered areas. The City of Madison estimates $20 per cubic foot to replace rain gardens. (P. Gaebler, personal communication, April 9, 2019).

Never push snow into a water of the state (wetland, lake, river). It is against the law. See Appendix A (MINN. R. 7053.0205).

Follow these guidelines for snow storage:

- Look for storage locations on the downhill side of parking lots and sidewalks
- Store in a place where debris can be easily collected after the snow melts
- Store where melt water will not run across the parking lot or sidewalk and refreeze (shown in Figure 4-8)
- Do not store where the melt water can run into a salt storage area
- Do not push snow onto public surfaces like city streets and sidewalks

Figure 4-8 Example of improper snow storage. Melt water coming from snow piles will freeze creating a slippery parking lot.

Salt storage

Proper salt storage can provide better quality material for use in winter, less waste and less damage to infrastructure, vegetation and water. Proper storage and good housekeeping around storage areas also looks professional and reflects well on your organization and properties. There is a new salt storage requirement in the MPCA permit for Municipal Separate Storm Sewer Systems' (MS4) that applies not only to the MS4 but also any businesses and institutions that store salt within thier jursidiction. Check out Appendix A for more details on the chloride requirements in the MPCA MS4 permit.

Poor winter salt storage has been linked to groundwater contamination.
(Mullaney et al, 2009)

Follow these guidelines for granular salt and salt/sand storage:

- Must be covered or stored indoors
- Must be located on an impervious (waterproof) surface
- Reduce exposure when transferring material in designated salt storage areas (e.g., keep loading area clean; sweep up spills and put back into storage area or into a spreader)
- No water should enter or leave the storage area
- Store away from lakes, rivers, ditches, storm drains and wetlands
- Store uphill of any snow storage area
- Plan for year-round material storage. Without year-round storage, materials will be wasted at the end of the winter in an effort to get rid of them. This will create more infrastructure damage, waste money and pollute the water.

Figure 4-9 Shipping containers provide portable waterproof deicer storage.

Best practices for liquid deicer storage include:

- Label all tanks
- Inspect tanks to make sure the plastic is not degrading, cracking, leaking and that all hoses or other connections are properly closed and well maintained
- Have secondary containment to catch a spill. Either a containment area:
  - That can hold 100% of the tank contents and an extra 10% if stored outdoors; or
  - Double walled tanks
- Post a sign if a person is not on site 24 hours a day, with the name, address, and telephone number of the facility owner or operator, or a local emergency response contact.

If tank has a capacity greater than 1,100 gallons and is located within 500 feet of Class 2 Surface Water it may have additional requirements with the MPCA Aboveground Storage Tank program. See Appendix A for more details.

Is bulk salt storage necessary on your property?

Avoid storing bulk salt on your site it will reduce your risk of groundwater contamination and infrastructure damage. If salt needs to be stored on site invest in the best storage and emphasize good housekeeping practices to reduce risks. Meet with maintenance staff and subcontractors to figure out the best storage and transport plan for deicer use on your property.

For more information on snow or salt storage attend the Smart Salting for Parking Lots and Sidewalks Training.

Evaluation 5: Property Evaluation

Each property maintained will have unique features and challenges. The following assessment should be completed for each property you maintain.

A. Itemize your property

Site name: _____

Date_____

For each area, what are you trying to accomplish?

- Bare pavement (how fast it is needed)
- Patches of bare pavement
- Compacted snow ok, could put sand on top for traction

Table 4-6 Maintenance areas and LOS goals

Fill in the table below:

Location:	Area (Sq. ft)	Target	How fast	Time Period
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend
				Weekdays Evenings Weekend

B. Review snow storage on your property

Site name: _____

Date: _____

Table 4-7 Review snow storage

Fill out the checklist below. For any problem that you check, think about a possible solution

✔	Problem	Solutions
	We push snow into the wetland, pond, lake, rain garden or river	
	Snow pile melts and runs across our surfaces causing slippery areas where people walk or drive	
	Snow pile melts and runs into salt storage area	
	Snow piles kill our trees, flowers and/or grass	
	Other:	

C. Review salt storage areas and methods

Site name: _____

Date: _____

If it is necessary to store salt on your property you will need an adequate plan and location. Fill in the chart below regarding each type of salt you will store on the property. Refer to best practices listed below the blank chart.

Table 4-8 Salt storage evaluation

	Winter storage		Summer storage	
Type of salt	**Where**	**How**	**Where**	**How**
Bulk salt				
Bulk sand/abrasives				
Bulk sand/salt mix				
Packaged deicer				
Liquid deicer				
Other				

Table 4-9 Salt storage best practices

Best practices for storing salt	
Type of salt	**Best practices**
Bulk salt stored	In a building or storage structure with a waterproof floor. No melt water from parking lot, snow or rain can enter the building
Packaged salt stored	In a can, bucket, bag that is tightly sealed or indoors
Liquid salt store	Where we can recover a spill. Double wall tanks, secondary containment. Labelled tanks.
Summer storage	Covered (in a building, can, bucket, etc.) and on a water-proof floor . We do not use up our salt in the winter to avoid storing it in the summer.
No salt storage on this property	Our contractors oversee this. It is not housed on our property.

D. Winter closures

Site name: _____

Date: _____

Assess your property for any low use or high-risk areas that could be closed for the winter season

Table 4-10 Low use areas and solutions

List any low use areas that could be closed in the winter season

Low use maintenance area	Solutions

Table 4-11 High risk areas and solutions

List any high-risk areas that could be closed in the winter season

High risk/hazard maintenance areas	Solutions

E. Find drainage problems and solutions

Site name: _____

Date: _____

Table 4-12 Identify drainage problems

Location	Problem	Solutions

F. Create a map

Site name: _____

Date: _____

After completing the above assessments integrate the following into the map of your property:

- Size of maintenance areas
- Level or service goals
- Snow storage areas
- Salt storage areas
- Winter closures
- Drainage problems

4.3 Winter maintenance smart salting basics

Smart Salting integrates science and best practices into winter maintenance decisions. Years ago, agricultural automation reduced significant waste with increased seeding, fertilizing, and harvesting efficiencies. The winter maintenance industry has a similar opportunity now to reduce salt use, save time and the environment. Many professionals, and especially the public, still believe that more salt means a safer surface. That is about as true as saying more corn seed leads to better yield!

State and local governments in Minnesota have been steadily improving winter maintenance practices, though there is still much opportunity for change. Private industry improvements range widely, but typically are behind governmental progress. Training class availability, capacity to attend, staff awareness or resistance, customer pressures and fear of liability have kept innovation low.

Smart salting certified winter maintenance staff have learned to maintain safe surfaces while reducing salt use by 30-70%!

Mechanical removal

Prompt, aggressive and frequent mechanical removal of snow is the best strategy for safe surfaces with less salt.

Reduced salt use from aggressive mechanical removal can prevent costly infrastructure damage

Your entire maintenance team should be trained and have a range of snow and ice management tools and strategies to be successful.

Mechanical removal tools

Do you have the right tools for the job? Aim to use the best-suited mechanical snow removal tools for the winter conditions. Consider the operator's experience. Automated tools are more likely to clear a surface without strenuous work.

Some examples of popular tools include:

- Broom attachments (Figure 4-10) are good for light snow or as a second pass after heavier snow has been removed.
- Flexible scrapers can remove compacted snow or ice
- Thick poly reversible push shovels
- Backpack blowers for lighter snow
- Equipment with shields to keep snow off of operators

Figure 4-10 Broom attachment example.

Reduced salt use from increased mechanical removal lessens the amount of chloride permanently polluting water resources.

Pavement temperature

Monitoring the current pavement temperature and temperature trends leads to better winter maintenance. It is pavement temperature, not air temperature that dictates on what and how much product to apply for the desired level of service.

Pavement temperature ≠ air temperature

Air and pavement temperatures are often quite different because of the wide range of pavements, exposure, surface and subsurface characteristics. Air and pavement temperatures can differ by as much as 20 degrees Fahrenheit. Any reference to temperatures in this document is pavement temperature. One affordable method for monitoring pavement temperatures is with a handheld infrared thermometer shown in Figure 4-11.

Figure 4-11 Handheld infrared thermometer.

How deicers work

Smart deicer use is an important component of winter maintenance. Deicers reduce the freezing point of water which can transition snow and ice into a liquid state. Scientific principles determine ice melt speed and capacity of each deicer.

Each type of deicer works differently and each deicer has its own strengths, limitations and side effects. Like having the right tool for the conditions, understanding the basic deicer properties helps in choosing the best deicer for the specific conditions.

There are no labelling laws governing deicers so buyer beware. No deicers are truly environmentally safe and no deicer will work in all conditions.

Know what you are buying. All deicers have environmental impacts, despite packaging claims. Most don't reveal ingredients or percentages and some exaggerate the practical deicer melting range

Ice melt capacity

Deicer melt capacity is the amount of snow and ice a fixed amount of that deicer will melt. Each chemically different deicer may melt a different amount of snow and ice.

Ice melt *capacity* and ice melt *speed* are often confused. For the most part, adding more of the same deicer to speed up the reaction is an incorrect and wasteful approach to managing snow and ice.

A white, salty surface after snow has melted, shown in Figure 4-12, indicates too much deicer was applied. This problem can be traced to trying to speed melting by adding more deicer or not knowing how to properly use deicers.

Figure 4-12 If your parking lot looks like this, too much salt was applied.

Ice melt speed

The speed of melting is dependent on several factors including those listed below:

- Pavement temperature and trend (higher temperature, faster melting)
- Deicer ingredients
- Form of deicer (liquids are faster than granular)

Pavement temperature should be monitored to select the best ingredients and appropriate form of deicer to increase the speed of melting yet provide enough ice melt capacity.

Common deicers

All deicers have an effective temperature range they perform best within depending on the chemical ingredients in the product.

Do you know what type of deicers are applied on your property?

Lowest practical melting temperature for common chemical deicers

Granular products melt snow and ice slowly. The grains are often kicked or blown off the surface before they are ever able to melt snow and ice. Products displaced from the sidewalk, steps or parking lot don't help melt snow or ice yet create property and environmental damage.

Liquid deicers are the way of the future. The industry is switching to more liquids because they act fast and reduce excess salt use.

Liquid vs. granular deicers

Progressive winter maintenance professionals will use a liquid, a granular or a combination product depending on conditions. Knowing when to use what form of deicer has been shown to improve the operational efficiency and effectiveness.

Liquid deicers are fast acting. Does your contractor use liquid products?

Granular deicers

- More melting power than liquid deicers
- Slower than liquid deicers
- Easily displaced before they have a chance to work

Liquid deicers

- Less melting power than granular deicers
- Faster than granular deicers
- Stays on target

Table 4-13 Lowest practical melting temperature table

This table simplifies the broad categories of material options available. *Not intended to provide comprehensive guidelines for deicing and applying deicers (MPCA, 2015).*

Chemical	Lowest practical melting temp.
NaCl (Sodium Chloride) —Delivered as rock salt, can be made into a brine. The basis of many bagged blends. Corrosive. Inexpensive. Very available. Most commonly us used without a corrosion inhibitor added, but corrosion inhibited products are available.	15° F
$MgCl_2$ (Magnesium Chloride)—Delivered primarily as a liquid, other forms available. Used for anti-icing, pre-wetting and stockpile treatments. Corrosive. Higher cost. Often has a corrosion inhibitor added. Often added to salt brine.	-10° F
$CaCl_2$ (Calcium Chloride)—Delivered as flakes, pellets, or liquid. Corrosive. Most effective ice melter at very cold temperatures. Sometimes used incorrectly to open storm drains. Higher cost. Often has a corrosion inhibitor added. Often added to salt brine.	-20° F
KAc (Potassium Acetate)—Delivered as a liquid. Often used on automated bridge deicing systems and airports. Use for anti-icing, deicing. Non-corrosive to steel but corrosive to galvanized, biodegradable. Alternative for areas where chloride use must be limited. Higher cost.	-15° F
Blends— Both chlorides and acetates exist in blends. Talk to the supplier and determine the lowest practical melting temperature, the optimal concentration and the basic components in the blend. Most blends are centered on rock salt since it is cheap.	Variable depending on chemicals in blend
Winter Sand/Abrasives—Winter sand has salt mixed in it to keep it from freezing. Abrasives should be used for cold temperatures when deicers are not effective. Want to minimize salt % in sand.	Never melts – provides traction only

Does your contractor or maintenance staff know how much deicer they apply? The application rate charts recommended to professionals are in the Winter Parking Lot and Sidewalk Maintenance Manual and in the Minnesota Snow and Ice Control Field Handbook.

For *technical and detailed deicer use and performance attend the Smart Salting for Parking Lots and Sidewalks Training*.

Application rates

The rates in these charts are not guaranteed to work. The guidelines were created by experts and are a best judgement as to what the lowest rates should be if operators have kept up with the storm. The variables dictating application rates are numerous and the simplified charts in these manuals serve only to give an idea of what rate might work.

If you need more than 4 pounds per 1000 square feet, it is time to revisit maintenance strategies and optimize performance.

Figure 4-13 One pound of salt is about one coffee mug.

Granular spread pattern

Spread patterns should resemble sprinkles of salt and not piles or a blanket of salt. Salt on the edges of paved surfaces is often wasted salt. To get more work out of applied salt, focus on spreading it in the middle of pathways and in high traffic areas, avoid spreading it to the edges of the sidewalk or corner of the parking lot. Foot or vehicle traffic will help move salt to the edges.

Figure 4-14 Too much salt and spread too far to the edges of the pavement.

Figure 4-15 The deicer should have space between the granules.

Liquid spread pattern

Liquid spread pattern strategies vary depending on how or when it is applied (before, during or after a storm) or if it is combined with granular salt.

Liquid products can save time, money and salt use if used correctly. Be careful! Incorrect liquid use can make surfaces slippery. To learn more about using liquid deicers attend a Smart Salting for Parking Lots and Sidewalks training class.

There is a great deal of research available to learn about the practical use of deicers and their side effects. More information is available in Appendix B: Resource section. To learn how to better select and properly apply liquid and granular products attend the Smart Salting for Parking Lots and Sidewalks training class.

Evaluation 6: Is training needed?

Site name: **Date:**

☐ Are sidewalks covered with crunchy salt?

☐ Are parking lots covered with white chalky residue?

☐ Are your indoor floors and mats covered with salt crystals or salty water residue?

If yes to any of the above, get your crew into training, you are wasting money on salt that is no longer doing work for you. If they are already trained, enable them to try a new approach.

Make a list of who should attend a Smart Salting Training:

Evaluation 7: Preferred tools

List the top 5 snow/ice removal tools preferred by your crew/subcontractors.

1. _____

2. _____

3. _____

4. _____

5. _____

Evaluation 8: Equipment wish list

Site name: **Date:**

This wish list will help you and your maintenance staff prioritize new purchases. Include notes about what needs to be repaired, updated or replaced.

Table 4-14 Equipment wish list

For a wish list of tools for entryways go to the Communications chapter.

Site:		**Date:**	
Motorized tools	**Have**	**Need**	**Notes**
PLOW TRUCK			
Truck liquid spreaders			
Trucks granular spreader			
Truck plow blades			
Truck other			
ATV, UTV			
UTV plow attachment			
UTV broom attachment			
UTV blower attachment			
UTV granular spreader			
UTV liquid spreader			
UTV attachment other			
LOADER/SKID STEER			
Loader attachment			
Skid steer broom attachment			
Skid steer blowers attachment			
Skid steer granular spreaders			
Skid steer other			
Hand tools	**Have**	**Need**	**Notes**
Scoop shovels			
Push shovels			
Ice chisels			
Flexible blade scrapers			
Backpack blowers			
Push motorized brooms			
Drop spreaders			
Shield for rotary spreader			
Rotary spreader w/ shield			
Backpack sprayer			
Other			

Table 4-15 Example equipment wish list

Example:

Site: Ridges Mall		**Date:** 6/11/2019	
Motorized tools	**Have**	**Need**	**Notes**
PLOW TRUCK	1	0	Subcontract out parking lots. Rarely use our own trucks.
Truck liquid spreaders	0	1	200 gallon tank, spray bar, pump controlled
Trucks granular spreader			
Truck plow blades			
Truck other			
ATV, UTV	1	1	Always in use. Want 1 more. Want model xyz
UTV plow attachment	1	1	
UTV broom attachment	0	2	
UTV blower attachment	1	0	In the shop, hit a rock last year
UTV granular spreader	1	1	
UTV liquid spreader	0	2	
UTV attachment other	0	0	
LOADER/SKID STEER	1	0	
Loader attachment	0	1	Bucket scale
Skid steer broom attachment	0	0	
Skid steer blowers attachment	0	0	
Skid steer granular spreaders	1	0	
Skid steer other			
Hand tools	**Have**	**Need**	**Notes**
Scoop shovels	3	0	Metal eaten away, replace with poly version
Push shovels	3	0	
Ice chisels	1	0	
Flexible blade scrapers	0	3	
Backpack blowers	0	2	Rechargeable. Use grant funds to purchase
Push motorized brooms	0	0	
Push spreaders	3	0	
Shield for rotary spreader	0	1	
Rotary spreader w/ shield	1	0	
Backpack sprayer	0	1	
Other			

4.4 Winter maintenance strategies

Maintenance strategies should be dictated by an established level of service (LOS) goal. If trying for bare pavement, there are proven strategies that minimize work, salt and risk. If the established level of service is non-bare pavement (traction on top of snow or a mix of bare pavement with some snow and ice) the maintenance strategy will be different.

Figure 4-16 Bare pavement vs. non-bare pavement

Bare pavement

Bare pavement requires the most effort and chemicals to achieve. It is a common goal in high traffic, high speed or high risk maintenance areas. Examples of areas that might establish bare pavement LOS goals include an interstate or a sidewalk in front of a school.

The most efficient strategy to bare pavement follows these 3 steps:

1. **Anti-icing (liquid deicer application before the storm):** When pavement and weather conditions allow
2. **Mechanical snow removal:** Early, aggressive and often
3. **Deicing (deicer application during or after the storm):** Only if needed

Although anti-icing can reduce overall salt use, it is not for every event or situation. It is one of many tools and should be used under appropriate conditions. Efficiency of methods are illustrated below in Figure 4-17.

Most efficient: Anti-icing followed by mechanical removal of snow

Less efficient: Mechanical removal of most snow followed by deicer application on a thin layer of snow or ice

Inefficient: Applying deicers without removing snow

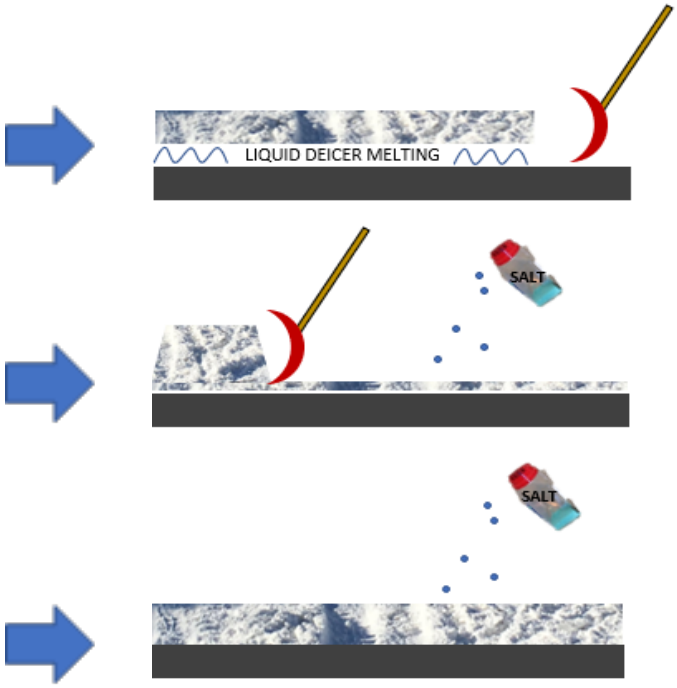


Figure 4-17 Efficiency of maintenance strategies.
Graphic credit: FCI

Anti-icing

Anti-icing is an application of a liquid deicer immediately before an event to create a micro layer of melting under snow and ice. This layer of melting reduces the bond of the snow and ice to the pavement, making mechanical removal much easier.

A wet-dry pattern, shown in Figure 4-18, is used when applying liquid deicer before the storm. The dry areas maintain pavement friction before the storm while the wet areas reduce the bond of snow and ice to the pavement. If you have seen stripes on the pavement, you have seen an anti-icing application of deicer.

Anti-icing is not always an appropriate tool for every pavement type or weather event. The type of winter event, liquid deicer, application rate and the spread pattern are all important factors in the success or failure of anti-icing. The MPCA Smart Salting for Parking Lots and Sidewalks training class covers anti-icing strategies in detail.

By and large, in the private sector, anti-icing is greatly under used. When looking for a contractor, ask if they use anti-icing techniques.

Figure 4-18 Wet-dry spread pattern.

Mechanical snow removal strategies

Snow should always be mechanically removed from surfaces before deicing, reducing the need for deicers while improving deicer efficiency.

Some events, like a freezing mist, do not require snow removal but most events do.

Employ mechanical removal early, often and aggressively. Removing snow from the pavement before foot and vehicle traffic, as shown in Figure 4-19, reduces compaction. Compacted snow and ice requires more salt, effort and time to remove.

Figure 4-19 Aggressive physical removal of snow.

Work to match the different equipment types with different weather events. Wet and heavy snow will require sturdy equipment such as scoops shovels and plows and dry snow can be removed well with brooms or blowers.

Allocate budget to staff time and equipment purchases for physical snow removal. It can reduce salt costs and repairing infrastructure damage.

Deicing

After snow has been cleared, determine what spots still need deicer. Deicer may not be needed.

Reduce salt use by only treating slippery spots.

Pavement temperature and trends will factor into the decision to use deicers. For example, if warm weather is on the way deicers are not needed, but if the pavement temperatures are dropping, applying deicers before it is too cold will work well. If it is too cold for deicers to be effective, no deicers will help. A shift to abrasives, such as sand, until pavements warm is a better strategy. Review Table 4-13 in the Winter Maintenance Basics chapter for practical melting temperatures of common deicers.

Deicing is not always necessary. Consider physical removal and salt application separately to make operations more versatile, efficient and less wasteful.

Plowandsalt
is not one word!
Plow - then salt -- only if needed.

Non-bare pavement

Non-bare pavement is a common level of service in lower traffic, lower risk, and lower speed areas. Greater Minnesota showcases this level of service more often than the Twin Cities. A little snow on the steps, sidewalk or parking lot is acceptable in many areas across our state.

Can we walk or drive in some snow? Can the Twins host the home opener in the snow? Can we sit on the ice and fish in the winter? Do we have winter festivals and snowball fights? Yes, of course, it is part of what makes Minnesota unique and, for many, a source of pride to live in the frozen north.

How clear do sidewalks, steps and parking lots need to be to accommodate your users?

Acceptability of non-bare pavement varies from location to location. Once a level of service goal is established, not meeting this goal often involves extra salt, extra cost, extra damages and a threat to the fishing and drinking water in Minnesota. As a property manager, remember you do have the ability to influence customer expectations. Safety is everyone's responsibility.

Non-bare pavement is adequate for many properties (Figure 4-20). Switching from a bare pavement level of service to a non-bare pavement level of service is difficult and uncommon (but great for our walleye and bass). It will require communication with the users of the property. If you are considering this step, inform users of the changing level of service plans.

Photo credit: FCI

Figure 4-20 Non-bare pavement.

Non-bare pavement typically has 2 steps:

1. **Mechanical snow removal:** Main strategy
2. **Deicing or abrasives:** If needed

Abrasives

Abrasives, such as sand or rock chips, are applied to create traction on top of snow and ice. Abrasives are more commonly used when the level of service goal is non-bare pavement.

Abrasives do not melt snow or ice. They provide traction.

Reasons to apply abrasives include:

- To provide traction in maintenance areas designated as non-bare pavement
- It is too cold for deicers to work (no deicers work below 0°F)
- It is a gravel surface
- Only temporary traction is needed
- Concern for infrastructure or vegetation damage from chlorides

Avoid applying a salt/sand mix. It is an inefficient strategy.

Evaluation 9: Is your contractor/crew using best practices?

Site name: _____

Date: _____

✔ **Which of these do you see your contractor or crew doing?**

Table 4-16 Best practices checklist

	Your contractor or crew best practices checklist
	Aggressive mechanical removal of snow/ice
	Applies deicer only on icy spots, avoiding dry pavement
	Applies different products according to pavement temperature
	Avoids using deicers on extreme cold days. Switches to abrasives
	Uses liquid deicers
	Knows what application rate they are trying to accomplish
	Uses light spread patterns
	Stores product in dry, covered area
	Advises you on drainage problems or other fixes that can prevent slippery conditions
	Sweeps up extra salt/sand after the storm
	Records their actions

How many boxes checked? _____

If you checked less than six of the above practices in Table 4-16, time to encourage attending a Smart Salting for Parking Lots and Sidewalks certification training.

Evaluation 10: How are you helping your contractor/crew?

Site name: _____

Date: _____

How have you helped your contractor/crew?

Table 4-17 Ways to help winter maintenance staff/contractors

✔	Ways to help winter maintenance staff/contractors
	Send them to MPCA Smart Salting training and/or hire certified contractors
	Set clear and reasonable goals
	Communicate your goals with contractors, staff and users of the property
	Be patient: deicers take time to work; it's not an instant fix
	Discuss issues and work to resolve them
	Provide ways for property staff to supplement mechanical removal between the crews/contractor's visits. Avoid using the salt bucket as the first and only approach.
	Fix drainage issues that result in icy conditions
	Educate staff so they are better able to field questions about their new approach to lower salt winter maintenance
	Encourage the users of your building to walk and drive without distraction
	Be proud of your Smart Salting certification and your efforts to lower salt use
	Consider using the Minnesota model snow and ice maintenance contract which allows contractors to use professional judgement, allowing for less salt use
	Adopt a snow and ice maintenance policy; educate property occupants on the policy so they know what to expect
	Close off difficult to maintain areas if possible

How many boxes checked?

Each of the above items will help make your properties' winter maintenance more efficient and effective.

Evaluation 11: Improve winter maintenance efficiency

Site name: _____

Date: _____

If you have a **bare pavement** policy does your contractor or crew follow these steps:

1. **Anti-icing (liquid deicer application before the storm):** When pavement and weather conditions allow
2. **Mechanical snow removal:** Early, aggressive and often
3. **Deicing (deicer application during or after the storm):** Only if needed

✔ _____ **Yes** _____**No**

If your crew/contractor does not use anti-icing or aggressive mechanical snow removal list two ways to help them use these strategies?

1) _____
_____

2) _____
_____

If you have **non-bare pavement** policy does your contractor or crew follow these steps?

1. **Mechanical snow removal:** Main strategy
2. **Deicing or abrasives:** If needed

✔ _____**Yes** _____**No**

If your crew/contractor does not use physically remove snow before applying deicer list two ways you could help them?

1) _____
_____

2) _____
_____

***If your crew/contractor uses a lot of salt getting to bare pavement (with a non-bare pavement goal):**

- Redefine your goal and follow the bare pavement steps above **or**
- Communicate with your contractor/crew so they know some snow and ice is acceptable

4.5 Smart education for smart salting

Some people still believe a visual over-abundance of salt amounts to a safer surfaces. This is not always true. This chapter will help you manage expectations and provide education ideas and tools.

Communication about winter maintenance

It is important to make property management decisions around level of service for certain areas, as well as considering some of the other training tools around policy development, liability, contracting practices, and more.

Once appropriate levels of service goals are establighed, the next step important step to success is user and staff education. Informing customers, employees, residents and visitors about what they can expect from you, inlcuding level of service goals and safe winter maintenance practices, will help influence their use of your property. Educational messaging may increase safety through relatively simple behavior changes. Know your audience and their current mindset on salt use and safety, to develop education that is meaningful to them. A sign or poster can be quite effective for occasional visitors, but ongoing newsletters or in person communication may be more effective for people who use sites more often, such as employees or residents. Catchy, short messages that remind everyone that safety is everyone's responsibility has shown to be very effective.

Before winter begins

Inform all property user, occupants, and staff of your clear, thoughtful level of service expectations for the entire property. Inform people they may see some changes as you adjust to the new service level. Detail how those changes will be implemented and what they may see (such as anti-icing applications or less salt granules). Emphasize that the practices provide safe surfaces even if visitors see less salt. This is also a good time to remind people to adjust their behavior including walking and driving carefully and wearing appropriate footwear for the season. Point out reasons for changing service levels. for example, a lower level of service is being used for the back walkway because no one walks in it during the winter.

Figure 4-21 A sign to encourage caution while walking.
Photo credit: Nick Queensland

Emphasize that your practices provide safe surfaces — even if customers see less salt.

During the winter season

Continue to remind all property users of level of service expectations, and why it's an important change. Remind them to walk and drive carefully. If any maintenance strategies change, inform people of when and how the changes will be made. Pay attention for slippery or hazardous areas. If the areas cannot be addressed during the winter season, a sign reminding people to walk carefully may reduce slips and falls (Figure 4-21). Get property users involved. Perhaps they have ideas for level of service adjustments that can be made with little impact to all.

Complaints

Educate public facing staff (or whoever fields winter maintenance complaints) on the winter maintenance policy and update them on maintenance practice so they are better equipped to handle winter complaints, such as requests for more salt to be applied. A response could include informing complainers of when salt was last applied and how long it will take before it works, that a trained and certified crew is managing the area, the level of service goals and practices being implemented to keep people safe. For collective living or working areas, provide information on how strategies protect the infrastructure and vegetation. Most people feel comfort that there is a well thought out plan to protect them and the infrastructure. It may be effective to talk about protecting a nearby water body that is commonly enjoyed. If the complaint is about a specific area, consider spot treating the area with deicers or abrasives, posting signs or closing the area.

Entryways

Entryways and the areas just outside of them are often prone to the effects of outdoor over salting. This results in damaged carpet, concrete, doors, flooring and more. Placing a salt bucket in entryways without instructions and/or alternatives will result in over salting. View the entryway as a communication opportunity. Carefully select the tools and messages you display.

Entryway tools

If you offer an entryway salt bucket, you should also provide snow and ice removal tools. If salt is the only option it will get used and probably in excess. It is best to have a few tools in the entryway suited for different situations such as an ice scraper, a push shovel and a scoop shovel. Provide a broom and dustpan in the entryway to sweep up excess salt or salt spills. Invite users to use the tools with encouraging signs.

Figure 4-22 A shovel is provided along with a salt bucket in this entryway.

Small hand spreaders that release salt slowly will encourage people to use less and spread salt more evenly

If you do not have a hand spreader, a smaller scoop and bucket of salt, with specific instructions that only a small amount is needed, may encourage less salt use. Cups with application rates can be created with a template from Wisconsin Salt Wise.

Liquid deicers are a good entryway tool if there are employees on-site who are trained in liquid application.

Entryway guidance

Always provide instruction with a salt bucket. Offer training for the employees most likely to use the entryway salt (either Smart Salting or your own training). The Winter Maintenance for Small Sites video offers a short, but informational entryway primer. Consider a policy and post signs that only trained employees can apply salt.

Figure 4-23 Salt bucket sticker
Photo credit: MPRB

An entryway is a prominent place to communicate winter maintenance practices with all building users. Effective entryway message examples:

- 1 tsp. of salt permanently pollutes five gallons of water
- Granules of salt should be spread sparingly
- Always clear snow and ice before applying any deicer
- If there is visible deicer, do NOT apply more

- It takes time for salt to work, applying more will not speed up melting, only waste money
- Salt will not work below 15°F (rock salt)
- Sweep up salt on clear sidewalks

After attending the Smart Salting for Property Management class you will receive a poster and window cling to hang in the entryway of your property (Figures 4-24 and 4-25)

Figure 4-24 Smart Salting poster for entryways

Figure 4-25 Smart Salting window cling for entryways

Evaluation 12: Entryway checklist

Site name: _____

Date: _____

Fill in:

Table 4-18 Entryway checklist

Site:		**Date:**	
Entryway tools	**Have**	**Need**	**Notes**
Entryway only hovels			
Entryway only scrapers			
Entryway only hand spreaders/ shakers			
Entryway only brooms			
Entryway only sprayers			
Entryway other			

Example:

Table 4-19 Example entryway checklist

Site:		**Date:**	
Entryway tools	**Have**	**Need**	**Notes**
Entryway only hovels	3	4	No tools left in entryway. Order tools to keep in entryway. Paint them bright orange.
Entryway only scrapers	0	7	
Entryway only hand spreaders/ shakers	2	5	
Entryway only brooms	0	7	
Entryway only sprayers	0	3	Red handled ultimate scrapers
Entryway other			

Evaluation 13: Educating and managing expectations of site users

Site name: _____

Date: _____

Fill out the chart below. List the types of visitors or users of your site, the message or information you want to tell them, the communication method to you will use to give them this information, and tools they will need.

Table 4-20 Example entryway checklist

Site:		**Date:**	
Site user or visitor	**Communication method**	**Message**	**Tools/resources**

Example:

Table 4-21 Example entryway checklist

Site:		**Date:**	
Site user or visitor	**Communication method**	**Message**	**Tools/resources**
Employees	Email, signs	Walk and drive carefully	N/A
Managers at retail stores	In person training	How to manage customer expectations and complaint	Script and handouts for complaining customers about salt pollution and snow and ice strategies at the site
Custodians	In person training, Small sites video	How to spot treat icy spots, rock salt in bucket stops working at 15°F	Shovel, ice scraper, effective melting temperature of deicer
General visitors	Signs at entrances, near stairs and parking lots	Walk carefully	N/A

5. Water softening

Many homes and businesses across Minnesota use water softeners to remove hardness from water. Most drinking water across the state is rated as hard to very hard, as shown in Figure 5-1. Water softeners are used to extend the life of appliances, protect fixtures, prevent hard water spots on dishes, make soap sudsy and reduce the amount of cleaning products needed. According to a 2019 study, water softening is one of the top 3 contributors for chloride going into Minnesota waters (Overbo et al., 2019).

Check if your city is already softening water. If so, you may not need a softener or can lower the settings.

When salt is added to a water softener, the softening process uses the sodium part of the salt, but the chloride part is not used. It is discharged with the flush water to either the wastewater treatment plant or septic system. Neither of these systems can remove the chloride from the water, so the chloride will move to surface waters such as lakes, rivers, streams, and wetlands, or seep into groundwater.

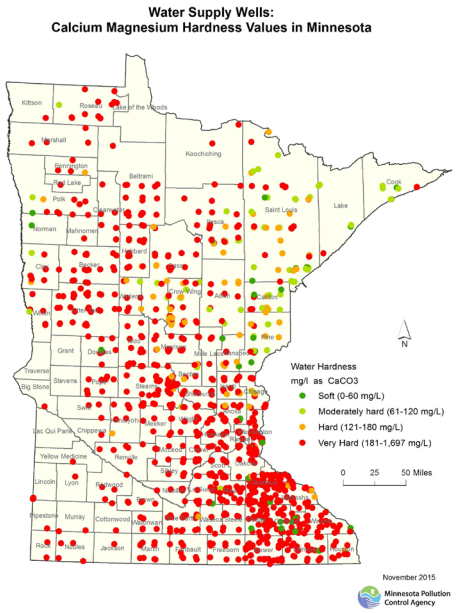


Figure 5-1 Water Supply Wells: Calcium Magnesium Hardness Values in Minnesota (MPCA Chloride Management Plan, 2020)

Water softening basics

Water "softening" is the process of removing hard ions (calcium and magnesium) and replacing them with the soft ion, sodium from the brine solution. This is also known as ion exchange. There is a wide variety in features and sizes for water softeners. An efficient softener will have a rating of 4000 grains hardness/ lb. of salt or higher.

Salt (sodium chloride) is added to the brine tank. As the water softener regenerates, brine flows through the resin and sodium ions attach themselves to the resin beads. This water is then discharged. The amount of salted needed or salt setting depends on the hardness of the water.

Hard water is then added to the softener. As the water flows through the softener, the hard ions trade places with the sodium on the resin beads. Allowing soft water to exit the water softener to travel to other areas of the house. When the soft water has been used, the water softener will regenerate again using brine.

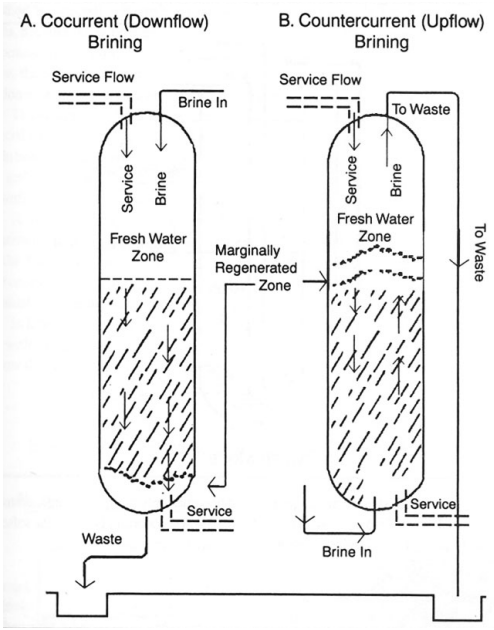


Figure 5-2 Water Softening Process. Graphic credit: MQA

Adjust your water softener to the incoming water hardness or you can work with a professional or buy a test kit to find out the hardness of your water. Many cities post water hardness on their website.

Water softeners should be inspected periodically to make sure they are set and functioning properly. They can often be optimized for salt efficiency. Consider hiring a water quality professional (see WQA website for list) to check and optimize your softening systems.

Time clock vs. demand initiated regeneration

Time clock regeneration: inefficient

Many older water softeners use a time clock regeneration mechanism. In this system, the water softener is set to regenerate after a certain number of days, no matter what the water use of the building. Time clock water softeners are generally less efficient than demand initiated regeneration softeners.

You can save salt by replacing time clock softeners with demand based softeners!

Demand initiated regeneration (DIR): efficient

Demand initiated regeneration water softeners track the amount of water used and regenerate when a certain amount of water is left in the tank. This is called the reserve capacity. When the softener is set up, this reserve capacity is set based on an estimated daily use of water so that there should be enough soft water in the tank to last until the system will regenerate in the early morning hours. Any softened water left at this point will be flushed from the system before regeneration.

Twin tank systems: more efficient

Twin tank systems have two water softener tanks in tandem. This eliminates the need for a reserve capacity. When the first tank has been fully depleted of soft water the system switches to the second tank while the first is regenerated. This system reduces water waste and the risk of running out of softened water.

Water efficiency

Using water efficient appliances such as washing machines, dishwashers, toilets, and low flow shower heads will cut down on the amount of softened water needed on the premises. Less water in turn means less salt needed to soften.

Changes in plumbing

Look at how the building is plumbed. Does your softened water go outside to water the flowers or lawn? Consider softening only the inside hot water. One of the main benefits from softened water is protecting appliances such as the water heater and dishwasher. By softening just the hot water you can keep these benefits while reducing the amount of salt needed.

Water softener alternatives (Non-salt technologies or water conditioners)

There are alternatives to the traditional water softener for dealing with hard water. Some of these options remove the hard ions from the water (soften) and some of them cause the hard ions to be suspended in the water, inhibiting scale formation. Water softener alternatives include Reverse Osmosis, Capacitive Deionization, and others. For more information see the UMN Water Resource Center's water softening resources.

Tips for water softeners

- Determine the hardness level of your water and consider:
  - If that level of hardness is acceptable for your needs
  - If a water softener necessary,
  - Hiring a professional to optimize your water softener for minimal salt use
- Consider replacing your water softener if:
  - It is more than 10 years old
  - It has time clock initiated regeneration
  - It has an efficiency rating of less than 4,000 grains hardness/ lb.
- If upgrading your water softener, look for an efficiency rating of at least 4,000 grains hardness/lb. salt.
- Water softeners should be inspected periodically to make sure they are set and functioning properly.
- Twin tanks can reduce salt and water use.
- Counter-current regeneration, also known as up-flow regeneration, uses less salt than co-current regeneration (down-flow and the most common type of regeneration).
- Softening only indoor water will reduce salt use substantially. Consider softening only hot water. Less water softened = less salt use.
- Research water softener alternatives to see if one might be a match for you.

Check out the MPCA's website for more information and resources about water softening. If you are looking to replace an old inefficient water softener there may be local rebate programs or grant and loan funds available to help cover the cost to upgrade to a salt efficient unit. The MPCA Small Business Assistance program offers 0% interest loans to business with 100 employees or less for purchasing equipment that has an environmental benefit.

Evaluation 14: Water softening

Site name: _____ Date: _____

1) **Does your city have central softening?**

_____**Yes** _____**No** _____**I don't know**

If your city softens water you may not need a home water softener.

2) **What is your water hardness?**

_____**grains per gallon** _____**I don't know**

You may also be able to find water hardness from your city or ask a professional to test your water. You may not need to soften your water or your settings may need to be adjusted.

3) **If you have a water softener, answer the following questions to see if it is optimized for salt savings.**

A) **How old is your water softener?**

_____

Consider replacing a water softener that is over 15 years old.

B) **Do you have a demand initiated regeneration or time clock initiated regeneration water softener?**

_____**Demand initiated regeneration *(based on water use)***

_____**Time clock initiated regeneration *(based on a set time interval)***

Switching from time clock regeneration to demand initiated regeneration can cut down salt use by 25-60%

C) **Does your softened water go outside?**

_____**Yes**

If your softened water goes outside you are wasting salt and may be damaging your plants. A plumber can adjust your plumbing to only soften water inside.

_____**No**

Great, you are cutting down on salt use by softening less water.

D) **Do you only soften hot water?**

_____**Yes**

Great, you are cutting down on salt use by softening less water.

_____**No**

Consider if you can switch to only softening hot water.

6. Turf and vegetation management

Property managers often oversee the maintenance of turfgrass and other landscape plants, either with employees or hired contractors. Landscape maintenance can be a source of chloride. Make sure your employees or contractors are knowledgeable in turfgrass maintenance. Most contractors and employees know how to mow and apply fertilizers, but are not familiar with the science behind how much is the correct amount of fertilizer. Hire contractors that are MPCA certified in Turfgrass maintenance. Turfgrass trainng and resources can be found in Appendix B: Resources.

Fertilizer as a source of chloride

Some fertilizers used for lawn care contain muriate of potash which is potassium chloride (KCl). Other sources of chloride in lawn fertilizers include calcium chloride ($CaCl_2$), ammonium chloride (NH_4Cl) and magnesium chloride ($MgCl_2$).

Potassium is one of the three essential macronutrients required for healthy turfgrass. These three macronutrients are nitrogen (N), phosphorus (P) and potassium (K). Fertilizer bags have the N-P-K ratio on the label to show the percent of the three macronutrients in the bag. Potassium aids in plant growth aspects such as photosynthesis, helps improve water retention, and suppresses plant disease. It possibly aids plant survival through stress such as drought, cold hardiness, and disease. Know that soils often have adequate potassium, especially in highly organic or clay soils.

Turf grass and plants use these nutrients whether in the soil naturally or via fertilizer. Some of the nutrients removed during grass mowing and eventually needs to be replaced. Nitrogen is used the most by turfgrass and must be replaced more frequently and usually in higher amounts.

Sources of potassium

The most common sources of potassium for lawn fertilizer are muriate of potash, also known as potassium chloride (KCl) and sulfate of potash, also known as potassium sulfate (K_2SO_4). Organic fertilizers and compost contain natural sources of potassium, and may have added sources. KCl contains 47% chloride and 53% potassium.

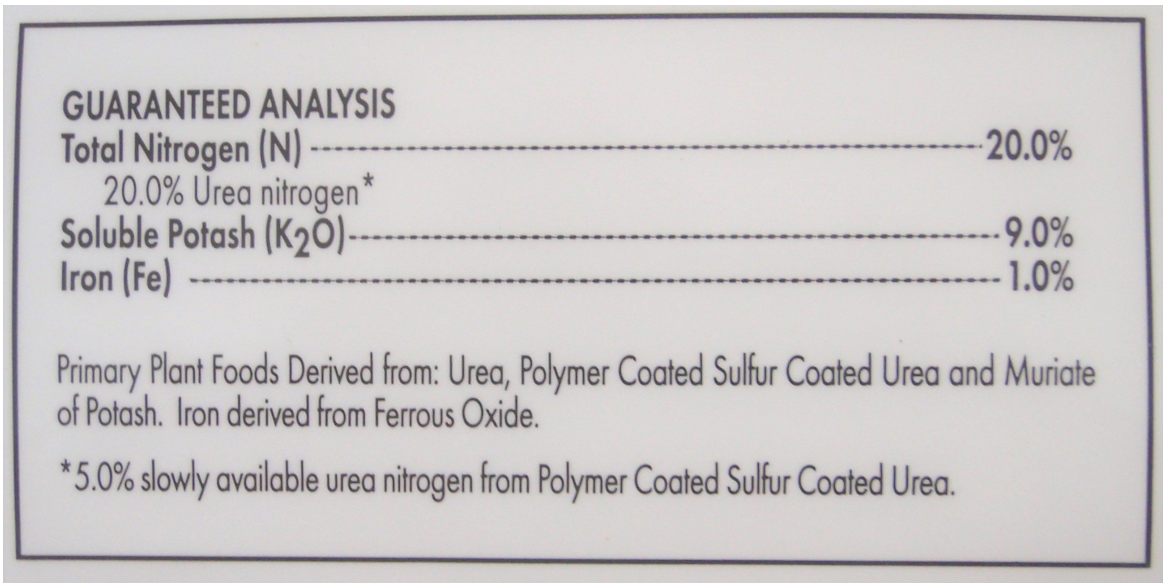


Figure 6-1 The label on this bag of 20 –0-9 fertilizer shows the potassium as K20, but the text below states it is derived from Muriate of Potash which is potassium chloride

Types of turfgrass and potassium sources

Since KCl is the cheapest source of potassium, it is the most commonly used potassium source for lawns and parks. Golf courses and sports turf managers may use potassium sulfate. Potassium sulfate is a more forgiving source. It is not prone to burn turf as potassium chloride is, and is a more available source and more efficiently taken up by the turf plants. Over-application of potassium chloride can cause salt burn. Potassium sulfate has a much lower salt index but is about $3 more per 50 lb. bag. This price difference is not as much of a concern for golf courses, but is for private contractors and probably municipalities.

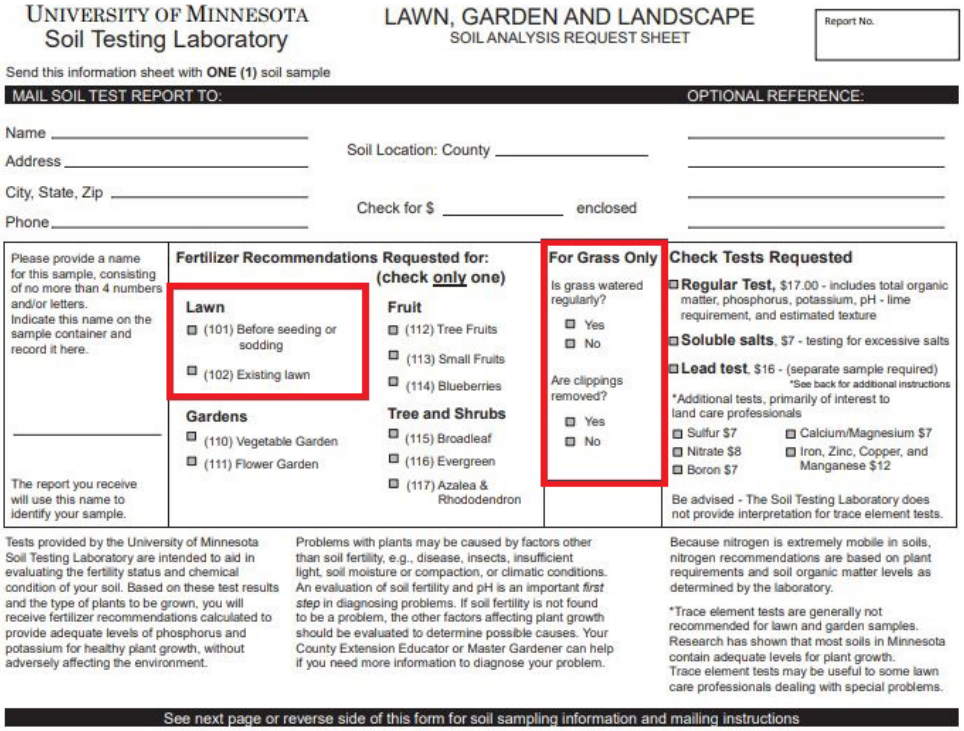
Many city maintenance staff and private contractors are not highly educated on what fertilizer sources to use and rely on the supplier's recommendations.

Reducing chloride by adopting turfgrass maintenance best practices

Use of potassium chloride can be reduced by managing turfgrass based on its actual needs and plant physiology. There are several turfgrass maintenance practices that will help provide for healthy turfgrass with reduced inputs of nutrients (nitrogen, phosphorus and potassium). Following these practices will also likely reduce chloride use.

Conduct a soil test

The best way to know how much fertilizer to apply to your specific site is to test the soil. Not all lawns require potassium and potassium is expensive to add to a bag of fertilizer. Many soils have plenty of it and don't need to be supplemented. However, not all of the potassium in the soil is available for uptake by turfgrass plants. Sandy soils generally have less available potassium than soils with high clay or organic content. A soil test will help determine if potassium is needed on a lawn.



UNIVERSITY OF MINNESOTA
Soil Testing Laboratory

LAWN, GARDEN AND LANDSCAPE
SOIL ANALYSIS REQUEST SHEET

Report No.

Send this information sheet with **ONE (1)** soil sample

MAIL SOIL TEST REPORT TO: OPTIONAL REFERENCE:

Name
Address
City, State, Zip
Phone

Soil Location: County
Check for $ enclosed

Please provide a name for this sample, consisting of no more than 4 numbers and/or letters. Indicate this name on the sample container and record it here.

The report you receive will use this name to identify your sample.

Fertilizer Recommendations Requested for: (check only one)

Lawn
- (101) Before seeding or sodding
- (102) Existing lawn

Gardens
- (110) Vegetable Garden
- (111) Flower Garden

Fruit
- (112) Tree Fruits
- (113) Small Fruits
- (114) Blueberries

Tree and Shrubs
- (115) Broadleaf
- (116) Evergreen
- (117) Azalea & Rhododendron

For Grass Only

Is grass watered regularly?
- Yes
- No

Are clippings removed?
- Yes
- No

Check Tests Requested

- **Regular Test,** $17.00 - includes total organic matter, phosphorus, potassium, pH - lime requirement, and estimated texture
- **Soluble salts**, $7 - testing for excessive salts
- **Lead test**, $16 - (separate sample required) *See back for additional instructions

*Additional tests, primarily of interest to land care professionals
- Sulfur $7
- Nitrate $8
- Boron $7
- Calcium/Magnesium $7
- Iron, Zinc, Copper, and Manganese $12

Be advised - The Soil Testing Laboratory does not provide interpretation for trace element tests.

Tests provided by the University of Minnesota Soil Testing Laboratory are intended to aid in evaluating the fertility status and chemical condition of your soil. Based on these test results and the type of plants to be grown, you will receive fertilizer recommendations calculated to provide adequate levels of phosphorus and potassium for healthy plant growth, without adversely affecting the environment.

Problems with plants may be caused by factors other than soil fertility, e.g., disease, insects, insufficient light, soil moisture or compaction, or climatic conditions. An evaluation of soil fertility and pH is an important *first step* in diagnosing problems. If soil fertility is not found to be a problem, the other factors affecting plant growth should be evaluated to determine possible causes. Your County Extension Educator or Master Gardener can help if you need more information to diagnose your problem.

Because nitrogen is extremely mobile in soils, nitrogen recommendations are based on plant requirements and soil organic matter levels as determined by the laboratory.

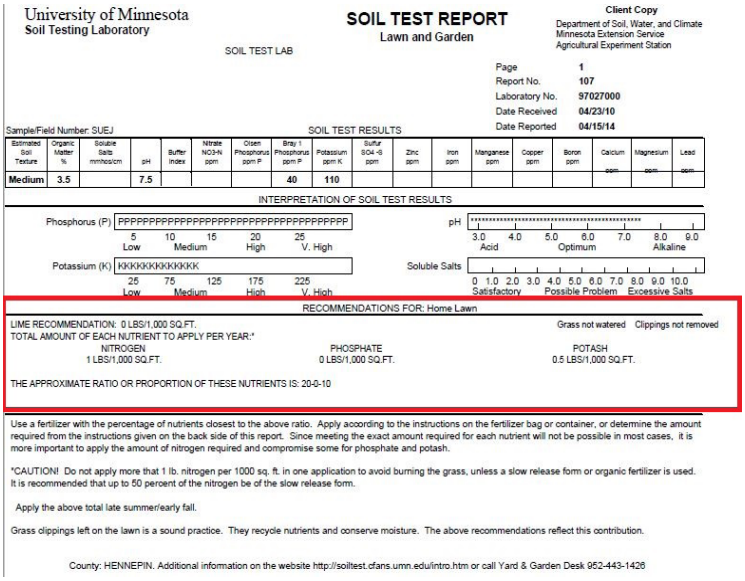
*Trace element tests are generally not recommended for lawn and garden samples. Research has shown that most soils in Minnesota contain adequate levels for plant growth. Trace element tests may be useful to some lawn care professionals dealing with special problems.

See next page or reverse side of this form for soil sampling information and mailing instructions

Figure 6-2 Front page of soil test form. Complete form found on UMN's soil testing website. Photo credit: UMN

The soil test results will list the level of potassium in the soils and recommendations for how much, if any, potassium should be added per year. The University of Minnesota provides low cost soil to anyone from homeowners to professional turf managers. Private companies also offer soil testing. Without a soil test, determining the amount of potassium needed is a guess.

In Figure 6-3, the area outlined in red includes the recommendations on ratio and amount of fertilizer to apply in pounds per year. In this case it is a ratio of 2-0-1 or 20-0-10 and a total of 2 lbs. nitrogen, no phosphorus and 1 lb. potassium per year, split in two applications.



University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Lawn and Garden

Client Copy
Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

SOIL TEST LAB

Page 1
Report No. 107
Laboratory No. 97027000
Date Received 04/23/10
Date Reported 04/15/14

Sample/Field Number: SUEJ

SOIL TEST RESULTS

Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm	Lead ppm
Medium	3.5		7.5				40	110									

INTERPRETATION OF SOIL TEST RESULTS

Phosphorus (P) PPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPP
5 Low 10 Medium 15 20 High 25 V. High

pH
3.0 4.0 5.0 6.0 7.0 8.0 9.0
Acid Optimum Alkaline

Potassium (K) KKKKKKKKKKKKK
25 Low 75 Medium 125 175 High 225 V. High

Soluble Salts
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0
Satisfactory Possible Problem Excessive Salts

RECOMMENDATIONS FOR: Home Lawn

LIME RECOMMENDATION: 0 LBS/1,000 SQ.FT.
Grass not watered Clippings not removed
TOTAL AMOUNT OF EACH NUTRIENT TO APPLY PER YEAR:*

NITROGEN
1 LBS/1,000 SQ.FT.

PHOSPHATE
0 LBS/1,000 SQ.FT.

POTASH
0.5 LBS/1,000 SQ.FT.

THE APPROXIMATE RATIO OR PROPORTION OF THESE NUTRIENTS IS: 20-0-10

Use a fertilizer with the percentage of nutrients closest to the above ratio. Apply according to the instructions on the fertilizer bag or container, or determine the amount required from the instructions given on the back side of this report. Since meeting the exact amount required for each nutrient will not be possible in most cases, it is more important to apply the amount of nitrogen required and compromise some for phosphate and potash.

*CAUTION! Do not apply more that 1 lb. nitrogen per 1000 sq. ft. in one application to avoid burning the grass, unless a slow release form or organic fertilizer is used. It is recommended that up to 50 percent of the nitrogen be of the slow release form.

Apply the above total late summer/early fall.

Grass clippings left on the lawn is a sound practice. They recycle nutrients and conserve moisture. The above recommendations reflect this contribution.

County: HENNEPIN. Additional information on the website http://soiltest.cfans.umn.edu/intro.htm or call Yard & Garden Desk 952-443-1426

Figure 6-3 Soil test results. Photo credit: FCI

Choose the correct fertilizer

Fertilizer recommendations are based on nitrogen needs. To get the correct amount of phosphorus and potassium, choose fertilizer with the recommended N-P-K ratio on the fertilizer bag. A soil test will provide the correct ratio, and an example of what you would find on a fertilizer bag. **Without a soil test, a 4-0-2 or 4-0-3 ratio is recommended.**

Note: Unless you have a soil test showing a need for phosphorus or are starting a new lawn by seeding or sodding, you cannot use a fertilizer that contains phosphorus.

Figure 6-4 Turf grass Maintenance Best Practices Matrix.

The label included here is a 22-0-10 fertilizer (Figure 6-5). This bag contains 22% nitrogen, 0% phosphorus and 10% potassium. This is close to a 4-0-2 ratio. You'll notice that the guaranteed analysis indicates that the soluble potash is derived from muriate of potash or KCl.

Figure 6-5 Example fertilizer label. The third number is always the potassium source, this is often a chloride source as well.

If weed or insect control is needed, separate the applications. Weed and feed or fertilizer with insecticide products may lead to over-application of one of the two products, and application at the wrong time. For example, crabgrass can be controlled with a pre-emergent herbicide in the spring depending on soil temperatures. If combined with a fertilizer, the fertilizer, which should be applied around Mother's Day, is often applied too early for the turfgrass to use it. If the turfgrass can't use it, some of the nutrients are lost to the environment.

Know how much to apply

The fertilizer recommendations from a soil test or the Best Practices Matrix are more accurate than what you'll find on a bag of fertilizer. Fertilizer manufacturers' are in the business of selling fertilizer. Recommendations on the bag are often much higher than needed (as much as eight times higher based on the frequency of applications recommended), leading to over-application of fertilizer and loss of potassium and other nutrients to surface water and groundwater.

Know when to apply

The best time to apply fertilizer is in the late summer to fall around Labor Day. A late fall application, after October 15, is not recommended since the soil temperatures are too cold for the turfgrass to use the fertilizer. Never apply fertilizer on frozen ground.

Fertilizing other vegetation

A soil test will provide recommendations for the correct fertilizer and amount to apply to trees, shrubs, flowers and vegetable gardens. When submitting the test, choose the type of plants you plan to fertilize. Additional recommendations can be found on the UMN website.

Evaluation 15: Fertilizer

Site name: _____

Date: _____

Do you fertilizer your turfgrass?

_____ No

Good news: You are not putting down extra potassium chloride

Bad news: You may want to find out how to meet the nutrient needs of your turf so you can have dense healthy turf. Consider sending your crew to the MPCA turfgrass maintenance certification course (link)

_____ Yes

↳ **Do you do a soil test to determine the nutrient needs of your turf?**

_____ No

Time to get out and take a soil test. It is inexpensive and easy to do (Link to UMN soil lab).

_____ Yes

↳ **Does your soil test recommend potassium? (It's the 3rd number on the bag.)**

_____ No

Great. Make sure to buy fertilizer with 0 in the third number.

_____ Yes

↳ **See if you can find a fertilizer without potassium Chloride KCl (potash) as the fertilizer source, such as potassium sulfate. Note: to determine the source of potassium: The "Guaranteed analysis" will list potassium as its K_2O equivalent. Look at the text further down to see "Derived from". If it states muriate of potash or potash on the list, that is potassium chloride.**

Congratulations, your organization is likely reducing chloride use and improving turf performance.

Definition of terms

Abrasive – Product used to provide traction on top of snow or ice e.g. sand

Anti-icing – Application of liquid deicer before a storm

Application rate – Predetermined amount of deicer that is put down on an area. Measured in pounds or gallons per 1000 square feet in this manual.

Bare pavement – level of service goal to remove of all snow or ice from a surface

Best practices – Methods that have been established in an industry as most effective and efficient (I tried to get rid of this term and use best practices

Chloride – Common chemical component in deicer. A persistent pollutant

Deicer – Product used to melt snow or ice e.g. rock salt

Deicing – Application of deicer during or after a weather event

End-user – Any pedestrian or vehicle that walks or drives on a property

Ice melt capacity – Fixed amount of snow or ice that a given amount of deicer will melt

Ice melt speed – How fast snow or ice melts determined by several factors

Level of service goal (LOS) – Established target for how clear a surface needs to be in a given time frame

Mechanical removal – Using equipment to physically remove snow and ice from a surface

MPCA – Minnesota Pollution Control Agency

Municipal Separate Storm Sewer System (MS4) -- Regulated parties subject to the MS4 General Permit (Permit No: MNR040000)

Non-bare pavement – Level of service goal that allows for some snow or ice to remain on a surface

Pavement temperature – The temperature of the surface. For our purposes the temperature of your winter maintenance area, sidewalk, steps, parking lot etc.

Smart salting — statewide certification program administered by the MPCA with the goal of reducing salt use.

Snow and ice policy — A document outlining your strategy for winter maintenance operations

Soil test – An analysis of soil nutrient content conducted in lab accompanied by fertilizer recommendations

Spread pattern – Where the deicers or abrasives come to rest after application. There are many strategies for optimizing material use by adjusting spread patterns.

Water quality standard –In Minnesota the aquatic life chloride water quality standards are 230mg/L (chronic) and 860mg/L (acute). The drinking water standard is 250 mg/L. It is our goal to keep concentrations below these thresholds.

Appendix A: Laws and ordinances

Minnesota Laws

Discharges to Waters of the State. Minnesota Rules 7053.0205 (2017)
Subp. 2. Nuisance conditions prohibited. No sewage, industrial waste, or other wastes may be discharged from either point or nonpoint sources into any waters of the state so as to cause any nuisance conditions, such as the presence of significant amounts of floating solids, scum, visible oil film, excessive suspended solids, material discoloration, obnoxious odors, gas ebullition, deleterious sludge deposits, undesirable slimes or fungus growths, aquatic habitat degradation, excessive growths of aquatic plants, or other offensive or harmful effects.

Liquid deicer storage regulation. Minnesota Rules, Chapter 7151.1200.
The general requirements for ASTs with less than one million capacity include: registration with the MPCA, properly labeled tanks, secondary containment, a sign at the facility, and tank construction using appropriate industry standards. However, liquid de-icing materials are considered **Other Regulated Substances** and are not subject to the same regulations as hazardous materials because they have limited risk. The MPCA does not require the registration of other regulated substance ASTs. The basic requirements for most liquid de-icer storage therefor includes labeling all tanks, having a posted sign on site, and secondary containment. However, the size and location of ASTs containing de-icer will influence the specific regulations that are required. Here is a summary of requirements that may apply to de-icer storage tanks:

- **Labeling ASTs containing de-icer:** All tanks must be clearly labeled indicating the type of substance stored and the tank's capacity. If there is more than one tank, each tank must be labeled with a unique tank number.
- **Sign posting:** If a person is not on site 24 hours a day, a sign must be posted with the name, address, and telephone number of the facility owner or operator, or a local emergency response contact. The sign must be posted so that it can be seen outside any containment area.
- **Secondary containment:** Other regulated substance ASTs need 100% containment area volume of the largest tank in the containment area. An additional 10% capacity is required for ASTs exposed to precipitation. Double-walled tanks satisfy the secondary containment requirement.

Aboveground Storage Tanks (AST) containing liquid substances may be subject to the MPCA's rules for design and operation of ASTs. For more information visit the MPCA AST website.

Snow Removal; Salt and Chemicals Restricted. Minnesota Rules 160.215.

(1) Minimize harmful or corrosive effects of salt or other chemicals upon vehicles, roadways, and vegetation;

(2) Reduce the pollution of waters; and (

3) Reduce the driving hazards resulting from chemicals on windshields; road authorities, including road authorities of cities, responsible for the maintenance of highways or streets during periods when snow and ice are prevalent, shall utilize such salt or other chemicals only at such places as upon hills, at intersections, or upon high-speed or arterial roadways where vehicle traction is particularly critical, and only if, in the opinion of the road authorities, removal of snow and ice or reduction of hazardous conditions by blading, plowing, sanding, including chemicals needed for free flow of sand, or natural elements cannot be accomplished within a reasonable time.

Street Sweepings. Minnesota Rules 7035.2855.

Street sweepings that are not screened for trash and debris are considered industrial solid waste and must be disposed of at a permitted solid waste facility that can accept the waste. Unscreened street sweepings must also be stored in accordance with solid waste storage standards. MPCA managing street sweepings fact sheet.

MS4 General Permit. Minnesota Rules chapter 7090.

An MS4 is a conveyance or system of conveyances that is owned by a state, city, town, village, or other public entity that discharges to waters of the U.S., designed or used to collect or convey stormwater (e.g., storm drains, ditches), not a combined sewer, and not part of a sewage treatment plant, or publicly owned treatment works. To prevent harmful pollutants from being washed or dumped into MS4s, certain operators are required to obtain NPDES permits and develop stormwater management programs (SWMPs). The SWMP describes the stormwater control practices that will be implemented consistent with permit requirements to minimize the discharge of pollutants from the sewer system.

Chloride specific language in the 2020 MS4 permit:

MCM 1: Public Education and Outreach.

16.5 At least once each calendar year, the permittee must distribute educational materials or equivalent outreach focused on the following:

a. Impacts of deicing salt use on receiving waters; and
b. Methods to reduce deicing salt use.

16.6 For businesses, commercial facilities, and institutions, the permittee must implement an education and outreach program focused on communicating appropriate deicing salt use (e.g., direct mailing, phone calls, and/or meetings). The permittee must *maintain a written or mapped inventory of businesses, commercial facilities, and institutions* that the permittee will target for education and outreach over the permit term. At a frequency defined by the permittee's education and outreach plan in item 16.8, the permittee must distribute educational materials or equivalent outreach to these audiences, which must include information on the following:

a. Environmental impacts of deicing salt use;
b. BMPs that reduce the use of deicing salt;
c. Proper storage of salt or other deicing materials; and
d. Training opportunities to improve winter maintenance activities.

MCM 3: Illicit Discharge Detection and Elimination (IDDE).

18.6 The permittee's regulatory mechanism(s) must require proper salt storage at commercial, institutional, and non-NPDES permitted industrial facilities. At a minimum, the regulatory mechanism(s) must require the following:

a. Designated salt storage areas must be covered or indoors;
b. Designated salt storage areas must be located on an impervious surface; and
c. Implementation of practices to reduce exposure when transferring material in designated salt storage areas (e.g., sweeping, diversions, and/or containment).

MCM 6: Pollution Prevention/Good Housekeeping For Municipal Operations.

21.5 The permittee must implement the following BMPs at permittee owned/operated salt storage areas:

a. Cover or store the salt indoors;
b. Store salt on an impervious surface; and
c. Implement practices to reduce exposure when transferring material from salt storage areas (e.g., sweeping, diversions, and/or containment). [Minn. R. 7090]

21.6 The permittee must implement a written snow and ice management policy for staff that perform winter maintenance activities. The policy must establish practices and procedures for snow and ice control operations (e.g., plowing or other snow removal practices, sand use, and application of deicing compounds).

21.7 Each calendar year, the permittee must train all staff that perform winter maintenance activities. The permittee may use training materials from the Agency's Smart Salting Training or other organizations to meet this requirement. The employee training program must include: a. the importance of protecting water quality; b. BMPs to minimize the use of deicers (e.g., proper calibration of equipment and benefits of pretreatment, pre-wetting, and anti-icing); and c. tools and resources to assist in winter maintenance (e.g., deicing application rate guidelines, calibration charts, Smart Salting Assessment Tool).

Discharges to Impaired Waters with a USEPA-Approved TMDL that Includes an Applicable WLA.

22.5 If the permittee has an applicable WLA for chloride, the permittee must document the amount of deicer applied each winter maintenance season to all permittee owned/operated surfaces.

22.6 If the permittee has an applicable WLA for chloride, each calendar year the permittee must conduct an assessment of the permittee's winter maintenance operations to reduce the amount of deicing salt applied to permittee owned/operated surfaces and determine current and future opportunities to improve BMPs. The permittee may use the Agency's Smart Salting Assessment Tool or other available resources and methods to complete this assessment. The permittee must document the assessment. The assessment may include, but is not limited to: a. operational changes such as pre-wetting, pre-treating the salt stockpile, increasing plowing prior to deicing, monitoring of road surface temperature, etc.; b. implementation of new or modified equipment providing pre-wetting, or other capability for minimizing salt use; c. regular calibration of equipment; d. optimizing mechanical removal to reduce use of deicers; or e. designation of no salt and/or low salt zones.

Industrial Stormwater General Permit. Minnesota Rules 7090.3000.

17.1 Salt storage, use, and management at the facility (If present at the facility).

17.2 The Permittees should implement the following BMPs if salt piles are present at the facility:

a. Cover salt piles or store the salt piles indoors;
b. Minimize the use of salt or other de-icing/anti-icing materials by using the proper equipment, material, and application rates.
c. Implement practices to reduce exposure resulting from adding or removing material from the salt piles (e.g., sweeping, diversions, containment); and
d. Document within the SWPPP the location of any storage piles containing salt stored outside.

17.3 Hired contractors should minimize the use of salt or other de-icing/anti-icing materials by using equipment, material, and application rates, as recommended by the MPCA Winter Parking Lot and Sidewalk Maintenance Manual. In addition, the Permittee may attend and/or encourage their contractor to attend training and/or utilize best practices for winter maintenance activities.

For questions about Minnesota rules and regulations contact: smartsalting.pca@state.mn.us

City, county and watershed ordinance examples

The selection of ordinances below is not a complete list, but some of them may apply to you. The list is intended to expand awareness and encourage you to check with your city, watershed or other governing organizations in the areas where you manage properties.

- Most cities prohibit pushing snow onto a public street or sidewalk.
- MPCA published a suite of model ordinances that include items such as required training for winter maintenance professionals, salt storage regulations, chloride management plan requirements, and sweeping regulations for excess deicers. These ordinances may be adopted by governing organizations in your area.
- Nine Mile and Riley Purgatory Bluff Creek Watershed Districts, located in the Twin Cities metro, both require a salt management plan, certified applicator and contact person on record to obtain certain land-disturbing permits.

Laws and codes out of Minnesota

- State of Virginia law forbids the use of deicing products containing nitrogen or phosphorus. Va. Code § 3.2-3607.2.
- New Hampshire law limits liability for certified commercial applicators and property owners who hire certified applicators. NH Rev Stat § 508:22 (2016)
- Wisconsin plumbing code requires water softeners to be demand initiated regeneration. For more information on water softeners go to chapter 5. WIS. STAT. 35.93 ch. SPS 382.40 (8) (j) (2016).

Appendix B: Resources

You now have access to many helpful resources for educating your staff, customers, and building occupants.

MPCA Smart Salting certification training

Training program overview: https://www.pca.state.mn.us/water/smart-salting-training

Training calendar: https://www.pca.state.mn.us/water/smart-salting-training-calendar

Smart Salting certificate holders: https://www.pca.state.mn.us/sites/default/files/p-tr1-01.xlsx

Smart Salting Assessment tool: https://smartsaltingtool.com/

Salt applicator resource page: https://www.pca.state.mn.us/water/salt-applicators

Smart salting contact: smartsalting.pca@state.mn.us

MPCA funding and assistance

Minnesota GreenCorps: This program places AmeriCorps members with host organizations around the state to assist with a variety of environmental efforts, including reducing salt use and minimizing chloride pollution. https://www.pca.state.mn.us/waste/minnesota-greencorps

GreenStep Cities: A free, voluntary challenge, assistance, and recognition program to help cities achieve their sustainability and quality-of-life goals. Reducing salt use is one of the recommended best practices. https://greenstep.pca.state.mn.us/

MPCA Small Business Environmental Assistance Loan Program: Helping small businesses meet regulatory obligations and reduce their environmental impacts. 0% interest loan program for small business applicants to purchase capital equipment that reduces salt use. https://www.pca.state.mn.us/smallbizloans

MPCA Clean Water Partnership loans: 0% interest loans to local government and tribal communities to implement practices that reduce non-point sources of chloride pollution. https://www.pca.state.mn.us/water/cwp-loans

Other funding sources: There often are grant or loan funding sources available locally, such as through your watershed district, city, or county websites. Contact those organizations to see what may be available or ask for referrals to other funsing programms.

General background and technical documents

Statewide chloride management plan: https://www.pca.state.mn.us/water/statewide-chloride-resources

Wisconsin Salt Wise: https://www.wisaltwise.com/

Minnesota Conservation Volunteer. Hold the Salt. https://www.dnr.state.mn.us/mcvmagazine/issues/2020/jan-feb/chloride.html

Peters Chemical Company: Break the Ice: Comparison of Ice Melting Chemicals. http://www.peterschemical.com/break-the-ice-comparison-of-ice-melting-chemicals/

Local Road Research Board Report TRS 1411: Chloride Free Snow and Ice Control Material: https://lrrb.org/media/reports/TRS1411.pdf

Clear Roads Report 11-02: Determining the Toxicity of Deicing Materials: https://clearroads.org/project/11-02/

MPCA Smart Salting training manuals and calibration charts: https://www.pca.state.mn.us/water/salt-applicators

Minnesota Snow and Ice Control Field Handbook: http://www.mnltap.umn.edu/publications/handbooks/documents/snowice.pdf

Policy and planning

Model snow and ice policy: https://www.pca.state.mn.us/sites/default/files/p-tr1-51a.pdf

Model ordinances: https://www.pca.state.mn.us/sites/default/files/p-tr1-54.pdf

Model contract: https://www.pca.state.mn.us/sites/default/files/p-tr1-51c.pdf

Education for customers and the public

Fight snow and ice, pollution free (Mississippi Watershed Management Organization): https://www.mwmo.org/wp-content/uploads/2016/11/mwmo-smart-salting-2018.pdf

Choosing a deicer (9 Mile Creek Watershed District): http://www.ninemilecreek.org/wp-content/uploads/Buying-a-Deicer_NMCWD.pdf

Don't pass the salt (City of Farmington): http://fmtn.org/DocumentCenter/View/1190/Dont-Pass-the-Salt---brochure-021612-2-1?bidId=

Be salt wise (WI Salt Wise): https://www.wisaltwise.com/Partner-Resources

Pledge to be salt smart (Clean Water MN): http://www.cleanwatermn.org/wp-content/uploads/Salt-smart-poster-large-copy.pdf

MPCA Salt pollutes postcard (MPCA)

Pledge to be salt smart poster (Clean Water MN)

Salt Smart Toolkit (Riley Purgatory Bluff Creek)

MWMO Winter Maintenance for Small Sites Videos: https://www.youtube.com/watch?v=-xMt-1kyzIcg

How to hire a contractor that uses less salt - Nine Mile Creek Watershed District: http://www.ninemilecreek.org/wp-content/uploads/Hiring-a-Contractor_NMCWD-web.pdf

Water softening resources

MPCA resources: https://www.pca.state.mn.us/water/statewide-chloride-resources

UMN Water Resources Center: https://www.wrc.umn.edu/watersoftening

MN Water Quality Association: http://www.mwqa.com/

Turfgrass maintenance training

MPCA Turf grass Maintenance Certification training webpage: https://www.pca.state.mn.us/water/summer-turf-grass-maintenance-training

- **Turfgrass maintenance manual:** Environmental impacts, fertilizing, irrigation, weed control, and cultural practices such as mowing and aeration.
- **Turfgrass mainetenance best practices matrix**: Planning tool from manual for six different site conditions and three turfgrass quality expectations. Funded by MWMO.

Turf grass maintenance for seasonal workers video: For cities and contractors hiring seasonal workers. It is a short version of parts of the certification and 18 minutes.. Funded by MWMO. https://www.youtube.com/watch?v=c5Y0SwdHAE4&list=PLWqLbtXkPxdbINh8MZRgmpfqfAB-B8qH-g&index=4

University of Minnesota soil test form: http://soiltest.cfans.umn.edu/

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