Technical Report No. 67

LEGAL AND POLICY CONSIDERATIONS FOR THE MANAGEMENT OF CHLORIDE

Prepared by:

Marquette University Water Law and Policy Initiative
Professor David A. Strifling, J.D., P.E.
Margaux Serrano
Ivy Becker
Marquette University Law School
1215 W. Michigan Street
Milwaukee, Wisconsin

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INTRODUCTION

Many scientific studies have examined the potential risks to human health and natural resources associated with excess chloride in the environment, such as deteriorated ambient water quality, toxicity to aquatic and benthic organisms, adverse effects on vegetation, and even impacts to drinking water supplies. Yet little, if any, of that work has been directed toward developing legal and policy strategies to address the chloride issue.

Building on the framework of the Southeastern Wisconsin Regional Planning Commission's comprehensive Chloride Impact Study for the Southeastern Wisconsin Region, this report examines a menu of responsive legal and policy options available to decision-makers in the Region. These include limiting slip-and-fall liability, relying on direct regulatory authority such as the Clean Water Act or corresponding state regulations and municipal ordinances, disseminating relevant information to stakeholders and the public, using alternatives to chloride where feasible, leveraging new policy strategies such as water quality trading, investigating integrated watershed management across jurisdictions, and leveraging economic measures and assistance. This report does not suggest that all of these options are appropriate in every context, nor does it rank them from most to least useful. Those decisions are left to affected communities.

The Chloride Impact Study was initiated due to heightened public concern over the effects of the growing use of road salt and evidence of increasing chloride concentrations in the surface and groundwater within the Region. The findings of this Study are being presented in a series of reports.

Major objectives of the Chloride Impact Study include:

1. Documenting historical and existing conditions and trends in chloride concentrations in surface and groundwater in the Southeastern Wisconsin Region

2. Evaluating the potential for increased amounts of chloride in the environment to cause impacts to surface water, groundwater, and the natural and built environment in the Region

3. Identifying the major sources of chloride to the environment in the Region

4. Investigating and defining the relationship between the introduction of chloride into the environment and the chloride content of surface and groundwater

5. Developing estimates of chloride loads introduced into the environment under existing conditions and forecasts of such loads under planned land use conditions

6. Evaluating the potential effects of climate change on the major sources of chloride under planned land use conditions

7. Reviewing the state-of-the-art of technologies and best management practices affecting chloride inputs to the environment and developing performance and cost information for such practices and technologies

8. Exploring legal and policy options for addressing chloride contributions to the environment

9. Developing and evaluating alternative chloride management scenarios for minimizing impacts to the environment from chloride use while meeting public safety objectives

10. Presenting recommendations for the management of chloride and mitigation of impacts of chloride on the natural and built environment

This Report addresses the eighth objective listed above and is organized into two chapters. Following this introduction, Chapter 1 summarizes the sources of chloride to the environment, as a basis for the legal and policy analysis. Chapter 2 describes and examines the various legal and policy options for controlling chloride levels in the environment.

Chapter 1

SOURCES OF CHLORIDE TO THE ENVIRONMENT

Chloride enters the environment via numerous routes, from anthropogenic sources such as snow and ice removal practices, salt storage facilities, wastewater treatment facility and septic system effluent, industrial facilities, agricultural operations, oil and gas wells, and natural sources such as atmospheric deposition.

This chapter briefly describes those sources and transmission routes to inform the legal and policy analysis. For a more detailed discussion of chloride sources to the environment, please see accompanying Technical Reports TR-62, *Impacts of Chloride on the Natural and Built Environment*, TR-63, *Chloride Conditions and Trends in Southeastern Wisconsin*, and TR-65, *Mass Balance Analysis for Chloride in Southeastern Wisconsin*.

1.1 PUBLIC AND PRIVATE SNOW AND ICE REMOVAL

Chloride use in the United States has increased significantly since 1950, and the major factor has been the use of salt for deicing during the winter months.[1] Perhaps the most visible source of chloride to the environment, widespread use of salt for snow and ice clearing began around 1960,[2] as transportation agencies began implementing "bare pavement" policies. Before then, vehicles had navigated snowy and icy conditions using tire chains or studded "winter" tires. But such tires have the potential to damage roadway surfaces, and their use is now prohibited in Wisconsin with very limited exceptions.[3]

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[1] John R. Mullaney et al., *Chloride in Groundwater and Surface Water in Areas Underlain by the Glacial Aquifer System, Northern United States,* U.S. Geological Survey 2 (2009) [hereinafter *USGS, Chloride in Groundwater*].

[2] *See* Walton R. Kelly et al., *Using Chloride and Other Ions to Trace Sewage and Road Salt in the Illinois Waterway*, 25 Applied Geochemistry 661, 662 (2010) [hereinafter Kelly et al., *Using Chloride*] ("Application of salt as a road deicer in the USA began in earnest around 1960.").

[3] Wis. Stat. § 347.45(2).

New Hampshire was the first state to adopt a general policy of using salt during the winter of 1941-42.[4] After World War II, the use of road salt increased because the United States (U.S.) highway system had become essential to the public and the economy. After the 1950s and 1960s, there was another rapid increase in use of road salt, but the use appears to have leveled off in the last 20 years.[5] Currently, the U.S. puts ten times the amount of salt on roads as it does in processed foods.[6]

The use of deicers on travel surfaces has been extremely effective, "reducing accident rates by a factor of 8 on two-lane highways and [a factor of] 4.5 on multi-lane highways."[7] This is highly important from a public safety perspective; according to the Wisconsin Department of Transportation (WisDOT), in 2022, 51 people died and 3,940 more were injured in crashes attributed to winter road conditions.[8]

Today, put simply, "[r]oad salts are essential to the transportation and highway maintenance industry in the United States."[9] Road salt performs two functions when used to clear snow and ice. First, it lowers the freezing point of water, often by several degrees: "The more salt is dissolved in the water, the more the freezing point is depressed."[10] Second, it inhibits ice from forming in the first place, and can prevent snow and ice from bonding to pavement surfaces. During the freezing process, water molecules arrange themselves into a more solid structure. Salt slows that process by adding impurities to the water and disrupting the ability of water molecules to organize.[11] Although some alternative deicing substances are available, salt is typically considered the most effective and least costly substance for performing these functions.[12] However, sodium chloride is only effective for this purpose within certain temperature limits.

[4] *Road Salt Use in the United States, Highway Deicing*, Transportation Research Board 17, 17 onlinepubs.trb.org/onlinepubs/sr/sr235/017-030.pdf (last visited July 12, 2023).

[5] *Id.* at 18.

[6] *See Mineral Commodity Summaries 2023*, 210 U.S. Geological Survey 1, 148 (Jan. 2023).

[7] *USGS*, *Chloride in Groundwater*, *supra*, at 8.

[8] Wisconsin Department of Transportation Program & Policy Analyst-Advanced Jacci Ziebert, to Margaux Serrano, Email (Feb. 27, 2023).

[9] Curtis A. Cooper et al., *Effects of Road Salts on Groundwater and Surface Water Dynamics of Sodium and Chloride in an Urban Restored Stream*, 121 BIOGEOCHEMISTRY 149, 149 (2014).

[10] Jenny Marder, *How Does Salt Battle Road Ice?*, PBS News Hour (Jan. 18, 2011), perma.cc/SZR4-WABW.

[11] *Id.*

[12] *See* Daniel L. Kelting et al., *Regional Analysis of the Effect of Paved Roads on Sodium and Chloride in Lakes*, 46 Water Res. 2749, 2749 (2012).

Below about 15 degrees F, the amount of ice melted by sodium chloride deicers is too small and the rate at which it melts is too slow to be of practical use.[13]

Although salt usage for deicing is often considered an issue for state or local governments, it is estimated that up to half of the salt used for winter maintenance enters the environment after being used to treat commercial or residential surfaces under private ownership such as parking lots, driveways, and sidewalks.[14] This complicates the legal and policy analysis due to the relative difficulty of regulating or otherwise influencing private chloride sources as compared to public sector sources.

Deicers can be grouped into two categories: chloride-based and non-chloride-based. Chloride-based deicers include sodium chloride, magnesium chloride, and calcium chloride.[15] For more detailed information on impacts of chloride-based deicers, please refer to TR-62. Non-chloride deicers are used infrequently on pavements due to their cost and availability.[16] In contrast, airports are known for almost entirely using non-chloride deicers on airplanes.[17] For more information about non-chloride deicers, refer to accompanying technical report TR-66, *State of the Art for Chloride Management*.

Non-chloride deicers also come with their own set of negative environmental impacts. For instance, organic deicers such as beet juice, glycols, and acetate compounds contribute to biochemical oxygen demand and can lower dissolved oxygen concentrations in waterbodies. Similarly, abrasives such as sand and cinders can improve traction but also contribute to sediment and suspended solids in waterbodies. Abrasives do not reduce ice accumulation and also lose their effectiveness once they are covered by snow or ice. These impacts may be reasons why they are used less than salts.

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[13] Wisconsin Department of Transportation, *Winter Maintenance Frequently Asked Questions*, wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/faq.aspx (last visited July 12, 2023).

[14] *See*, e.g., *Environmental Fact Sheet: Road Salt and Water Quality*, N.H. Dep't of Env't Servs., WD-WMB-4N.H. (2016), perma.cc/V8VR-3HVC.

[15] *Environmental Impact of Road Salt and Other De-Icing Chemicals*, Minnesota Stormwater Manual, (last updated Nov. 23, 2022 3:05pm), stormwater.pca.state.mn.us/index.php/Environmental_impacts_of_road_salt_and_other_de-icing_chemicals.

[16] *How Salt Works and Overview of Deicing Chemicals*, Minnesota Stormwater Manual, (last edited Nov. 23, 2022 2:04pm), stormwater.pca.state.mn.us/index.php/How_salt_works_and_overview_of_deicing_chemicals.

[17] *Id.*

As salt deicing has increased, other "best practice" alternatives to salting have become more popular as a way to limit salt use. Businesses and communities have a variety of alternatives that include anti-icing or using infrared thermometers to determine pavement temperature and applying less salt when the pavement temperature is higher.[18] Individuals can limit salt use by shoveling the snow first, maintaining a 3-inch spacing between salt grains, measuring pavement temperature, sweeping up excess salt for reuse, and even asking contractors to limit salt use on their property.[19]

Deicers can enter the environment during storage, transportation, and application stages.[20] In Wisconsin, there has been a steep increase in chloride levels in waterbodies since 2000. In 2000, the Wisconsin Department of Natural Resources (WDNR) measured about 600,000 tons of chloride annually in the state's largest river systems, but by 2018, that number increased to 800,000 tons per year.[21] The WDNR has designated over 40 lakes and streams within the state as impaired with high chloride concentrations because those waters are not in compliance with the relevant water quality standards.[22] As of 2022 in southeastern Wisconsin, there were 34 water bodies that had impairments due to chloride.[23] Currently, the WDNR aims to have municipalities and industries reduce their chloride concentrations through the WPDES permitting program.[24]

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[18] *See Reducing Use of Deicing Salt for Businesses & Custodial Staff*, Sea Grant Lake Champlain, www.uvm.edu/seagrant/reducing-use-deicing-salt-businesses (last visited July 12, 2023).

[19] *See Reducing Use of Deicing Salt for Homeowners*, Sea Grant Lake Champlain, www.uvm.edu/seagrant/reducing-use-deicing-salt-homeowners (last visited July 12, 2023).

[20] *Id.*

[21] Limber, Suzan, *DNR Reminds Wisconsinites to Reduce Salt Use This Winter,* Wis. Dep't Nat. Res. Newsroom (Jan. 11 2021). This comes from a WDNR study where chloride was monitored at twenty-six of Wisconsin's largest river systems.

[22] Shannon K. Hayden, *Reduce Salt Use This Winter*, Wis. Dep't Nat. Res. Newsroom (Jan. 21, 2022), dnr.wisconsin.gov/newsroom/release/52716#:~:text=Recent%20studies%20have%20shown%20a,impaired%20by%20high%20salt%20concentrations.

[23] *See 2022 Impaired Waters List*, Wis. Dep't Nat. Res., apps.dnr.wi.gov/swims/Documents/DownloadDocument?id=307141807 (last visited June 8, 2023).

[24] *See* Shannon Hayden, et al., *Chlorides Workgroup Recommendations on a Statewide Chloride Strategy*, Report to Water Initiatives Steering Committee (WISC) (Dec. 6, 2022), dnr.wisconsin.gov/newsroom/release/52716#:~:text=Recent%20studies%20have%20shown%20a,impaired%20by%20high%20salt%20concentrations. More information on these permitting programs can be found at: dnr.wisconsin.gov/topic/Wastewater/Permits.html.

WisDOT purchases an average of 452,000 tons of salt and 21,000 tons of sand per season.[25] Some of this amount is used on state highways, and some municipalities purchase salt through the state. While WisDOT facilitates this bulk purchase, it contracts with Wisconsin's counties for salt application to state and interstate highways. In the 2016-2017 winter season, 63 out of 72 counties in the state used anti-icing techniques.[26] WisDOT's Highway Maintenance Manual contains recommended deicer application rates for a variety of road conditions and pavement temperatures.[27] As already noted, salting is only cost effective if the pavement temperature is above 15-20 degrees F.[28] It will take about 5 times more salt to melt ice when the pavement temperature is 20 degrees F compared to 30 degrees F.[29]

In 2022, WDNR surveyed Wisconsin communities and businesses about their snow and ice removal practices.[30] The results showed that legal concerns—and specifically, slip-and-fall liability—are a significant driver of winter maintenance practices, especially for private contractors and their clients.

Some salt used for deicing is transported with runoff to surface waters, and the resulting "[d]etrimental impacts . . . [are] evident on local, regional, and national scales."[31] According to some studies, essentially "all chloride ions that enter the soil and groundwater can ultimately be expected to reach surface water."[32] This

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[25] *Winter Facts*, Wis. Dep't Trans., wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/facts.aspx (last visited Aug. 8, 2023).

[26] *Id.*

[27] *See* Wisconsin Department of Transportation, Highway Maintenance Manual, Chapter 6, Section 20, Subject 25 (2008) ("Application Rates De-Icing"), available at wisconsindot.gov/Documents/doing-bus/local-gov/hwy-mnt/mntc-manual/chapter06/06-20-25.pdf.

[28] Supra, note 25.

[29] *Id.*

[30] *See* Wisconsin Department of Natural Resources, winter maintenance survey results, available at www.surveymonkey.com/stories/SM-XJfjhobmtTXrvfBhuXmbUA_3D_3D/ (communities) and www.surveymonkey.com/stories/SM-uu1knyQwL5cGWqdGiRE2Kw_3D_3D/ (businesses).

[31] Steven R. Corsi et al., *A Fresh Look at Road Salt: Aquatic Toxicity and Water- Quality Impacts on Local, Regional, and National Scales*, 44 Envt. Sci. & Tech. 7376, 7381 (2010) [hereinafter Corsi et al., *A Fresh Look at Road Salt*].

[32] *Priority Substances List Assessment Report: Road* Salts, Env't Can. & Health Can. 1, 1 (2001).

occurs during deicing, after disposal and melting of snow cleared from roadways, through dispersal by splashing and spray from vehicles, and via wind.[33]

For a more complete evaluation of the detrimental effects of chloride in the environment, see the accompanying technical reports TR-62 and TR-63.

1.2 WATER SOFTENING

"Water softeners can release . . . large[ ] amounts of chloride to the environment" through "septic systems, dry wells, or wastewater-treatment facilities."[34] One recent study showed that on average, home water softeners discharge about 0.56 pounds of chloride per person per day to wastewater systems.[35] However, softener efficiency affects how much chloride is discharged. The softener efficiency, age, type of regeneration, salt dosage, and reserve capacity all may play a role in chloride contributions to either septic systems or the treatment plant.[36]

Water hardness depends on the amount of calcium, magnesium, and iron ions found in the water source.[37] There is neither a state nor national standard for how hard or soft water should be to be suitable for drinking water.[38] However, waters with inorganic chemicals in excess of the limits contained in the *Wisconsin Administrative Code* "may be objectionable to an appreciable number of persons."[39] This code section

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[33] *Id.*

[34] *USGS*, *Chloride in Groundwater*, *supra*, at 12.

[35] Kathleen Lake, et al., *The Reduction of Influent Chloride to Watewater Treatment Plants by the Optimization of Residential Water Softeners*, Madison Metro. Sewerage Dist. 1, xii perma.cc/Y968-RZKZ (last visited July 12, 2023).

[36] Recently, softeners are starting to become more efficient, and some cities have made recommendations on target efficiencies. For example, Madison Sewerage District recommends all new softeners to meet or exceed a target efficiency of 4,000 grains per pound. *See* Madison Metropolitan Sewerage District*, Salt Reduction Through Efficient Water Softening, Training Workbook 2020*.

[37] *Water Hardness*, City of Milwaukee FAQS-Water Quality and Public Health, city.milwaukee.gov/water/customer/FAQs/qualityandhealth/Water-hardness.htm (last visited July 12, 2023); Michael Harrington et al., *Development of a Reasoned Approach to Chloride Reduction in Michigan's Surface Waters*, University of Michigan School for Environmental Sustainability 11 (2022).

[38] *Groundwater Resources of Southeastern Wisconsin*, TR 37, Se. Wis. Reg'l Plan. Comm. 1, 93 (June 2022).

[39] Wis. Admin. Code § NR 809.70(1).

applies to all public water systems.[40] Therefore, if the WDNR receives complaints, it may require a water supplier to monitor the water it provides.[41] Should the WDNR determine that the chemical levels in the drinking water are in excess of the standard based on an objection from an appreciable number of people and detrimental to public welfare, the WDNR can require the water supplier to take remedial action "to insure that the public receives the highest quality water practically obtainable."[42] Wisconsin has adopted a secondary drinking water standard of 250 milligrams per liter (mg/L) for chloride based on U.S. Environmental Protection Agency (EPA) guidelines for aesthetic effects.[43]

In Wisconsin, both the surface waters and groundwater are generally considered hard or very hard in the central and western parts of the state.[44] For cities that rely on Lake Michigan as their drinking water source, the natural water hardness is fairly moderate. For example, the hardness of Milwaukee's water averages 137 mg/L, with a reported range between 112-142 mg/L.[45] Similarly, Kenosha's water hardness averages 138 mg/L.[46] The natural water hardness of groundwater varies widely, from 317 mg/L (City of Oconomowoc wells),[47] to 380 mg/L (Village of Jackson wells), to 383-581 mg/L (City of Brookfield wells), to 308-513 mg/L (City of Waukesha wells).[48]

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[40] Wis. Admin. Code § NR 809.70(2).

[41] Wis. Admin. Code § NR 809.71(1).

[42] Wis. Admin. Code § NR 809.71(2).

[43] *See* Wis. Admin. Code § NR 809.70.

[44] Mullaney J.R., Lorenz D.L., & Arntson A.D., *Chloride in groundwater and Surface Water in Areas Underlain by the Glacial System, Northern United States*, U.S. Geological Survey Scientific Investigation Report 2009-5086, 41, 1, 12.

[45] *Water Hardness*, City of Milwaukee FAQS-Water Quality and Public Health, city.milwaukee.gov/water/customer/FAQs/qualityandhealth/Water-hardness.htm (last visited July 12, 2023).

[46] 2021 Annual Report, Kenosha Water Utility 1, 30 (June 2022) www.kenosha.org/images/water/Reports/2021_Annual_Report_web.pdf.

[47] Oconomowoc Water Utility Annual Water Quality Report, www.oconomowoc-wi.gov/DocumentCenter/View/8613/2021-Water-Quality-Report (Last visited July 13, 2023).

[48] Drinking Water Report, Jackson Water Utility (2022) villageofjacksonwi.gov/index.asp?Type=B_BASIC&SEC=%7bF8362B0A-F532-4BC8-9902-CCB97E421F11%7d (Last visited July 13, 2023). *See What is the Hardness of my City Water?,* City of Brookfield FAQs www.ci.brookfield.wi.us/Faq.aspx?QID=89_(Last visited July 13, 2023). The Waukesha hardness range is found on the monthly water bills of customers of the City of Waukesha.

The Southeastern Wisconsin Regional Planning Commission (Commission) has previously prepared a generalized map of hardness in the shallow aquifer of the Southeastern Wisconsin region.[49] The map shows that most of the region that is dependent on groundwater for water supply is dealing with very hard water.

Commonly, households and corporate facilities employ some mechanism to soften water in order to prevent scale build-up in plumbing and appliances and to allow soap to lather better.[50] Accordingly, there are multiple types of systems available to soften water, as explained below.[51]

One of the more common systems for household water softening is the use of point of entry ion exchange.[52] This system is installed directly at the main water service line, and here water is treated for the entire house or building.[53] In the point-of-entry ion-exchange water softening systems, calcium and magnesium ions are exchanged with sodium ions, in turn creating softened water and a waste brine.[54] This exchange of ions depletes the ion exchange resin of sodium. Ion exchange water softeners typically use sodium chloride to recharge the sodium on the resin. The waste brine contains the chloride from the salt used for recharge. The amount of chloride in the waste brine depends on various factors. For example, the amount of calcium, magnesium, and other metals that make up the hardness of the water may impact the amount of chloride found in the waste brine. Particularly, higher magnesium drives up the mass of chloride used, the efficiency of the treatment, and the efficiency of the regeneration. Usually, a high efficiency softener will send 1 milligram (mg) or more of chloride to the wastewater treatment plant for every 1 mg of hardness treated.[55]

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[49] Southeastern Wisconsin Regional Planning Commission TR-37, *Groundwater Resources of Southeastern Wisconsin*, at 92 (Map 24).

[50] *A Blueprint for Salt Sustainability on the University of Wisconsin-Madison Campus*, The University of Wisconsin-Madison Nelson Institute for Environmental Studies, 2019 Water Resources Management Practicum Report 4 (2019), https://nelson.wisc.edu/wp-content/uploads/wrm-report-2019.pdf.

[51] *See* Baishali Bakshi et al., *Centralized Softening as a Solution to Chloride Pollution: An Empirical Analysis Based on Minnesota Cities* 11 (2021). *See also* Southeastern Wisconsin regional Planning Commission TR-66.

[52] Bakshi, *supra* at 2.

[53] *Id.*

[54] *Id.*

[55] *Chloride Work Group Policy Proposal for Minnesota*, Minnesota Pollution Control Agency 8 (April 2017).

Generally, the waste brine from the point-of-entry ion-exchange water softening system is discharged to wastewater treatment plants or onsite wastewater treatment systems such as septic tanks, causing significant chloride loading.[56] Wastewater treatment plants may attempt to remove chloride before it is released back into surface water; however, the wastewater treatment plants are not always successful in this attempt due to limited treatment technology and expenses involved.[57] Similarly, chloride may end up in groundwater due to the inability of septic systems to remove it. Faulty or old water softening systems may contribute elevated levels of chloride to wastewater treatment facilities or septic systems.[58] Although there are problems that may occur with the point-of-entry ion-exchange water softening system contributing significantly to chloride discharge into ground and surface water, the Wisconsin Plumbing Code may help reduce these risks. For example, the Code requires ion exchange water softeners to be equipped with a water meter or a sensor unless there is a wastewater treatment system downstream of the softener that documents the amount of chlorides received.[59]

There are alternative systems that can be used to soften water. For example, a centralized water softening system allows for water to be softened at a water treatment plant or wastewater treatment plant.[60] A centralized system may approach water softening in various ways.[61] One approach is ion exchange.[62] This is similar to the process involved in the at-home point-of-entry ion-exchange water softening systems where calcium and magnesium ions are exchanged with sodium ions.[63] Two other approaches for a centralized softening system are the use of reverse osmosis or the use of lime soda.[64] Centralized softening can have a huge impact on reducing chloride discharges to receiving waters; however, it can be expensive.[65]

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[56] Bakshi *supra* at 2.

[57] *Id.*

[58] *See* Harrington et al., *supra*, at 14.

[59] Wis. Admin. Code SPS § 382(8)(j).

[60] A more detailed discussion of centralized softening is provided in SEWRPC TR-66.

[61] *See* Bakshi, *supra* at 11 (Table 2).

[62] Bakshi, *supra* at 11.

[63] *Id.*

[64] *Id.*

[65] Jim Gruenke, *Potential Solutions to Reduce Chloride Output from Water Softeners*, Water Quality Products (May 28, 2021) www.wqpmag.com/softening-conditioning/water-softening/article/10958705/potential-solutions-to-reduce-chloride-output-from-water-softeners.

Moreover, centralized softening, specifically centralized softening by use of lime, is most efficient when used to soften groundwater, not surface water.[66]

The vast majority of utilities in the Southeastern Wisconsin Region do not employ centralized softening. The 2005 inventories in the Regional Water Supply Plan (SEWRPC PR-52) show the treatment processes at utility plants in the Region. The processes at the water utilities serving Union Grove, the Country Estates Sanitary District, and Elkhorn include ion exchange; those at Williams Bay included lime soda addition, and those at Pell Lake include both ion exchange and lime soda addition. While these processes were implemented to treat for radium, there may have been a water softening side benefit.

1.3 AGRICULTURAL USES

Agricultural operations use salt as a feed additive and in other products such as pesticides and fertilizers.[67] Researchers have recommended that improved agricultural practices that use less water could simultaneously reduce salt loading to freshwater.[68] The Colorado River Basin Salinity Control Program has effectively reduced salt loading to the river by about 1.3 million tons per year, largely through improved irrigation practices.[69]

Potassium chloride fertilizers are the most commonly used potassium fertilizers because of their many advantages. They are low in cost, contain a higher amount of potassium compared to other fertilizers, and can be dissolved in water for spray or fertilization applications.[70] Studies have shown that applying this type of fertilizer to soils with inadequate potassium can improve crop yields and quality.[71] However, these types of fertilizers can also be disadvantageous depending on their chemistry, behavior in soils, and nutrients

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[66] Bakshi, *supra* at 14.

[67] Molly Hunt et al., *Chlorides in Fresh Water* 2 (2012), https://perma.cc/M3PG-XQRC.

[68] M. Canedo-Arguelles et al., *Saving Freshwater from Salts*, 351 Science 914, 916 (2016).

[69] *Id.*

[70] Alan Blaylock, *Potassium Fertilizers: Muriate of Potash or Sulfate of Potash?*, eKonomics, https://nutrien-ekonomics.com/news/potassium-fertilizers-muriate-of-potash-or-sulfate-of-potash/ (last visited Aug. 25, 2023); *Potassium Chloride*, Mosaic, https://www.cropnutrition.com/resource-library/potassium-chloride/ (last visited Aug. 25, 2023).

[71] *See* L. Ren, et al., *The Value of KCL as a Fertilizer with Particular Reference to Chloride*, International Potassium Institute 9 (2015).

supplied in addition to the potassium.[72] One study even demonstrated that while potassium fertilizer application maximizes yield and crop quality, it cannot be sustained because new evidence shows that there are consequences to agricultural productivity, food safety, and soil degradation.[73]

Chloride-containing compounds are also often found in agricultural disinfectants and pesticides. "Sodium chloride is one of two active ingredients in a disinfectant used to treat feeding and watering appliances, [as well as] equipment and premises in poultry operations."[74] Sodium chloride is also the active ingredient used in polyethylene pellets used to prevent slugs and snails from entering gardens.[75]

1.4 WASTEWATER TREATMENT FACILITIES

Although most researchers have concluded that winter deicing runoff is the dominant source of chloride in surface waters, other studies reveal that treated wastewater can be a major chloride source.[76] Chloride is "non-reactive," meaning that there is little or no loss when chloride in wastewater passes through wastewater treatment facilities or septic systems.[77] Instead, chloride "remain[s] in solution."[78] This is because it "cannot be removed using standard wastewater treatment technology;[79] therefore, chloride that arrives in wastewater passes through treatment plants and enters natural water bodies or groundwater as treated effluent."[80] Part of this is due to decentralized water softening, as already discussed. But chloride can also

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[72] Blaylock, *supra*.

[73] *See* S.A. Khan, et al., *The Potassium Paradox: Implications for Soil Fertility, Crop Production and Human Health*, Univ. Ill. Urbana-Champaign Dep't Nat. Res. & Sci. (2013).

[74] U.S. Environmental Protection Agency Office of Prevention, Pesticides and Toxic Substances, *R.E.D. Facts: Organic Halides*, EPA-738-F-93-015, 1993.

[75] *Id.*

[76] *See* Kelly et al., *Using Chloride*, *supra*, at 671.

[77] *USGS*, *Chloride in Groundwater*, *supra*, at 8.

[78] Corsi et al., *A Fresh Look at Road Salt*, *supra*, at 7376.

[79] *See, e.g.*, AECOM/Madison Metropolitan Sewerage Commission, Chloride Compliance Study—Nine Springs Wastewater Treatment Plant (2015) (discussing additional treatment technology necessary for chloride removal) (available at www.madsewer.org/wp-content/uploads/2021/12/STUDY-2015-District-Chloride-Compliance.pdf).

[80] Lake et al., *supra* note 3, at xi.

enter the waste stream from food, beverages, and cleaning products.[81] An average person consumes about 4.7 pounds of salt per year, and releases about 2.9 pounds of that to wastewater discharges.[82]

As explained above, chloride from water softening goes to municipal wastewater treatment facilities or private onsite wastewater treatment systems, eventually ending up in surface water or groundwater.[83] Most wastewater treatment plants in the Southeastern Wisconsin Region discharge into surface waters, with a few that discharge into shallow groundwater.[84] Meanwhile, almost all private onsite wastewater treatment systems discharge into shallow groundwater, and the biochemical activity in the discharge field is part of the treatment process.[85]

In the Southeastern Wisconsin Region, there are forty-four public wastewater treatment plants and eight private wastewater treatment plants.[86] Seventeen of these public plants and one private plant discharge effluent into Lake Michigan or its tributary streams. The remaining twenty-seven public plants and seven private plants discharge treated effluent into streams, watercourses, and groundwater in the Fox, Des Plaines, and Rock River Basins.[87]

With the multitude of contributing sources, wastewater treatment facilities receive a large amount of chloride per day.[88] For example, the Nine Springs Wastewater Treatment plant, in Madison, receives nearly

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[81] USGS, Chloride in Groundwater, *supra*, at 8. A Michigan study suggests that chloride in household products contribute to around 2,956 tons per year of chloride. If taking into account failed septic systems, the number would be around 3,286 tons per year of chloride. *See* Harrington et al., *supra*, at 15.

[82] *Id.* at 12.

[83] *See infra* ch.1, section B.

[84] *See Prospectus for a Chloride Impact Study for the Southeastern Wisconsin Region*, Southeastern Wisconsin Regional Planning Commission 40, 41 (Map 10) (Mar. 2016).

[85] *See Id.* at 40.

[86] *Id.*

[87] *Id.*

[88] *Development and Implementation of Water Quality Standard Variances,* 3400-2022-02 Wisconsin Department of Natural Resources i, 31 (1st ed.) (July 19, 2022).

220,000 pounds of salt per day.[89] Removing chloride from water using these facilities is expensive and the technology to do so is limited.[90] One method to remove chloride, reverse osmosis, can have capital costs of $28 million per 1 million gallons per day of flow.[91] There are also secondary consequences to reverse osmosis treatment, such as an increase in energy use, waste disposal costs, and operator training needed.[92]

Some wastewater treatment facilities have difficulty meeting the chloride effluent limits in their discharge permits, and as discussed in more detail in Chapter 2, are granted variances from their limits by the WDNR. These variances typically set site specific objectives to reduce chloride loads.[93] In Wisconsin, most of the facilities that have chloride variances are in the southern and eastern part of the state, where limestone and dolomite aquifers are located and naturally produce hard water.[94]

1.5 INDUSTRIAL SOURCES – FOOD PROCESSING

Some industries, especially food processing and chemical manufacturing, use or generate significant amounts of chloride and chloride salts.[95] Chloride discharges from publicly owned wastewater treatment facilities may include these industrial sources as well.[96]

Sodium chloride is regulated for food processing under 21 CFR 182.70 and is considered a "substance generally recognized as safe."[97] It has a variety of uses within the food industry that include food flavoring,

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[89] *Chloride*, Madison Metropolitan Sewerage District, www.madsewer.org/pollution-prevention/chloride/ (last visited Aug. 4, 2023).

[90] Bakshi, *supra*, at 4.

[91] *Chloride Work Group Policy Proposal for Minnesota*, *supra*, at 9.

[92] *Id.*

[93] *Development and Implementation of Water Quality Standard Variances, supra*, at 1.

[94] *Id.* at 31.

[95] Gregory E. Grants to, et al, U.S. Geological Survey, Rep No. 2015-1080, Methods for Evaluating Potential Sources of Chloride in Surface Waters and Groundwaters of the Conterminous United States 2 (2015).

[96] *Id.* at 21; USGS, Chloride in Groundwater, *supra*, at 3 fig. 1, 5, 8.

[97] *Calcium Chloride—A Useful Preservative and Food Additive*, Chemgrit SA, www.chemgritsa.co.za/post/calcium-chloride-a-useful-preservative-and-food-additive (last visited Aug. 25, 2023).

preservation, fermentation, and for manufacturing a wide range of products.[98] The 2020-2025 Dietary Guidelines for Americans recommends no more than 2,300 mg of sodium per day. However, the average sodium intake for the U.S. population is 3,393 mg/day, significantly higher than the recommended amount.[99] Most human sodium intake comes from processed food as opposed to table salt. Sodium is added to food for reasons including flavor enhancement, preservation of freshness, and texture and appearance improvement.[100] Similarly, calcium chloride is used as a food additive because it can help extend shelf life and maintain desirable texture and flavor properties.[101]

In Wisconsin, chloride is commonly used in the cheesemaking process in multiple ways. The first is through the brining process. Once the cheese is submerged in a brine solution, the flavor is preserved and the cheese itself is preserved. Brine can also be injected into the cheese during the process. Second, in a process known as dry salting, the curds are mixed with salt and left to sit while the salt is absorbed into the cheese. Third, the use of softened water introduces additional salt. The fourth way chloride is used in the cheese making process is through the use of milk itself, and the last way is through chemicals to help remove phosphorus. On average, every pound of cheese made consists of two percent salt. In addition, up to fifty percent of the salt used during the cheesemaking process can be lost in brine waste. The chloride byproduct is typically disposed of by sending it to municipal wastewater treatment plants. Some companies, however, share the brine solution waste with nearby communities for deicing in the winter months. Currently, the cheesemaking industry does not have a viable alternative for salt in its production process.

1.6 OTHER INDUSTRIAL SOURCES

Two other industrial sources that are less common in Wisconsin contribute to chloride discharge: the oil and gas industry and the steel industry. Sodium chloride content varies among geological formations and

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[98] *Sodium Chloride*, ChemicalSafetyFacts.org (updated Oct. 14, 2022) www.chemicalsafetyfacts.org/chemicals/sodium-chloride.

[99] U.S. Dep't Agric., Dietary Guidelines for Americans, 2020-2025, www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf.

[100] CDC, Key Messages on Sodium and Sodium Reduction (Mar. 2021), www.cdc.gov/dhdsp/docs/sodium-reduction-key-messages-508.pdf.

[101] *Food Processing*, Occidental Chem. Corp., www.oxycalciumchloride.com/applications/food-processing#:~:text=Calcium%20chloride%20is%20used%20as,desirable%20texture%20and%20flavor%20properties (last visited Aug. 25, 2023).

drilled wells.[102] However, the average sodium chloride concentration in brine[103] from oil and gas fields is about 30,000 mg/L.[104] In June 2016 the EPA banned oil and gas operators from delivering wastewater to municipal sewage treatment plants.[105] Consequently, oil and gas operators now discharge the wastewater from fracking in offsite injection wells.[106]

Similarly, the steel industry "is one of the largest energy intensive and water-intensive process industries," using an average of 7,560 gallons of water per ton of steel.[107] Specifically, the cooling water used in the steel production process has a high chloride concentration.[108] Recently, the steel industry has improved its water management. For example, it is now a common practice to use recycled wastewater in the steel production process.[109] By using the recycled wastewater, it is necessary to remove excess chloride due to its corrosive effects on steel, and so reverse osmosis is a possible method used to remove the chloride.[110]

Another industry that commonly uses a large amount of chloride is the leather tanning industry.[111] This industry, which was mainly popular due to German immigrants, flourished in the nineteenth and twentieth

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[102] *Salting the Earth: The Environmental Impact of Oil and Gas Wastewater*, 124-12 Environment Health Perspective A231, A231 (Dec. 2016).

[103] Brine in this context is the water that comes out of the well with crude oil. *Produced Water: Oil and Gas Terminology Glossary*, Water Environment Federation 1 (2018) www.wef.org/globalassets/assets-wef/direct-download-library/public/03---resources/wsec-2017-fs-013-iwwc-og-glossary---final---5.21.18.pdf. The brine is commonly referred to as produced water in the oil and gas industry. *Id.*

[104] M.K Steele & J.A. Aitkenhead-Peterson, *Long-Term Sodium and Chloride SurfaceWater Exports from the Dallas/Fort Worth Region*, 2474 Department of Soil and Crop Science Texas A&M University 3021, 3031 (2011).

[105] *Salting the Earth*, *supra*, at A231.

[106] *Id.*

[107] Valentina Colla, et al., *Sustainable Reverse Osmosis Application for Wastewater Treatment in the Steel Industry*, 130 Journal of Cleaner Production 103, 104 (2016). *See* Alberto Conejo, et al., *A Review of the Current Environmental Challenges of the Steel Industry and its Value Chain*, Journal of 259, 1.

[108] Colla, *supra*, at 105.

[109] *See* Colla, *supra*, at 104.

[110] *See* Colla, *supra*, at 103.

[111] Chunxiao Zhang, et al*., A Salt-Free and Chromium Discharge Minimizing Tanning Technology: The Novel Cleaner Integrated Chrome Tanning Process*, 112 Journal of Cleaner Production 1055, 1055 (2016).

century.[112] Historically, Wisconsin, and in particular Milwaukee, had been known for its leather industry; however, this industry has become less prominent in Wisconsin and the United Sates in recent decades.[113]

The tanning process consists of three phases: (1) pickling, (2) tanning, and (3) basification.[114] The first phase, the pickling phase, is where the most chloride is used.[115] Pickle float consists of a 6% solution of sodium chloride, and chloride residue from this phase stays in the water source used in the other tanning phases of the tanning process.[116] In total, the chloride concentration from leather tanning water discharge is around 20,000 mg/L.[117]

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[112] John Gurda, *Hides and Hemlock: Milwaukee's Tanneries Had a Strong Connection with Manitowoc County*, Milwaukee Journal Sentinel (Nov. 4, 2021).

[113]*See Id.*

[114] Zhang, *supra*, at 1055.

[115] The pickling phase reduces the swelling of the skins or hides. *Id.* at 1056.

[116] *Id.* at 1055.

[117] *Id.* at 1056.

CHAPTER 2

LEGAL AND POLICY STRATEGIES TO CONTROL CHLORIDE DISCHARGES

Elevated chloride concentrations in the environment pose serious risks to human health and the environment. Reports of drinking water supplies contaminated with chloride have emerged in a number of locations.[118] The United States Geological Survey (USGS) has called chloride contamination of drinking water supplies "[t]he primary concern for water quality" related to chloride.[119] A recent USGS study identified chloride contaminations above the EPA secondary maximum containment level (SMCL) in about 1.7% of drinking water wells.[120] This contamination can result in human health impacts, deterioration of the biotic environment, degraded water quality, influences on soil structure and vegetation, and other negative consequences. These impacts are more fully described in TR-62.

Yet to date, little or no legal incentives or policies exist to avoid overuse of chloride. To the contrary, over-application and overuse of deicing salt has historically been the "safe" strategy in light of potential concerns about legal liability. That may change, however, given recent reports of citizen-instituted lawsuits against municipalities and private property owners for over-application of salt and the resulting environmental harms.

For example, in 2017, residents of Brighton, Michigan sued General Motors claiming that the company's use of road salt to clear ice from its nearby Milford proving grounds resulted in groundwater contamination causing health impacts and property damage. [121] The complaint alleged that General Motors "released hundreds of thousands of tons of salt . . . over the last several decades, leading to extremely high

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[118] *See S.V.* Panno et al., *Database for the Characterization and Identification of the Sources of Sodium and Chloride in Natural Waters of Illinois*, Ill. State Geological Survey 1 (2015) ("[Chloride] has adversely affected municipal and private water supplies in Illinois and other states").

[119] *USGS*, *Chloride in Groundwater*, *supra*, at 2.

[120] *Id.* at 15.

[121] *See generally* Class Action Complaint & Jury Demand, Moore v. Gen. Motors, No. 2017-29670-CE (Mich. Cir. Ct. filed Nov. 30, 2017).

concentrations of sodium and chloride in surface and groundwater" that "migrated . . . in[to] water used by Plaintiffs." [122] The citizens alleged damages under two state laws—the Michigan Natural Resources and Environmental Protection Act and the Michigan Environmental Protection Act—and under common law theories including fraud, negligence, trespass, private nuisance, and public nuisance.[123] The suit appears to have been resolved out of court.

In another case, a citizen alleged that the City of Omaha had overapplied salt in a floodplain—tantamount to open dumping of solid waste—and in the process violated the Resource Conservation and Recovery Act (RCRA).[124] The court ultimately dismissed the lawsuit because it found the City's salt application practices to be consistent with the intended purpose of the product, and therefore not the equivalent of unlawful "discarding" under RCRA.[125] On appeal, the City again prevailed, with the Eighth Circuit concluding that the district court correctly determined that the salt application did not rise to the level of discarding solid waste.[126]

In contrast, some manure-spreading operators have recently been held liable under RCRA where the loads applied were far in excess of spreading requirements.[127] Because the manure applications were completely untethered to applicable best management practices and crop fertilization needs, the manure ceased to be a "useful product" and became "solid waste" for RCRA purposes.[128] The plaintiff in the Omaha case, who represented himself, did not make similar arguments related to the over-application of salt as compared to best practices, but certainly could have (and future plaintiffs might).

In another recent case, a citizen-plaintiff alleged that his property had been rendered undevelopable because the municipality's over-application of salt contaminated the groundwater underlying his property.[129] The court dismissed the suit because it found no imminent harm to human health or the

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[122] *Id.* at 5 (abbreviation omitted).

[123] *Id.* at 17–23.

[124] Krause v. City of Omaha, No. 8:15CV197, 2015 WL 5008657, at *3 (D. Neb. Aug. 19, 2015).

[125] *Id.* at *4.

[126] Krause v. City of Omaha, 637 Fed. App'x 257, 258 (8th Cir. 2016).

[127] Cmty. Ass'n for Restoration of the Env't v. Cow Palace, 80 F. Supp. 3d 1180, 1221 (E.D. Wash. 2015).

[128] *Id.*

[129] Scotchtown Holdings v. Town of Goshen, No. 08-CV-4720(CS) 2009 WL 27445, at *1 (S.D.N.Y. Jan. 5, 2009).

environment, a requirement for RCRA liability.[130] It is conceivable that the court would have reached a different outcome if the groundwater was actively being consumed on the property—although, concerns over chloride are somewhat stronger in connection with environmental impacts than with human health impacts.

Because chloride is so difficult to remove using traditional water and wastewater treatment approaches, use reduction (or put differently, optimization) appears to be the only effective management strategy.[131] However, "management or mitigation of this issue is complex. Solutions would require consideration of environmental, political, economic, and safety issues."[132] The report addresses these issues next.

Specifically, this chapter analyzes several legal and policy strategies for addressing excess chloride concentrations in surface waters and groundwater, and, where possible, identifies successful efforts underway using the identified strategy. These options include:

- Limiting liability
- Other direct regulatory strategies—i.e., relying on the Clean Water Act (CWA), state regulations, municipal ordinances, and mandated best practices
- Informational strategies
- Chloride alternatives—i.e., green infrastructure and other salt alternatives
- Water quality trading
- Integrated watershed management
- Economic measures and assistance

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[130] *Id.* at *2–3.

[131] *Accord* Corsi et al., *A Fresh Look at Road Salt*, *supra* at 7376 ("currently, reduction in usage appears to be the only effective road-salt-runoff management strategy").

[132] *Id.* at 7382.

The intent of these measures should be to encourage optimization, not elimination, of chloride usage. Moreover, the report does not propose a "one-size-fits-all" strategy to suit every situation; rather, the goal is to provide a menu of options for policymakers seeking to address chloride issues.

2.1 LIMITING LIABILITY

As it relates to chloride reduction, fear of "slip-and-fall" liability is one of the most-cited reasons for overapplication of winter deicers, especially on private property. This concern could be partially alleviated by granting a liability waiver against damages associated with snow and ice conditions to contractors certified for deicing best management practices, absent extreme circumstances such as intentional wrongdoing. A waiver addresses the widespread liability fears common to most deicing contractors and their customers, which undoubtedly lead to significant over-application of deicing salt.

The primary example of a liability waiver is New Hampshire's innovative "Green SnowPro" program, administered by the New Hampshire Department of Environmental Services (NHDES).[133] The program includes multiple levels of deicing certification options. An individual who performs snow and ice removal services but does not hire employees may earn an Individual Certification.[134] Larger organizations with one or more employees may earn a Master Certification, which serves as an umbrella for the whole company.[135] However, all employees applying salt must undergo initial and refresher training.[136] The organization's employees may obtain either an individual certificate or a subordinate certificate to qualify under the master certificate. The organization must ensure that all employees operating with a subordinate certificate under its master certificate receive the required training, and the organization must provide the required record keeping on behalf of all commercial applicators working under the master certificate.[137]

A person who seeks certification under the Green SnowPro program must complete several prerequisite steps. First, the person must complete the training course, which includes four to five hours of classroom

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[133] U.S. Envtl. Prot. Agency, New Hampshire Road Salt Reduction Program Protects Personal Safety and the Environment, NONPOINT SOURCE NEWS-NOTES, Jan. 2016, at 9, 9, perma.cc/65RW-L55A [hereinafter EPA, Green SnowPro].

[134] *Id.* at 10.

[135] *Id.*

[136] April 5, 2023 Salt Wise webinar. Some larger firms have had staff members certified as trainers and conduct annual training of all employees. *Id.*

[137] N.H. RSA § 489-C:2.

instruction on efficient and environmentally friendly winter maintenance practices.[138] The training covers basics of salt reduction, including equipment calibration, anti-icing, brine making, pre-wetting with brine, efficient application rate changes,[139] and effective plowing techniques, among other things.[140] The next step is a thirty-minute examination covering the program topics.[141] If the person receives a passing score on the exam, the person is eligible to apply for the Voluntary Salt Applicator Certification and Liability Protection Program.[142]

Certified persons must also track salt use and report the results to a salt accounting system on an annual basis.[143] This record keeping includes the statutory requirement for the contractor to "keep a written record describing its winter road, parking lot and property maintenance practices. The written record shall include the type and rate of application of de-icing materials used, the dates of treatment, and the weather conditions for each event requiring de-icing."[144] The tracking program is intended to hold applicators accountable and to document salt usage from year to year. However, there is no requirement that a certified individual or company documents salt application volume decreases over time.

In addition to the initial requirements for Green SnowPro certification, the program includes several ongoing tasks that certified persons must complete for recertification. For example, the program requires annual re-application.[145] Certified applicators must also complete a two-hour refresher every two years.[146]

In exchange for completing the certification program and complying with its ongoing requirements, certified applicators receive general liability protection against liability for damages arising from snow and ice conditions. Specifically, pursuant to the waiver, commercial salt applicators that were certified by NHDES,

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138 *Green SnowPro Training and NHDES Certification*, U.N.H. Tech. Transfer Ctr., https://perma.cc/X2ZQ-FWES.

139 Program leaders continue to stress the importance of making and maintaining good records for companies operating under the waiver. April 5, 2023 Wisconsin Salt Wise webinar.

140 Green SnowPro Training and NHDES Certification, U.N.H. TECH. TRANSFER CTR.

141 *Id.*

142 *Id.*

143 *See* EPA, *Green SnowPro*.

144 N.H. REV. STAT. ANN. § 508:22(II) (2017).

145 See N.H. CODE ADMIN. R. ANN. Env-Wq 2203.04(c)(2)(c), 2203.06 (2017); see also N.H. REV. STAT. ANN. § 489-C:2.

146 N.H. CODE ADMIN. R. ANN. Env-Wq 2203.06(a)(2)(b).

and the property owners or managers who hired them, are granted liability protection against such damages so long as the applicators used the "best management practices for winter road, parking lot, and sidewalk maintenance adopted and published by the [New Hampshire] [D]epartments of [T]ransportation and [E]nvironmental [S]ervices."[147] However, the waiver does not apply if a court finds that the certified contractor acted with "gross negligence or reckless disregard of the hazard."[148] Certified persons are "presumed to be acting pursuant to the best management practices in the absence of proof to the contrary."[149] The liability waiver was a great incentive for applicators to become certified, and quickly became the cornerstone of the program.

The New Hampshire program carries several advantages. It stresses the need to balance both environmental and safety concerns and motivates increased participation in several ways.

Liability waiver. First, the liability protection for program participants and those who hire them is unlike any other chloride reduction program. It addresses one of the greatest fears of deicing contractors, along with those who hire them and those who insure them: that they will be held liable for accidents resulting from remaining snow and ice that should have been removed.[150] Without such an incentive, over-application of salt is perceived to be the safe strategy for deicing contractors.[151]

Environmental and Process Improvements. Preliminary evaluative metrics show significant progress. According to NHDES, by the end of 2017, over 1,000 individuals had been trained and certified under the New Hampshire program, mostly in the private sector.[152] Preliminary water quality data show a downward trend in aquatic chloride levels, and annual reports from certified contractors show salt applications

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[147] N.H. REV. STAT. ANN. § 508:22(I).

[148] *Id.*

[149] *Id.*

[150] Kamal Hossain & Liping Fu, *Optimal Snow and Ice Control of Parking Lots and Sidewalks*, Univ. of Waterloo 7 (2015).

[151] *Id.*

[152] Green SnowPro Training and NHDES Certification, U.N.H. TECH. TRANSFER CTR.

decreasing by 30%.[153] These reductions in applications would result in corresponding cost savings for contractors and their clients.

Cost savings due to forced efficiencies. The training offers an opportunity for "efficiency-forcing" as participants learn best management practices.[154] In turn, this leads to cost savings for participants as salt use decreases.

Marketing advantages. Further, there is a significant marketing advantage for certified entities. The most direct aspect of this is that the liability waiver extends to those who hire certified contractors.[155] This means that a private entity hiring a contractor to keep, for example, its parking lot free of snow and ice can simultaneously gain the peace of mind of liability protection simply by hiring a certified contractor. Certified contractors will no doubt also market themselves as "green" to distinguish themselves from competitors. Certified contractors can use the Green SnowPro program logo on their website and related marketing materials to demonstrate to current and potential clients their certification.

Insurance advantages. Insurance companies in New Hampshire appear willing to give discounts if a business hires a certified snow removal contractor.[156] Insurers issuing policies in New Hampshire have already begun advising contractors on how best to limit liability under the program.[157] For example, one major insurer has told its insureds to fully document—with written records and photographs—treatment dates, times, and

[153] Interview with Patrick Woodbrey, Salt Reduction Coordinator, N.H. Dep't of Envtl. Servs. (Mar. 8, 2016); see also EPA, Green SnowPro, (citing "anecdotal information pointing to reductions in the amount of salt applied. . . . Many contractors have told us they've been able to use less" (quoting Patrick Woodbrey)).

[154] Eric Williams, *Become a Certified Green SnowPro*, UNH T2, Fall 2011, at 1, 6.

[155] See N.H. REV. STAT. ANN. § 508:22(I) (2017) (extending liability waiver to owners, occupants, and lessees of land maintained by a certified contractor).

[156] EPA, Green SnowPro at 10.

[157] See generally THOMAS BROTHERS, LIBERTY MUT. INS., LIMITING SNOW PLOWING LIABILITY (2014) (discussing best practices for snow removal companies).

subsequent inspections, because under the statute, a certified person is assumed to be adhering to best practices only "in the absence of proof to the contrary."[158]

Despite these advantages, the New Hampshire program administrators have identified several ongoing challenges that should be addressed if the program is replicated elsewhere.

Financial stability. Program administrators expressed uncertainty about the continued financial viability of the Green SnowPro program if the current fee structure remains unchanged. Currently, the training course costs $150 (for individual certificates) or $250 (for master certificates).[159]

Difficulties in program adoption and uptake. Program administrators noted the difficulty in passing the statutes to create the liability waiver program. To do so took four legislative sessions, and in the end, the program survived only as a late addendum to a budget bill.[160] After passage, program administrators stressed the need to find early program "champions" who are willing to invest the time and money needed to become certified under the program.[161] The administrators conceded that it took some time for insurance companies and business owners, who hire salt applicators, to realize the benefits of this certification.[162] Finally, the danger of higher-than-desired program attrition exists due to the voluntary nature of the recertification path.

Legal strength of liability waiver. So far, the liability waiver program has withstood legal challenges, and it was "developed in close coordination with legal experts and insurance companies."[163] More complex legal battles could arise in the future. For example, a certified person (or her insurance carrier) defending a slip-and-fall case would likely file a motion for summary judgment to end the case, citing the liability waiver statute. The plaintiff would no doubt produce evidence related to the parking lot or sidewalk conditions

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[158] Id. at 6–9; see also N.H. REV. STAT. ANN. § 508:22(I) ("All commercial applicators, owners, occupants, or lessees who adopt such best management practices shall be presumed to be acting to the best management practices in the absence of proof to the contrary.").

[159] New Hampshire Department of Environmental Services, New Hampshire Voluntary Salt Applicator (Green SnowPro) Certification Guide, available at www.des.nh.gov/sites/g/files/ehbemt341/files/documents/gsp-certification-guide.pdf.

[160] 2013 N.H. Laws 287, 321–23.

[161] Interview with Patrick Woodbrey, *supra*.

[162] *Id.*

[163] The most recent challenge was dismissed upon appeal. *See Rogers v. Chartwell Management*, 2023-0016 (N.H. 2023).

around the time of the injury. The success or failure of the claim would likely depend on whether the certified person followed best practices. The case could turn on photographs or documentary evidence of the certified person's winter maintenance practices.

In addition to case-specific challenges based on questions of material fact, a more general (and perhaps constitutional) challenge to the statute could arise. For example, the statutory waiver could be challenged as a deprivation of a plaintiff's right to substantive due process, or a violation of state and federal rights to equal protection.

The innovative nature of New Hampshire's Green SnowPro program makes it a likely candidate for duplication in other places.

Pending proposals. A bill pending in the Wisconsin Legislature would create a program extremely similar to New Hampshire's: in short, program-certified commercial deicing contractors that implement best practices and maintain records would receive limited liability protections from slip and fall claims, as would their customers.[164] Similar legislation has been introduced in the Minnesota Legislature.[165] Maryland has enacted programs reducing salt application to roadways[166] and is working on a voluntary certification program for deicer applicators.[167]

2.2 OTHER DIRECT REGULATORY STRATEGIES

Several potential regulatory strategies are examined here, including direct regulation under the Clean Water Act (CWA), mandated or incentivized best management practices, and municipal ordinances.

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[164] Wisconsin S.B. 52.

[165] Minnesota H.F. 820 (2023); Minnesota S.F. 755 (2023).

[166] Maryland Reduces Use of Road Salts to Protect the Environment and Public Health (Jan. 18, 2019), available at news.maryland.gov/mde/2019/01/18/maryland-reduces-use-of-road-salts-to-protect-the-environment-and-public-health/ (last visited Sept. 8, 2023).

[167] Managing Chloride in Maryland's Waters, presentation by Gregorio Sandi, Maryland Dep't of the Environment (Nov. 20, 2020), available at news.maryland.gov/mde/2019/01/18/maryland-reduces-use-of-road-salts-to-protect-the-environment-and-public-health
www.mwcog.org/file.aspx?&A=zrYK4q6SEpfk%2B57y0L8rDLD%2B3I0IkD%2B9kYR0AOSohSk%3D (last visited Sept. 8, 2023).

The Clean Water Act. The CWA prohibits the addition of any pollutant from a point source to waters of the United States without a permit.[168] Wisconsin has enacted water quality standards for chloride pursuant to the CWA.[169] The associated surface water numerical criteria for chlorides are 395 mg/L for chronic exposure and 757 mg/L for acute exposure.[170] However, there is some evidence that these limits should be lower in order to minimize impacts to aquatic organisms.[171]

Chloride limitations are included in many permits issued pursuant to the CWA, and for Wisconsin dischargers that are unable to meet these requirements, chloride variances may be granted which mandate source reduction measures.[172] In Wisconsin, chloride variances are authorized in Wis. Stat. § 283.15. Chapter NR 106 of the *Wisconsin Administrative Code* sets forth the process for setting effluent limits, which states that chloride source reduction activities are often preferable to end-of-pipe treatment.[173]

When chloride discharge levels are too high, the WDNR may issue variances to single facilities in lieu of enforcement. The variance is customizable and includes a site-specific plan and goals to reduce pollution.[174] Most of the approved chloride variances are to dischargers in the southern and eastern parts of Wisconsin, where limestone and dolomite aquifers often produce hard water.[175]

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168 CWA, 33 U.S.C. §§ 1311(a), 1342(a)(1).)

169 *See Variances to Water Quality Standards*, Wis. Dep't Nat. Res., dnr.wisconsin.gov/topic/Wastewater/variances.html.(last visited Aug. 25, 2023) [hereinafter WDNR, *WQS Variances*].

170 *Id.* Chronic toxicity is "the ability of a substance to cause an adverse effect in an organism that results from exposure to the substance for a time period representing that substantial portion of natural life expectancy of that organism." *Id.* Acute toxicity is "the ability of a substance to cause mortality or an adverse effect in an organism *that* results from a single or short-term exposure to the substance." *Id.*

171 *See, e.g.,* W.D.Hintz, et al. "*Current Water Quality Guidelines Across North America and Europe Do Not Protect Lakes from Salinization,*" Proceedings of the National Academy of Sciences*, 119:e2115033119* (2022).

172 The permittee must demonstrate, by the greater weight to credible evidence, that attaining the water quality standard is not feasible. The variance may be approved based on one or more of factors listed in Wis. Stat. § 283.15(4). WDNR, *WQS Variances*, *supra*.

173 Wis. Admin. Code NR 106.83(a)(3).

174 *Development and Implementation of Water Quality Standards Variances*, Wisconsin Department of Natural Resources, 3400-2022-02, 1st ed. (July 19, 2022) [hereinafter WDNR, *Development and Implementation of WQS Variances*].

175 *Id.*

Another option under the CWA is the preparation of a Total Maximum Daily Load (TMDL) for chloride discharges to a particular receiving water. Under the CWA, states must develop and adopt criteria that are sufficient to protect the designated uses of waters within their borders.[176] The criteria may include narrative statements and specific numerical values.[177] Those waters that do not meet the standards are classified as "impaired" and are reported to EPA pursuant to Section 303(d) of the Act.[178] The next step is for the state to develop a TMDL designed to meet the water quality criteria, considering pollutant inputs from both point and nonpoint sources.[179] Pollutant budgets are assigned to each discharger to the water.[180] Pollutant reductions required to meet these budgets are added as a condition in discharge permits.[181] EPA must approve the final TMDL pollutant allocation.[182]

Best Management Practices for Water Softening Systems and Wastewater Treatment Facilities. At least some of the chloride entering wastewater treatment facilities comes from the use of residential water softeners.[183] Unlike other chloride source pathways that depend on action by governmental or corporate entities, the use of softeners is almost entirely discretionary on the part of private citizens. To develop a strategy to reduce chloride from residential water softeners, it is important to evaluate softeners on a case-by-case basis on a variety of metrics including regeneration frequency (time-initiated or demand-initiated), the age of the softener, and when the softener was last calibrated.[184]

Several policy options are available to reduce chloride inputs from water softening. For example, state plumbing codes could require higher-efficiency or on-demand softeners when a water softening system is replaced or installed. Likewise, at the residential level, a municipality could evaluate the potential for a rebate

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176 *See* 40 CFR 131.11(a)(1).

177 *Id.*

178 *See Overview of the Total Maximum Daily Loads (TMDLs)*, U.S. Env't. Prot. Agency, www.epa.gov/tmdl/overview-total-maximum-daily-loads-tmdls (last visited Aug. 25, 2023).

179 *Id.*

180 *Id.*

181 *Id.* The WDNR can either add the conditions upon permit reissuance or they can reopen existing permits and add the condition. Typically, WDNR has added or updated permit conditions upon reissuance.

182 *Id.*

183 *See Infra* Chapter I, Section B.

184 WDNR, *Development and Implementation of WQS Variances*

program to install high-efficiency softeners or residents could be encouraged to purchase higher efficiency or on-demand softeners at the time of sale.[185] At municipal water facilities, operators could evaluate blending of softened water with unsoftened water to reduce the amount of water softening required.[186] At commercial facilities with water softeners, operators could evaluate the potential for local brine reuse as a deicer instead of discharging to the wastewater treatment plant.[187]

Finally, industrial dischargers to wastewater treatment facilities should "train plant personnel to be more aware of salt conservation, emphasizing simple, cost effective housekeeping measures."[188] For example, spilled salt can be cleaned up as a solid waste or reused rather than flushed down the floor drain.[189]

Winter Road Maintenance Level of Service. Recommended deicer application rates vary from state to state, with little guidance from the United States Department of Transportation. This section will focus on the deicing responsibilities for Wisconsin roadways.

The transportation level of service considerations could be addressed in a salt management plan (SMP) providing guidelines for proper training of service providers, development and implementation of winter road condition models, route optimization, road weather information systems, and use of pre-wetting treatment.[190] The SMP is generally agency-based and aims to achieve "safety, environmental protection, continual improvement, fiscal responsibility, accountability, measurable progress, communication, and a knowledgeable and skilled workforce."[191] Overall, the management plan is most effective when it is periodically updated and revised.[192]

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[185] *Minnesota Statewide Chloride Management Plan*, Minn. Pollution Control Agency, wq-s1-94. [hereinafter MPA, *Minn. Statewide Management Plan*].

[186] *Id.*

[187] *Id.*

[188] Wis. Admin. Code NR 106.90(2)(c).

[189] *Id.*

[190] *See Id.*

[191] *Id.*

[192] *Id.*

A main area to focus on in the SMP is route optimization, where treatment may vary by roadway type, such as residential roadways receiving less treatment than highways. Another option is targeted use, with deicing applications made on high traffic or difficult to navigate areas such as at intersections or on hills. The agency responsible for deicing varies by county and roadway. This can make it difficult to implement best management practices consistently. In some areas, municipal roads are governed by the Department of Public Works;[193] in other places, the highway departments are responsible for winter road maintenance.[194] This may lead to different practices. The WisDOT is technically responsible for ice control on state and federal highways and the Interstate system, but it delegates that duty to the counties. In addition, responsible agencies may use different winter road maintenance equipment and deicers, provide different types and levels of staff training, and apply different levels of service to similar types of roads.

Wisconsin's county highway departments have the authority to determine the appropriate response for winter weather events for county highways in compliance with certain guidelines.[195] Some examples of management practices beyond route optimization that could be effective in treating winter roads while using less chloride include using a liquid brine solution instead of solid salt.[196] The application of the blended liquid brine products should be tailored to the specific air and road conditions present at the time of application.[197]

Applicators, counties, and municipalities have the option of creating their own brine blend or purchasing pre-blended brine.[198] By creating their own brine, an agency has control of what goes into the blend and

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[193] *Street Maintenance,* City of Racine, www.cityofracine.org/Street-Maintenance/; www.waukeshacounty.gov/DPW/dpw-divisions/ (last visited Aug. 25, 2023); *About Snow and Ice Control Operations*, City of Milwaukee, city.milwaukee.gov/dpw/operations/snowoperationstatus/About (last visited Aug. 25, 2023).

[194] *Highway Division*, Walworth County WI, www.co.walworth.wi.us/331/Highway-Division (last visited Aug. 25, 2023); *Highway Department*, Washington County Wis., www.washcowisco.gov/departments/highway_department (last visited Aug. 25, 2023).

[195] *See Winter Maintenance*, Wis. Dep't Transp., wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/default.aspx (last visited Aug. 25, 2023).

[196] Laura Fay & Karalyn Clouser, *Alternative Methods for Deicing,* Clear Roads, CR 18-05 (May 2020).

[197] *See Id.* Clear Roads CR 15.01 Guidebook Application Rate Guidelines for Light Snow Table 3 sets forth the differences in pavement temperature and road surface conditions along with how salt, either liquid or solid, should be applied to road.

[198] Fay & Clouser, *Alternative Methods for Deicing*, *supra*.

may reduce the costs of producing the blend by using locally sourced byproducts.[199] However, a pre-blended brine can reduce an agency's liability and reduce the amount of time for staff to mix brine.[200] Using pre-blended brine could also reduce the storage capacity an agency needs for winter maintenance materials.[201] Brine applied before the storm event has proven to be effective in reducing salt use by fifty percent, along with corresponding cost savings.[202]

Other effective roadway management practices include reducing speeds of the truck during application and proper transportation of salt before use.[203] First, the truck should apply salt at the speed of no more than thirty-five miles per hour, with the ideal speed being twenty-five miles per hour.[204] By applying salt at a lower speed, salt is less likely to bounce and scatter into unintended areas.[205] Second, salt should be properly stored and transported to reduce waste and improper placement. The *Wisconsin Administrative Code* sets out the storage requirements for highway salt. The Code requires salt storage facilities to be constructed in a manner which prevents any runoff into waters of the state.[206] Requirements include provision of a roof that sufficiently prevents contact between road salt and precipitation and wind that could potentially transport salt into surface or groundwaters.[207]

WisDOT could encourage Wisconsin counties to optimize salting practices for their winter road maintenance. For example, Carver County, Minnesota[208] reduced its salt use by 800 tons per year by implementing smart salting.[209] The county calibrated all of its equipment, began using prewetted salt, and

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199 *Id.*

200 *Id.*

201 *Id.*

202 *Id.*

203 *Id.*

204 *See Id.*; *See also Winter Facts*, Wis. Dep't Transp., https://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/facts.aspx. (last visited Aug. 25, 2023).

205 Fay & Clouser, *Alternative Methods for Deicing*, Clear Roads, CR 18-05 (May 2020).*supra*.

206 Wis. Admin. Code Trans 277.04(3)(a)(2).

207 Wis. Admin. Code Trans 227.04(3)(b).

208 MPA, *Minn. Statewide Management Plan*, *supra*.

209 *Id.*

purchased a 5,000 gallon tank to gear up for liquids.[210] The following year, the Carver County Board adopted a Snow and Ice Policy which continued the smart salting practices while also prioritizing education for drivers on proper salting practices. Carver County also began buying trucks equipped with side tanks, eliminated more of its manual controllers, and reviewed salt application amounts for each route.[211] A year later, it purchased a brine salting tank system and truck that was capable of using salt brine.[212] Carver County also cut down the use of rock salt and transitioned to treated salt, which has better melting capabilities at colder temperatures and adhesion to roads.[213] Through these advancements, educational efforts, and focusing salt placement on hills, curves, and intersections, Carver County significantly decreased its salt use.[214]

Funding to Convert Trucks from Salting to Brining. Using liquid brining for anti-icing and deicing can save money, reduce salt use, and be more efficient for winter road maintenance.[215] While $1,000 worth of rock salt used in granular form can clear 86 lane miles, a brine made from the same amount of salt can clear 224 lane miles.[216] An example of savings by use of salt brine comes from Jefferson County, Wisconsin. Jefferson County cut its salt use by 30-40% or nearly 4,500 tons when switching to exclusively liquid brine for its

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[210] *Id.*

[211] *Id.*

[212] *Id.*

[213] *Id.*

[214] *Id.*

[215] The calculation used to understand the cost and benefit is B/C= ((Benefit ($/ln-mi/storm)) x (Salt Brine Routes (ln-mi) x (Storms (Storms over 10 years))/ (Cost ($ over 10 years)). Boris Claros, et al., *Evaluation of Winter Maintenance with Salt Brine Applications in Wisconsin*, Dep't Civ. & Env't Eng'g Traffic Operations & Safety Lab'y Univ. Wis. Madison, WIS DOT ID no. 0092-20-53 (Dec. 2021).

[216] *Wisconsin Department of Transportation*, Wis. SaltWise, Success Stories, www.wisaltwise.com/Success-Stories (last visited Aug. 25, 2023).

winter maintenance.[217] This in turn saved taxpayers $500,000 in the winter of 2019-2020.[218] Similarly, cities in Minnesota started using salt brine and other best management practices to reduce their salt use, leading to cost savings. For example, the City of Waconia, Minnesota switched from a 1:1 sand:salt use to salt and liquid anti-icing practices, changed its equipment, and considered air and pavement temperatures.[219] Waconia has reduced its salt use by 70% since it implemented its plan in 2010, and as of 2022, the yearly savings on winter road maintenance is $8,600.[220]

The use of a liquid brine solution not only reduces salt use, but it also allows for even distribution of the solution on the pavement surface and reduces the wait time for the salt to start working.[221] Rock salt often takes a while to work as salt in its solid form has very little impact on melting ice or preventing the road from freezing.[222] Once the rock salt mixes in with moisture on the road, creating a brine solution, melting occurs.[223] The time for rock salt to begin working may be up to two hours.[224] In contrast, solid salt mixed beforehand with water to create a liquid brining solution will decrease the time necessary for the melting properties to start working.[225]

While converting trucks from salting to brining can provide a significant financial benefit to a county or municipality, it requires an initial capital investment. Federal grants provide opportunities to fund

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[217] *Want to Reduce Road Salt Impacts on Ecosystems and Infrastructure? Just Add Water.,* Univ. Wis. Madison, Water Blogged (Feb. 7, 2019) [hereinafter UWisMad, *Reduce Road Salt Impacts*]. *See The Cost of Salt Has More than Doubled Since 2006*, Wis. SaltWise, wisaltwise.com/It%27s-Getting-Pricey.

[218] *The Cost of Salt Has More than Doubled Since 2006*, *supra*. According to Jefferson County's highway commissioner, Bill Kern, the county by 20222 has had a total savings of $1.6 million since it switched to exclusively using a brine solution in 2018. Jenny Gross, *Road Salt Works. But It's Also Bad for the Environment*, N.Y. Times (Jan. 7, 2022).

[219] MPA, *Minn. Statewide Management Plan*, *supra*.

[220] *Success Stories: Salt Reduction and Cost Savings Examples*, Minn. Pollution Control Agency (last edited Nov. 23, 2022). https://stormwater.pca.state.mn.us/index.php?title=Success_stories:_salt_reduction_and_cost_saving_examples.

[221] U Wis. Mad, *Reduce Road Salt Impact*, *supra*.

[222] *Id.*

[223] *Id.*

[224] *Id.*

[225] *Id.*

conversion costs.[226] Additionally, counties may save money by making a conscious effort to track air and pavement temperatures and responding as needed.

Placement of Snow. Proper winter maintenance includes designating areas for snow placement and installing snow fences.[227] Snow piles should not be placed near receiving waters or on permeable soils.[228] Rather, snow should be placed on slopes less than six percent[229] and where meltwater discharges into less vulnerable receiving waters.[230] Snow fences are relatively inexpensive for keeping snow off of roads, and municipalities could launch programs that provide incentives to farmers and landowners to install snow fences.[231]

Communities Buying Back Salt. Municipalities could buy back salt from private applicators and residents to prevent overapplication at the end of the winter or improper salt storage. Similarly, municipalities could trade unused bags of residential salt at the end of the winter season with materials commonly used in spring maintenance.[232] This trade could be for mulch, plants or trees, or a bag of compost.[233]

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[226] *Safe Streets and Roads for All (SS4) Grant Program,* U.S. Dep't Transp., www.transportation.gov/grants/SS4A#:~:text=The%20Bipartisan%20Infrastructure%20Law%20(BIL,roadway%20deaths%20and%20serious%20injuries. This grant focuses on projects that reduce traffic fatalities (last visited Aug. 25, 2023).

[227] Snow fences are a non-chemical solution to snow maintenance where fencing is strategically placed to protect roadways and sidewalks from blowing and drifting snow. MPA, *Minn. Statewide Management Plan*, *supra*. Snow fences can be structural, which are built from plastic or wood, or living, which comes from planting tress, shrubs, and native grasses nearby each other. Laura Fay, et al., *Strategies to Mitigate the Impacts of Chloride Roadway Deicers on the Natural Environment*, Nat'l Coop. Highway Rsch. Program, Synthesis 449 (2013) [hereinafter Fay, *Strategies to Mitigate Impacts of Chloride*].

[228] MPA, *Minn. Statewide Management Plan*, *supra*.

[229] Slopes of less than 2% are preferred. *Guidance and Recommendations for Storing Transported Snow and For On-Site Snow Storage*, Minn. Stormwater Manual, stormwater.pca.state.mn.us/index.php?title=Guidance_and_recommendations_for_storing_transported_snow_and_for_on-site_snow_storage (last visited Aug. 23, 2023).

[230] *Id.*

[231] *See* MPA, *Minn. Statewide Management Plan*, *supra*. The cost for a snow fence is around $1.39 per square feet of fence. Fay, *Strategies to Mitigate Impacts of Chloride*, *supra*.

[232] *Id.*

[233] *Id.*

City Ordinance. Many cities have ordinances that address proper winter maintenance. These ordinances usually require residents to properly remove snow and ice from sidewalks following a winter event.[234] However, the City of Madison, Wisconsin implemented additional requirements for residential winter maintenance. The current ordinance for snow and ice removal also requires salt and other chemical melting agents to be used "only to the extent necessary to treat the ice so that the ice can be removed."[235] The ordinance further requires excessive salt and chemical melting agents to be removed from the sidewalk following ice or snow melt, and the salt "shall not unreasonably accumulate on the sidewalk following ice melt or snow removal."[236] Failure to follow the ordinance by a private homeowner may result in a fine.[237]

2.3 INFORMATIONAL STRATEGIES

Environmental law and policy figures have long advocated the value of transparency and increased public consciousness of the environmental consequences of various policy and individual decisions. Some environmental laws, such as the National Environmental Policy Act (NEPA), are almost entirely non-substantive, yet have been highly influential as information-forcing tools. These strategies are no less applicable in the context of chloride policy development. They may be targeted to the public at large, or to chloride users in particular, to encourage the optimal usage of chlorides for a variety of purposes.

Broad-based communications intended for the public at large tend to emphasize actual data showing the widespread overuse of chlorides (especially in the context of road salt and water softeners), and also illustrate strategies that empower ordinary citizens to take actions to reduce that usage. For example, "Wisconsin Salt Wise" is a general online outreach effort created in 2015 pursuant to a partnership between Dane County; the City of Madison; the Madison Metropolitan Sewerage District; the City of Madison Water Utility; Public Health Madison Dane County; the University of Wisconsin-Madison Environment, Health, and

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[234] *See* Milwaukee City Ordinance 116-8-4; Waukesha City Ordinance 6.12; Walworth Cnty. Snow Removal Ordinance No. 05132014-2.

[235] Madison Gen. Ordinance 10.28(1).

[236] *Id.*

[237] *Id.* The first offense can cost a total of $124 and the second offense can cost a total of $187. This total includes both the fines and court costs. *City Updates Salt Use Ordinance for Public Sidewalks, Lots*, City of Madison (Dec. 15, 2022) www.cityofmadison.com/news/city-updates-salt-use-ordinance-for-public-sidewalks-lots.

Safety Department; and the Madison Area Municipal Storm Water Partnership.[238] The program has recently expanded to include the whole state. Its partners outside of Dane County include the WDNR, the City of Milwaukee, Waukesha County, Superior Fox-Wolf Watershed Alliance, and Root Pike Watershed Initiative Network.[239]

The Salt Wise program interactively educates the public about the overuse of deicing salt. The Salt Wise website features statistics that put the quantity of road salt used in perspective: it notes, for example, that it only takes one teaspoon of road salt to pollute five gallons of water.[240] The website also provides objective information about salt usage: in 2015, Wisconsin used almost 670,000 tons of salt on its highways alone.[241] To make this statistic more relatable, the site illustrates other things that weigh 670,000 tons; for example: 53,500 school buses or 121,800 elephants.[242]

Salt Wise also educates viewers on how to optimize their personal salt use. The website is broken down into several distinct categories, dependent on a person's role in the community. The categories are: homeowners, municipal, motorists, emergency medical services (EMS), and salt applicators.[243] In each section, the Salt Wise website gives guidance, advice, and illustrations relevant to each intended audience. The website also offers printable handouts so that the public can share the information with others. The Wisconsin Salt Wise Partnership also offers workshops on effective winter maintenance of parking lots, driveways, sidewalks, and trails.

Another set of informational strategies includes more detailed communications that are targeted at salt users themselves. Many of these are government and municipal users. There are nearly 100,000 miles of local roads in Wisconsin, and every year over one billion dollars is spent to maintain them.[244] In 1983, the Wisconsin Transportation Information Center (TIC) was created to help local highway officials manage this

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[238] Municipal Salt Resources, Wis. Salt Wise Partnership. *Municipal Salt Resources*, Wis. SaltWise Partnership, perma.cc/2CRM-F6D9.

[239] *See The WI Salt Wise Partnership*, Wisconsin SaltWise, www.wisaltwise.com/About-Us (last visited Aug. 9, 2023).

[240] *See Be Salt Wise*, Wis. Salt Wise Partnership, https://perma.cc/WQM3-YM52.

[241] *Id.*

[242] *Id.*

[243] *Id.*

[244] *Workshops & Training*, Univ. Wis. Madison Transp. Info. Ctr., perma.cc/7HUE-JGEM.

large road system and road budget.[245] The Federal Highway Administration, WisDOT, and University of Wisconsin-Extension provide the funding, education, and technical assistance necessary for the TIC to operate.[246] The TIC provides training to help Wisconsin local officials effectively maintain roads and improve street and highway safety. While the Wisconsin Salt Wise website is effective as a public tool for education regarding salt use, the TIC offers a more technical informational tool.

Minnesota offers Smart Salting training to help improve operator effectiveness and chloride reduction while still keeping roads safe.[247] The program offers individual training, organizational training, and property management training depending on the scenario. This program claims that participating organizations were able to reduce their salt use between 30%-70% while also preventing chloride contamination in bodies of water.[248] Minnesota Pollution Control Agency (MPCA) tracked this program's effectiveness in Dakota County through two winters. MPCA found that in the first winter after the training, Dakota County applied 14,175 tons of salt for 35 snow events, an average of 405 tons per event. During the following winter, Dakota County applied less salt: 9,585 tons for 27 events, an average of 355 tons per event.[249] Minnesota also keeps track of salt reduction in its Stormwater Manual.[250]

2.4 CHLORIDE ALTERNATIVES

As discussed in Chapter 1, most non-chloride-based deicers also have negative environmental impacts. Thus, this section will focus on green infrastructure options that reduce the need to use deicers.

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[245] *Id.*

[246] *About TIC*, Univ. Wis. Madison Transp. Info. Ctr., https://perma.cc/9AW4-GMLH.

[247] *Smart Salting Training*, Minn. Pollution Control Agency, https://www.pca.state.mn.us/business-with-us/smart-salting-training (last visited Aug. 25, 2023).

[248] *Id.*

[249] *Id.*

[250] *Success Stories: Salt Reduction and Cost Saving Examples*, Minn. Stormwater Manual, stormwater.pca.state.mn.us/index.php?title=Success_stories:_salt_reduction_and_cost_saving_examples (last visited Aug. 23, 2023).

Green infrastructure. Green infrastructure is a diverse group of strategies that manages stormwater at its source, while delivering environmental, social, and economic benefits.[251] Stormwater runoff occurs when rain or snowmelt flows over hard surfaces such as roads, driveways, and parking lots, instead of soaking into the ground. In addition to road salt, stormwater runoff collects oil and other pollutants such as heavy metals, nutrients, sediment, and pathogens as it flows to the storm sewer system and is discharged to local waterways.[252] Green infrastructure practices are intended to force precipitation to slowly percolate back into the ground, or capture it for later reuse, rather than quickly transporting it to surface waters as traditional stormwater infrastructure does.[253] To do so, green infrastructure vegetation, soils, and other elements and practices mimic and restore natural processes in urban environments.[254] Some of these practices, especially—as discussed below—permeable pavements, may be effective in reducing chloride use and transport to waterways.[255]

Chloride-specific aspects of green infrastructure use. Green infrastructure practices will only be successful at reducing chloride applications to the extent that they can direct water away from impervious surfaces, thus preventing pooling and freezing. Once salt is applied, it is difficult to prevent its movement to waterways; green infrastructure is valuable because it reduces the application requirement in the first place.

Permeable pavement is typically used as a stormwater control mechanism that allows stormwater to quickly infiltrate below the pavement surface without pooling or freezing.[256] As a result of this rapid surface

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[251] See Roopika Subramanian, *Rained Out: Problems and Solutions for Managing Urban Stormwater Runoff,* 43 Ecology L.Q. 421, 432 (2016) (describing how green infrastructure solves "[s]ome of the central problems related to urban stormwater runoff, such as flooding, increased flow, and velocity of flow"); *What is Green Infrastructure?*, U.S. Env't Prot. Agency, perma.cc/M868-ZCBV.

[252] See Subramanian, *supra*, at 424; *What is Green Infrastructure?*, *supra*.

[253] *Green Infrastructure: A Strategy for Restoring the Great Lakes and Great Communities*, Sierra Club, perma.cc/4H2L-VWA7.

[254] *What is Green Infrastructure*, *supra*.

[255] David Strifling, *Reducing Chloride Discharges to Surface Water and Groundwater: A Menu of Options for Policymakers*, Marquette L. School Legal Studies Paper No. 17-07 at 204 (revised Jun. 14, 2018).

[256] *Permeable Pavements*, Stormwater Best Mgmt. Prac., U.S. Env't Prot. Agency 1, 1, www.epa.gov/system/files/documents/2021-11/bmp-permeable-pavements.pdf (last visited Aug. 23, 2023).

drainage, permeable pavement typically requires less application of deicing substances.[257] A study done at the University of New Hampshire showed that once a porous asphalt lot was installed, it required 75% less deicing material compared to traditional asphalt lots.[258] The study also showed that porous asphalt often did not require any deicing material application because it provided better traction compared to traditional pavement.[259]

Other community-based efforts. Other community-based green infrastructure practices may also yield reductions in chloride transport to waterways. They can be implemented at the neighborhood scale and include rain barrels, rain gardens, green roofs, and downspout disconnections.[260] Rain barrels are containers that capture water from a roof so that it can be used later on lawns, gardens, and indoor plants.[261] Rain gardens "are shallow, vegetated basins that collect and absorb runoff from rooftops, sidewalks, or streets."[262] Green roofs are a layer of plant material on a flat roof that absorbs water and are especially effective in urban areas where space restraints limit the use of other practices.[263] Lastly, downspout disconnections involve rerouting rooftop drainage from discharging directly to the storm sewer system to rain barrels or permeable areas.[264] All of these green infrastructure practices are simple to install at the residential or neighborhood level.

2.5 WATER QUALITY TRADING

Water quality trading is a market-based approach to reduce pollutant transport to receiving waters. Trading programs generally allow regulated dischargers to meet permitting requirements or water quality standards by purchasing credits from another discharger of the same pollutant in the same watershed. Typically, trades

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[257] *Id.* at 5.; See generally Robert M. Roseen et al., Assessment of Winter Maintenance of Porous Asphalt and Its Function for Chloride Source Control, J. TRANSP. ENGINEERING, 2013, 04013007 (examining the performance of porous asphalt in freezing conditions for reduction of road salt application).

[258] *Id.*

[259] *Id.* at 5.

[260] *What is Green Infrastructure*, *supra*.

[261] *Soak Up the Rain: Rain Barrels*, U.S. Env't Prot. Agency, https://perma.cc/RKN2-G692.

[262] *What is Green Infrastructure*, *supra*.

[263] *Id.*

[264] *Id.*

occur between a point source facing high compliance costs and a nonpoint source subject to no permit requirements.[265]

The EPA has long supported water quality trading as a way to help meet permit requirements under the Clean Water Act, but it had largely allowed states to take the lead in implementing such programs. As a result, each state program operates differently, and some states have no trading program at all. However, in July 2023, the EPA announced that trading programs have not been adopted "to their fullest potential," and so it plans to propose a new federal rule that would clarify the requirements for state programs.

The Wisconsin Legislature has authorized water quality trading in Wisconsin,[266] and the WDNR has published extensive guidance establishing the rules for water quality trading in Wisconsin.[267] The option to trade is available to municipal and industrial WPDES permit holders to demonstrate compliance with water quality based effluent limits (but not technology based effluent limits) in permits. Trading can be used whether or not a TMDL has been established for the receiving water for the traded pollutant; where a TMDL exists, it essentially creates a cap-and-trade system.

Under the Wisconsin program, trades must result in improved water quality.[268] This is achieved by requiring a higher pollutant load reduction at the discharger's point of compliance than would be achieved without trading. In practical terms, this involves the use of trade ratios in which more than one pound of pollutant reduction must be achieved by the credit provider to offset a pound of the pollutant discharged by the permit holder.

It is not yet clear whether any revisions to the Wisconsin program will be necessary as a result of the forthcoming federal rule.

Wisconsin's trading program has largely been used to facilitate trades related to phosphorus pollution. Phosphorus trades have largely been between wastewater treatment plants as point sources (as the credit

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[265] In Wisconsin, however, trades can occur between a point source and a nonpoint source, or between two point sources.

[266] Wis. Stat. §283.84.

[267] Wis. Dep't Nat. Res., *Guidelines for Implementing Water Quality Trading in WPDES Permits,* Guidance No. 3200-3400-3800-2020-03, (2nd edition) (June 18, 2020).

[268] Wis. Stat. § 283.84.

buyer) and agricultural sources (as the credit seller). Trades involving chloride would likely involve different trading partners (most likely wastewater treatment plants and MS4 permittees) and perhaps lower transaction costs.

As required by 2019 Wisconsin Act 151, the Wisconsin Department of Administration has contracted with a third party to operate a single clearinghouse for trading of water quality credits. Activities conducted by this clearinghouse include producing credits by entering into contracts with third parties to undertake water pollution reduction activities, maintaining a bank of credits, selling credits, verifying credit amounts with the WDNR, establishing a centralized registry of all credits generated, and verifying that all such credits have been incorporated into discharge permits.[269]

2.6 INTEGRATED WATERSHED MANAGEMENT

Recent studies have advocated management of water resources using an integrated approach at the watershed level, necessarily crossing traditional geopolitical and agency boundaries.[270] Generally, this "integrated watershed management" or "one water" methodology aims to coordinate development and management of water and related resources so as to maximize economic and social welfare without compromising environmental sustainability.[271] Although its precise scope and content remains unclear, implementation of the approach requires innovative and cooperative governance mechanisms. It may play a role in the implementation of innovative technologies and policies such as green infrastructure or water quality trading. Effective intergovernmental cooperation in these areas could lead to both environmental and technological advances, including improvements related to chloride management.

Integrated water resources management approaches have been known by many names, and differ in scope and content along a spectrum of potential structures including information sharing, informal planning, and

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[269] This clearinghouse can be accessed at wiclearinghouse.org.

[270] See, e.g., Keith S. Porter, *Good Alliances Make Good Neighbors: The Case for Tribal-State-Federal Watershed Partnerships*, 16 Cornell J.L. & Pub. Pol'y 495, 502, 504–05 (2007); A. Dan Tarlock, *Putting Rivers Back in the Landscape: The Revival of Watershed Management in the United States*, 14 Hastings W.-NW J. Env't L. & Pol'y 1059, 1061 (2008) (referring to "ideal of integrated watershed management" and explaining the importance of the watershed as a planning and regulatory tool).

[271] This definition is closely modeled on that adopted by the Global Water Partnership. See Jan Hassing, et al., U.N. Educ., Sci. & Cultural Org., Integrated Water Resources Management (IWRM) In Action 3 (2009), perma.cc/SQ4M-TDQD.

even shared management.[272] It may also include informal or non-traditional watershed groups (as often form in connection with the agricultural sector).[273] Proponents may create groups to facilitate watershed-based decision making, such as watershed planning councils or interagency working groups. In any format, however, the approach is intended to address the interlinked nature of water resources—surface water and groundwater, point and nonpoint sources, storm water and wastewater management, water quality and water quantity, all may be considered under the integrated approach.[274]

In concept, multiple agencies or agencies from multiple jurisdictions (local, state, and federal) work together within a utility footprint—at city scale, in a watershed, or even regionally—to address a broad range of water-related issues of which chloride pollution could be one.

An integrated approach often has several advantages. It is flexible and allows for adaptive management as a core principle of its use. It can be a broad, inclusive process that involves diverse stakeholders and can complement or supplement traditional regulatory approaches. In some forms, it can provide incentives for regulated entities to meet environmental goals as an alternative to enforcement strategies.

Yet the integrated approach also faces certain difficulties. The most direct involve lack of funding and administrative inertia or reluctance to cooperate. Partly for these reasons, the concept's precise application or structure in a particular context is often poorly defined. When efforts bog down, partial integration can lead to increased fragmentation through the creation of additional entities without full control but holding some stake in regulatory outcomes.

The integrated approach may bear on several aspects of chloride reduction efforts, including the general control of nonpoint source pollution and the implementation of green infrastructure approaches. Chloride control efforts need to evaluate, understand, and optimize discharges from a wide range of sources; as discussed above, chloride emanates from both nonpoint and point sources, and from many different industries. In these contexts, while it may be difficult to suggest an aggressive integrated management approach to deal only with the chloride issue, chloride should be part of the portfolio to be addressed where

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[272] *See, e.g.*, Neil S. Grigg, *Integrated Water Resources Management*, Water Encyclopedia, perma.cc/7VSK-PV7N (noting "functional integration" and "conjunctive use").

[273] *Id.*; Effective Util. Mgmt. Steering Grp., *Taking the Next Step: Findings of the Effective Utility Management Review Steering Group* 11, 15, perma.cc/T7M7- YCPS.

[274] *Id.*

integrated management is pursued. At a minimum, informational sharing strategies should be pursued between agencies.

The Chicago Area Waterway System (CAWS) Chloride Initiative (CAWS Initiative) is one of the few integrated management efforts to have addressed chloride pollution.[275] In July 2015, the Illinois Pollution Control Board set a water quality standard of 500 mg/L chloride in most CAWS waterways, effective July 2018.[276] Led by the Metropolitan Water Reclamation District of Greater Chicago (MWRD), the CAWS Initiative participant organizations also include municipal, industrial, highway, wastewater treatment, and regulatory groups.[277] Ultimately, the efforts are intended to further the goal of meeting the new standards by "assessing current water conditions, documenting current road deicing activities, developing a pollutant minimization plan, identifying opportunities to reduce road salt runoff while maintaining public safety, and then implementing the plan and documenting progress."[278] The CAWS Initiative is ongoing, and the results will likely be used in preparing technical reports to be used for discharger variance petitions.[279]

2.7 ECONOMIC MEASURES AND ASSISTANCE

Bipartisan Infrastructure Law. On November 15, 2021, Congress passed the Infrastructure Investment and Jobs Act.[280] The Act aims to "rebuild America's roads, bridges, expand access to clean drinking water . . .tackle the climate crisis, advance environmental justice, and invest in communities that have often been left behind."[281] The Act will invest $50 billion to expand access to clean drinking water across the country and

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275 More information on the Chicago Area Waterway System Chloride Initiative can be found at www.cawswatershed.org/chlorides.

276 See generally Salt Inst. v. Ill. Pollution Control Bd., No 1–15–2003, 2016 WL 5853625 (Ill. App. Ct. Sept. 30, 2016) (affirming the Illinois Pollution Control Board's 500 mg/L chloride standard); Chicago Area Waterways Chloride Initiative Work Group, METROPOLITAN WATER RECLAMATION DISTRICT GREATER CHI.

277 *Hold the Salt!*, Friends Chi. River, https://perma.cc/4RTL-PN75.

278 Chicago Area Waterways Chloride Initiative Work Group, METROPOLITAN WATER RECLAMATION DISTRICT GREATER CHI.

279 See *Salt Inst.*, 2016 WL 5853625, at *3–6 (discussing potential availability of variances from chloride water quality standard).

280 Infrastructure Inv. & Jobs Act, Pub. L. No. 117-58 (Nov. 15, 2021).

281 *Fact Sheet: The Bipartisan Infrastructure Deal*, The White House (Nov. 6, 2021), www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/ (last visited Aug. 23, 2023).

water infrastructure and $110 billion in additional funding to repair roads, bridges, and other transformational projects.[282] While the scope of these projects remains unclear, there is the possibility that some components could reduce chloride transport to waterways as part of larger transportation or wastewater projects.

For example, Wisconsin, among other states, may apply for the grant programs made available under the Bipartisan Infrastructure Law. The Safe Streets for All program allows states to compete for $6 billion in funding toward 'vision zero' plans to improve road and traffic safety.[283] This grant could potentially be used to purchase more efficient deicing trucks or trucks that have tanks for brining for winter road maintenance.

Wisconsin is expected to receive a total allotment of $56,920,000 in 2023 for funding from the Bipartisan Infrastructure Law.[284]

Great Lakes Restoration Initiative. Another program that may provide funding for chloride management is the Great Lakes Restorative Initiative.[285] The goal of this program "is to restore and maintain the chemical, physical, and biological integrity of the Great Lake Basin Ecosystem."[286] The major focus areas of restoration include nonpoint source pollution impacts on nearshore health, habitats and species, and foundations for future restoration actions.[287] Eligible uses are "addressing toxic substances and areas of concern, reduction of nonpoint source pollution . . . reduction of runoff contributing to [harmful algal blooms], ecosystem and wetland restoration, storm water treatment and control, . . . and more."[288]

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[282] *Id.; A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Other Partners,* the White House, www.whitehouse.gov/wp-content/uploads/2022/05/BUILDING-A-BETTER-AMERICA-V2.pdf#page226 (last visited Aug. 8, 2023) [hereinafter The White House, *A Guidebook to the Bipartisan Infrastructure Law*].

[283] *The Bipartisan Law Will Deliver for Wisconsin*, U.S. Dep't Transp., www.transportation.gov/sites/dot.gov/files/2022-01/BIL_Wisconsin.pdf (last visited Aug. 9, 2023).

[284] Memo from Radhika Fox, U.S, Env't Prot. Agency (Feb. 24, 2023), www.epa.gov/system/files/documents/2023-02/FY23%20CWSRF%20BIL%20Allotments%20Memo_February%202023.pdf.

[285] The White House, *A Guidebook to the Bipartisan Infrastructure Law.*, *supra*.

[286] *Id.*

[287] *Id.*

[288] *Id.*

CWA Funding. The Bipartisan Infrastructure Law also provides additional funds to the Clean Water State Revolving Funds (CWSRF) and Drinking Water State Revolving Funds (DWSRF).[289] Both of these programs may provide funding for projects necessary to reduce chloride entering the environment.

CWSRF provides funds for a wide variety of water infrastructure projects.[290] Among these projects, there are funds available for public, private, or nonprofit entities that implement a state nonpoint source pollution management plan.[291] Under the CWSRF, financial assistance may be in the form of subsidized loans, additional subsidies to reduce existing loans, or a combination of assistance in order to keep project costs low.[292] In Wisconsin, the WDNR helps with the application and provides other assistance related to the CWSRF.[293]

The Safe Drinking Water State Revolving Loan Fund. The DWSRF provides financial assistance to help water systems and states achieve the health protection objective of the Safe Drinking Water Act.[294] Some of the program's objectives include improving drinking water treatment, fixing leaky or old pipes, improving source of water supply, replacing or constructing finished water storage tanks, and other infrastructure projects that are needed to protect public health.[295] The EPA will provide a grant to the state, and the state then contributes an additional 20 percent to match the federal grants.[296] The states are responsible for the operation of their DWSRF programs.[297]

Projects have been funded that have reduced chloride discharge. For example, the Redwood Falls Water System, located in Minnesota, constructed a new facility which uses reverse osmosis treatment for water

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[289] *See Id.*

[290] *Clean Water State Revolving Fund,* U.S. Env't Prot. Agency, https://www.epa.gov/cwsrf (last visited Aug. 23, 2023) [hereinafter U.S. EPA, *CW State Revolving Fund*].

[291]U.S. EPA, *CW State Revolving Fund*, *supra*.

[292] *Environmental Loans*, Wis. Dep't Nat. Res., https://dnr.wisconsin.gov/aid/EIF.html (last visited Aug. 23, 2023).

[293] *Id.*

[294] *How the Drinking Water State Revolving Fund Works*, U.S. Env't Prot. Agency, https://www.epa.gov/dwsrf/how-drinking-water-state-revolving-fund-works#Types%20of%20DWSRF%20Assistance (last visited Aug. 23, 2023).

[295] *Id.*

[296] *Id.*

[297] *Id.*

softening.[298] The facility was designed "to reduce the amount of salt needed for water softening in homes and to reduce the amount of chlorides discharged into the Minnesota River."[299]

WisDOT Funding. Although there are no specific grants or loans in Wisconsin for the reduction of chloride use, the WisDOT has funded high-capacity brine makers for the past five years.[300] The WisDOT pays for the brine maker and storage in the initial setup.[301]

WisDOT has recently offered a winter readiness payment where counties that meet all requirements of its Highway Maintenance Manual get a payout per truck.[302] The process for receiving funding so far has left it up to the counties to invest in equipping trucks with brining dispensing equipment and constructing buildings to store the trucks.[303] Nevertheless, the counties are paid back for their investment by WisDOT based on equipment rates.[304] The majority of the state funding for this conversion to brining goes to counties as they deice the state and interstate roads for WisDOT.[305]

Other programs. MPCA additionally administers several programs to help assist organizations looking to reduce salt use and chloride pollution.[306] Some of these programs include grant and loan funding for certain communities that first target reductions from businesses and industrial water softening systems.[307] First, the Minnesota GreenCorps places AmeriCorps members around the state to assist in many environmental

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[298] *Drinking Water State Revolving Fund Eligibility Handbook*, EPA (2017), www.epa.gov/sites/default/files/2017-06/documents/dwsrf_eligibility_handbook_june_13_2017_updated_508_version.pdf.

[299] *Id.*

[300] Wis. Dep't Trans. Winter Maint. Eng'g Cody Churchill, to Laura Herrick, Email (Jan. 3, 2023).

[301] So far, the Wisconsin Department of Transportation has funded thirty-five brine makers, and more requests have come in. Wis. Dep't Trans. Winter Maint. Eng'g Cody Churchill, to Laura Herrick, Email (Jan. 3, 2023).

[302] *Id.*

[303] *Id.*

[304] *Id.*

[305] *Id.*

[306] *Statewide Chloride Resources*, Minnesota Pollution Control Agency, www.pca.state.mn.us/business-with-us/statewide-chloride-resources (last visited Aug. 9, 2023).

[307] *Id.*

efforts, including salt reduction and chloride pollution mitigation.[308] Second, the GreenStep Cities program is a free and voluntary challenge to help cities achieve sustainability and quality-of-life goals with salt reduction being one of the recommended best practices.[309] Third, there is the Small Business Environmental Assistance through which MPCA currently offers zero-interest loans to businesses to upgrade their equipment to help reduce salt use.[310] Lastly, MPCA offers Clean Water Partnership zero-interest loans to local government and tribal communities to help implement practices that reduce non-point source pollution, which includes chloride.[311] The Wisconsin Legislature and Wisconsin state agencies could consider authorizing similar programs in Wisconsin.

2.8 CONCLUSION

Without question, the foregoing policy options will not all be appropriate in every context. After evaluating community-specific considerations, policy makers may choose one or more to reduce the problem of chloride transport to surface waters and groundwater. This work is not intended to suggest the elimination of chloride use in its most visible forms (deicing and water softeners). Rather, it suggests that such use be optimized. Optimization carries "triple bottom line" benefits for the environment (in chloride reductions); for the economy (in cost savings on chloride expenditures and personnel hours); and for society (in improved public health).

[308] *Id.*

[309] *Id.*

[310] *Id.*

[311] *Id.*