Review of Progress:

Code of Practice for the Environmental Management of Road Salts 2014 to 2019

Environment and Climate Change Canada
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List of acronyms

AVL – Automated Vehicle Location
BMP – Best Management Practice
CCME – Canadian Council of Ministers of the Environment
CEPA – Canadian Environmental Protection Act, 1999
COA – Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health
CWQG – Canadian Water Quality Guideline
DLA – Direct Liquid Application
ECCC – Environment and Climate Change Canada
MDSS – Maintenance Decision Support System
MTO – Ministry of Transportation of Ontario
MTQ – Ministère des Transports et de la Mobilité durable du Québec
RSWG – Road Salt Working Group
RWIS – Road Weather Information Systems
SAR – Salt Application Rate
SMP – Salt Management Plan
SVA – Salt Vulnerable Area
SWIM – Single Window Information Management
TAC – Transportation Association of Canada
WSI – Winter Severity Index

Acknowledgements

Environment and Climate Change Canada would like to acknowledge the many contributors to this report. This report would not have been possible without the collaboration of the multi-stakeholder Road Salts Working Group, consisting of government, industry, academia, and non-governmental environmental representatives. This working group was originally formed in 2002 to assist in the development of the Code of Practice and its members continue to actively collaborate with ECCC on the implementation of the Code of Practice.

1. Executive summary

This report presents a 5-year review of the progress achieved through implementation of the Code of Practice for the Environmental Management of Road Salts (the Code) from 2014 to 2019.

Road salts enter the environment through their release from storage facilities and their use on roads for winter maintenance. In 2001 the Government of Canada published an assessment report on the impacts of road salts. It concluded that the quantity of road salts used in Canada was raising the chloride levels of both ground and surface waters, and was having adverse effects on the environment. The Government of Canada published the Code in 2004 under the *Canadian Environmental Protection Act*, 1999, to assist public road authorities in managing their use of road salts to ensure environmental protection while maintaining roadway safety.

The basic premise of the Code is that the implementation of best practices to control salt release at storage sites and optimization of road salt use could help reduce the level of chlorides released into the environment. The Code is voluntary and targets public road authorities that use more than 500 tonnes of road salts per year. The Code is not implemented in Quebec because the province has their own strategy to address road salts that follows similar principles to the Code. The Code recommends that road authorities prepare salt management plans that identify actions they will take to improve their practices in salt storage, general use on roads and snow disposal and to report annually on these practices.

The objective of this review was to determine whether the Code has been effective in increasing the level of implementation of best practices for managing road salt, and in preventing and reducing the negative environmental impacts of road salts in Canada. The review will also assist Environment and Climate Change Canada (ECCC) in identifying future actions that may be needed to achieve risk management objectives for road salts.

Environment and Climate Change Canada, in collaboration with the National Road Salt Working Group (RSWG), undertook a first review of the effectiveness of the Code from 2004 to 2009 and concluded the Code has been effective in increasing the use of best practices for managing road salts in Canada. The Review was published in 2012 and identified eight actions (Refer to Table 1 in section 3.4) that could be considered for the continued improvement in road salt management. These actions included setting national targets for the implementation of best practices against which performance of the road organizations and the success of the Code could be evaluated and to schedule a second review. The Performance Indicators and National Targets published in 2014 and have been used during this second review of the Code.

This second review of the Code considered the following eight factors:

1. Level of adoption of the Code

The level of adoption of the Code is fairly high and has been just short of or met the target of 220 reports annually in recent years (Target 1). Consistency in reporting has decreased; 170 organizations reported regularly in the 2015 to 2019 period which is a decrease from the 222

organizations that were identified as reporting regularly between (2005 to 2009) in the first review.
Despite the inconsistency in the number of reporters, it is evident that the reporting covers a large portion of the organizations expected to be subject to the Code. Organizations that have reported at least once in the 2015 to 2019 period represent 73% of the Canadian population (excluding Quebec). The largest salt users, including most provincial road authorities and almost all large municipalities (90%) have reported under the Code, with some notable exceptions of large municipal road authorities not reporting where milder weather conditions exist, and low salt use is expected.

2. Salt management plans

There has been a significant decline in the number of organizations reporting having a salt management plan (SMP) in place with 80% of organizations reporting having an SMP in place in 2019. Only 62% of organizations reported reviewing their SMP in 2019 (Target 2). The annual review of plans is essential to ensure the plan is up to date and reflects any lessons learned from the previous season.

3. Training

Training levels for in-house and outsourced staff at municipalities has remained fairly constant over the 2015 to 2019 period, with in-house staff receiving much higher levels of training than outsourced. Training levels for all personnel and especially outsourced contractors need to be increased to meet the Transportation Association of Canada (TAC) and Code recommendation of all personnel to receive training at least once a year.

4. Implementation of best management practices (BMPs) and National Targets

Road organizations have made significant improvements in their salt application practices since the 1990s and the Code resulted in an accelerated adoption of many best practices at that time. Since the adoption of the Code, progress has been achieved and maintained by many road organizations in the implementation of many best management practices in salt management including coverage of salt storage sites, salt application and snow disposal practices.

Most of the National Targets developed in response to the first review are being or close to being met. Efforts are still needed to reach the targeted levels of adoption of best practices in certain areas including coverage of abrasive storage, and the use of pre wetting and pretreated salt technologies. Further effort is also needed to increase use of salt storage site runoff collection systems.

5. Identification of salt vulnerable areas (SVAs)

As of 2019, fewer than half of the reporting organizations inventoried their salt vulnerable areas and 35% prepared an action plan to address the salt vulnerable areas. Further efforts are needed to reach the 95% target set for 2024.

ECCC has encountered some challenges over the past several years while working to develop additional guidance to help organizations identify SVAs. There is some discussion on the need for additional guidance with some members of the Road Salt Working Group expressing the need for further guidance while other members have suggested that ECCC revisit the concept

of salt vulnerable areas suggesting that the identification of SVAs may encourage road organizations to focus efforts on SVAs at the expense of other areas.

6. Salt use

The total quantity of salt used reported under the Code has fluctuated significantly reaching a low of 2,153,000 tonnes in 2010 to a high of 4,972,000 tonnes in 2017. It is difficult to evaluate the quantity of salt used and the level of implementation of best practices and salt quantities reported because of other factors influencing salt usage (for example, winter severity, expanding road networks and number of reports).

The Code only applies to public road authorities using more than 500 tonnes of salt and is not implemented in Quebec therefore the salt use reported under the Code does not reflect all the salt entering the environment from road salt use in Canada. Salt use quantities for domestic, private and institutional uses are not available in Canada. ECCC has attempted to collect this data by doing a voluntary survey however this was unsuccessful due to lack of response and ECCC is considering mandatory information gathering to collect salt use data for these sectors.

7. Road safety

Long term road safety data suggest that the implementation of the Code has had no observable negative effects on roadway safety.

8. Chloride in the environment

There are no comprehensive studies on chloride concentrations across Canada. Many recent studies investigating long-term trends in chloride concentrations in certain North American freshwater ecosystems have shown increasing chloride concentrations and de-icing has been recognized as a major source of this contamination, particularly in urban areas. There is insufficient data to correlate changes in environmental concentrations with the implementation of the Code.

Conclusion and actions for consideration

The use of National Targets has been effective at monitoring the adoption of best practices. There has been a significant engagement from public road organizations across Canada in implementing and reporting on best practices. While the control of releases from salt storage sites though the coverage of stockpiles has improved the biggest challenges for the management of road salts are to continue to improve coverage of treated abrasives, optimize salt application through better technologies, improve drainage control at maintenance yards and to determine if organizations not subject to the Code are a significant source of chlorides in the environment.

Based on the current review, the Code is still considered an effective instrument. In order to improve even further the effectiveness of the Code the following actions should be considered by ECCC:

- **Continue to manage the environmental risks of road salts through the Code of Practice and to promote its adoption.**

The results reported since the implementation of the Code indicate a high level of engagement by public road organizations and demonstrate that the Code, as a risk management tool, is valid and effective. While progress has been achieved in adopting the Code and implementing best management practices; over time, progress has plateaued and areas for improvement remain. Environment and Climate Change Canada will continue working with the working Group and consider further opportunities to raise awareness of the Code and encourage its adoption by all road organizations, with an emphasis on medium sized municipalities (10,000 to 50,000 population) and inconsistent reporters.

- **Encourage improved adoption of best management practices by road organizations.**

Road organizations have a responsibility to ensure that they continue to meet the requirements of the Code, and should consider focusing efforts and resources to:

- ensure that they have a current salt management plan, and that this plan is reviewed annually (target 2)
- increase training for outside contractors and staff to meet the Transport Association of Canada recommendation for annual training
- increase coverage of treated abrasives through permanent roofs systems or temporary cover such as tarps (target 4) and
- improve runoff control at salt storage sites and maintenance yards

- **Continue to use national targets to evaluate effectiveness of the Code and further investigate targets that pose challenges for implementation.**

The National Targets have proven effective, however there remain uncertainties in 2 target areas:

- Target 7 (SVAs): Developing plain language guidance to help road organizations to identify SVAs has been a challenge for ECCC. Some stakeholders have suggested it may be more appropriate for road organizations to focus on best practices in all service areas rather than identifying SVAs. ECCC will consider studying a sample of the organizations that have already identified SVAs to understand how this information has been incorporated into their salt management plans and if it has been effective at protecting these areas. Pending the results of this investigation, ECCC will continue discussions with the Working Group to determine if the target (95%) and target date (2024) are still appropriate

- Targets 6a, 6b (Prewetting and Pre-treatment): The uptake for use of new technologies for road salt application has been slow and has not met the expected targets. It is unclear whether the adoption of these advanced technologies is limited by resources within road organizations or by lack of awareness of the advantages of these techniques on reducing salt use. ECCC will consider investigating the barriers to adoption of these techniques and work with the working group to develop recommendations

- **Investigate other uses of road salt beyond the Code of Practice**

Salt used for de-icing on private roads, commercial and institutional parking lots, sidewalks, personal driveways and salt storage by smaller users. also contribute to environmental

chloride loadings. Localized studies are indicating high levels of chlorides in certain water bodies. ECCC will consider mandatory data gathering on road salt use beyond organizations subject to the Code to determine the relative impact of these sectors and whether road salt management should be expanded beyond the large public road organizations that are subject to the Code.

- **Renew discussions with provinces and territories to explore opportunities for implementing the actions identified in this review.**

Given the voluntary nature of the instrument, continued contact is needed with partner organizations to maintain awareness of the need for support and engagement in the Code.

- **Schedule another review of the Code**
  5 years after the publication of this review to determine if the actions to consider have improved implementation of the Code.

2. Introduction

This report presents a review of the progress achieved under the Code of Practice for the Environmental Management of Road Salts[1] (the Code), published in April 2004 under the *Canadian Environmental Protection Act, 1999*. The objective of the review is to determine whether the Code has been effective in increasing the level of implementation of best practices for managing road salt, and in preventing and reducing the negative environmental impacts of road salts in Canada. The review will also assist Environment and Climate Change Canada (ECCC) in identifying future actions that may be needed to achieve risk management objectives for road salts. A first review was published in 2012 that covered the first 5 years of the Code's implementation from 2004 to 2009 and this review covers to 2019.

This report describes:

- the background on the Code and road salt management in Canada
- the design of the review
- the performance in implementing the Code and best practices
- the trends in salt usage in Canada
- the road safety data available
- the overview of environmental studies relevant to the review
- conclusions based on the review and
- actions for consideration

3. Background

3.1 History of the Code of Practice

Road salts have been used in cold regions of the world for more than half a century to maintain safe winter travel conditions for motorists and pedestrians. They are an essential tool for maintaining safe and efficient mobility during the winter by making the removal of snow and ice from travel routes (for example, roads, parking lots, sidewalks) easier, quicker and more cost effective than other de-icing alternatives.

In 1995, in response to a growing body of evidence that the annual loading of road salts to the environment was having adverse effects on the environment, road salts were placed on the second Priority Substances List under the *Canadian Environmental Protection Act*. A Ministers' Expert Advisory Panel concluded that an assessment should focus on the environmental effects of road salts and did not identify concerns with respect to human health.

Since 1995, a number of steps have been taken to assess and manage road salts in Canada, as summarized in Figure 1.

[1] The Code of Practice.

Figure 1. History of road salt management in Canada

A comprehensive science assessment of road salts was conducted from 1995 to 2001. On December 1, 2001, a summary of the final assessment report[2] was published in the *Canada Gazette*, Part I. The report showed that an average of 5 million tonnes of road salts was used on Canadian roadways annually.

The assessment covered chloride salts: sodium chloride, calcium chloride, magnesium chloride and potassium chloride. It also considered brines used in de-icing/anti-icing and dust suppression, the salt portion of sand/salt blends and ferrocyanide[3] additives used as anti-caking agents.

The assessment found sufficient evidence that the quantity of road salts used in Canada was raising the chloride levels in both ground and surface waters and was responsible for harmful adverse effects on aquatic species, terrestrial vegetation, wildlife mortality and soil chemistry. The sources of these impacts were identified as the use and storage of road salts, and snow disposal practices associated with road maintenance. The assessment report recommended that management options focus on storage facilities, roadway application, snow disposal and salt additives (ferrocyanides). The assessment report specifically recognized the importance of salt in maintaining road safety and stated that:

[2] The priority substances list assessment report for road salts is available in HTML and in PDF.
[3] Ferrocyanide is an anti-caking agent added to salt before the distribution by suppliers to keep it free flowing during storage and de-icing operations. The assessment report identified the substance as having an ecosystem impact from its use. Under the Code of Practice, “road salts” is defined as road salts that contain inorganic chloride salts with or without ferrocyanide salts. Implementation of best management practices under the Code are expected to minimize impact of ferrocyanides on the environment.

> Any measure developed as a result of this assessment must never compromise human safety; selection of options must be based on optimization of winter road maintenance practices so as not to jeopardize road safety, while minimizing the potential for harm to the environment.

On December 1, 2001, the federal Ministers of the Environment and of Health also published in the *Canada Gazette*, Part I a notice of intent to recommend that road salts containing inorganic chloride salts with or without ferrocyanide salts be added to the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999). They also advised that consultations would be held on the development of an instrument under CEPA 1999 respecting preventative or control action. This action launched the development of a risk management strategy to manage the environmental impacts of road salts while maintaining road safety.

The risk management strategy process involved the development of several reports and case studies, and an evaluation of risk management tools. The *Risk Management Strategy for Road Salts*,[4] published in May 2002, identified a best management practices approach that would build on the existing work of the Transportation Association of Canada (TAC) in its *Salt Management Guide*[5]*.* The Strategy proposed that a code of practice or guideline be developed under CEPA 1999.

The Code was developed through an extensive consultation process with interested stakeholders from across Canada, representing the federal, provincial/territorial and municipal transportation sectors; industry; road safety groups; environmental groups; and academia. This multi-stakeholder Road Salt Working Group provided advice on the development of an appropriate management instrument. The Working Group met numerous times over a two-year period to assist the department in developing the principles of the Code. This working group has continued to provide a forum for discussion of the Code since its inception.

In March 2004, the Code of Practice for the Environmental Management of Road Salts was published under CEPA 1999, in the *Canada Gazette*, Part I.

The Code of Practice focuses on the development of best practices respecting storage, application and snow disposal while leaving application rate decisions to local authorities familiar with road and weather conditions to ensure that road safety is not compromised.

Of note, in Quebec, a Strategy for the Environmental Management of Road Salts was launched in 2010. Every administration that manages and maintains public and private roads in Quebec is invited to participate in the Strategy on a voluntary basis. The general objectives of the Code and of the Strategy are similar including the development of environmental road salts management plans to help implement best practices and reduce impact on the environment. As a result, the federal Code is not implemented in Quebec. To help evaluate the effectiveness of the strategy, Quebec surveys road administrations every 5 years on their salt management practices[6]. A total of 64 municipalities and the Ministère des Transports et de la Mobilité durable du Québec (MTQ) responded to the first 5-year survey conducted in 2018 to 2019. Results from this survey have been included in this report where possible.

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[4] The Risk Management Strategy can be requested by email off the road salts technical document web page.
[5] The TAC *Salt Management Guide*.
[6] Stratégie québécoise pour une gestion environnementale des sels de voirie (French only).

The Code required a review of its effectiveness 5 years after its publication in the *Canada Gazette*. The first 5-year review of the Code, published in 2012, was conducted for the years 2005 to 2009[7]. The objective of this review was to determine whether the Code had been effective in increasing the level of implementation of best practices for managing road salts, and in preventing and reducing the negative environmental impacts of road salts in Canada. Through this first review, ECCC identified actions needed to improve risk management for road salts. Section 3.4 presents the list of actions for consideration that came out of the first review as well as an update on the work related to these recommendations.

One of the actions for consideration identified in the first 5-year review was to set national targets for the implementation of best management practices against which performance could be evaluated. Seven performance indicators and national targets were published in *Canada Gazette*, Part I in 2014 that form the basis of the current review. Section 3.4 presents these performance indicators and national targets.

Another action for consideration stemming from the first 5-year review was to schedule another review of the Code to evaluate whether the Code implementation was improved. This second review provides an opportunity to monitor continued performance and progress.

In February 2018 a draft screening assessment and risk management scope for cyanides were published in *Canada Gazette*, Part I, under the Government of Canada's Chemicals Management Plan for a 60 days public comment period. According to the information presented in the draft screening assessment, it was proposed that free cyanide and precursors of free cyanide may be harmful to the environment and meet the criteria set out it paragraph 64(a) of the *Canadian Environmental Protection Act, 1999* (CEPA). As a result, it was proposed that free cyanide, cyanide salts and cyanide complexes be recommended for addition to the List of Toxic Substances (Schedule 1 of CEPA). The sectors of concern identified in the assessment are metal mining, integrated iron and steel manufacturing and road salts (use of ferrocyanides as an anti-caking agent). Since the Code of Practice applies to the use of roads salts that contain inorganic chloride salts with or without ferrocyanide salts, any reductions in releases of inorganic chloride salts to the environment resulting from the Code should have a co-benefit of reducing releases of ferrocyanide salts to the environment. In the risk management scope, ECCC proposed to work with the road salt mining sector, as well as importers and users of road salts, to gather information required to determine the feasibility of controlling the concentration of ferrocyanide salts in road salts or their release to the environment. Should it be determined that controls are necessary, revisions to the Road Salts Code of Practice could be considered to minimize the need for ferrocyanides or their release to the environment.

[7] Publication of the Five-year review of progress.

3.2 Overview of the Code of Practice and the Syntheses of Best Practices

The objective of the *Code of Practice for the Environmental Management of Road Salts* is “to ensure environmental protection while maintaining roadway safety.” The Code has 7 sections and 3 annexes, which are described in the text box below. The Code applies to organizations that use more than 500 tonnes of road salts per year or have vulnerable areas in their territory that could be potentially impacted by road salts. The Code does not apply to road salts used for domestic purposes, or for private or institutional uses.

The Code recommends that road authorities prepare salt management plans that identify actions they will take to improve their practices in salt storage, general use on roads and snow disposal. A salt management plan (SMP) provides the mechanism through which the organization commits to implementing salt best management practices as it fulfills its obligation to provide safe, efficient and cost-effective transportation systems. An SMP should contain best management practices to protect the environment from the negative impacts of road salts.

Highlights of the Code of Practice[1]

Interpretation
This section defines the terms used in the Code. It defines "organization," "road salts," "TAC Syntheses of Best Practices" and "vulnerable areas." It further explains that the Code is aimed at the environmental management of road salts to protect the environment, that it does not replace or supersede existing laws or regulations and that it is not meant to be the sole guidance on salt management. It stresses that nothing in the Code should be construed as a recommendation to take action to the detriment of road safety.

Application
This section explains that the Code applies to organizations using more than 500 tonnes per year on average or that have vulnerable areas in their territory that could be affected by road salts. It also explains that the Code does not apply to salt used for domestic, private or institutional uses.

Salt management plan
A key element of the Code is the preparation of Salt Management Plans (SMPs). This section describes the need to prepare a salt management plan and the expected contents. It recognizes that the content and level of detail of an SMP may vary according to the size of an organization. It also states the need for a yearly review of the plan by the organization.

Best management practices
The underlying premise of the Code is that the application of the Best Management Practices set out in the TAC's *Syntheses of Best Practices* – Road Salt Management, published in September 2003, will result in effective salt management and, therefore, environmental protection. This section of the Code identifies the best practices associated with salt storage, snow disposal and salt application.

Implementation
This section of the Code identifies the expectation that subject organizations will prepare their SMPs within 1 year of publication of the Code in the *Canada Gazette* and begin implementation in the financial period immediately following the preparation of the plan. Organizations using agents or contractors are expected to have them comply with the SMP as well.

Record-keeping and reporting
This section of the Code recognizes the importance of good record-keeping and reporting. It also sets out the need to monitor and measure progress and submit an annual report to Environment and Climate Change Canada by June 30 of each year. The section also sets out the need to retain records for 7 years for reference and audit purposes.

Review of progress and need for further action
This section of the Code sets out the requirement for a review of progress 5 years after publication of the Code. This review "…*will help to determine if other steps or programs are needed to further prevent or reduce negative impacts of road salts on the environment.*"

Annex A: environmental impact indicators for road salts
Annex A of the Code provides guidance by identifying concentration of chlorides in the environment at which certain negative environmental impacts are likely to occur. It focuses on surface water, groundwater and soils.

Annex B: guidance for identifying areas that are vulnerable to road salts
Annex B of the Code provides additional salt management measures that may be taken in vulnerable areas, recommendations on consulting with other jurisdictions and considerations to be taken into account when identifying vulnerable areas.

Annex C: monitoring and measuring progress
Annex C of the Code provides a common approach to monitoring and measuring progress in road salt use, the implementation of best management practices with respect to road salts and the concentration of road salts in the environment. This is the basis for the annual reports that are filed with Environment and Climate Change Canada each June. This information is used to determine the extent and effectiveness of implementation of the Code.

The Code references TAC's *Syntheses of Best Practices – Road Salt Management*[8], which were updated in September 2013. The Syntheses of Best Practices provide background information to help understand road salt management and the environmental impacts, and define practices that should be implemented immediately and over the long term.

The Syntheses of Best Practices addresses 10 topics:

- salt management plans
- training
- road, bridge and facility design
- drainage and stormwater management
- pavements and salt management
- vegetation management
- design and operation of road maintenance yards
- snow storage and disposal
- winter maintenance equipment and technologies and
- salt use on private roads, parking lots and walkways

3.3 Organizations subject to the Code of Practice

The vast network of freeways, highways, roads, streets, laneways and sidewalks in Canada are maintained by numerous jurisdictions. The federal government maintains parts of the national highway system, such as roads within national parks. Provinces and territories maintain extensive inter-regional road networks and the majority of the national highway system. Municipal organizations maintain extensive local road systems. All of these jurisdictions use their own staff and equipment and may also outsource some or all of these services to private contractors through various contracting models. These organizations are referred to in this report as **road organizations** and are subject to the Code if they use more than 500 tonnes of road salts per year (5-year rolling average) and have salt vulnerable areas in their jurisdiction. The Code also applies to any company that holds a concession or lease to manage a public road, unless they are party to a salt management plan developed by that public road organization.

The Code does not apply to road salts used for domestic purposes, or for private or institutional uses; therefore, a vast number of large and small contractors who maintain roads, parking lots and sidewalks for private, commercial, manufacturing and institutional organizations are not subject to the Code. In addition, the federal Code does not apply in Quebec as the province has implemented an independent road salt strategy based on the principles of the Code. Therefore, provincial and municipal road organizations in Quebec do not report to ECCC on the implementation of the Code.

[8] TAC's *Syntheses of Best Practices – Road Salt Management*.

3.4 Summary of the 5-year review of progress and update on actions for consideration

The first review[7] (2005 to 2009) was developed with input from the multi-stakeholder Road Salt Working Group. This review identified several actions for consideration to improve the Code implementation. Table 1 lists the recommendations from the first review and provides an update on the activities to address those recommendations. Overall, the results obtained in the first 5-year review of the Code were encouraging. Reporting was generally good with 238 submissions received in 2009, and the level of adoption of the Code by road organizations was high.

Table 1. Update on activities addressing actions for considerations from the first 5-year review of the Code

Actions for consideration	Update on progress	Overall status
Continue to manage the environmental risk of road salts through the Code of Practice and to promote its adoption.	ECCC continues to promote compliance with the Code, including the reporting of data. ECCC publishes an annual report summarizing the data submitted by road authorities on the implementation of best management practices.	Ongoing
Include national targets for the implementation of best management practices against which performance can be evaluated.	Performance indicators and national targets were developed through a public consultative process. Final *Performance Indicators and National Targets for the Code of Practice for the Environmental Management of Road Salts*[9] were issued as Environmental Quality Objectives under subsection 54(1) of CEPA in December 2014. The road salt working group was engaged throughout the development and finalization of the performance indicators and national targets. The 7 published performance indicators cover 4 main activities of the Code: adoption of the Code, salt storage, salt application and salt-vulnerable areas.	Completed
Establish a framework that road organizations can adopt and implement for the protection of vulnerable areas.	ECCC is working to develop additional guidance to better support road organizations in the identification and management of salt vulnerable areas.	Ongoing

[9] Performance indicators and national targets for environmental management of road salts.

Actions for consideration	Update on progress	Overall status
Revise the Code's annual reporting form to facilitate and improve the analysis of data.	In the 2012-2013 reporting year the Single Window Information Management[10] (SWIM) program was implemented to allow for online reporting. The road salt annual reporting form (seen in Appendix B) available through SWIM is reviewed routinely and modifications are made to the form as needed and when resources are available to increase efficiency and improve reporting and data analysis. In particular, since 2013, reporting on materials used and storage of materials has been simplified.	Completed
Schedule another review of the Code.	ECCC has conducted the second review of the Code as outlined in this report. This review allows the Department to evaluate whether the Code implementation has improved by assessing the level of implementation of best practices against the national targets. It also provides an opportunity to monitor performance of the Code in protecting the environment and helps determine if additional measures are required to further reduce the negative impacts of road salt on the environment.	Completed
Collaborate with provinces and territories to explore opportunities for implementing the actions identified in this review (the first 5-year review).	In 2012 and 2013, ECCC met with provinces individually to explore options to enhance collaboration and support to the management of the Code of Practice in the provinces. ECCC also collaborates with provinces through the multi-stakeholder Road Salt Working Group whose membership includes provincial departments of the environment and transportation.	Completed Ongoing

[10] The Single Window Information Management (SWIM) program.

Actions for consideration	Update on progress	Overall status
	The Government of Canada also collaborates with the province of Ontario under the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health[11] (COA). The COA is an agreement to restore, protect and conserve Great Lakes water quality and ecosystem health. The agreement includes commitments for the province and federal governments related to managing chloride from road salts. The ninth COA has been signed and has been in effect since June 1, 2021.	Completed
Obtain additional information on annual salt use.	The first review of the Code identified an important data gap on road salts used by organizations not subject to the Code. In an attempt to fill the data gap, ECCC issued a contract to estimate total road salt use across Canada by all sectors not covered by the Code (that is, private contractors for maintenance of parking lots and sidewalks, sale to consumers for personal use on driveways and sidewalks, private companies and small municipalities using less than 500 tonnes per year). The study that largely relied on voluntary participation was unsuccessful. Therefore, the department plans to issue a mandatory notice under CEPA 1999 that will require stakeholders subject to the notice to provide information on quantities of salt.	Ongoing
Support the revision of the Transportation Association of Canada's (TAC) *Salt Management Guide*.	A series of Syntheses of Best Practices in Road Salt Management were published by TAC in April 2013. A chapter of that series on salt use on private roads, parking lots and walkways as well as a chapter on successes in road salt management (case studies) were developed under a contract with ECCC.	Completed

3.5 Performance indicators And National Targets

During the first review of progress of the Code, the lack of quantitative targets and performance indicators were identified as creating a challenge in determining whether the objective of the Code had been achieved. As such, it was recommended that indicators and national targets be

[11] Summary of the Canada-Ontario Great Lakes Agreement.

developed drawing on key components of the Code and current techniques in winter maintenance.

The indicators and targets were developed in consultation with the road salts working group and the public. Seven performance indicators were chosen under four main activities of the Code (adoption of the Code, salt storage, salt application and salt-vulnerable areas) and reflect current techniques in winter maintenance. The targets recognize the fact that the Code has been implemented for over fifteen years and sufficient time has been allocated for road organizations to phase in the required investments in most areas. All road organizations are expected to reach a minimum level of progress in best practices to prevent and reduce negative impacts from road salts; however, leadership to surpass these targets is encouraged.

The performance indicators and national targets for the implementation of best practices were published in Canada Gazette, Part I in 2014. The targets, published as Environmental Quality Objectives under CEPA subsection 54(1), provides a basis for conducting the current review of the Code. Table 2 describes the performance indicators, units of measurement and national targets.

Table 2. Performance indicators and National Targets

Area of the Code and purpose	Performance indicator	Unit for measuring performance	Target
Adoption of the Code To preserve a high level of participation in the Code and to inform on best practices in road salt management.	Submission of annual report	Number of road organizations reporting regularly	Target #1: By 2019, 220 road organizations are reporting regularly
Review of salt management plans To ensure planning is current and to encourage continuous improvement. This is a key component of the Code and all organizations are expected to conduct annual reviews.	Annual review of salt management plan	% of road organizations that annually review their salt management plan	Target #2: By 2019, 100% of reporting organizations review annually their salt management plan
Salt Storage To ensure that all road organizations in Canada have committed to managing their material storage facilities and to ensure best practices at these point sources.	Road Salts are stored under a permanent roof and on impermeable pads	% tonnes of road salts that are stored under a permanent roof and on impermeable pads	Target #3: By 2019, 100% of road salts are stored under a permanent roof and on impermeable pads
Storage of treated abrasives To ensure that all road organizations in	Treated abrasives are covered	% tonnes of treated abrasives covered	Target #4: By 2019, 75% of treated abrasives are covered, either under

Area of the Code and purpose	Performance indicator	Unit for measuring performance	Target
Canada have committed to managing their material storage facilities and to ensure best practices at these point sources. Case studies have illustrated an elevation in the quantity of salt leached through uncovered piles of abrasives.			a permanent roof or by a tarp
Salt application (electronic controllers) Groundspeed oriented electronic controllers on salt spreaders help to ensure that salt is applied at the proper rate regardless of the speed of the truck being used to spread the salt, and that salt stops discharging when the truck is stopped. Adoption and use of technologies are expected to increase and become a core practice for all organizations.	Spreaders are equipped with groundspeed electronic controllers	% of vehicles with groundspeed electronic controllers	Target #5: By 2019, 95% of vehicles are equipped with groundspeed electronic controllers
Salt application (optimization of de-icers)	More organizations are adopting practices that optimize the salt	(a) % of organizations pre-wetting or using pre-treated salts	Target #6a: By 2019, 95% of organizations use

Area of the Code and purpose	Performance indicator	Unit for measuring performance	Target
To encourage use of advanced salt application. Several studies show significant reductions in salt use with the introduction of new application technologies including pre-wetting. Further, pre-treated material is now offered on the market as a cost-effective alternative that can provide similar results.	application either by increasing their pre-wetting capacity or using pre-treated salts	(b) % of vehicles equipped for pre-wetting	pre-wetting or using pre-treated salt Target #6b: By 2019, 75% of vehicles are equipped for pre-wetting When reporting on this target, the percentage of vehicles is calculated based only on organizations that use pre-wetting.
Salt Vulnerable Areas To improve progress in identifying, monitoring and protecting areas that may be particularly sensitive to road salts.	Salt Vulnerable Areas are identified and an action plan is prepared to prioritize areas where best available techniques economically achievable are considered.	% road organizations where salt vulnerable areas are identified and an action plan is prepared	Target #7: By 2024[12], 95% of road organizations identify their salt vulnerable areas and prepare an action plan

[12] While Targets 1 to 6 are set for 2019, Target #7 is set for 2024 as organizations have indicated that they do not have the capacity or expertise to address salt vulnerable areas without further guidance and to allow ECCC time to develop the additional guidance.

4. Review design

4.1 Purpose and scope

The objective of this review is to determine whether the Code has been effective in encouraging implementation of best practices for managing road salts, and in preventing and reducing the negative environmental impacts of road salts in Canada. Through this review, ECCC also identifies future actions needed to improve risk management for road salts.

While the first review covered the 5-year timeframe from 2004 to 2009, the second review covers a longer timeframe and considers information available up to winter 2018 to 2019. The review assesses progress of road organizations in implementing the Code through an analysis of annual reports submitted by road organizations (Section 5). The review also considers key sources of information such as trends in salt usage (Section 6), road safety data (Section 7), trends in chloride concentrations in the environment, and impact of chloride on aquatic ecosystem (Section 8).

4.2 Review methodology

This review of the Code is based primarily on an analysis of annual reports submitted by road organizations under the Code where results are assessed against the national targets. To monitor and report on progress, the Code of Practice requests organizations that are subject to the Code to provide ECCC with annual reports. Annex C of the Code sets out the information to be reported by June 30 of each year, which is directly related to the performance indicators and national targets identified in Table 2. Information provided in annual reports are compiled and assessed against the national targets which were developed to help monitor progress in specific areas of the Code. Although the Code applies to organizations using more than 500 tonnes of road salt per year some organizations that do not meet this threshold also report. Information submitted by those that use 500 tonnes or less has been included in this report to present a better picture of the level of implementation of best practices and overall usage of road salts.

The review also considered several other sources of data:

- Salt production estimate in Canada using data from NRCan
- Salt imports and exports data from Statistics Canada
- Trends in chloride concentrations in surface water from federal and provincial monitoring programs and scientific literature
- Scientific literature on impacts of chloride on aquatic ecosystems
- Road network data and road safety data from Transport Canada and Statistics Canada
- Considerations provided by the multi-stakeholder Road Salt Working Group on the evolution of road salt management practices and challenges to implementing the Code

5. Performance in implementing the Code of Practice and Best Practices

This section presents an assessment of the level of implementation of the Code of Practice and best practices in different areas of salt management including storage of road salt and treated abrasives, salt application, disposal of snow containing road salt, management of salt vulnerable areas and training of staff involved in winter road maintenance activities. The level of implementation of best practices is assessed by summarizing the information reported annually by federal, provincial, municipal and private road organizations that adopted the Code. For performance indicators with established national targets, results are compared and assessed against those targets.

Data submitted in annual reports are compiled and analyzed for a winter period, which is generally from November of one year to April of the next year. Throughout this report, a reporting year is represented by the final year of that winter (for example, 2019 represents the winter starting in 2018 and ending in 2019). Note that some year-to-year variation in results exists due to variance in the number of reports submitted annually. Although annual reports are due by June 30 of each year, a number of reports are usually received after this date. For the purposes of this report, submissions received up to November 2019 for the 2018 to 2019 winter season are included in the analysis.

There is year to year variation in the number of road organizations reporting to ECCC and data quality. Due to resource limitations, ECCC follows up with stakeholders only on key data inconsistencies. In addition, some information in the online reporting form is not mandatory and not provided by all organizations in their annual reports. Therefore, the sample size (that is, the number of organizations) is not the same for all analyses presented in this section. Results presented as percentages exclude the organizations that did not report on that issue.

Where available, data on the adoption of the Quebec Strategy and implementation of best management practices obtained from the Ministère des Transports et de la Mobilité durable du Québec (MTQ) is also presented. These data are not compiled with the information reported under the federal Code. However, note that 2 other federal organizations located in the province did report under the Code and their data was compiled in the tables and figures in sections below.

5.1 Adoption of the Code of Practice

Overall level of adoption of the Code of Practice

Adoption of the Code by road organizations is measured by the number of reports submitted annually to ECCC. Figure 2 presents the results of this indicator against the national Target 1 of 220 submitted reports which was established based on the number of reports that had been received in the first 5 years of the Code implementation (2005 to 2009). Data from 2013 to 2019 show the proportion of reports that were submitted before and after the due date of June 30. The exact submission dates for the period of 2005 to 2012 are not available. In recent years, ECCC has undertaken a phone campaign to previous reporters who have not met the June 30 deadline to encourage submission.

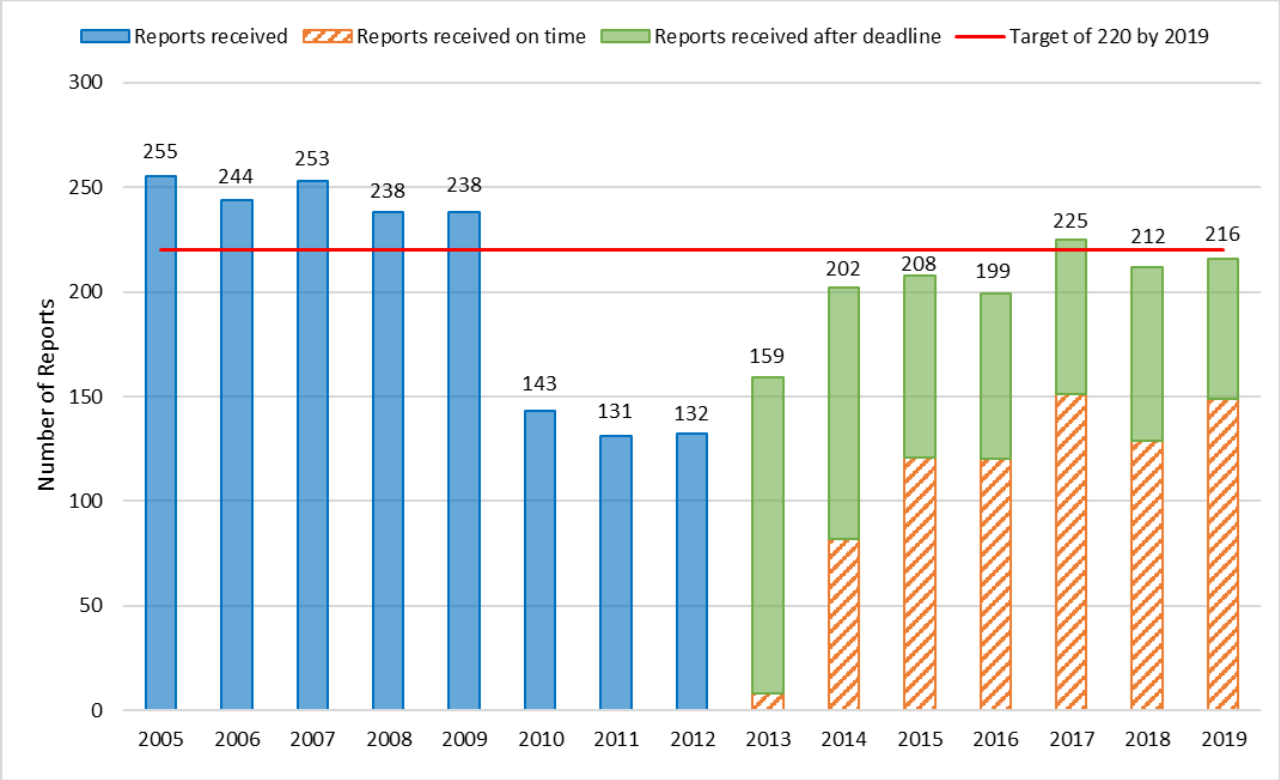

Figure 2. Number of reports submitted by road organizations to Environment and Climate Change Canada from 2005 to 2019.

The number of reports received in the first 5 years of the Code implementation (2005 to 2009) is significantly higher than the number of reports received from 2010 to 2013. However, the target for the level of adoption of the Code is close to being met for the last 3 years (Figure 2).

The drop in the number of reports received from 2010 to 2013 could be due to the decrease in compliance promotion activities (for example reminders to report were not sent to road authorities) during that period. Additional analysis of reporting by organization type is presented below to explore the reasons why the number of reports received from 2014 to 2019 is lower than the number received from 2005 to 2009.

Adoption of the Code of Practice by type of organizations

Table 3 presents the breakdown of organizations by type that have reported since winter 2010. Reports represent all types of road organizations, including a range of population sizes and varying climatic regions/conditions across the country.

Appendix E lists the 170 organizations that have been reporting consistently over the last 5 years (that is, at least 4 out of the 5 years from 2015 to 2019). This is a decrease from the 222 organizations that were identified as regular reporters (4 reports between 2005 to 2009) in the first review. However, a total of 290 different road organizations reported at least once during

the period of 2015 to 2019. Of the 120 organizations that reported fewer than 4 times in the 2015 to 2019 period, 98 use more than 500 tonnes. Further investigation and outreach should be considered to encourage the inconsistent reporters to report on an annual basis.

Table 3. Breakdown of the type of road organizations that have reported under the Code between 2010 and 2019

Type of road organization	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Provinces and territories	10	8	8	8	8	8	9	9	9	9
Municipalities	122	112	114	138	180	184	175	200	187	189
National parks and other federal organizations	8	8	8	10	10	11	10	10	11	11
Private organizations	3	3	2	3	4	5	5	6	5	7
Total number of reporting organizations	***143***	***131***	***132***	***159***	***202***	***208***	***199***	***225***	***212***	***216***

At the provincial and territorial level, many of the provinces and territories reported regularly under the Code between 2010 and 2019. For those that did not report regularly, it should be noted that:

- Quebec is not a participant in the Code.
- Although Newfoundland and Labrador has not reported since 2011 and the Northwest Territories and Nunavut have not reported, in the northern regions, winter temperatures and road characteristics limit the usefulness of road salts. Therefore, total salt used in these regions is likely low compared to provinces.

A consistent number of federal road organizations reported since 2013, 7 of which are national parks all managed by Parks Canada.

Seven private organizations reported in 2019, 5 of which were regular reporters. These private organizations are mostly under contract to maintain the safety of provincial and local public roads.

Level of adoption of the Code of Practice by municipal road organizations

The largest category of reporters is municipal organizations. In the period of 2015 to 2019, there were 262 municipal road organizations that reported at least once under the Code. No municipalities in the territories or Quebec reported. Of the reporting municipalities, 145 reported regularly, at least 4 out of the 5 years from 2015 to 2019 (55%) including 11 low salt users (<500 t/yr). Of the 117 that did not report regularly, 22 were low salt users. It is unclear why the 95 municipalities that reported using >500t/year do not report annually. Data showed that 71 municipal organizations that reported at least once between 2005 to 2009 did not report in the period of 2015 to 2019 and 42 of these reported salt use over 500 tonnes**.**

The number of municipal road organizations that reported varied largely by province. The provinces with the largest number of municipalities that reported consistently was in Ontario (91), followed by Alberta (22), and British Columbia (11). In the other provinces, a lower number

of municipalities reported: New Brunswick (8), Newfoundland and Labrador (6), Nova Scotia (4), Saskatchewan (2) and Manitoba (1).

Population analysis

Although population size is not a criterion for adopting the Code, population analysis[13] for municipalities managing road salts provides useful indications of the Code adoption rate. Although traditionally it would be expected that urban centres would use more salt, this varies considering the usefulness of road salts under local weather conditions, responsibility for road management between jurisdictions, etc. In many areas across Canada, a particular geographical region may have roads managed by various jurisdictions including provinces, regional municipalities, counties and individual municipalities. Note that the data presented in this analysis excludes Quebec and organizations (such as regional municipalities and counties) that result in double counting of a population have been excluded. For this analysis, the census definition of municipality is used, which covers both urban centres and rural jurisdictions such as towns, townships, counties, etc.

There are 81 Canadian municipalities[14] with a large population (greater than 50 000), that represent 68% of the Canadian population (excluding Quebec). Of these, 90% (73) adopted the Code and submitted an annual report at least once between 2015 and 2019; 4 large municipalities, all located in British Columbia did not report. The mild climate in the West could result in low salt use and explain why these large BC municipalities did not report. Of these large municipalities, 3 did not meet the reporting threshold, confirming that population size is not directly correlated with salt use. The larger reporting municipalities represent 64% of the population.

In the segment comprised of smaller populations (between 10 000 and 50 000), there are 227 municipalities, which represents approximately 16% of the Canadian population (excluding Québec). Of these small municipalities, approximately 42% (96) adopted the Code and submitted an annual report at least once between 2015 and 2019; most (93%) of the reporting small municipalities were meeting the Code's criterion of using more than 500 tonnes of road salt per year. The reporting municipalities represented 7% of the population.

Smaller (<10,000 population) are less likely to report as there is lower likelihood of meeting the 500 t/yr reporting threshold. These could include small municipalities, but also rural areas such as townships and counties with much lower population density. A total of 71 small municipalities reported at least once. Of these, roughly two-thirds (47) met the threshold of 500 t/yr. These reporting municipalities represent only 1% of population.

Almost all large municipalities report under the Code and most of these reports regularly and meet the threshold. The proportion reporting under the Code decreases with the size of the population, with less reporting from smaller municipalities. As population declines, a greater proportion of municipalities do not meet the threshold for reporting. Municipalities that have reported under the Code represent 73% of the population.

[13] Source of population data: Statistics Canada 2016 Canadian Census.
[14] Total number of municipalities and associated populations from Census: Statistics Canada 2016 Canadian Census.

Level of adoption of the Québec Strategy for the Environmental Management of Road Salts

In 2019, the province conducted a 5-year study during which an online questionnaire was made available to all municipalities to learn about best management practices in place. Sixty-four municipalities responded to the questionnaire. Results presented in the following subsections summarize the information obtained from these 64 municipalities and the MTQ during the 2019 study.

Summary – Level of adoption (Target 1)

The target of 220 reports annually has only been met once since 2014 though recently the number of reports received has been close to the target. A total of 170 organizations reported regularly in the 2015 to 2019 period which is a decrease from the 222 organizations that were identified as reporting regularly between (2005 to 2009). A significant drop in reporting was experienced between 2010 and 2013. This could be the result of less compliance promotion activities undertaken by ECCC in this time period. Recent phone campaigns have resulted in some increase in reporting.

Most provinces and almost all large municipalities (90%) have reported under the Code, but some focus should be given to medium size municipalities (10,000 to 50,000 population) to determine if they meet the threshold for reporting. All reporting organizations represent 73% of the Canadian population (excluding Quebec).

5.2 Personnel involved in winter operation activities

Federal, provincial and municipal road organizations often use their own staff and equipment for winter road maintenance activities and may also outsource some or all of services to private contractors. To reduce the environmental impact of road salt, best management practices in winter maintenance operations should be implemented by all personnel, including in-house staff and outsourced contractors.

The large majority of reporting municipalities (approximately 95% with some year-to-year variation) conduct salt storage activities in-house and about 10% relied on outsourced contractors for all or part of their activities related to salt storage (Figure A-1, Appendix F). For salt application, municipalities also rely mainly on in-house personnel, but a larger percentage also hire contractors (34% in 2019). For snow disposal, in 2019, 77% of reporting municipalities indicated conducting activities in-house and 13% relied on contractors for all or some of their activities.

Seven of the nine provinces indicated for 2019 that their salt storage and salt application activities are done in-house. Of the 9 reporting provinces, 5 indicated hiring outsourced contractors for salt storage and 6 hire contractors for salt application activities.

Of the 11 federal organizations that reported in 2019, all except 2 have indicated doing salt storage and salt application activities in-house. Two federal organizations reported hiring outsourced contractors for activities related to salt storage and salt application. Since none of

the reporting provinces and very few federal organizations dispose of snow at designated sites, these sectors will not be discussed in the next section.

Training of personnel

Training of personnel at all levels is important to achieve safe and effective implementation of best practices. It is a critical component of successful change in management, especially when trying to replace long-term practices with less familiar ones. A number of training programs were implemented as a result of the Code.

TAC developed a synthesis on training to provide information to assist in assessing, developing and implementing a successful salt management training program[15]. It recommends that each organization include a comprehensive training program that demonstrates the purpose and value of new procedures and ensures that personnel are prepared and competent to carry out their duties.

The Ontario Good Roads Association offers various winter maintenance operations training for mechanics and technicians, equipment operators as well as supervisors and patrollers. Information on this training is available on the Ontario Good Roads Association's website[16]. The Smart About Salt Council also developed training programs for owners/operators and facility managers[17].

Municipal organizations have reported a higher percentage of in-house personnel receiving training (either new or refresher) compared to outsourced contractors regardless of the level or type of position (that is, managers, supervisors, operators, mechanics and patrollers) (Figures 3 and 4).

Amongst in-house municipal personnel, operators are more likely to receive training (78% in 2019), followed by supervisors (73% in 2019), patrollers (68%), managers (62%) and mechanics (53%). Similarly, outsourced operators and supervisors more often receive training compared to outsourced patrollers, managers and mechanics. Percentages of trained contractors varied between 9% to 28% in 2019 depending on the level or type of position. However, it was noticed that these values may be underestimated as the current reporting form do not indicate and exclude organizations that do not have all of these categories of personnel. ECCC will look into ways to correct this in the future.

[15] Syntheses of Best Practices in Road Salt Management (2013): 2.0 – Training. Transportation Association of Canada.
[16] Ontario Good Roads Association's Winter Maintenance Operations Training.
[17] Smart About Salt Training Programs.

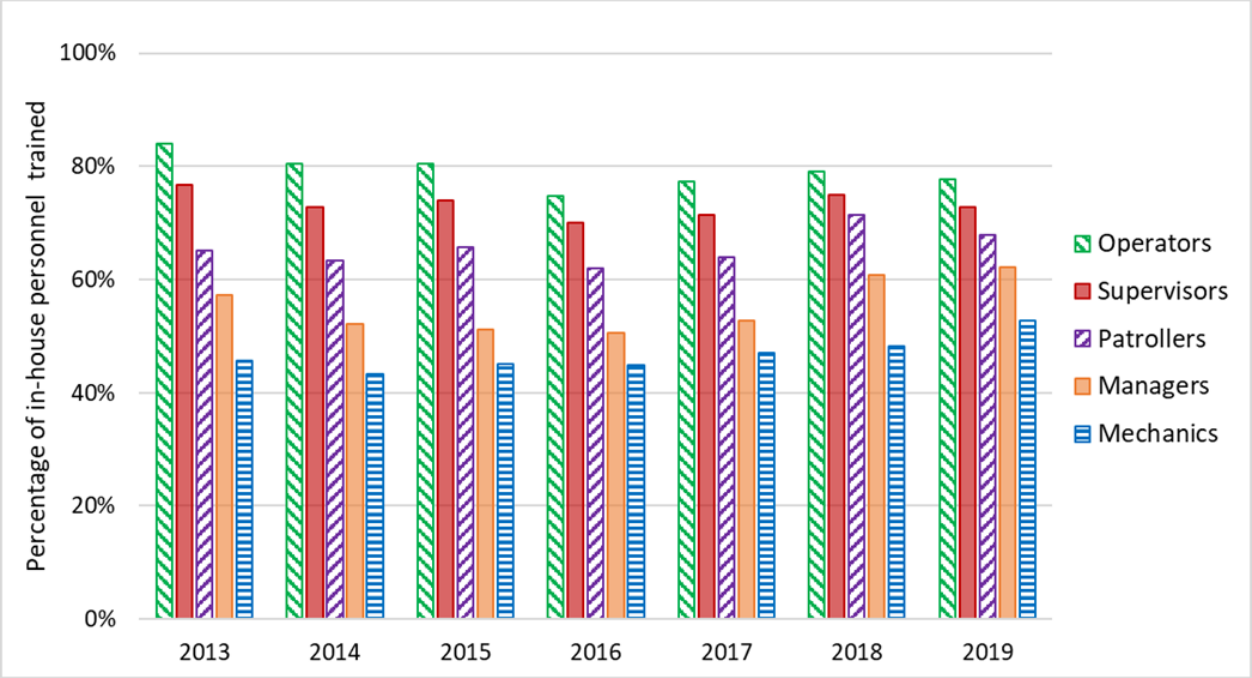

Figure 3. Percentage of training to different levels of in-house personnel from 2013 to 2019.

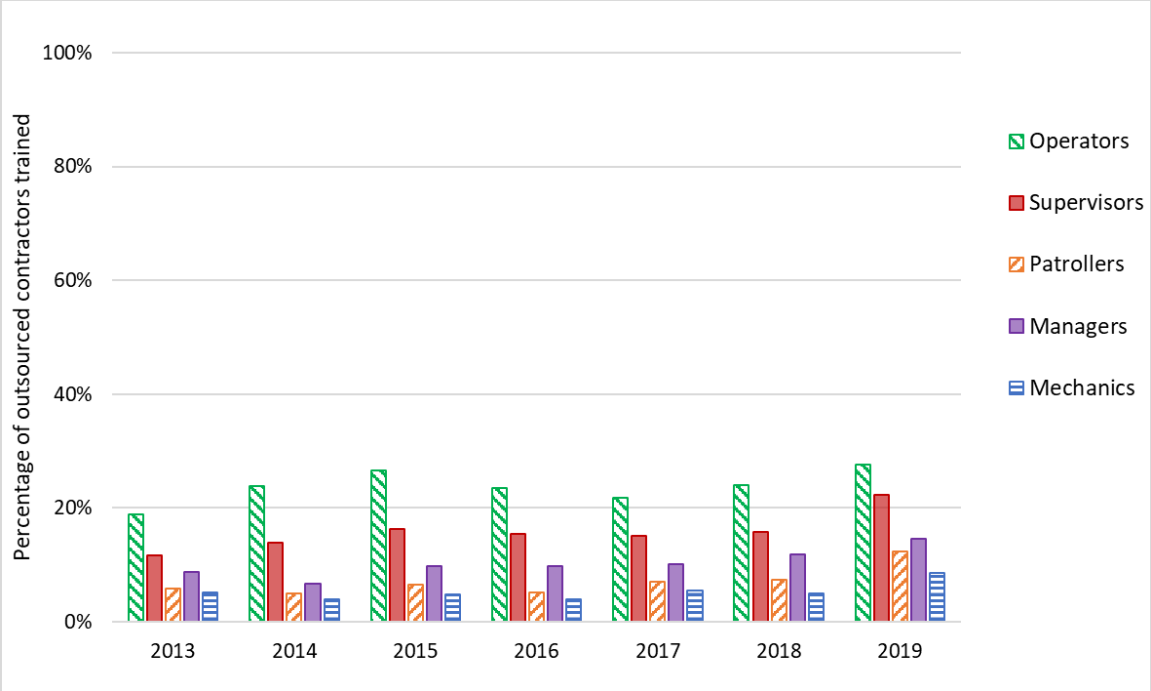

Figure 4. Percentage of training to different levels of outsourced contractors from 2013 to 2019.

Overall, the percentage of municipal organizations offering training to their in-house staff, especially to operators involved in winter maintenance activities is high. However, TAC recommends that road organizations should train all their staff once a year. The level of detail of the training should be tailored to the position. The frequency of training provided to in-house staff and especially outsourced contractors needs to be improved if it is to meet TAC's recommendation.

Summary – training

Training is not provided to all in house personnel with mechanics and managers being trained less than operators. In addition, training for outsourced contractors is much less prevalent. Training levels for all personnel and especially outsourced contractors need to be increased to meet the TAC and Code recommendation of all personnel receiving training at least once a year.

5.3 Annual review of salt management plans

The Code of Practice recommends the development of salt management plans. A SMP provides the mechanism through which the organization commits to implementing salt best management practices while maintaining roadway safety. Road organizations are encouraged to annually review their SMP to ensure that planning is current and allows for continuous improvement. Road organizations should revisit their SMP at the end of each winter in order to identify shortcomings, issues and areas where improvements are needed prior to the start of the next winter season. In addition, TAC recommends road organizations report to their management at the end of the season on implementation of the SMP to ensure management is aware of the progress achieved.

When the target for reporting on the annual review of SMPs was developed, it was expected that all organizations would have a SMP in place, as this is a fundamental element of the Code. However, in recent years over 20% of reporters indicate they either do not have a plan or are unaware if one exists (Table 4). The reasoning behind the shortfall in reporting on SMPs needs to be explored and solutions identified. The Code requires organizations to ensure an endorsement of the plan by the highest levels in the organization and TAC recommends that organizations report annually to senior management on the implementation of the SMP. For salt management planning to be effective it is critical that organizations have an SMP and ensure senior management is supportive of the SMP and its implementation.

Table 4. Number of organizations reporting not having or not knowing if they have an SMP

Year	2013	2014	2015	2016	2017	2018	2019
Organizations that reported "No" SMP	12	16	25	27	38	33	33
Organizations that reported "Not sure" about SMP	1	5	6	6	10	10	10
Combined % for all reporting organizations	8%	10%	15%	17%	21%	20%	20%

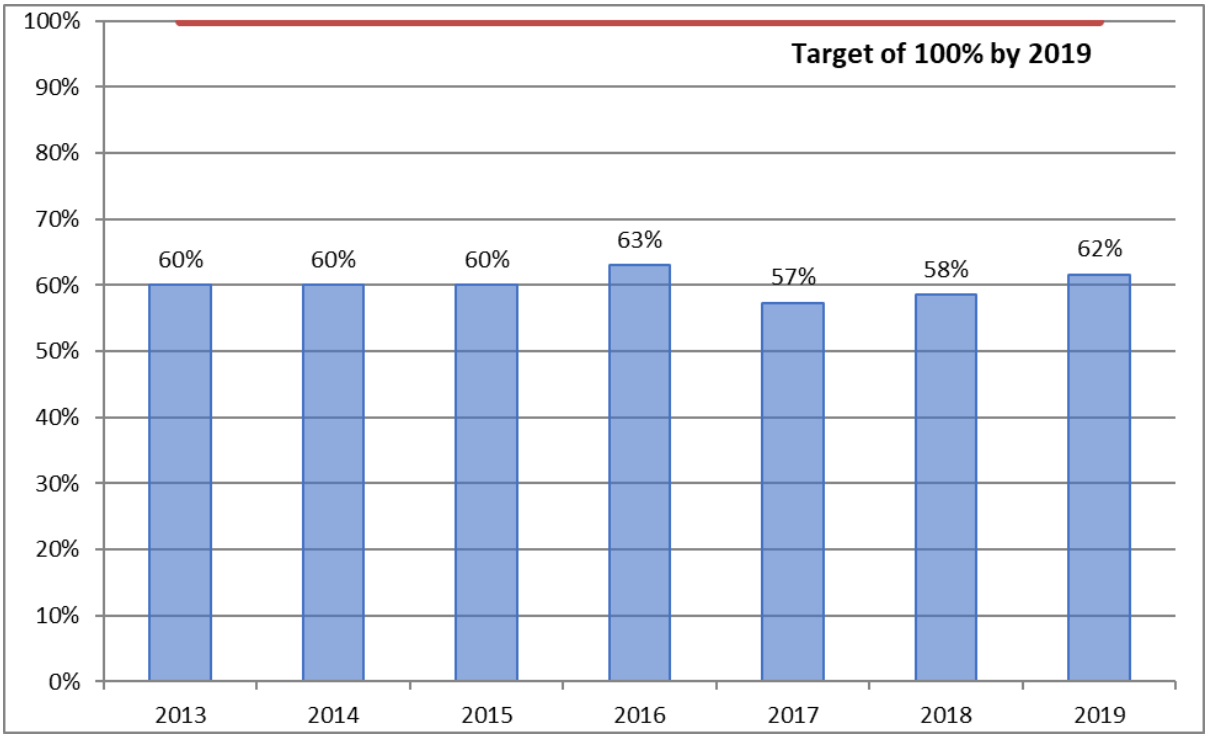

Figure 5. Percentage of road organizations that review their salt management plan (Target 2).

Since 2013, approximately 60% of the reporting organizations have indicated conducting an annual review of their SMP with some year-to-year fluctuations (Figure 5). Organizations reporting under the Code are asked to report separately on whether they conducted an annual review or updated their salt management plans. Through discussions with the multi-stakeholder Road Salt Working Group, road authorities have noted it is unclear what is meant by “annual review of salt management plan” and the level of effort that should be involved in the review. ECCC has noted that organizations should read their plans annually to ensure they are still valid but reviewing salt management plan may not necessarily result in modifying/updating it every year. Additional detail could be included in the reporting form to clarify what is meant by an annual review.

Development and Update of Salt Management Plans reported under the Québec Strategy for the Environmental Management of Road Salts

13% of the 64 municipalities that participated in the 5-year study conducted by the MTQ in 2019 indicated having a salt management plan in place or updated it over the course of the last year. It should be noted that of those 64 municipalities, only 26 reported using 500 tonnes or more of road salt per year.

Summary – SMP annual review (Target 2)

A significant number of organizations report not having implemented a salt management plan that covers the elements described in the Code. In recent years, about **20%** of all reporting organizations do not have or do not know if they have implemented a plan. Only 62% of organizations reported reviewing the plan in 2019. More efforts are needed to ensure all organizations have developed, implemented and conduct annual reviews of their SMP.

5.4 Storage of road salt and treated abrasives

One of the largest potential point sources of salt entering the environment is the material storage facility. This applies to straight salt and blended sand/salt (treated abrasives). Salt releases from storage sites can be controlled through the use of covered storage on impermeable pads (creating a barrier to control salt loss), runoff management to prevent salts or chloride contaminated runoff from entering the environment and good housekeeping practices.

In 2019, a total of 414 salt storage sites were reported by municipalities. Provinces reported 984 storage sites and federal and private organizations reported 27 and 26 storage sites respectively (Figure 6). The lower number of reported sites from 2010 to 2013 reflects the lower number of submissions received during those years.

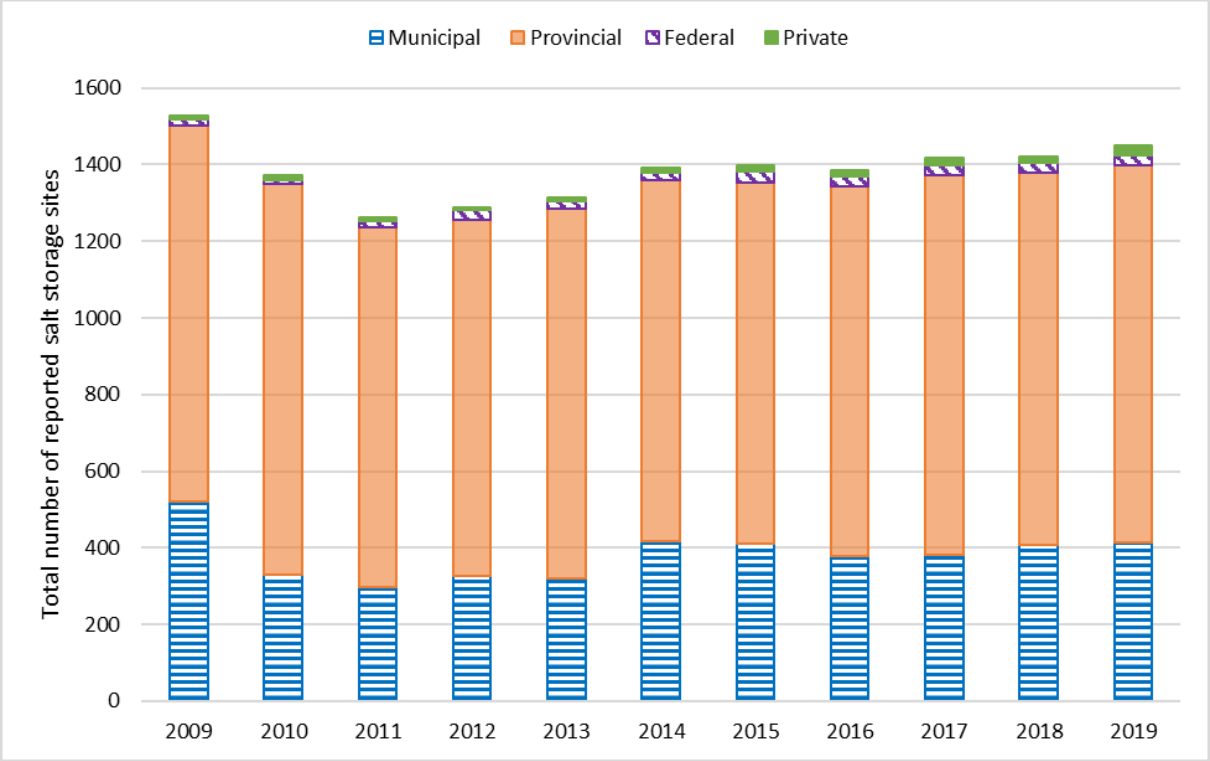

Figure 6. Total number of storage sites reported between 2009 and 2019 by type of organization.

5.4.1 Coverage of road salt and treated abrasives

Solid salt and treated abrasive stockpiles should be covered to protect them from the elements. Salt that is exposed to rain will dissolve, enter the site drainage and potentially contaminate groundwater. National targets have been established to assess whether salts and treated abrasives are adequately covered. The targets have been set at 100% for road salt that should be covered under a permanent roof and on impermeable pads and 75% for treated abrasives that should be stored under cover, either under a permanent roof or by a tarp.

Most reporting road organizations have implemented best management practices for storage of road salts and treated abrasives. By 2011, 100% of road salts reported were stored under a permanent roof and on impermeable pads but a slight decrease has been observed since 2015 (Figure 7).

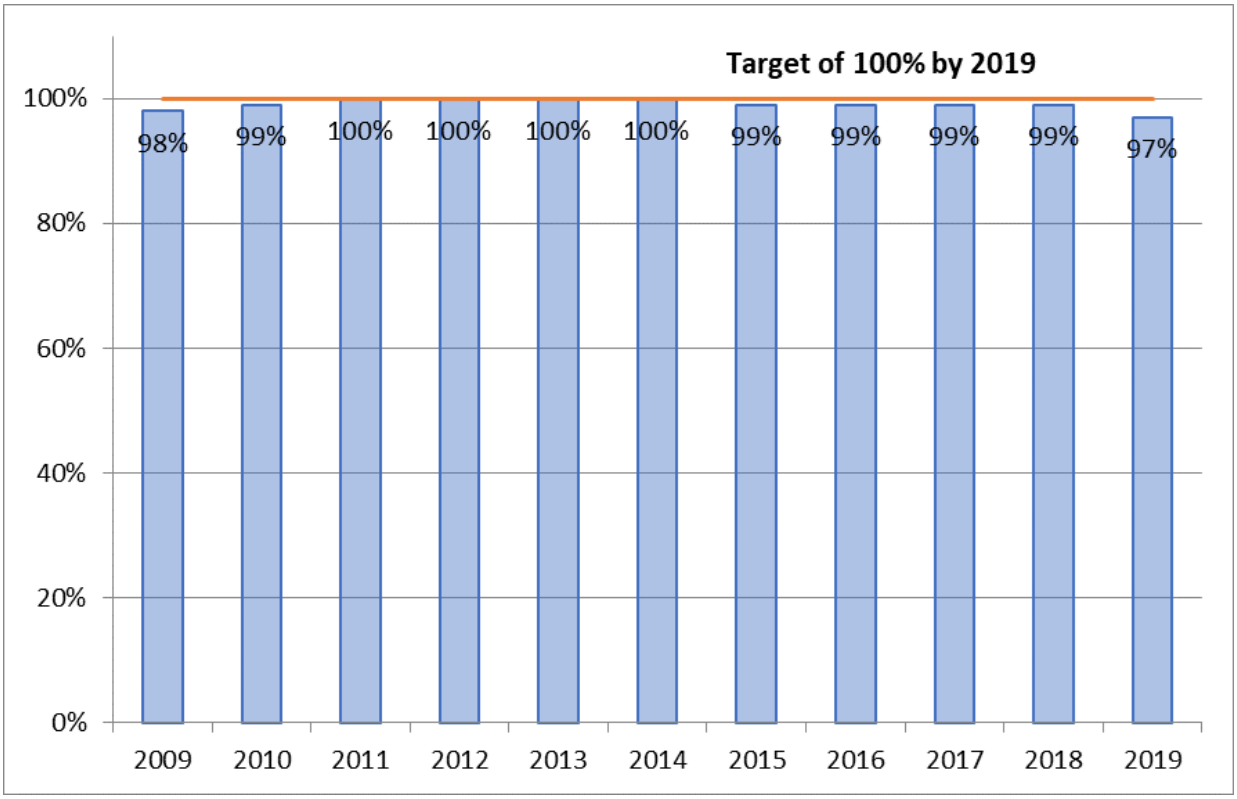

Figure 7. Percentage of tonnes of road salts stored under a permanent roof and on an impermeable pad (Target 3).

The target of 75% of treated abrasives stored under cover has not been reached (see Figure 8). Detail on the type of cover (tarp or permanent roof) is not available for 2009 to 2012 as the reporting form did not ask to specify the type of cover. In 2019, 72% of reported treated abrasives were covered by either tarp or permanent roof.

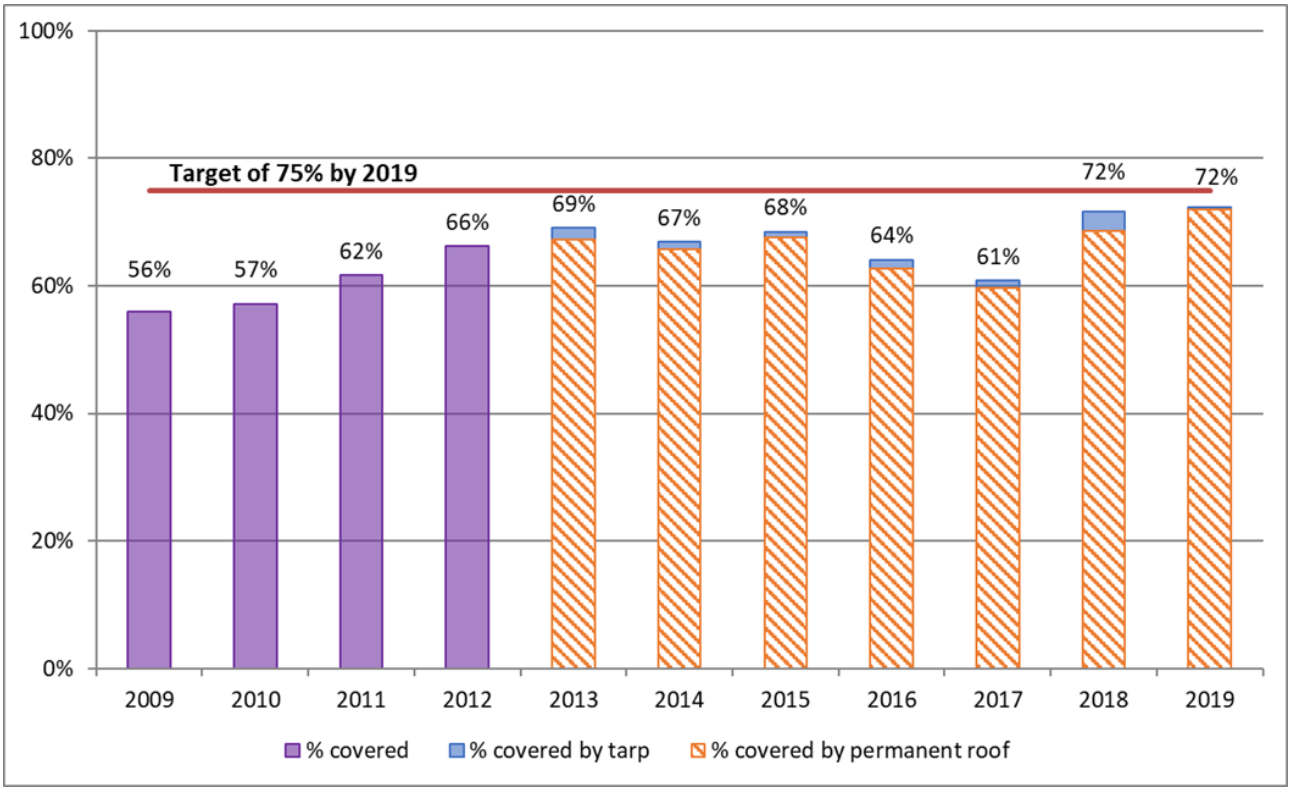

Figure 8. Percentage of tonnes of treated abrasives stored under cover (Target 4).

Coverage of road salts reported under the Québec Strategy for the Environmental Management of Road Salts

The information provided by 64 Québec municipalities indicates that salt is stored under a permanent roof at 91% of the reported municipal storage sites that are managed in-house and at 66% of the sites managed by outsourced contractors. Salt is stored on impermeable pads at 82% of the in-house municipal storage sites and at 43% of sites managed by contractors.

Salt is stored under a permanent roof at approximately 93% of the storage sites that are owned and managed by the MTQ and at 98% of the Department's storage sites managed by outsourced contractors. In rare cases where only small salt quantities are occasionally stored, the construction of a permanent facility cannot be justified. In such situations, the Department ensures that tarps are used to cover salt piles. Salt is stored on impermeable pads at all storage sites managed by the MTQ and at 97% of the Department's storage sites managed by outsourced contractors.

Coverage of treated abrasives reported under the Québec Strategy for the Environmental Management of Road Salts

The information provided by 64 Québec municipalities indicates that treated abrasives are stored under a permanent roof or tarp at 77% of the reported municipal storage sites that are managed in-house and at approximately 47% of the sites managed by outsourced contractors. Abrasives are stored on impermeable pads at 56% of the in-house municipal storage sites and at 26% of sites managed by contractors.

Treated abrasives are stored under a permanent roof or tarp at approximately 48% of the storage sites that are owned and managed by the MTQ and at 18% of the Department's storage sites managed by outsourced contractors. Abrasives are stored on impermeable pads at 76% storage sites managed by the MTQ and at 45% of the Department's storage sites managed by outsourced contractors.

Case study: coverage of treated abrasives

The City of Calgary adjusted operational practices in 2019 to cover their treated abrasive stockpiles to minimize salt release to the environment. During winter months abrasive materials (rock chips and 2% salt mix) are stockpiled and handled indoors at the newest facilities, but there is substantial outdoor storage and handling at older maintenance depots. At that time, expanding and upgrading their permanent storage structures was not a viable option due to capital budget constraints. As a result, any surplus materials not used for snow and ice control were vulnerable to salt leaching and runoff when stored outside during Calgary's typically wetter late spring and summer months.

Faced with limited options and a motivation to innovate and continually improve, Calgary Roads contracted services for custom installation, maintenance, and removal of tarps seasonally including material specifications and provisions for 24/7 emergency repair. The tarps were used successfully in several locations for 2 full seasons, between April and September, in 2019 and 2020. Adjustments to standard procedures for material delivery timing and quantities were also made to reduce outdoor storage, and some material double-handling costs were incurred. Temporary cover of stockpiles had been considered but not pursued previously due to concerns for practicality in an often windy city like Calgary, however these concerns did not pose a problem.

Preliminary analysis of ongoing water quality sampling at retention ponds in those locations indicates their effectiveness, with reduced chloride concentrations for the 2019 and 2020 seasons (with tarps installed) compared with historical data. These observations indicated that temporary cover, when applied and maintained appropriately, can be an efficient and effective means of creating a barrier between salt-treated materials and the weather and thereby minimize salt leaching and release from sites.

Summary – Salt storage - Coverage of road salt and treated abrasives (Targets 3 and 4)

The coverage of road salts with a permanent roof is a practice used for almost all road salts by all types of organizations. The use of permanent roof for the storage of salts appears to be standard practice among public road authorities given the consistent high rate of adoption. The coverage of treated abrasives is less well established. While the use of this practice has increased, the national target of 75% of treated abrasives being stored under cover is not being met.

5.4.2 Storage site design and operations processes

Good housekeeping practices

Good housekeeping practices are a defined set of policies and procedures for preventing the release of salt to the environment during the operation of the salt storage site. They typically include preventative measures, such as not overloading trucks, proper management of vehicle wash water, and emergency response procedures, such as cleaning up salt spills. Prevention of the overloading of trucks is an important practice to reduce spillage of excess salt outside of the loading area and the collection of wash water from the cleaning of trucks is an important practice because washing of truck boxes is frequent (usually done after every storm event).

Information reported under the Code of Practice since 2013 show that most organizations (approximately 90% with some year-to-year variation) handle road salt in a designated area with an impermeable surface and conduct ongoing clean up of spilled materials from site surfaces (Figure A-2, Appendix F).

In 2019, 57% of organizations reported use of equipment to prevent overloading of trucks, 58% use systems for collecting or treating wastewater from the cleaning of trucks, 55% control and divert external waters not impacted by salt and 71% have a risk management and emergency measures plan in place. Overall, annual results have been similar since 2013. Detailed results from 2013 to 2019 for all types of organizations are presented in Appendix F.

There are no established targets for good housekeeping practices at storage sites.

Good housekeeping practices as reported under the Québec Strategy for the Environmental Management of Road Salts

The compilation of the information provided by 64 Québec municipalities indicates that materials are handled in a designated area characterized by an impermeable surface at 33% of the municipal storage sites managed in-house and at 20% of those managed by outsourced contractors. At 82% of the storage site managed by the province, materials are handled in a designated area characterized by an impermeable surface compared to 27% of the provincial sites managed by outsourced contractors.

Drainage and collection systems

TAC Syntheses of Best Practices recommends that salt-contaminated wash water from maintenance yards should be reclaimed for brine production. If this is not possible, it should be directed to a sanitary sewer[18]. If no sanitary sewer is available, the wash water should be directed to a properly designed stormwater management pond. Such ponds dilute salt-impacted water with surface drainage from non-impacted areas to lower the salt concentrations prior to discharge into a ditch or receiving body. The water that is collected should be periodically monitored/ checked to ensure compliance with release concentration requirements.

In 2019, reporting organizations indicated that 35% of municipal storage sites had a drainage and collection system for runoff of salt-contaminated waters, compared to 10% of provincial sites, 44% of federal sites and 50% of sites from private companies (Figure A-3, Appendix F).

Of the municipalities that reported having a drainage collection system at 1 or more of their storage sites in 2019, about 45% indicated discharging into a municipal sewer system (40 organizations), 43% into a containment system for removal (38 organizations), 11% into a watercourse (10 organizations) and 24% reported “other” as the discharge point (21 organizations). See Figure A-4 of Appendix F for results for the period of 2013 to 2019. In 2019, of the 7 provinces that indicated having at least 1 site with a drainage system in place, 2 reported discharging into a municipal sewer system, 5 into a containment system, 2 into a watercourse and 3 reported “other”. Only 3 federal organizations indicated having at least 1 site with a drainage system in place in 2019, 2 of which reported discharging into a containment area and 1 reported “other”. Six private organizations reported having at least one storage site with a drainage system. Of these, 1 reported discharging into a municipal sewer system and 4 into a containment system.

Analysis of data reported under the Code indicates that many salt storage sites do not yet have drainage and collection systems, so there still may be uncontained runoff that is contaminated with chlorides. In addition, the majority of those that do collect, discharge runoff to the sewer. The preferred method is to collect the runoff and reclaim it for use in brine production because chlorides are not removed or reduced to any significant extent by conventional secondary wastewater treatment plants. This information demonstrates that the majority of sites, even those with collection systems, eventually deposit the chloride contaminated runoff into watercourses.

Stormwater management and collection systems as reported under the Québec Strategy for the Environmental Management of Road Salts

Drainage and collection systems are uncommon at municipal salt storage sites in Quebec. The information provided by 64 Québec municipalities indicates that 24% of sites managed in-house and 13% managed by outsourced contractors have stormwater management and collection systems in place and 6% of sites managed in-house and 11% managed by outsourced contractors have a collection system for runoff of salt-contaminated waters.

Forty percent (40%) of the salt storage sites owned and managed by the province have drainage and collection systems in place compared to 22% of the provincial sites managed by outsourced contractors. Collection system for runoff of salt-contaminated waters are present at

[18] Syntheses of Best Practices in Road Salt Management (2013): 7.0 – Design and Operations of Maintenance Yards. Transportation Association of Canada.

21% of sites owned and managed by the province and only 3% of those managed by outsourced contractors.

Chloride monitoring in runoff from salt storage sites

Reporting on chloride monitoring is not a mandatory element in the reporting forms; only 63% of organizations report on chloride monitoring. From the data submitted it appears that monitoring of chloride concentrations in runoff from storage sites is not a common practice amongst all types of organization. In 2019, of the 88 municipalities that reported having at least 1 site with a drainage and collection system in place, only 15 monitor chloride in the runoff (17%). Only 1 provincial and 3 federal organizations have ever reported monitoring chlorides in runoff from storage sites. In 2019, 4 out of the 6 private organizations that reported having a collection system in place indicated monitoring chloride in the runoff.

Summary – Storage site design and operations processes

Road organizations have a high degree of adoption of several good housekeeping practices such as using impermeable areas to store salts and conducting, as needed, spill clean-ups (90% of municipalities). There are however lower levels of uptake for other practices such as collecting wash water from trucks, diversion of external water not impacted by salt, and monitoring of chloride in runoff from salt storage sites.

In addition, less than 50% of salt storage sites have collection systems for salt contaminated runoff. Higher levels of uptake of best practices in this area would be desirable especially practices related to the control of external water and the collection of salt contaminated runoff.

5.5 Salt application

The objective for best practices in salt application is to reduce the negative impacts of road salts used by delivering the right amount of road salts in the right place at the right time. Road organizations should give consideration to using the most recent technologies including the use of vehicles equipped with groundspeed electronic controllers and using pre-wetting or pre-treated salt to optimize salt use.

5.5.1 Groundspeed electronic controllers

Figure 9 presents the percentage of vehicles equipped with groundspeed electronic controllers. Groundspeed oriented electronic controllers on salt spreaders help to ensure that salt is applied at the proper rate regardless of the speed of the truck being used to spread the salt, and that salt stops discharging when the truck is stopped. Use of this technology is expected to become a core practice for all organizations. The percentage of vehicles equipped with groundspeed electronic controllers has increased since 2009 and reached the target in 2016.

In 2019, 93% of the total fleet of vehicles assigned to solid salt application reported were equipped with groundspeed electronic controllers.

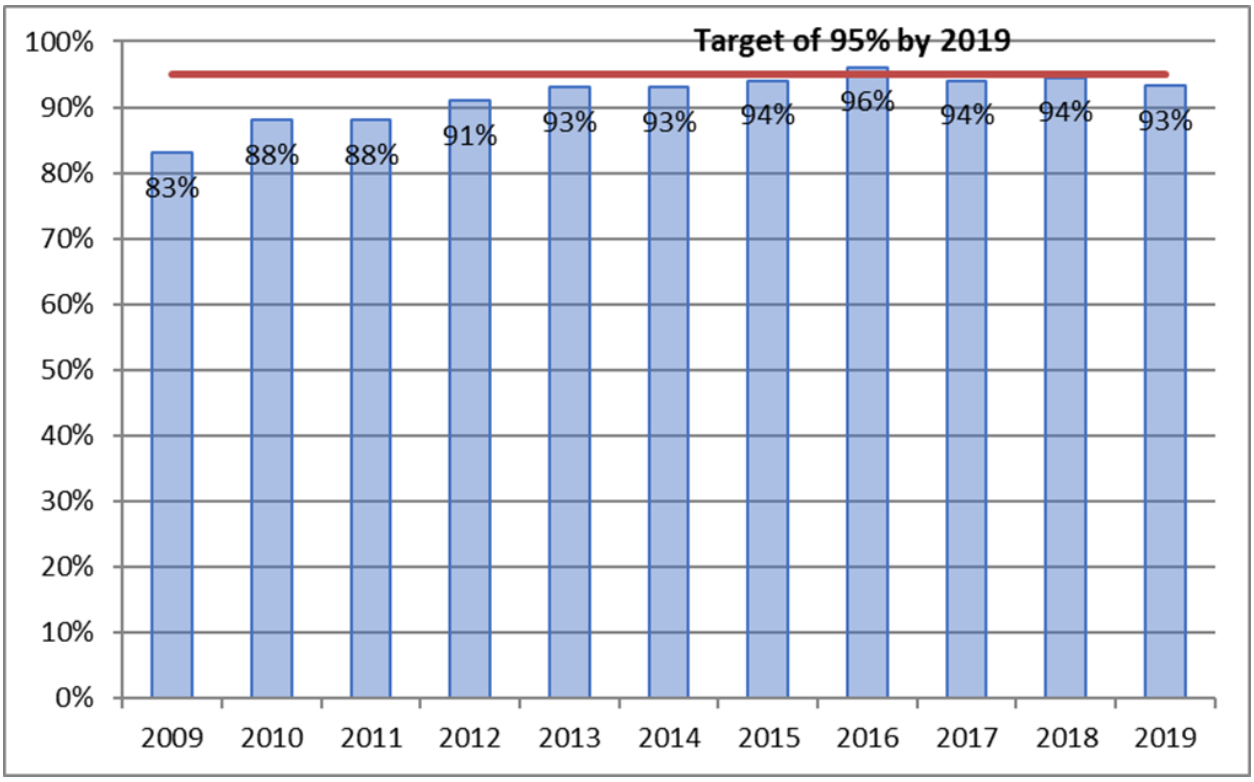

Figure 9. Percentage of vehicles equipped with groundspeed electronic controllers (Target 5).

Groundspeed electronic controllers as reported under the Québec Strategy for the Environmental Management of Road Salts

In Québec, 83% of all vehicles are equipped with groundspeed electronic controllers. It should be noted that the MTQ and its contractors have 1,634 vehicles out of the 2,149 reported and that the Department requires that vehicles be equipped with groundspeed electronic controllers for all contracts of 500 tonnes and more.

Summary – Salt application – vehicles equipped with groundspeed electronic controllers (Target 5)

There has been an increase in the use of groundspeed electronic controllers in the past 10 years and use is approaching the target of 95% vehicles equipped with the technology.

5.5.2 Pre-wetting and use of pre-treated salt

Pre-wetting is a technique whereby a concentrated liquid freeze point depressant is sprayed onto solid salt or sand at the time it is placed onto the pavement surface. It reduces salt waste as it makes the salt sticky and stays on the road better by reducing the effects of bouncing, blowing and sliding of the salt. In addition, because the salt is already wet, it reacts faster with snow and ice and therefore it can reduce the amount of salt needed to maintain safe winter conditions[19].

Pre-treatment of salt is the addition of a liquid to solid salt at the time it is stockpiled[19]. Pretreated salt can have the same benefits as pre-wetted salt without having to invest in new equipment thus providing an easy entry into the use of liquid technology. Salt is pre-treated by applying brine directly to the salt.

Figure 10 shows the percentage of organizations that use pre-wetting or pre-treated salts. While data for use of pre-wetting are available for all years since 2009, data for use of pre-treated salts are not available for 2009-2012. Results for these years are therefore not included. Results of Figure 10 are based on the number of organizations that reported any quantity of pre-treated salts or any quantity of liquids of any types. Figure 11 shows a breakdown of organizations using pre-wetted salt, pre-treated salt, or both.

[19] Syntheses of Best Practices in Road Salt Management (2013): 9.0 – Winter Maintenance Equipment and Technologies. Transportation Association of Canada.

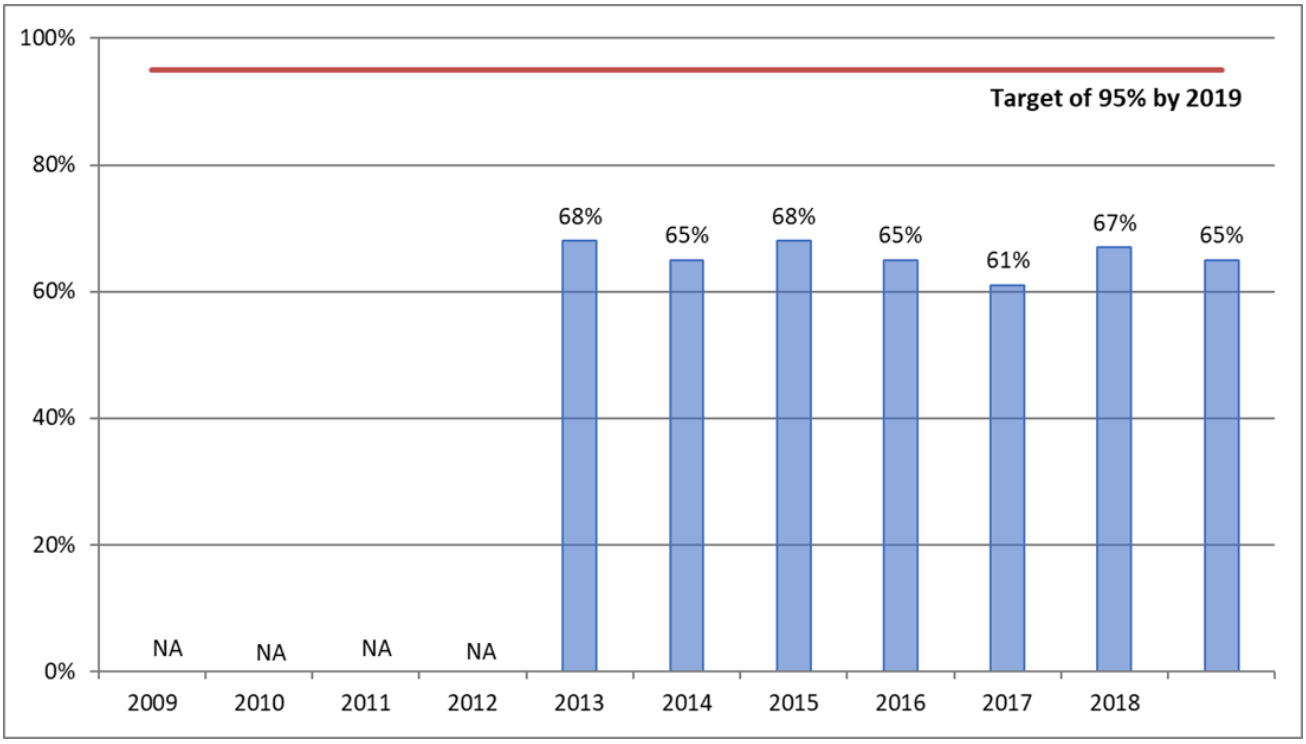

Figure 10. Percentage of organizations using pre-wetting or pre-treated salts (Target 6a).

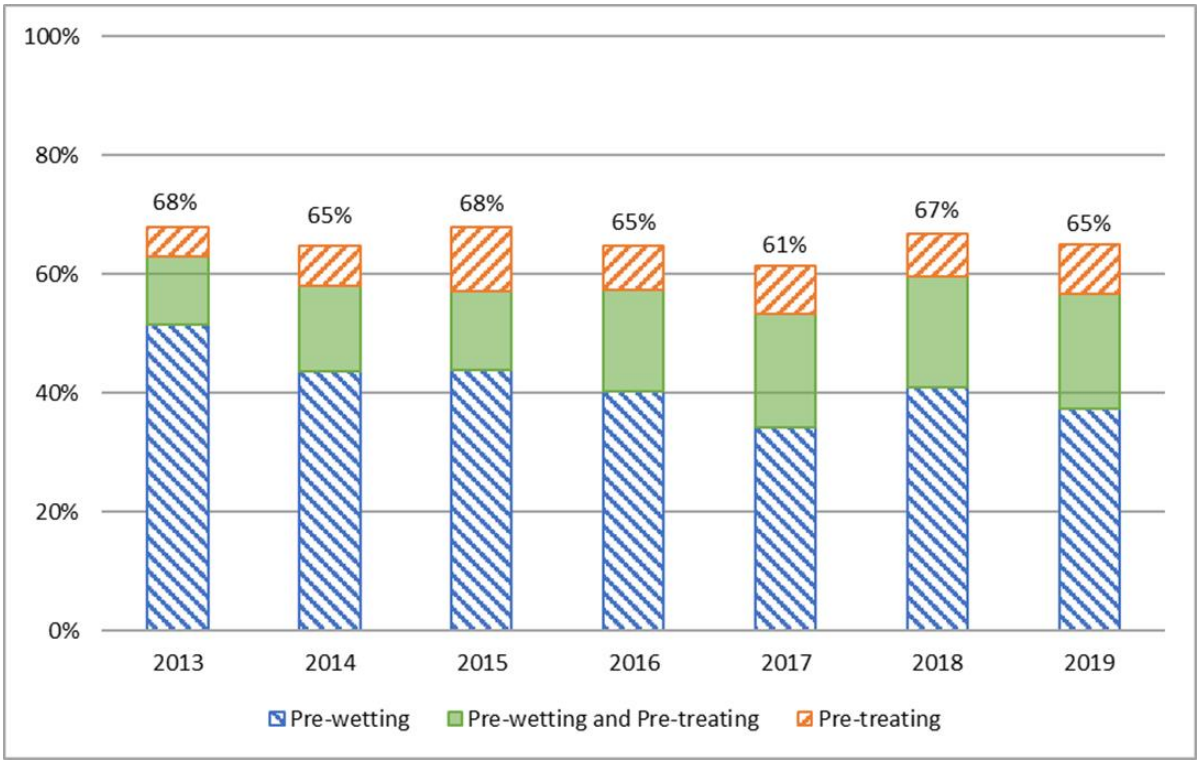

Figure 11. Breakdown of organizations using pre-wetting, pre-treating, and both.

Figure 12 shows the percentage of vehicles assigned to solid salt application that are equipped for pre-wetting.

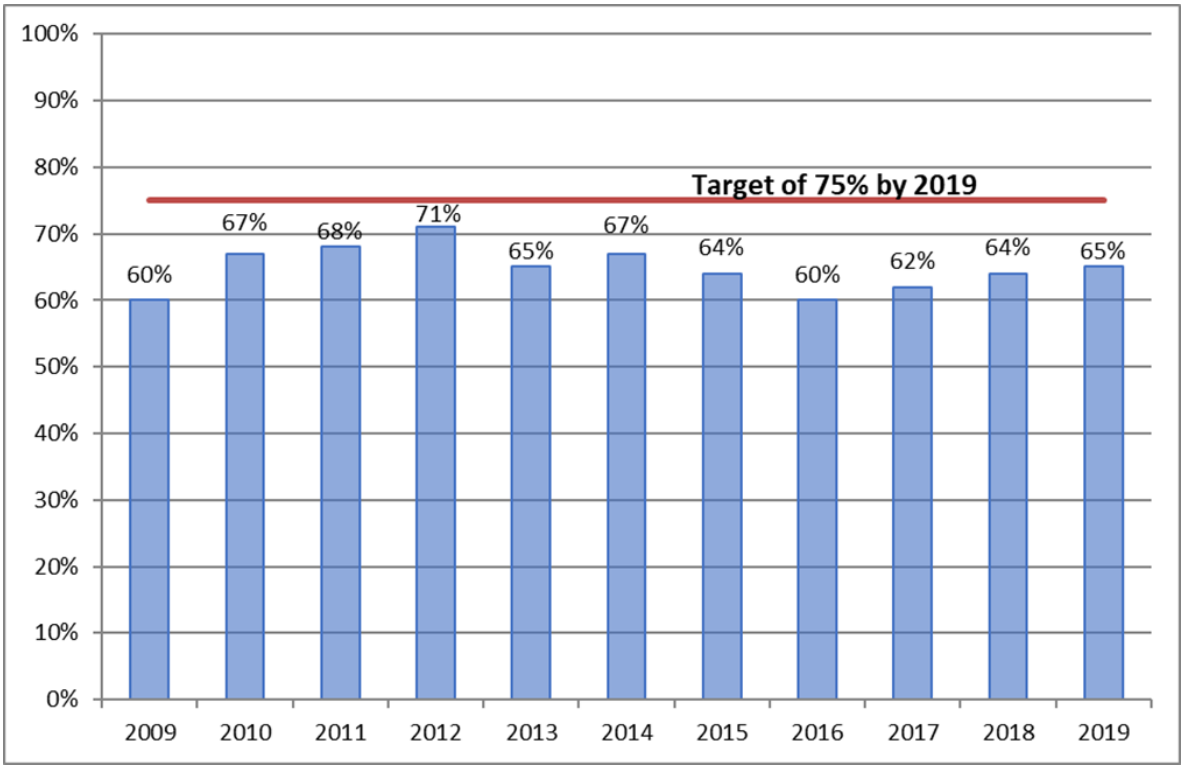

Figure 12. Percentage of vehicles assigned to solid salt application that are equipped for pre-wetting (Target 6b).

The targets established for the use of pre-wetting and pre-treated salts (95% of organizations) and the vehicles equipped for pre-wetting (75% vehicles) have not been met. The level of pre-wetting has remained fairly constant since 2013 with a slight increase in the use of pretreated salts. The percentage of vehicles equipped for pre-wetting reached 65% in 2019. Stakeholders have suggested potential barriers for meeting these targets. These include the high cost to maintain equipment for pre-wetting, lack of awareness and education on effectiveness of pre-wetting and pre-treated salt and low effectiveness of pre-wetting on non-paved roads compared to paved roads.

In small and remote municipalities, the use of sand mixed with salt may be more common as it is less expensive than pre-wetting technologies. In addition, there may also be limited support for pre-wetting equipment repairs and limited availability of pre-treated salt in those municipalities. These suggested barriers are supported by further analyses of the reported information showing that smaller municipalities are less likely to use pre-wetting technologies or pre-treated salts. Only 41% of the reporting municipalities with a population of less than 25,000 have indicated using pre-wetting or pre-treated salts, compared to 72% for population ranges of 25,000 - 49,999, 85% for population ranges of 50,000 to 99,999 and 100% of municipalities with a population above 100,000.

5.5.3 Direct liquid application

Direct liquid application (DLA) is a technique that sprays a liquid de-icer directly onto the road surface. DLA is efficient since it provides immediate melt action and does not take the time to dissolve and form brine that a solid chemical does. DLA can significantly reduce the volume of road salt required compared to the application of dry salt alone[20].

Overall, the use of DLA has increased since 2009. The percentage of municipalities reporting having at least 1 vehicle designed for DLA increased from 37% in 2009 to 46% in 2019 (Figure 13).

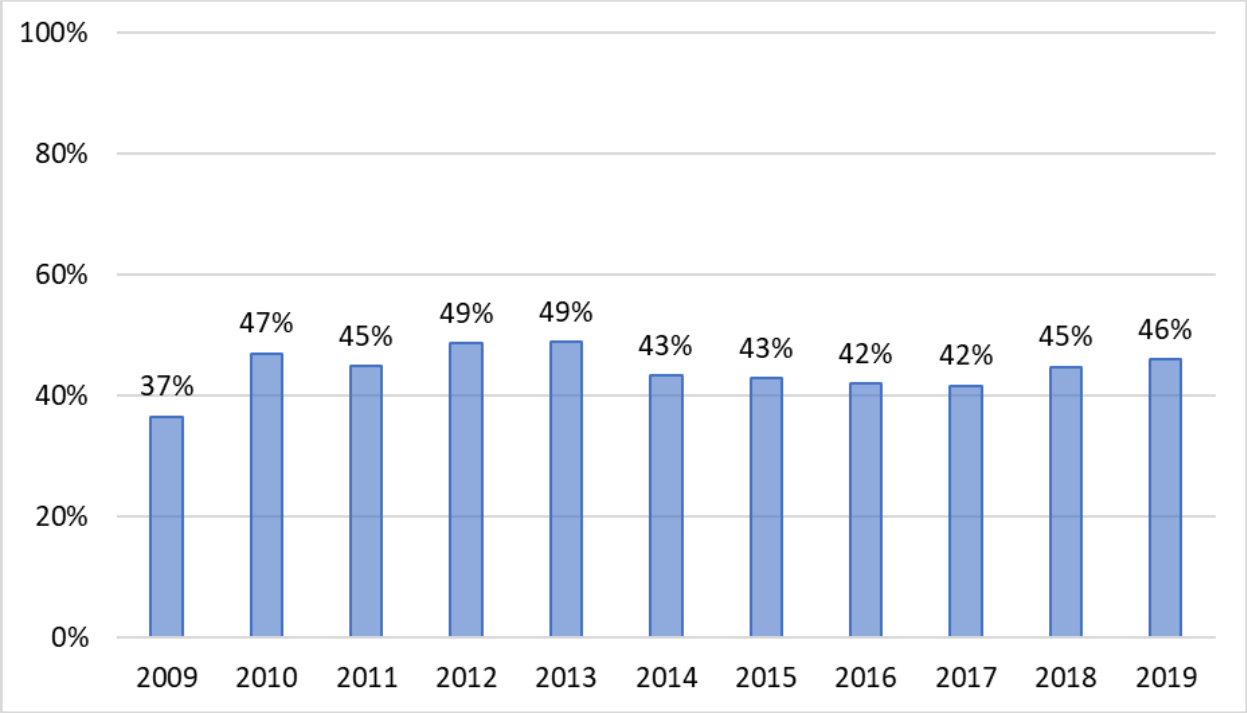

Figure 13. Percentage of reporting municipalities with at least 1 vehicle designed for DLA.

The use of DLA by provincial organizations gradually increased since 2009, from 5 provinces reporting having at least 1 vehicle equipped for DLA in 2009 to 8 in 2019 (Table A-1 of Appendix F). The only reporting territory, Yukon, has never reported having vehicles for DLA. Use of DLA by federal organizations, mainly National Parks is still uncommon. In 2009, 38% of all reporting federal organizations reported having at least 1 vehicle for DLA and 30% in 2019. Only 1 of the reporting private organization has reported not having vehicles equipped for DLA.

DLA is used by fewer than half of the reporting organizations with the exception of provinces. DLA is less common than the use of pre-treated salts and pre-wetting and may also be explained by the lack of awareness and the cost of DLA equipment.

Use of liquids as reported under the Québec Strategy for the Environmental Management of Road Salts

[20] Good Practices for Winter Maintenance in Salt Vulnerable Areas by Conservation Ontario.

Use of liquids by reporting municipal road organizations in Québec is uncommon. Fewer than 7% of the 64 reporting municipalities have indicated using the pre-wetting technique, pre-treatment of salt or direct liquid application technology.

Summary – Salt application

Pre-wetting and pre-treated salts and vehicles equipped for pre-wetting (Targets 6a and 6b)

The number of organizations using pre-wetting or pretreated salts have been in the 61-68% range since 2013 and are not close to meeting the 95% target. The percentage of vehicles equipped for pre-wetting reached 65% in 2019. There has been good uptake in larger municipalities. Smaller and medium population municipalities typically use less salt so the environmental impact of the low level of adoption of these practices will be somewhat less.

DLA

DLA is used by fewer than half of the reporting organizations with the exception of provinces where 8 report using DLA. The number of organizations reporting the use of at least one DLA equipped vehicle has remained fairly constant for the last 10 years. DLA is less common than the use of pre-treated salts and pre-wetting and this may be explained by cost of DLA equipment and lack of awareness of this technique.

5.5.4 Calibration of spreading equipment

Proper calibration of spreaders is important to ensure that the application rate settings are accurate and that the proper amount of salt is applied. TAC recommends that all spreaders be calibrated before the start of the season[19]. In addition, calibration checks or recalibration should take place several times during the season, including after repairs to any system that can affect salt delivery, when distribution calculations show a discrepancy between theoretical and actual and as a result of spot-checks on units in the fleet throughout the season.

The percentage of organizations reporting calibrating their equipment at least once a year in 2019 was 87% and reporting has been at high levels over the last 10 years. In 2019, 87% of municipalities who reported on calibration indicated calibrating their spreading equipment. All provinces indicated calibrating their equipment annually during the period of 2009 to 2019. All private organizations that reported on this practice have consistently indicated calibrating their equipment regularly. A large majority of organizations have indicated calibrating their spreaders once or twice a year. See Figures A-5 and A-6 of Appendix F for data compilation related to calibration of spreading equipment.

As calibration of spreading equipment is important to ensure the right application rate, TAC recommends all organizations should regularly use this practice.

5.5.5 Pavement temperatures and road weather information systems

Different types of road salt and brine are effective at different temperatures. Pavement temperatures and road weather information systems (RWIS) can support decision making in snow and ice control. This information helps to make better and timely salt application decisions and can lead to less wasted salt.

Infrared thermometers are used by the majority of the reporting organizations to help make decisions for winter event responses, including what type of anti-icing or de-icing product to apply and the timing of its application. In 2019, infrared thermometers were reported to be used by 77% of all reporting organizations where the breakdown is 76% by municipalities, 78% by federal organizations, 86% by private organizations and all reporting provinces. The use of meteorological services is an even more common practice amongst organizations; 91% of the municipalities and all provincial, federal and private organizations reported using meteorological services to make decisions for winter maintenance operations. See Figures A-7 and A-8 of Appendix F for a summary of the results from 2013 to 2019.

RWIS consist of automated stations installed along the roadway that gather and communicate real-time road and atmospheric conditions at specific locations to help those making decisions about winter road maintenance activities. From 2013 to 2019, 35 to 42% of municipalities reported using fixed RWIS stations and 8-11% reported using vehicle-mounted mobile RWIS. Of the 9 provinces that reported in 2019, only 1 indicated not using either fixed or vehicle-mounted mobile RWIS. Five provinces use fixed stations only and three use both fixed and vehicle-mounted mobile stations. Out of the 9 federal organizations that reported on RWIS in 2019, 4 used fixed stations and 1 used vehicle-mounted mobile RWIS. As of 2019, all but 1 private organization reported using fixed RWIS stations, but none used vehicle-mounted mobile RWIS. See Figures A-9 and A-10 of Appendix F for a summary of the results on use of RWIS from 2013 to 2019.

Many organizations are relying on pavement temperatures and/or RWIS to make effective winter maintenance operations decisions, including what materials or technology to use (for example, DLA, pre-wetting, mixture of sand and salt) and the best timing for maintenance operations. Using the right material at the right time can increase effectiveness of the anti-icing or de-icing materials and could reduce salt use.

5.5.6 Other decision support systems

In addition to pavement temperatures and RWIS there are other different systems that help improve decision making for maintenance strategy, materials and application rate including use of records of salt application rates (SAR), charts for application rates adapted to road or weather conditions and Automated Vehicle Location (AVL).

AVL is a way of tracking equipment movements along with the services provided using GPS receivers/transmitters and software[19]. The electronic records can either be actively followed real-time or can be passively recorded for later analysis. This equipment can provide operational support to greatly enhance the monitoring of salt usage, to demonstrate prudent usage and to correlate with the achievement of the required level of service. AVL can support a

number of management needs including: route optimization to rationalize the number of trucks required (and thus the expected salt to be used on the roads serviced), thermal mapping where pavement temperatures from on-board sensors can be related to location, automatic spreader adjustments by location and determining salt loadings on service segments or within salt vulnerable areas.

At the municipal level, the percentage of reporting organizations using records of SAR varied between 68% and 75% depending on the reporting year and the use of charts for applications rates has been relatively steady between 41-46% of organizations. The use of the AVL technology by municipalities has increased from 60% in 2013 to 76% in 2019.

In 2019, all reporting provinces and the 1 reporting territory indicated using records of SAR; while out of 8 reporting provinces, 6 indicated using chart for application rates and 7 reported using AVL.

Of the 10 federal organizations that reported on decision support systems in 2019, 8 indicated using records of SAR, 6 reported using charts for application rates and 2 reported using the AVL technology.

Most private organizations have reported using record of SAR, charts for application rates and AVL. Figures A-11 to A-14 in Appendix F provides a summary of results on the use of decision support systems by the different types of organizations from 2013 to 2019.

Summary – calibration, pavement temperature, RWIS and other systems used

Calibration of salt spreading equipment has been reported at high levels in the past 10 years with most organizations that reported on calibration completing this step annually or more frequently. Calibration is an essential technique to ensure the right amount of salt is being applied at any time. However, over 10% of organizations are not reporting on calibration. All organizations should be using this practice.

While decisions on winter maintenance operations should be supported by some type of temperature/weather information or other decision support systems, it is not expected that each organization will use all systems or technologies available. Organizations are best placed to determine what systems or techniques to use. Availability (for example, fixed RWIS stations) and cost of certain equipment are factors to consider.

5.6 Snow disposal

When plowed snow threatens road or sidewalk capacity or safety, road organizations remove the snow and haul it to a snow disposal site where the snow eventually melts. This activity is largely a municipal practice. The snow at disposal sites contains contaminants, including road salts. The TAC Syntheses of Best Practices notes that studies have indicated much of the salt applied to pavement does not stay in the snow that is removed and only a small percentage of

the salt may be reaching the snow disposal site[21]. However, salt concentrations are still elevated in runoff from snow disposal sites, necessitating the proper design and implementation of good housekeeping practices at these sites to help minimize release of road salt to the environment.

5.6.1 Use of designated snow disposal sites

Approximately 70% of the reporting municipalities have been disposing of snow at designated sites since 2010 with some year-to-year variations (Figure 14). In 2019, 273 snow disposal sites were reported to be managed by municipal road organizations (Figure A-15 of Appendix F). While most reporting municipalities have indicated managing 1 or 2 snow disposal sites over the past 10 years, a few, mainly located in Ontario, reported more than 10 sites. None of the reporting provinces and very few federal and private organizations have indicated disposing of snow at designated sites since 2013.

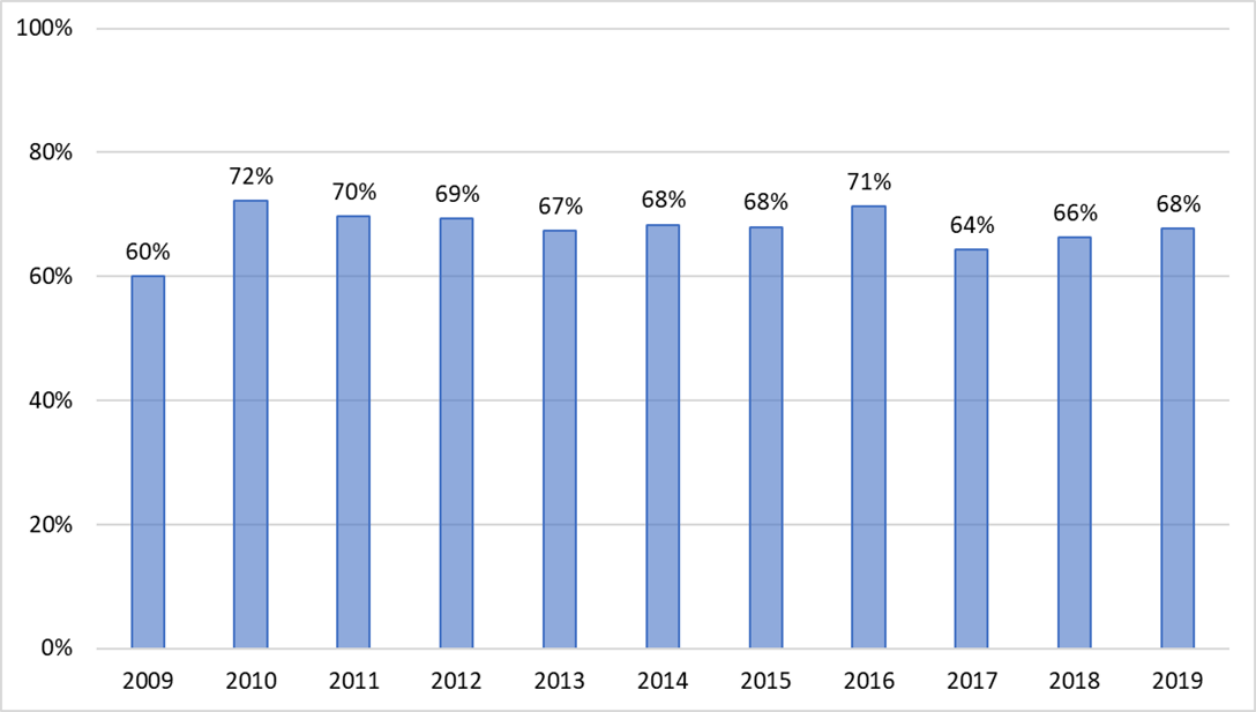

Figure 14. Percentage of reporting municipalities with snow disposal sites between 2009 and 2019.

[21] Syntheses of Best Practices in Road Salt Management (2013): 8.0 – Snow storage and Disposal. Transportation Association of Canada.

5.6.2 Design of snow disposal sites

An important feature to take into consideration in the selection of snow disposal sites is the type of soil. The base should have low permeability to minimize contamination of groundwater resources. Information reported by municipalities between 2013 and 2019 indicates that not all snow is disposed on a low permeability surface. Complete use of low permeability surfaces occurs at only 62 to 65% of municipal snow disposal sites (Figure A-16 of Appendix F).

The meltwater from the snow disposal sites should be managed properly to further minimize contamination of groundwater. For example, drainage systems can be designed to direct meltwater to a retention pond before its discharge. Meltwater can also be collected and discharged into a municipal sewer system. Management of meltwater at municipal snow disposal site is not a common practice. In 2019, fewer than 30% of municipal snow disposal sites had a system in place where meltwater is directed to a retention pond before its discharge or was collected and discharged into a municipal sewer system, whereas 36% of sites collected meltwater and discharged into a watercourse. Figure A-17 of Appendix F summarizes the information on meltwater management at municipal snow disposal sites between 2013 and 2019.

The province of Québec regulates snow disposal sites under the *Regulation respecting snow elimination sites* under the *Environment Quality Act*. Under this Regulation, snow that is removed and transported for elimination purposes may be placed for final deposit only at a disposal site authorized by the Minister. The purpose of the Regulation is to ensure impacts on groundwater, surface water and aquatic life, as well as health risks are minimized.

Case study: management of meltwater by the City of Kitchener

In 2016, a new snow disposal facility became operational in the City of Kitchener that minimizes the release of chloride into the environment. Costs associated with the facility including construction, consultants, and related studies were approximately $3 Million with an annual operating budget of approximately $200,000. The facility is designed in a way that all melt water flows through a chamber where chloride is continuously being monitoring. If the chloride concentrations measured in the chamber exceeds the short-term exposure benchmark concentration indicating the potential for severe effects established by the CCME (that is, 640 mg chloride/L), then the melt water is diverted to the sanitary system. A flow meter in the sanitary line allows the city to report on discharge amounts into the sanitary system. The melt water with chloride levels below 640 mg/L flows into a retention pond. This engineered solution, with the intent of preventing high chloride meltwater from entering the natural environment, has the benefit of extending the life of the downstream drinking water well head and reducing direct impact to receiving aquatic environments.

5.6.3 Snow melters

Snow melters, either mobile or stationary, can be used to accelerate snow melting. Snow is put into a heated box and the resulting melt water is usually drained directly to the storm sewer system. Melters provide a solution to shortages of snow storage space, either in urban areas with limited snow storage capacity adjacent to the road on the right-of-way or in parking lots where snow volumes restrict usable parking spaces or meltwater causes icing problems. Melters may be an economical solution where the hauling costs are high (that is where snow disposal facilities are far from snow removal locations). More information on snow melters is available in TAC's Syntheses of Best Practices in Road Salt Management[19,21].

The use of snow melters by reporting organizations is uncommon. In 2019, only 4 organizations reported using snow melters.

Summary – Snow disposal

The use of low permeability surfaces occurs at only 62 to 65% of municipal snow disposal sites. Management of meltwater at municipal snow disposal site is not a common practice.

Snow melters provide a solution to shortages of snow storage space as well as an economical alternative where the hauling costs are high. However, the use of snow melters by reporting organizations is uncommon.

5.7 Salt vulnerable areas

Salt vulnerable areas are areas in the receiving environment that may be particularly sensitive to road salts. As previously noted, the Code of Practice applies to organizations that have vulnerable areas in their territory that could potentially be impacted by road salt in addition to those that use more than 500 tonnes of salt per year. The Code encourages road authorities to take additional measures to minimize salt releases in salt vulnerable areas. Annex B of the Code provides general guidance for identifying vulnerable areas and lists additional salt management measures that could be used in vulnerable areas.

The 5-year review (2012) noted that the protection of salt vulnerable areas by road organizations was a weak component of most salt management plans. It also identified a need to for more specific guidance to better support road organizations in identifying and developing an action plan for salt vulnerable areas. A national target was established to measure if salt vulnerable areas are identified and an action plan is prepared. A target of 95% of road organizations was set for 2024 to allow time for guidance development.

5.7.1 Development of a guide for the identification and management of salt vulnerable areas

Following the 5-year review, ECCC initiated the development of additional guidance to support road authorities in the identification of SVAs.

In 2012, ECCC issued a contract to develop a general framework for the identification of SVAs to Kilgour & Associates Ltd. This framework provided ECCC and road authorities with the key components and practical advice toward the development of a detailed SVA guide. As a next step, in 2013 to 2014, through contract with nXstream, a conceptual model was developed for road authorities to assess the vulnerability of areas to salt loading. The model included a limited prototype of a web-based mapping tool for entities to use to identify SVAs. This model was not determined to be viable for further work by ECCC due to costs and resources required for further development on a national scale.

In June 2017, a contract was issued to GHD for the development of a written step-by-step guide to help users in the identification, prioritization and management of SVAs. GHD developed a step-by-step guide on the basis of users using Geographic Information Systems (GIS) to analyze the data. General comments from the RSWG on the guide was that, the methodology was sound, however many members felt that it was too complex to be implemented by small organizations without GIS expertise. As a result, ECCC is investigating development of more simplified guidance material.

5.7.2 Identification of salt vulnerable areas and development of action plans by reporting organizations

The Code recommends that once salt vulnerable areas are identified, organizations should prepare an action plan to address specifically those areas. An action plan should provide details on mitigation measures to be implemented to minimize the effects of road salt in salt vulnerable areas.

As of 2019, fewer than half of the reporting organizations inventoried their salt vulnerable areas and 35% prepared an action plan to address the salt vulnerable areas (Figure 15). While information on the number of road organizations identifying salt-vulnerable areas is available for all years except 2013 (due to data collection inconsistencies), information on preparation of an action plan is not available for 2009 to 2013.

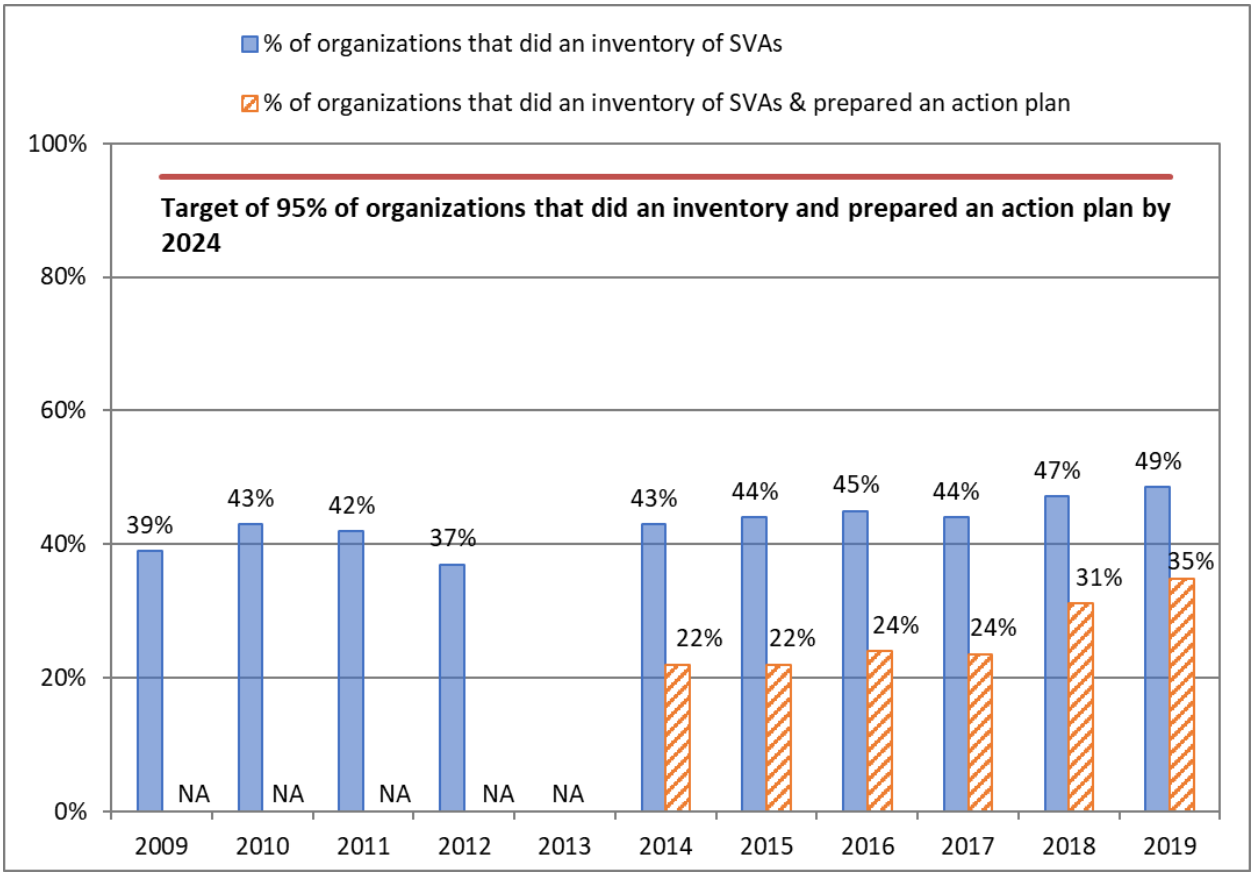

Figure 15. Percentage of road organizations that have identified salt vulnerable areas and prepared an action plan (Target 7).

Identification of salt vulnerable areas and development of action plans as reported under the *Québec Strategy for the Environmental Management of Road Salts*

The 5-year study conducted by the MTQ in 2019 shows that only 24% of the 64 municipalities that participated in the study have identified their salt vulnerable areas and 17% have developed mitigation measures.

Summary – SVAs (Target 7)

Reporting organizations have made limited progress in the identification and management of SVAs over the last 2 years, and further efforts will be needed to reach the target set for 2024. As of 2019, fewer than half of the reporting organizations inventoried their salt vulnerable areas and 35% prepared an action plan to address the salt vulnerable areas.

While some members of the Road Salt Working Group have expressed the need for further guidance on the identification of salt-vulnerable areas and management of those areas, others have suggested that ECCC revisit the concept of salt-vulnerable areas, noting that efforts should be focussed on achieving the greatest adoption of best practices possible across the entire service area.

5.8 Summary of performance against National Targets

Progress in the implementation of best practices in the management of road salt for winter road maintenance has been made in some areas. However, there is still room for improvement in other areas, in particular in the annual review of salt management plans, improved storage of treated abrasives and in the use of pre-treated salts and pre-wetting techniques. Figure 16 summarizes the information reported by federal, provincial, municipal and private road organizations that adopted the Code against the national targets set for 2019 (Target #7 is set for 2024). Overall, in 2019, 4 of the targets (1, 3, 4 and 5) were achieved or were close to being achieved and 2 are not reached (2 and 6a, b).

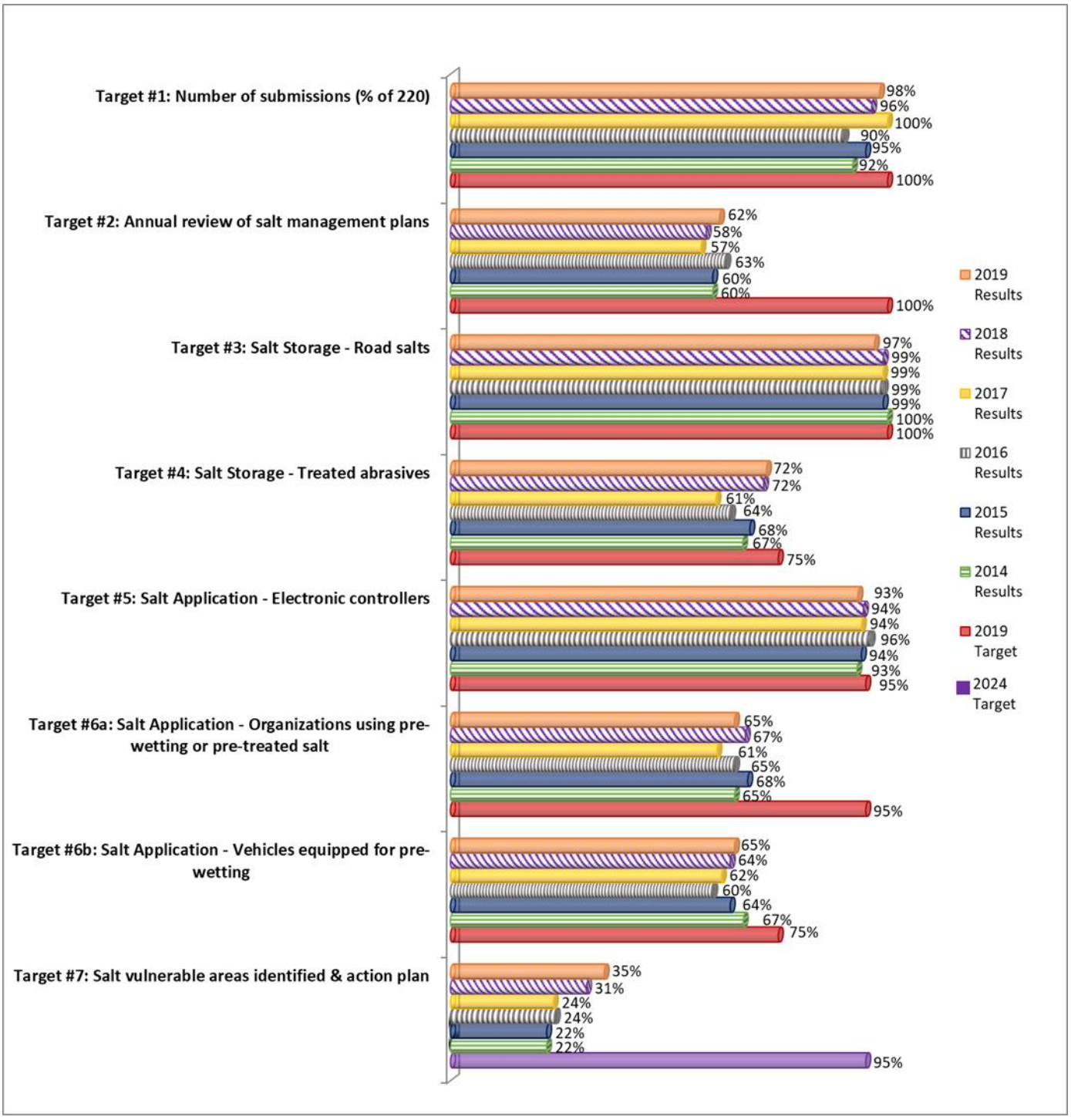

Figure 16. Summary results for performance and comparison to national targets from 2014 to 2019**.**

6. Trends in salt usage

Canada is the largest consumer of salt in the world, mainly due to the demand of road salt for de-icing roads in winter conditions[22]. Approximately 90 to 95% of Canada's salt consumption is for de-icing and chemical production. The remaining percent is for water conditioning, food processing, fisheries and other industrial uses.

Quantities and types of salt used are reported by road organizations under the Code. However, the reported salt use does not represent total salt use for de-icing across Canada since the Code is voluntary, does not apply to road salts used for domestic purposes, or for private or institutional uses, targets organizations that use more than 500 tonnes of road salts per year, and is not implemented in Quebec.

Section 6.1 presents the information on salt use for winter road maintenance as reported under the Code, while Section 6.3 discusses the potential salt use by other sectors not covered by the Code.

6.1 Quantities and materials used reported under the Code of Practice

Overall use of materials reported under the Code

Data from the annual reports submitted to ECCC under the Code of Practice show year-to-year variations in the usage of solid salt with a low of 2,153,000 tonnes reported in 2010 to a high of 4,972,000 tonnes in 2017 (Figure 17). The predominant snow and ice control de-icer used in Canada is sodium chloride. In 2019, 92% of the reported de-icer was sodium chloride. Other salts, such as calcium chloride, magnesium chloride and potassium chloride, are used to a lesser extent. From 2009 to 2019, reported quantities of abrasives follow a similar pattern over time as the reported quantities of solid salt. The quantities of all liquids (used for pre-wetting, pre-treatment and direct liquid application) of all types (NaCl, CaCl, MgCl) reported under the Code was relatively stable between 2009 and 2015 and showed a steady increase since 2015.

The year-to-year variability in reported salt use may be explained in part by the variability in the severity of winters and the number of organizations reporting under the Code. As shown in Figure 17, it should be noted that in years when liquid use is higher (2010, 2012, 2016) the use of solid salt is lower and vice versa, which is potentially an indicator of the winter weather conditions. In addition, other factors such as the expanding road networks can influence total salt use. This is discussed further in Section 6.2. There was a decrease in the number of reports received in 2010 to 2013, and this may account for a reduction in the reported salt use over the same period as shown in Figures 17 and 18.

[22] Natural Resources Canada. Salt. Canadian Minerals Yearbook, 2008.

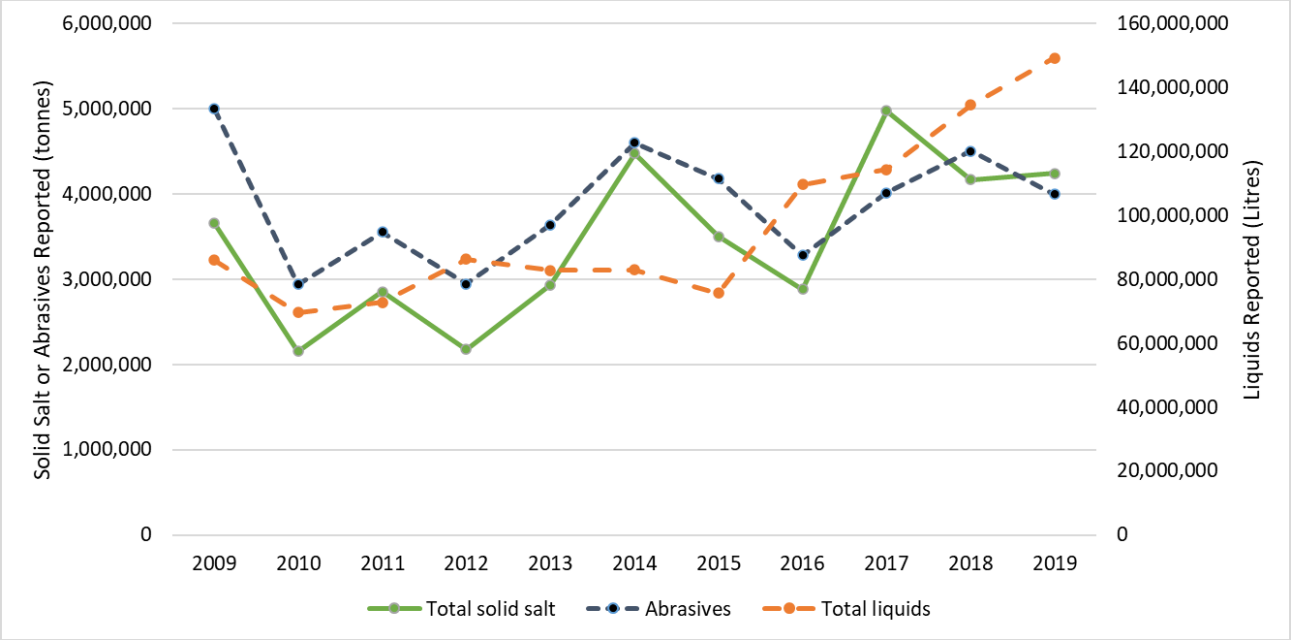

Figure 17. Total quantities of road salts (solid form), abrasives and liquids of all types reported under the Code from 2009 to 2019 by all types of organizations (municipal, provincial, federal and private).

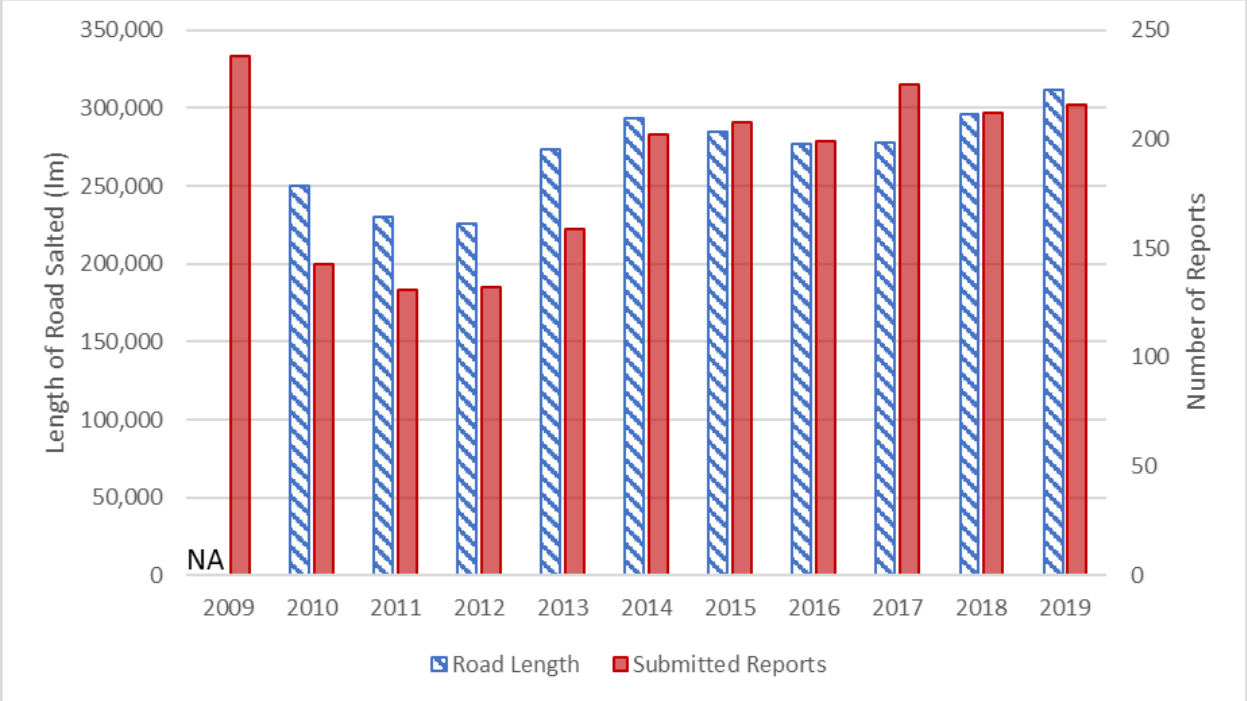

Figure 18. Total quantities of reports submitted and reported total road length per year.

Materials used by type of organizations

Reporting provincial organizations use more abrasives and liquids compared to municipal organizations (Figure A-18 of Appendix F). The lower rates of use of liquids by municipal organizations may be explained by the higher cost or availability of vehicles and equipment required for pre-wetting or direct liquid application. It may also be due to lack of knowledge of this technology. The quantities of solid salts, abrasives and liquids reported by federal and private organizations are negligible compared to municipal and provincial organizations.

Materials used by municipal organizations

In 2019, Ontario municipalities reported the largest use of solid salts, abrasives and total liquids (Figures 19 and 20) compared to municipalities in other provinces. Usage of other materials varied across the country. Municipalities in Alberta were the next largest users of solid salts. Alberta and Saskatchewan municipalities reported the second and third largest quantities of abrasives, while municipalities from Newfoundland and Labrador and British Columbia reported the second and third largest quantities of liquids.

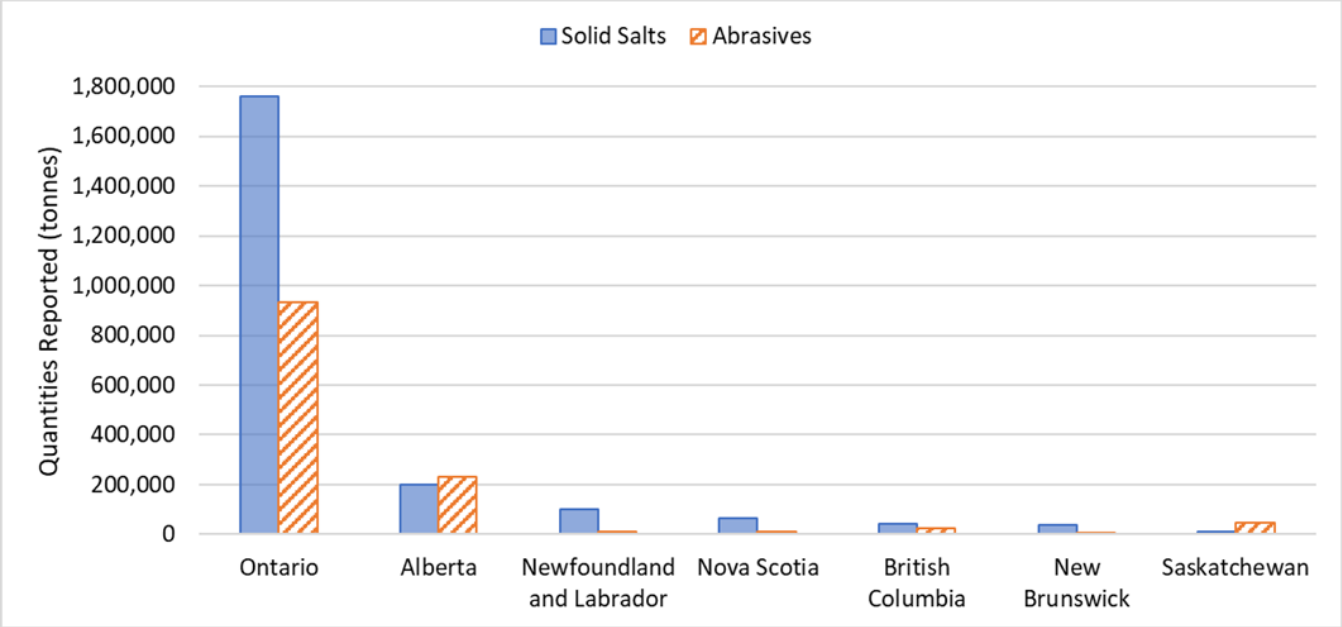

Figure 19. Quantities of solids salts and abrasives reported by municipal organizations across different provinces in 2019.

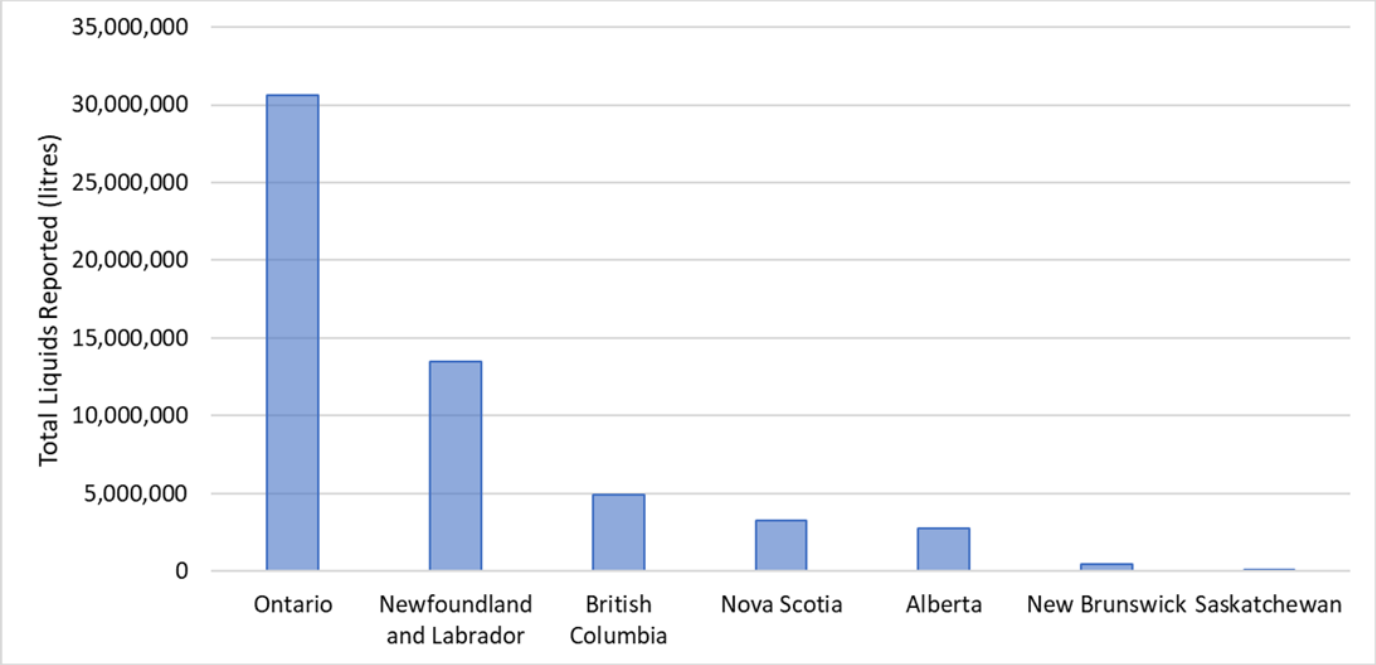

Figure 20. Quantities of total liquids of all types reported by municipal organizations across different provinces in 2019.

Further analysis of the quantities of solid salts reported by municipal organizations in 2019 revealed that the 75 large reporting municipalities (with population greater than 50,000) accounted for 75% of total reported municipal salt use (Figure 21). These large municipalities, on average, use 16 times more salt than the average small municipality (population <10,000) (Figure 22). The 69 reporting municipalities with populations between 10,000 and 50,000, represented only 23% of the total reported municipal salt use. Finally, the 44 small municipalities (population below 10,000) represented only 3% of the total reported municipal salt use. This demonstrates the importance of large organizations to the management of road salts.

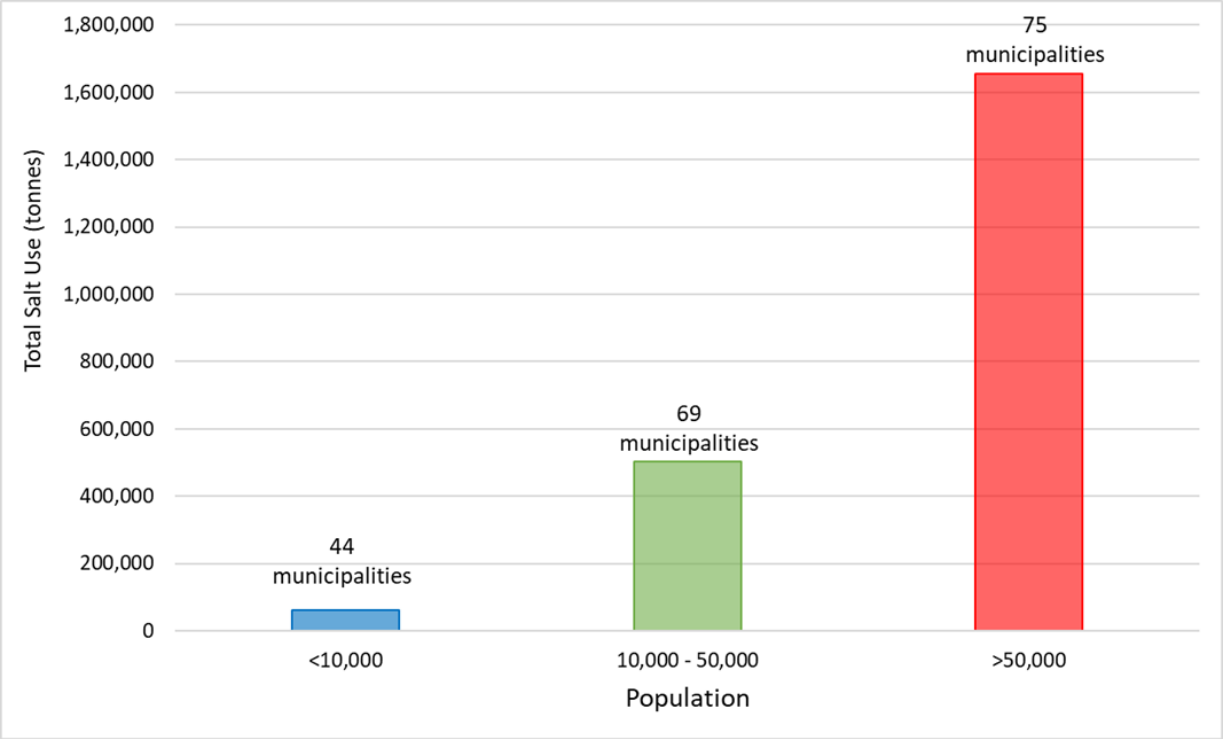

Figure 21. Total salt use by all municipalities that reported in 2019, based on population size.

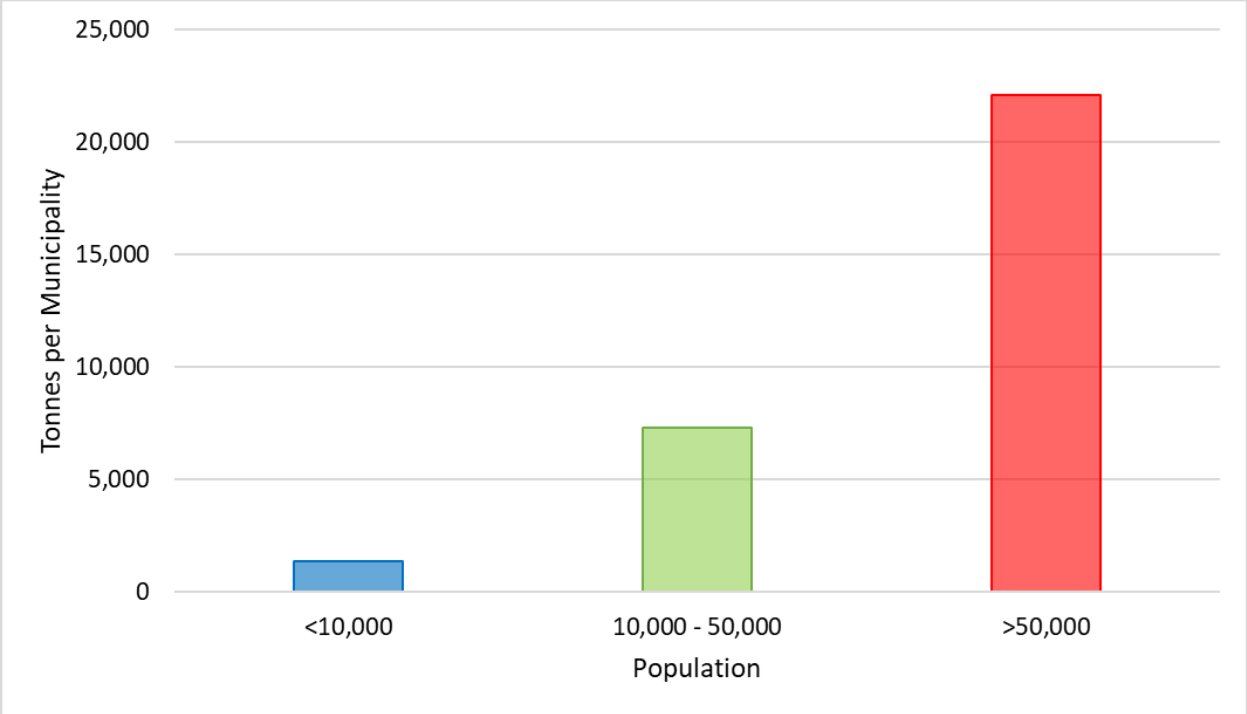

Figure 22. Average salt use per municipality, in tonnes, reported in 2019.

6.2 Consideration of factors influencing salt usage

While salt application rate can be reduced with the implementation of best practices, total salt use data alone is not a good indicator for measuring progress in implementing the Code as many factors can influence salt usage, including variability in winter conditions, expanding road networks, perception of risk and liability.

6.2.1 Variability in winter severity

The year-to-year variability in salt use may be explained in part by the variability in the severity of winters. Some organizations in Canada and the United Sates have developed winter severity indexes so that salt use can be adjusted based on the variability in winters, making year-to-year comparisons possible. When combined with other performance measures, a WSI becomes a powerful tool to determine the efficiency and effectiveness of winter maintenance activities[23].

The Ministry of Transportation of Ontario (MTO) defines their Winter Severity Index (WSI) as a measure of how challenging the winter has been with respect to the amount and type of precipitation including snow, blowing snow, ice, rain, freezing rain and temperatures. The ministry's Road Weather Information System is used to forecast winter weather and icing conditions. There are 152 stations across Ontario that monitor current conditions and provide site-specific forecasts. This helps maintenance crews prepare the right equipment and materials before a winter storm, act quickly once the winter storm arrives, and adjust their activities as conditions change. MTO uses the information from their Road Weather Information System stations, along with Environment and Climate Change Canada weather stations, to calculate the Winter Severity Index for each winter season[24].

The Pennsylvania Department of Transportation conducted a project on Winter Severity Index[23]. As part of the project, they surveyed various states and learned that New Hampshire was able to successfully analyze salt usage, correlating the amount of salt used and their Winter Severity Index rating for a season. Using state environmental services data, they were able to show that salt use was decreasing relative to the severity of a winter.

6.2.2 Expanding road networks

There are more than 1 million two-lane equivalent lane-kilometers of public road in Canada. About 40% of the road network is paved, while 60% is unpaved[25].

In 2017 and 2018, road construction accelerated at an average of 24,000 kilometres per year, compared with an average of 9,000 kilometres per year from 2000 to 2016[26]. Based on the total

[23] Pensylvannia Dept. of Transportation, 2014. Winter Severity Index Development.
[24] MTO. How we clear Ontario's highways in winter.
[25] Statistics Canada. 2018. The Canadian Transportation System.
[26] Statistics Canada. 2020. Canada's Cord Public Infrastructure Survey: Roads, bridges and tunnels, 2018.

public road length in Canada (including Québec), this would represent a 2.4% increase in road length per year.

In 2019, a total of 307,398 km (2 lane equivalent) of salted roads were reported under the Code. The distance of salted road reported under the Code increased by 10% from 2015 to 2019 which is consistent with the national average increase in road expansion. The impact of road network expansion should be considered when assessing salt use volumes, however, because there are numerous sources of road data and regional variability in salt application this makes it difficult to assess.

6.2.3 Perception of risk and liability

There is a societal expectation of bare pavement and sidewalks throughout winter. Decisions around the application of salt, including how much to apply, are often driven by the perception of risk and liability, and may lead to oversalting. There is a widely held belief that applying more salt results in safer conditions, but liability case law and some studies are demonstrating that the application of too much salt may actually create unsafe conditions[27].

However, note that public road organizations that have adopted the Code of Practice have made progress in optimizing salt use and implementing best management practices based on the established targets. Since the Code only applies to public road authorities using more than 500 tonnes, data for applications not covered by the Code such as commercial parking lots and sidewalks is not available. This progress may not have extended to these applications and organizations that are not subject to the Code.

Summary – Trends in salt usage – factors influencing trends

The type of salt mostly used for road salt is sodium chloride (92%). Provincial organizations use more abrasives and liquids than municipal organizations. There is a correlation between the size of the municipality and the quantity of salt used. For example, the average large municipality uses 16 times more salt than the average small municipality. In 2019, the 75 large municipalities (>50,000) used 75% of all reported municipal salt use.

Other factors than the size of population can influence the salt usage such as the expansion of road networks and concerns for risks and liability. Winter severity should also be considered when evaluating salt use however few organizations have been able to effectively correlate winter severity with Salt Use with the exception of New Hampshire.

Given the number of factors influencing salt use the quantity of salt used cannot be considered on its own as the best indicator for measuring the progress in implementing the Code.

[27] Lake Simcoe Region Conservation Authority, Friction and Parking lots, 2020

6.3 Salt *usage by other sectors not covered by the Code of Practice*

6.3.1 Estimated quantities of salt used by other sectors

Total salt reported to ECCC under the Code of Practice, as presented in the previous section, does not represent total amounts of salt used for de-icing across the country since the Code:

- is voluntary
- does not apply to road salts used for domestic purposes, or for private or institutional uses
- targets organizations that use more than 500 tonnes of road salts per year, and
1) is not implemented in Quebec

Road salt reported to ECCC in 2018 under the Code totaled 4.2 M tonnes. Quebec estimates the total road salt used in the province to be 1.5 Mt. Total consumption of salt in Canada based on production, import and export of salt from Natural Resources Canada and Statistics Canada data was approximately 11.2 Mt in 2018. This means there is 5.5 Mt of salt used for purposes not reported to the Code or covered under the QC strategy.

These salt uses not included under the Code or the Quebec strategy includes uses of salt other than road salt such as for chemical production, water conditioning, food processing, fisheries and other industrial uses. It also includes road salt used by private contractors, households and organizations not covered by the Code. NRCan has estimated that 90 to 95% of Canada's domestic salt consumption is for chemical production and de-icing purposes, but again the proportion of salt consumption for de-icing alone is unknown.

To fill the data gap on how much salt is used for de-icing outside of the Code, ECCC issued a contract in 2018, to estimate the total salt used as de-icers in Canada, by categories of users that do not report under the Code of Practice. These other categories of users are:

- private contractors (for maintenance of parking lots and sidewalks)
- citizens for personal use on driveways
- private companies
- small municipalities using less than 500 tonnes of road salt per year
- all of the above categories of users located in Québec (as Quebec has its own strategy and therefore the federal Code is not implemented in the province) and
- potential non-reporters

Through this contract ECCC also sought information on the ferrocyanide content in road salts. The contract to gather information on road salts and ferrocyanide use was unsuccessful as stakeholders declined to participate in the voluntary survey.

In order to have reliable estimates of salt use for each category of users not reporting under the Code, ECCC is planning a mandatory information gathering activity on the use of road salts and ferrocyanide in road salts.

6.3.2 Addressing salt use on parking lots and walkways: Ontario Freshwater Roundtable

The Ontario Freshwater Roundtable was created in 2018 with the goal to address salt use by private snow and ice management contractors on commercial properties in Ontario. The Freshwater Roundtable participants include real estate investment trusts, large retailers, snow and ice management contractors, risk management companies, the legal community, First Nations, environmental organizations and conservation authorities. Federal and provincial representatives serve an advisory role. Roundtable members developed the "Freshwater Roundtable's Discussion Paper: Road Salt Use on Commercial Properties forward" that was presented to the Ontario Government. The following 4 recommendations are presented in the paper:

- that the snow and ice management industry, with the support of their client base and regulators, undertake a consultative process to develop a single set of Best Management Practice guidelines for snow and ice management and salt use on parking lots and walkways
- that the snow and ice management industry and government recognize a training and certification program for salt application contractors
- that the Ontario government develop regulations to limit liability for certified snow and ice management contractors
- that the Freshwater Roundtable create and implement a media and public education strategy to inform the public regarding the threats posed by salt to freshwater resources, including sources of drinking water, and the inherent importance and recognition of the use of best practices to optimize salt use while maintaining safe conditions

These 4 recommendations arise from the adoption of the New Hampshire model. New Hampshire has adopted BMPs, and offers a training and certification program for contractors. Certified contractors, and the clients who hire them, are shielded from liability provided they follow the practices identified by the state. This approach has been met with support from the snow and ice management industry, commercial property owners, and environmental stakeholders.

Summary – Trends in salt usage – other sectors

Other organizations gather data on salts in Canada, but do not differentiate between type of salts and their end usage which makes it difficult to estimate adequately the quantity of salt use for all road maintenance in Canada vs other uses, such as chemical formulation. The use by domestic, private and institutional road salt users is not available since this data is not reported under the Code.

ECCC has attempted to collect data, from domestic, private and institutional uses, by doing a voluntary survey however this was unsuccessful and ECCC is considering mandatory information gathering under the CEPA (1999) for these sectors.

7. Road safety data

The road salts assessment report and the Code stressed that public safety was of paramount concern and that nothing in the Code was intended to compromise roadway safety. Figure 23 shows a decrease in the number of police-reported collisions on public roads in Canada since 2000, despite increased motor vehicle registrations and vehicle-kilometres travelled. Figure 24 focuses on the number of collisions reported on different road surface conditions usually observed in winter months. The large majority of reported collisions occurred on dry/normal road surfaces. Collisions in winter conditions (fresh/loose snow, slush/wet snow or icy road surface) are not as frequent. Collisions on icy roads represent 4.5 to 8.5% of the total number of collisions. This data has no direct correlation with the Code, but it does suggest that the implementation of the Code has had no observable negative effects on roadway safety. There are other factors (for example, severity of winters, seasonality of the injury and fatality data, and the introduction of snow tire regulations in Quebec) that may influence the data in Figure 23, which would need to be assessed in order to draw a conclusion as to their relevance to the Code.

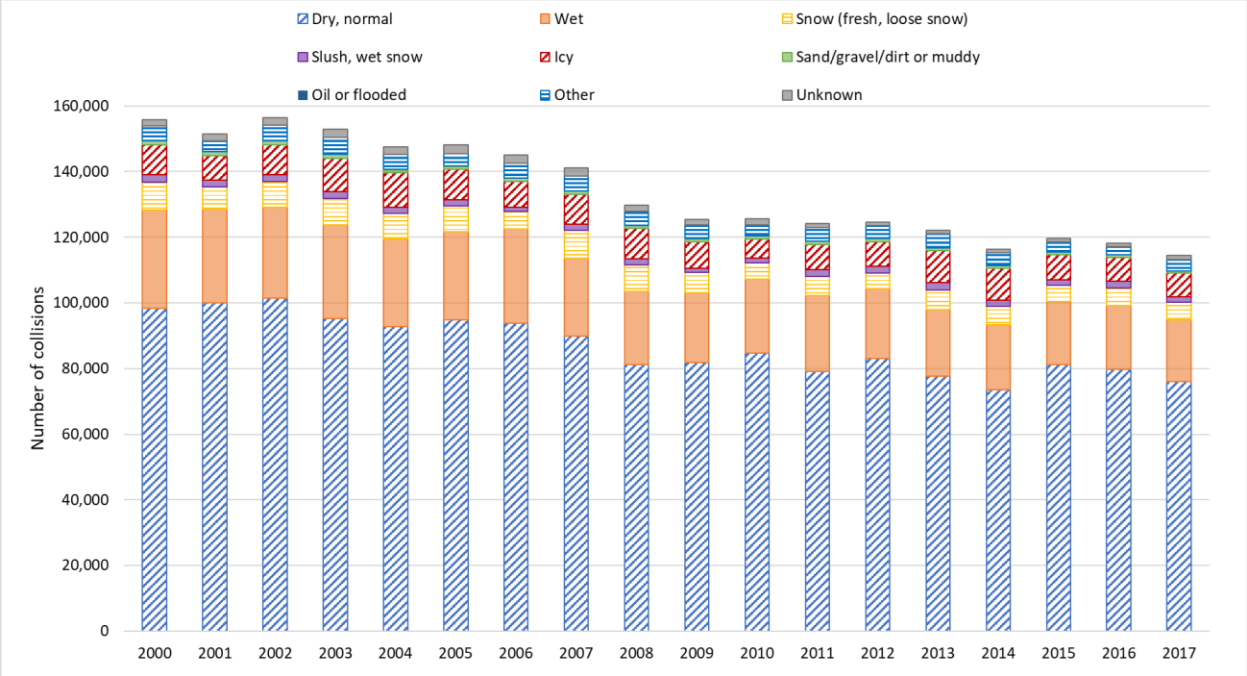

Figure 23. Number of police-reported motor vehicle collisions on public roads in Canada under different road surface conditions from 2000 to 2017[28].

[28] Transport Canada National Collision Database.2012.

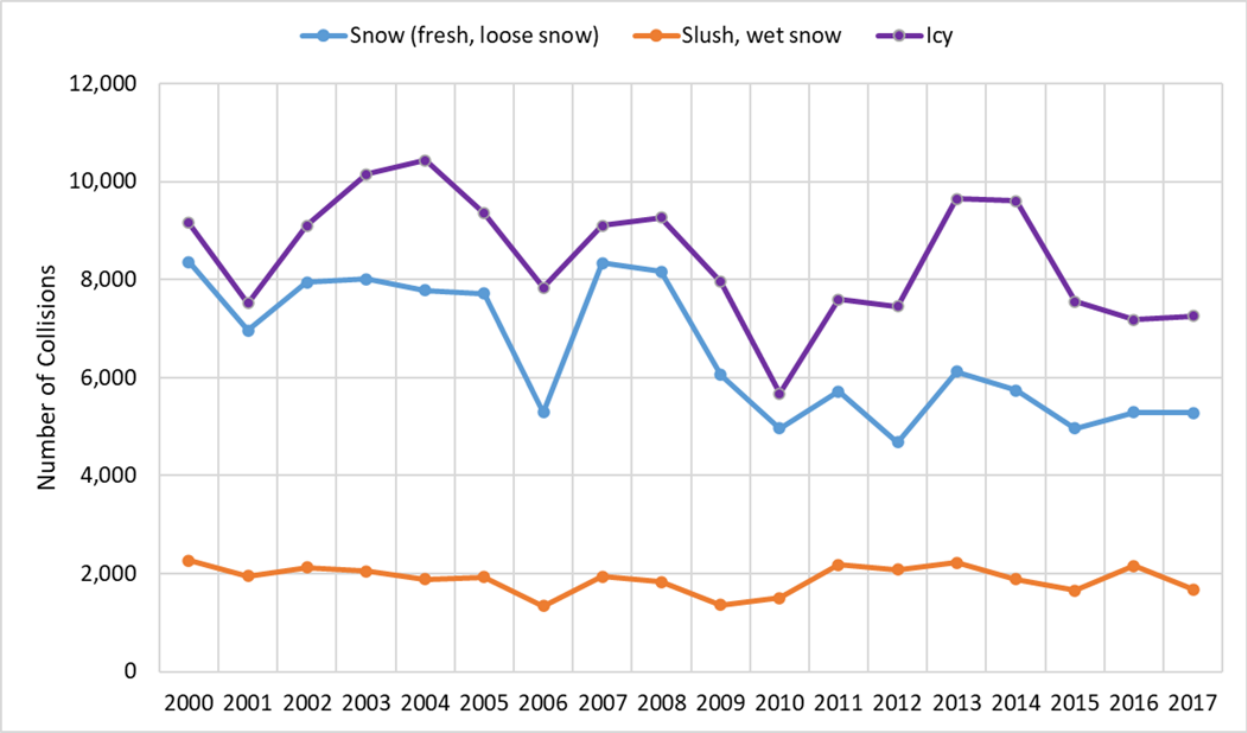

Figure 24. Number of police-reported motor vehicle collisions on public roads in Canada under different winter road surface conditions from 2000 to 2017[28].

Summary – road safety

Collisions on icy roads represent 4.5 to 8.5% of the total number of collisions in Canada. This data has no direct correlation with the Code, but it does suggest that the implementation of the Code has had no observable negative effects on roadway safety. There are other factors (for example severity of winters, seasonality of the injury and fatality data, and the introduction of snow tire regulations in Quebec) that may influence road safety data, which would need to be assessed in order to draw a conclusion as to their relevance to the Code.

8. Environmental impacts

The Canadian Council of Ministers of the Environment (CCME) developed the Canadian Water Quality Guideline (CWQG) for the chloride ion for the protection of aquatic life (CCME, 2011). The short-term exposure benchmark concentration indicating the potential for severe effects (for example lethality or immobilization) to sensitive freshwater life during transient events is 640 mg Cl/L and the long-term exposure for the protection of freshwater life is 120 mg Cl/L. The thresholds are meant to protect the majority of aquatic species. These conservative recommended guidelines can be used when the chloride thresholds for specific species are unknown.

The number of studies conducted on the ecological impacts of de-icing salts on freshwater ecosystems have increased substantially in the last few decades. Recent research indicates that the presence of high levels of chloride in freshwater resulting from de-icing salt can have environmental impacts at different trophic levels, including at the species and population levels[29], community level[30] and ecosystem level[31]. Impacts have been observed in different freshwater ecosystems, including lakes, streams and rivers.

Many recent studies that have investigated long-term trends in chloride concentrations in North American freshwater ecosystems have shown increasing chloride concentrations where salt application for de-icing purposes has been recognized as a major source of this contamination[32].

For example, the Credit Valley Conservation Authority in Ontario has conducted a study, on long-term trends in chloride concentrations in Sheridan Creek, a small creek running through a highly urbanized area and draining into the wetland, Rattray Marsh. The study found that chloride concentrations have been increasing since the mid 70s even as the population has stabilized (Figure 25). The increasing chloride concentration in Sheridan Creek is believed to be related to the use of road salt[33].

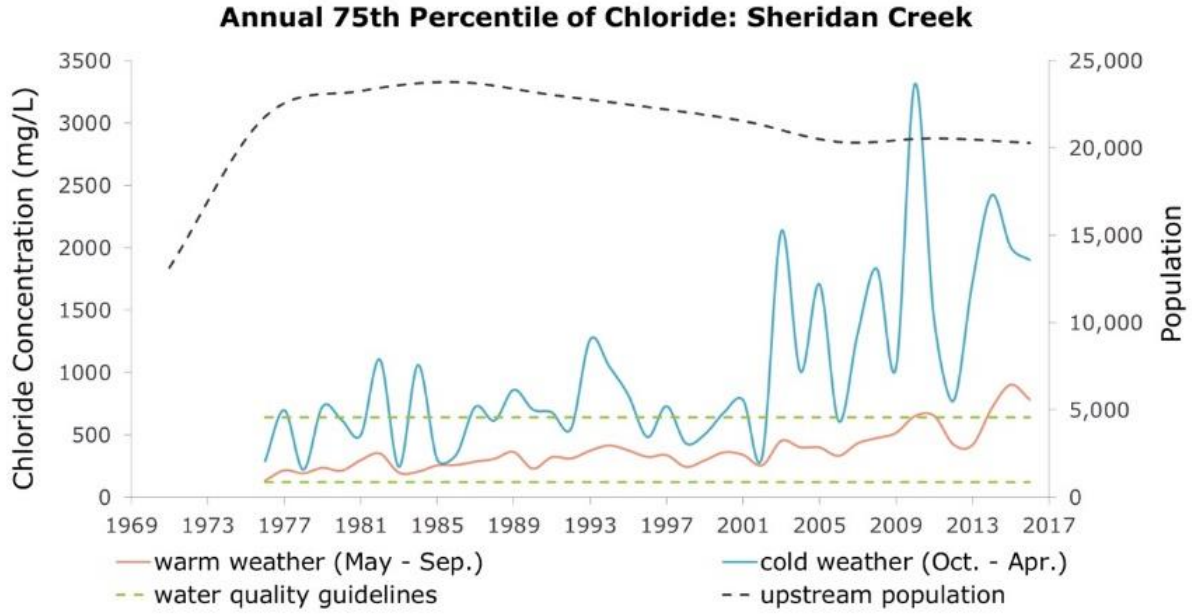

Figure 25. Chloride concentrations from 1976 to 2016 in Sheridan Creek located in the Credit Valley watershed in southern Ontario. Source: Credit Valley Conservation Authority

[29] Hintz et Relyea, 2017; Hintz and Relyea, 2018; Holland et al. 2010; Lambert et al. 2016; Tiwari and Rachlin, 2018
[30] Hintz et al., 2017; Hintz and Relyea, 2018; Tiwari and Rachlin, 2018
[31] Dupuis et al, 2019; Hintz and Relyea, 2018; Tiwari and Rachlin, 2018; Wiltse et al., 2019; Wyman and Koretsky, 2018
[32] Corsi et al. 2015; Dugan et al. 2017; Kelly et al. 2018; Kerr, 2017; Laceby et al., 2019; Lax et al. 2017; Scott et al. 2019
[33] (; Credit Valley Conservation Authority, 2017.

A study conducted by the University of Calgary for ECCC investigated long-term trends in chloride concentrations using data from federal and provincial water quality monitoring networks across Canada (unpublished). The study looked at 103 monitoring stations[34], the majority of which had data starting in the 1960s, 1970s or 1980s and up until 2014 or 2015.
The study resulted in 2 main observations:

- Significant increases in chloride concentrations over the years leading to 2004 (when the Code was implemented) were found at 78% of the stations (80 stations) (Figure 26). In the period of 2004 onward, increases in chloride concentrations were found at 11% of the stations (11) and most stations (77) had no significant changes.
- The overall chloride mean concentrations were higher in the period of 2004 onward compared to the period before 2004 at 84% of the stations.

Although most stations have shown no significant increases in the chloride concentrations in the period from 2004 onward, the mean concentrations measured since 2004 are higher at 84% of the stations compared to the pre-2004 data. These 2 analyses suggest there could be a legacy effect of road salt on chloride concentrations in freshwater ecosystem. In other words, although chloride concentrations in water from 2004 onward has not increased at a level found to be statistically significant for that timeframe, chloride resulting from road salt added to the environment over a long period of time (for example since the 1960 to 1970) is not negligible.

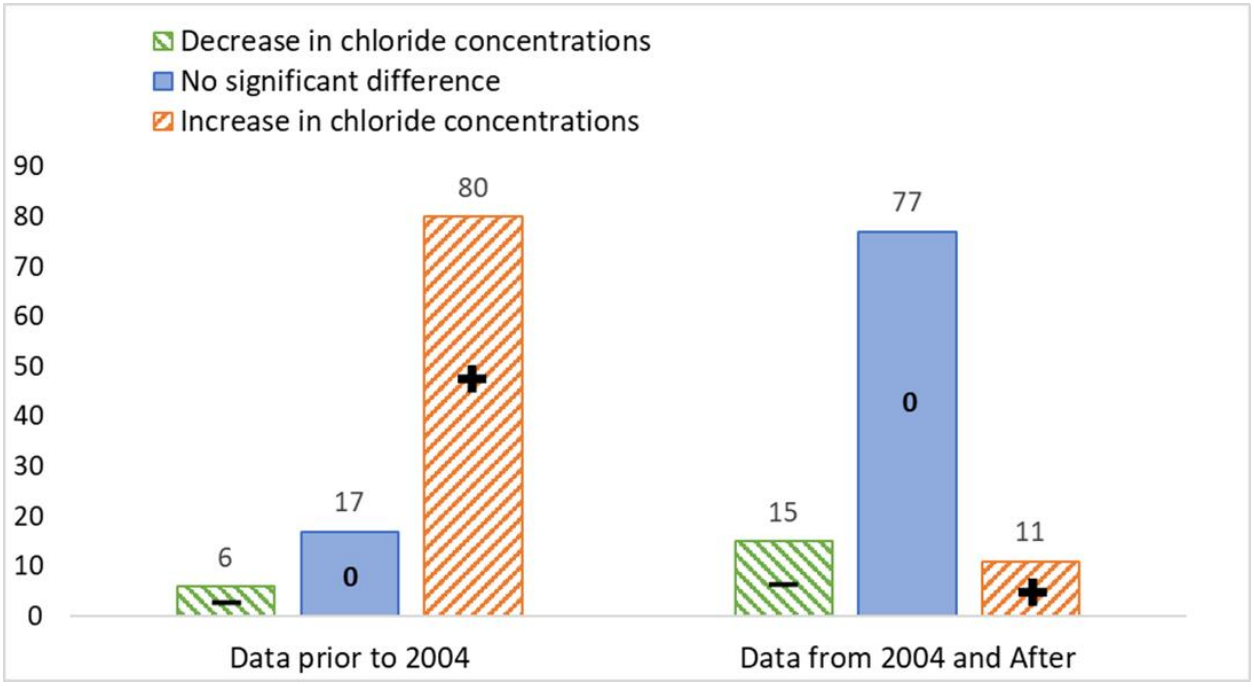

Figure 26. Number of stations showing decreases, increases and no change in chloride concentrations in the time period of prior to 2004 and from 2004 onward.

[34] 86 stations located in Ontario, 15 in Alberta, 1 in Manitoba and 1 in Prince-Edward-Island.

Summary – Chloride in the environment

Research indicates that the presence of high levels of chloride in freshwater resulting from de-icing salt can have environmental impacts. A number of studies have shown increasing chloride concentrations over the long-term, likely as a result of salt application for de-icing purposes. Based on a study by the University of Calgary for ECCC, most freshwater sampling stations studied have shown no significant increases in the chloride concentrations in the period from 2004 onward, however, the mean concentrations measured since 2004 are higher at 84% of the stations compared to the pre-2004 data.

8.1 Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health

The Government of Canada collaborates with the province of Ontario under the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health (COA). In July 2019, a draft COA was published in the *Canada Gazette*, Part I, for public comment. The final agreement was published in January 2021. Annex 2: Harmful Pollutants of the agreement serves as a guide for cooperative and coordinated actions to reduce or eliminate releases of harmful pollutants into the Great Lakes basin. The agreement[11] includes commitments to implement ECCC's current activities related to the environmental management of road salt under the Code of Practice as well as additional actions by the province of Ontario for preventing chloride from road salt from entering groundwater and surface water.

9. Conclusion

The assessment conducted in 2001 showed that the quantity of road salts used in Canada was raising the chloride levels in both ground and surface waters, and was responsible for harmful adverse effects on aquatic species, terrestrial vegetation, wildlife mortality and soil chemistry. The implementation of best practices in the management of road salt is key to protect the environment from the negative impacts of road salts because appropriate salt application techniques vary from region to region and there is no one-size fits all solution for road salt application across Canada. Voluntary measures such as the Code of Practice can be successful when there is willingness among the intended users to implement the best management practices that are the foundation of the Code.

Road organizations have made significant improvements in their salt application practices since the 1990s and the Code resulted in an accelerated adoption of many best practices at that time. The National Targets developed in response to the first review are effective in measuring the progress of the Code. This review of the Code of Practice for the Environmental Management of Road Salts has been prepared in collaboration with the Road Salt Working Group.

Level of adoption of the Code

The level of adoption of the Code (Target 1), as measured by the number of annual reports submitted by road organizations that are subject to the Code, is fairly high, and has been just short of or met the target of 220 reports annually in recent years. Consistency in reporting has decreased; 170 organizations reported regularly in the 2015 to 2019 period which is a decrease from the 222 organizations that were identified as reporting regularly between (2005 to 2009) in the first review. Increasing the consistency of reporting would help ensure the target on number of reports received is consistently achieved.

Despite the inconsistency in the number of reporters, it is evident that the reporting covers a large portion of the organizations expected to be subject to the Code. Organizations that have reported at least once in the 2015-2019 period represent 73% of the Canadian population (excluding Quebec). The largest salt users, including most provinces and almost all large municipalities (90%) have reported under the Code, with some notable exceptions where milder weather conditions exist. Reporting by smaller municipalities (10,000 to 50,000 population) has been lower (42%) and could be targeted for additional outreach. Several municipalities with populations below 10,000 have voluntarily reported, but there is lower likelihood of these organizations using enough salt to meet thresholds and they represent a minimal amount of the reported salt use.

Salt management plans

There has been a significant decline in the number of organizations reporting having a SMP in place with 80% of organizations reporting having an SMP in place in 2019. Developing and implementing a plan is a key element of the Code and this reduction could be due to a lack of awareness of existing plans by reporting staff or the expiry of previous plans.

Only 62% of organizations reported reviewing their SMP in 2019 (Target 2). The annual review of plans is essential to ensure the plan is up to date and reflects any lessons learned from the previous season. More efforts are needed to ensure all organizations have developed, implemented and reviewed a SMP.

Training

Training levels for in-house and outsourced staff at municipalities has remained fairly constant over the 2015 to 2019 period with in-house staff receiving much higher levels of training than outsourced. Training levels for all personnel and especially outsourced contractors need to be increased to meet the TAC and Code recommendation of all personnel to receive training at least once a year.

Implementation of best management practices (BMPs)

Progress has been made and maintained by many road organizations in the implementation of best management practices in salt management including salt storage, salt application, and snow disposal since the implementation of the Code, whereas efforts are still needed to reach the targeted levels of adoption of best practices in certain areas.

1) Salt and treated abrasive storage

Virtually all organizations report the use of permanent roof and impermeable pad for the storage of salts (Target 3) since the publication of the Code. The coverage of treated abrasives (Target 4) has increased to 72% but falls short of the 75% target. Further effort could be made to encourage the use of cover, by tarp or permanent roof systems for treated abrasive storage to prevent runoff of salt to the environment.

2) Storage site design and operations processes

Road organizations have a high degree of adoption of some good housekeeping practices such as using impermeable areas to store salts and conducting, as needed, spills clean-ups (90% of

municipalities). There are, however, lower levels of uptake for other practices such as overload prevention mechanisms, collecting wash water from trucks, diversion of external water not impacted by salt, and monitoring of chloride in runoff from salt storage sites.

In addition, fewer than 50% of salt storage sites have collection systems for salt contaminated runoff. Given that salt storage sites are a significant point source for chlorides entering the environment, higher levels of uptake of best practices in this area would be desirable, especially practices related to the control of external water and the collection of salt contaminated runoff.

3) Salt application

The implementation of BMPs in salt application has succeeded to varying degrees. There has been an increase in the use of groundspeed electronic controllers (Target 5) to 93% and use is approaching the target of 95% vehicles equipped with the technology. The use of calibration of salt spreading equipment has remained fairly constant in the past 10 years with 86% of organizations reporting they do it at least once a year. Calibration is an essential technique to ensure the right amount of salt is being applied at any time and all organizations should be using this practice.

The number of organizations using pre-wetting or pretreated salts (Target 6a) has been in the 61 to 68% range since 2013 and is less than the target of 95%. The percentage of vehicles equipped for pre-wetting (Target 6b) reached 65% in 2019 which is less than the 75% goal. Most of the organizations not using pre-wetting or pretreated salts are smaller municipalities. The number of organizations reporting the use of Direct Liquid Application (DLA) has remained fairly constant over the past 10 years with fewer than half of the reporting organizations reporting using DLA. DLA is more commonly used by provinces with 8 reporting its use. DLA is less common than the use of pre-treated salts and pre-wetting and this may be explained by the lack of awareness and the cost of DLA equipment. Potential barriers for use of these alternatives include high cost to maintain equipment for pre-wetting, lack of resources for pre-wetting equipment in small or remote municipalities, availability of pre-treated salt, lack of awareness and education on effectiveness of pre-wetting and pre-treated salt and low effectiveness of pre-wetting on non-paved roads compared to paved roads. These technologies should be further studied to determine the current relevancy and challenges to achieve these targets.

The effectiveness of various salt application techniques varies based on temperature and weather conditions. While decisions on winter maintenance operations should be supported by some type of temperature/weather information or other decision support systems, it is not expected that each organization will use all systems or technologies available. Organizations are best placed to determine what systems or techniques to use. Availability (for example, fixed RWIS stations) and cost of certain equipment are factors to consider. The use of infrared thermometers, RWIS automated stations and meteorological services is common amongst all reporting organizations, with 77% of organizations using infrared thermometers. In 2019, the use of Automated Vehicle Location has increased to 76% of municipalities and those using Salt Application Rate (SAR) systems is about 70%.

4) Snow disposal

The use of best practices at snow disposal sites is mixed. The use of low permeability surfaces occurs at 62 to 65% of municipal snow disposal sites while the management of meltwater at municipal snow disposal site is not a common practice.

Identification of salt vulnerable areas (SVAs)

As of 2019, fewer than half of the reporting organizations inventoried their salt vulnerable areas and 35% prepared an action plan to address the salt vulnerable areas (Target 7). Further efforts are needed to reach the 95% target set for 2024.

ECCC has encountered some challenges over the past several years while working to develop additional guidance to help organizations identify SVAs. There is some discussion on the need for additional guidance with some members of the Road Salt Working Group expressing the need for further guidance while other members have suggested that ECCC revisit the concept of salt vulnerable areas suggesting that the identification of SVA may encourage road organizations to focus BMPs on SVAs at the expense of other areas.

Salt use

The purpose of best practices is to assist road organizations to optimize salt use and as a result, minimize release of salt into the environment. The total quantity of salt used that was reported under the Code has fluctuated significantly reaching a low of 2,153,000 tonnes in 2010 to a high of 4,972,000 tonnes in 2017. It is difficult to evaluate the quantity of salt used and the level of implementation of best practices and salt quantities reported because of other factors influencing salt usage (for example, winter severity, expanding road networks and number of reports). However, studies have shown that implementation of best practices in salt application can reduce salt quantities applied to roads[35].

Salt can be used for de-icing on public roads, private roads, commercial and institutional parking lots, sidewalks, personal driveways, etc. These various locations where salt is applied all contribute to the accumulation of chlorides in the environment. However, the relative contribution of each of these sectors is unknown. Efforts to limit environmental damage from road salts have been focused to-date on public road organizations that were thought to be the greatest salt users. The de-icer most used by road organizations is sodium chloride (92%). There is a strong correlation between the size of the municipality and the quantity of salt used with the average large municipality (>50000 population) using 16 times more salt than the average small municipality (<10000 population). In 2019, the 75 large municipalities reporting under the Code used 75% of all salt reported by municipalities.

The Code only applies to public road authorities using more than 500 tonnes of salt and is not implemented in Quebec therefore the salt use reported under the Code does not reflect all the salt entering the environment from road salt use in Canada. It was originally estimated that commercial and industrial salt use for the maintenance of parking lots, sidewalks and private roads accounted for 5 to 10% of salt used in Canada[36]. Other studies have reported a higher percentage of salt use for these applications[37]. For comparative purposes, in the state of New Hampshire, it was estimated that close to 40% of total salt is applied by the private sector, on parking lots and sidewalks. Salt use quantities for domestic, private and institutional uses are not available and could be a significant fraction of total salt use. ECCC has attempted to collect this data by doing a voluntary survey however this was unsuccessful and ECCC is considering mandatory information gathering to collect salt use data for these sectors.

[35] Haake and Knouft, 2019; Kilgour et al., 2014

[36] Cheminfo, 1999

[37] Stone et al., 2010; University of Minnesota, 2007; Plymouth University, 2007

With these various complexifying factors it is not possible to draw conclusions on the trends in salt use. Not withstanding this, progress made in implementing BMPs is expected to reduce the amount of salt released into the environment thereby resulting in environmental benefits.

Road safety

The goal of the Code was to ensure environmental protection while maintaining road safety. Long term road safety data suggest that the implementation of the Code has had no observable negative effects on roadway safety.

Chloride in the environment

There are no comprehensive studies on chloride concentrations across Canada. Many recent studies investigating long-term trends in chloride concentrations in certain North American freshwater ecosystems have shown increasing chloride concentrations and de-icing has been recognized as a major source of this contamination, particularly in urban areas. In a study by the University of Calgary on monitoring data across Canada, most of the 103 freshwater sampling stations studied have shown no significant increases in the chloride concentrations in the period from 2004 onward following the publication of the Code, however, the mean concentrations measured since 2004 are higher at 84% of the stations compared to the pre-2004 data. There is insufficient data to correlate changes in environmental concentrations with the implementation of the Code.

Summary

The objective of the Code of Practice was to ensure environmental protection while maintaining roadway safety. The basic premise of the Code was that the implementation of best practices to control salt release at storage sites and optimization of road salt use could help reduce the level of chlorides released into the environment. There has been a significant engagement from public road organizations across Canada in implementing and reporting on best practices. While the control of releases from salt storage sites though the coverage of stockpiles has improved the biggest challenges for the management of road salts are to: continue to improve coverage of treated abrasives, optimize salt application through better technologies, improve drainage control at maintenance yards and to determine if organizations not subject to the Code are a significant source of chlorides in the environment.

10. Actions for consideration

Overall, the level of adoption of the Code was high and reporting was good. Several additional actions, which are supported by the multi-stakeholder Road Salt Working Group, will be considered to improve Code implementation and better understand road salt management in Canada:

Continue to manage the environmental risks of road salts through the Code of Practice and to promote its adoption.

The results reported since the implementation of the Code indicate a high level of engagement by public road organizations and demonstrate that the Code, as a risk management tool, is valid and effective. While progress has been achieved in adopting the Code and implementing best management practices; over time, progress has plateaued and areas for improvement remain. Environment and Climate Change Canada will continue working with the working Group and consider further opportunities to raise awareness of the Code and encourage its adoption by all road organizations, with an emphasis on medium sized municipalities (10,000 to 50,000 population) and inconsistent reporters.

Encourage improved adoption of best management practices by road organizations

This evaluation has revealed some areas that need improvement. Road organizations have a responsibility to ensure that they continue to meet the requirements of the Code, and should consider focusing efforts and resources to:

- ensure that they have a current salt management plan, and that this plan is reviewed annually (Target 2)
- increase training for outside contractors and staff to meet the Transport Association of Canada recommendation for annual training
- increase coverage of treated abrasives through permanent roofs systems or temporary cover such as tarps (Target 4) and
- improve runoff control at salt storage sites and maintenance yards

ECCC will share the results of this review, and will be available to assist road organizations who have questions on these best management practices.

Continue to use National Targets to evaluate effectiveness of the Code and further investigate targets that pose challenges for implementation.

The National Targets have proven themselves as effective indicators for measuring the progress in implementing certain key elements of the Code, however, there remain uncertainties in 2 target areas:

- Salt Vulnerable Areas (SVA) (Target 7) – Development of the plain language guidance for the identification of salt vulnerable areas requested by road organizations has posed a challenge for the Department and the Road Salts Working Group. Working group members have also questioned the need for identifying SVAs, suggesting it may be better to focus on greater adoption of best practices across all service areas. ECCC will consider studying a sample of the organizations that have already identified SVAs to understand their method for identifying SVAs and how SVAs have been incorporated into their salt management plans and practices. This study should consider whether identifying SVAs has been effective at protecting these areas or whether it has impacted resources available for the application of BMPs elsewhere. Pending the results of this

investigation, ECCC will continue discussions with the Working Group to determine if the target (95%) and target date (2024) are still appropriate.

- Targets for prewetting and pre-treatment of road salts (Target 6a, b) – The uptake for use of new technologies for road salt application has been slow and has not met the expected target. It is unclear whether the adoption of these advanced technologies is limited by resources within road organizations or by lack of awareness of the advantages of these techniques on reducing salt use. ECCC will consider investigating the barriers to adoption of these techniques and work with the Working Group to develop recommendations.

Investigate other uses of road salt beyond the Code of Practice

Salt used for de-icing on private roads, commercial and institutional parking lots, sidewalks, and personal driveways, etc. also contribute to environmental chloride loadings. Localized studies are indicating high levels of chlorides in certain water bodies. ECCC will consider mandatory data gathering on road salt use beyond organizations subject to the Code to determine the relative impact of these sectors and whether road salt management should be expanded beyond the large public road organizations that are subject to the Code.

Renew discussions with provinces and territories to explore opportunities for implementing the actions identified in this review.

Given the voluntary nature of the instrument, continued contact is needed with partner organizations to maintain awareness of the need for support and engagement in the Code. Follow-up to the 2012/2013 meetings with the Provinces/Territories should be undertaken to explore options to enhance collaboration and support to the management of the Code within their jurisdictions on: 1) Code promotion within their jurisdiction; and 2) potential for environmental monitoring near salt storage and application zones.

Schedule another review of the Code.

ECCC plans to conduct a review of the Code 5 years after the publication of this second review. This review will allow the department to determine if these actions have improved the implementation of the Code.

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Appendix B: Annual road salt reporting form

Identification

- **Company**

  Company Name

  Canadian Federal Business Number

  Type of Organization

  Indicate Structure Level

  Private contractor - Indicate below the road organization you are reporting for (ensure you have an agreement to avoid duplication in reporting)

  Population (for municipalities)

- **Head Office**

* Physical Address (required)

Unit Number

Street Number

Street Name

Street Type

Street Direction

* City (required)

Province/State (in North America)

Postal Code / ZIP

* Country (required)

* Mailing Address (required)

Unit Number

Street Number

Street Name

Street Type

Street Direction

* City (required)

Province/State (in North America)

Postal Code / ZIP

* Country (required)

- ## Main contact person

***** Name (required)

Position

***** Mailing Address (required)

Unit Number

Street Number

Street Name

Street Type

Street Direction

* City (required)

Province/State (in North America)

Postal Code / ZIP

* Country (required)

***** Telephone number (required)

Extension

Fax

***** Email (required)

- ## Additional contact person

***** Name (required)

Position

***** Mailing Address (required)

Unit Number

Street Number

Street Name

Street Type

Street Direction

* City (required)

Province/State (in North America)

Postal Code / ZIP

* Country (required)

***** Telephone number (required)

Extension

Fax

* Email (required)

1. Salt Management Plan

* 1.1 Has your organization developed and implemented a salt management plan that covers all elements described in the Code of Practice? (required)

* 1.2 In the past year, did your organization conduct an annual review of its salt management plan? (required)

1.3 In the past year, did your organization update its salt management plan?

1.4 In the past year, was a training program delivered to employees involved in winter maintenance operations and decision making? Indicate whether a training program (new or refresher) was delivered to employees at the following levels of responsibility:

- Training In-house Staff

Type of staff	Was training taken?
Manager(s)	
Supervisor(s)	
Operator(s)	
Mechanic(s)	
Patrollers(s)	

- Training Outsourced Contractors

Type of staff	Was training taken?
Manager(s)	
Supervisor(s)	
Operator(s)	
Mechanic(s)	
Patrollers(s)	

- Objectives Identified and Achieved

1.5 Indicate the number of objectives that were identified in your salt management plan with respect to the following areas:

Areas of Improvement	Number Identified	Number Achieved
Material Storage Facilities		
Salt Application		
Snow Disposal		
Vulnerable Areas		

2. Winter Operation Information

- Winter Operation Activities

2.1 Identify whether any of your winter salting operations are conducted by contractors (outsourced as opposed to in-house) and, where applicable, what portion of the work was conducted in this way.

Activity	Are these activities conducted in-house?	Are these activities outsourced?	Indicate the portion of outsourced operations (quantity)	Measurement Unit
Salt Storage				Number of sites
Salt Application				% of total road network
Snow Disposal				Number of sites

- Road Length Serviced

2.2 What is the total length of road on which any salt is applied in your jurisdiction (including roads with abrasive)? km of two-lane equivalent (centre line)

- Winter Conditions

2.3 What was the total number of days requiring salt application for winter road maintenance during the winter season?

3. Material Used

3.1. Provide the total quantity of material used for winter road maintenance (including sidewalks) as of May 31st (including both materials applied in-house and by out-sourced contractors).

If using other types of material (such as acetate or multi-chloride products) use Section 8 Additional comments.

- Solids

- De-icers

Type	* Tonnes (required)
Sodium chloride (NaCl)	
Magnesium chloride (MgCl2)	
Calcium chloride (CaCl2)	

- Pre-treated Salts

Type	* Tonnes (required)
All types	

- Treated Abrasives

* Indicate the quantity of abrasives (sand, stone dust or aggregates) before mixing (tonnes): (required)

Indicate quantity of solid salts mixed with abrasives (tonnes):

If the exact quantity of salt mixed with abrasive is not reported separately above, indicate the % of salt mixed with abrasives:

- Liquids

* Provide the quantity of ALL liquids used for pre-wetting, pre- treatment and direct liquid application (anti-icing) of ALL types (NaCl, MgCl2, CaCl2) (litres) (required)

4. Design and Operation of Road Salt Storage Sites

- Design and Operation

* 4.1 How many salt storage sites are managed and/or controlled by your organization? (required)

- Coverage

4.2. Provide the percentage of all the materials that are stored under the following conditions. If your organization manages more than one site, indicate the number of sites where the material is stored under each condition.

- Road salts

Type	* Type Percentage of materials (required)
Covered by a permanent roof	
Covered only with a tarp	

- Coverage of treated abrasive

Type	Type Percentage of materials
Covered by a permanent roof	
Covered only with a tarp	

- Storage Surface

4.2. Provide the percentage of all the materials that are stored under the following conditions. If your organization manages more than one site, indicate the number of sites where the material is stored under each condition.

- Materials stored on an impermeable surface

Type	Type Percentage of materials
Road salts	
Treated abrasive	

- Good Housekeeping Practices

4.3 Provide the characteristics of your storage site design and the working activities that support good housekeeping practices.

- Practices

Practice	Applied or used?
All materials are handled in a designated area characterized by an impermeable surface	
Equipment to prevent overloading of trucks	
System for collection and/or treatment of wastewater from cleaning of trucks	
Control and diversion of external waters (not impacted by salt)	
Ongoing cleanup of the site surfaces and spilled material is swept up quickly	
Risk management and emergency measures plans are in place	

- Drainage

Number of sites that have drainage and collection system for runoff of salt-contaminated waters?

Does your organization monitor the chloride concentration in the run off?

- Specify discharge point into:

Specify discharge point into:	Located in?
a municipal sewer system	
a containment system for removal	
a watercourse	
other(s)	

5. Salt Application

- Management of Equipment

5.1 Indicate the number of vehicles used for salt application (including combination units).

Vehicle equipment	* **Number of vehicles** (required)
* Total number of vehicles assigned to a solid salt application (required)	
* Vehicles with conveyors and ground speed sensor electronic controller (required)	
* Vehicles equipped with pre-wetting equipment (required)	
Vehicles designed for **direct liquid application DLA**	

Is spreading equipment regularly calibrated?

Frequency of calibration (times per year)

- Weather Monitoring

5.2 Indicate the sources of information your organization relies on to make decisions for winter event responses, supplementing road patrol observations.

Sources	**Is used?**	**Number**
Infrared thermometer		
Meteorological service		
Fixed Road Weather Information System **(RWIS)** stations		
Vehicle-mounted mobile RWIS		

- Maintenance Decision Support

5.3 Indicate the type of system your organization relies on to help improve decision making for maintenance strategy, materials and application rate.

Types	**Is used?**	**% of Fleet**
Record of salt application rates		
Automated vehicle location (AVL)		
Use of a chart for application rates adapted to road or weather conditions (e.g., temperature)		
Testing of Maintenance Decision Support System (MDSS)		

6. Snow Disposal

- Management of Snow

6.1 Does your organization perform snow disposal at a designated site?

Total number of sites

Total design capacity of all snow disposal sites (in cubic metres)?

6.2 Does your organization use snow melters?

Percentage of disposed snow with snow melters:

6.3 Is the meltwater from snow melters discharged through the storm sewer system?

- Design of Snow Disposal Sites

6.4 Provide the percentage of disposed snow managed under the following conditions. If your organization manages more than one site, indicate the number of sites meeting these conditions.

Design feature	Percentage of snow disposed	Number of sites
Snow is disposed of entirely on a low permeability surface		
All meltwater is directed to a retention pond before its discharge		
All meltwater is collected and discharged into a municipal sewer system		
All meltwater is collected and discharged into a watercourse		

7. Management of Salt Vulnerable Areas

- Inventory - Identification of Salt Vulnerable Areas

* 7.1 Has your road organization completed an inventory of salt vulnerable area within your territory? (required)

- Salt vulnerable areas within territory - Identification of Salt Vulnerable Areas

* 7.2 Do you have salt vulnerable area(s) within your territory? (required)

- Action Plan - Identification of Salt Vulnerable Areas

* 7.3 Has your organization prepared an action plan to prioritize areas where measures will be put in place? (required)

- Supplementary Protection or Mitigation Measures

* 7.4 Did your organization implement supplementary and specific protection or mitigation measures to eliminate or reduce road salt impacts on vulnerable areas? (required)

- Environmental Monitoring

7.5 Does your organization conduct environmental monitoring to measure impacts of road salts on vulnerable areas?

- Types of Vulnerable Areas

7.6 Specify the type and number of vulnerable areas identified, where protection levels are in place or chloride levels are monitored.

Type of Vulnerability	Number of areas identified	Number of areas with protection measures in place	Number of areas with chloride monitoring
Drinking water (surface or groundwater)			
Aquatic life (lake and watercourse)			
Wetlands and associated aquatic life			
Delimited areas with terrestrial fauna or flora			
Valued lands			

8. Additional information

Salt Management Plan

Winter Operation Information

Materials Used

Design and Operation of Road Salt Storage Sites

Salt Application

Snow Disposal

Management of Salt-vulnerable Areas

Report Submission and Electronic Certification

Statement of Report Submission

By clicking the Submit button below, the reporting lead acting on behalf of the road organization will be submitting the report.

Authorized reporting lead name

The amounts and values for this organization are accurate, based on reasonable estimates using available data. The data for the organization that I represent are hereby submitted using the Environment and Climate Change Canada Single Window system.

Please enter any additional comments you have regarding this submission

Appendix C: Glossary of terms

Anti-icing

A proactive snow and ice control practice whereby a pavement surface is treated before a bond can form between frost, snow or ice and the pavement.

Calibration (as in calibrating a spreader)

A process of determining the specific relationship between settings on a salt spreader and the amount of salt that is discharged at various operating speeds.

De-icers

Products used to de-ice pavement (see “De-icing”). There are several bases for de-icers. Chloride-based de-icers (sodium chloride, calcium chloride and magnesium chloride) exist in both solid and liquid forms. Acetate-based de-icers include potassium acetate, calcium magnesium acetate, sodium acetate and calcium magnesium potassium acetate. Acetate/formate-based de-icers also exist but are not common. There are also biological de-icers based on molasses, sugar beet, urea, carbohydrates, proteins, complex sugars, or other organic or agricultural by-products. Finally, de-icers can also be glycol-based (propylene glycol, ethylene glycol), but in this case, additives must be added.

De-icing

A reactive snow and ice control strategy of applying salt on top of snow or ice during or after a storm to break an ice/pavement bond that has already formed. It is generally accepted that solid forms of freeze point depressants work better than liquid forms with this strategy.

Direct liquid application (DLA)

DLA is a technique that sprays a liquid chemical directly onto the road surface. The chemical prevents the formation of snow and ice, and also prevents snow and ice from bonding with the road surface. DLA can reduce the amount of road salt needed.

Freeze point depressant

A material (e.g. salt) that will lower the temperature at which a solution will freeze. Used for snow and ice control to either prevent or break the ice/pavement bond that forms on driving and walking surfaces.

Good housekeeping practices

A defined set of policies and procedures for preventing the release of salt to the environment at salt and snow storage sites. The practices typically include preventative measures such as not overloading trucks and proper management of vehicle wash water, and emergency response procedures such as cleaning up salt spills.

Groundspeed oriented electronic controllers

Electronic devices used to control the amount of material that is applied using a truck/tractor mounted mechanical spreader. The amount of material being applied is automatically adjusted according to the groundspeed of the vehicle. This allows for a known, consistent amount of material to be applied regardless of the speed of the vehicle. Most modern controllers have the ability to collect, store and transmit application rate data allowing material use to be closely monitored and managed better.

Impermeable pads

Refers to an asphalt or concrete base on which salt storage buildings are built. The base is constructed of a strong, impervious material that prevents salt and water that may be on the pavement from entering the ground below the structure.

Infra-red pavement temperature sensor/infrared thermometer (IRT)

A device used to quickly measure pavement temperatures and trends. Comes in both hand-held and vehicle-mounted (with digital readout in the truck cab) versions.

Maintenance yard

A maintenance yard is the location from which snowfighting agencies and companies stage their maintenance operations. Agency yards may be dedicated to operating a single department like roads, or shared with other operating groups such as Sewer and Water, Waste and/or Parks Maintenance. They are referred to by a variety of other names including: patrol yards, camps, garages or depots.

Pavement temperature

The temperature of the surface of a paved area (e.g. parking lots, roads, sidewalks, stairs). The area may be paved with materials such as concrete, asphalt or paving stones.

Plow/Plowing

A plow is a vehicle, or a device intended for mounting on a vehicle, for removing snow and sometimes ice from outdoor surfaces, typically those serving transportation purposes. Plowing is the process of using a plow to remove snow from a surface.

Pre-treatment

A technique whereby materials are mixed at the time it is stockpiled. For example, a liquid may be added to solid salt as it is stockpiled to enhance its performance when it is placed on a paved surface.

Pre-wetting

A technique whereby a concentrated liquid freeze point depressant is sprayed onto solid salt or sand at the time it is placed onto the pavement surface.

Road Organization

Any public entity that uses or is responsible for the use of road salts on public roads in Canada.

Road Salt

Chloride-based freeze point depressants including sodium chloride, calcium chloride, magnesium chloride and potassium chloride.

Road weather information system (RWIS)

A system for the transportation that uses weather and road data from automated weather reporting stations installed along the roadway and special sensors embedded in and below the road to provide real-time information to road operations staff about pavement and weather conditions at the specific station location. The information that is gathered assists weather forecasters in predicting icing conditions before they occur and allows road maintainers to better track evolving road conditions and to intervene proactively before road friction is lost.

Runoff controls/collection

The process of collecting runoff from specific sites (e.g. salt storage sites and snow disposal sites) that is usually contaminated by salt and other contaminants, and managing it in a way that minimizes the negative environmental impacts.

Salt management plan

A detailed plan of how salt users propose to improve the management of their use of road salt through the introduction of best salt management practices. These plans take into consideration all activities potentially resulting in the release of road salts into the environment, including storage, application of salts on roads and disposal of snow containing road salts.

Salt vulnerable areas (SVAs)

SVAs are areas of a receiving environment that may be particularly sensitive to road salts. Additional salt management measures may be required in these areas to ensure environmental protection. Guidance on the identification of SVAs can be found in Annex B of the *Code of Practice for the Environmental Management of Road Salts*.

Sand/Salt blends or treated abrasives

A mixture of an abrasive such as sand that mixed with a salt to prevent the sand from freezing during storage during and use. A minimum blend of 3–5% salt by volume is usually sufficient to prevent freezing.

Snow disposal site

A property where snow is hauled to, stockpiled and allowed to melt. The water created by the melting process (melt water) is usually released to a ditch, storm sewer or sanitary sewer.

Spreader

Equipment designed to apply a substance (e.g. sand or salt) to pavement (e.g. road, parking lots or sidewalk) at a specific rate.

Storage site

A location where salt and sand/salt blends are stockpiled.

Training

Specific education programs designed to teach road organization staff about proper winter maintenance techniques and salt management practices.

Winter severity index

A measure of the relative winter weather impact on winter road maintenance. To calculate this indicator, meteorological and RWIS data are used as independent variables, and winter road maintenance data are used as dependent variables. The first group of variables includes temperature, precipitation, snowfall and snow drifting, while the second one includes costs, level of services, number of lane kilometres, traffic flow and population density.

Appendix D: Road salt working group members as of February 2022

Last Name	First Name	Organization
Askey	Ethan	City of Calgary
Baril	Anne	Ministère des Transports Québec (MTQ)
Bartman	Allan	Alberta Ministry of Transportation
Betts	Andrew	GHD
Birmingham	Steve	Ontario Ministry of Transportation
Boone	Jonathan	Ontario Ministry of Transportation
Brassard	Pierre-Guy	Ministère des Transports Québec (MTQ), de la Mobilité durable et de l'Électrification des transports
Cantor	Michael	City if Winnipeg
Carter	Darren	Alberta Ministry of Transportation
Clifford	George	New Brunswick Transportation and Infrastructure
Dassouki	Ahmed	New Brunswick Transportation and Infrastructure
Deacoff	Cameron	Halifax Regional Municipality
Disegni	Rodrigo	British Columbia Ministry of Transportation
Dromer	Jean-Baptiste	K+S Windsor Salt Ltd.
Dumont	Michel	Natural Resources Canada
Finn	Craig	NSC Minerals Ltd.
Frass	Len	Saskatchewan Ministry of Highways and Infrastructure
Frenette	Michel	Consultant (formerly with City of Montreal)
Gagnier	Patrick	K+S Windsor Salt Ltd.
Gharabaghi	Bahram	University of Guelph
Gillon	Eleanor	Region of Peel
Godbout	Emilie	Ministère des Transports Québec (MTQ), de la Mobilité durable et de l'Électrification des transports
Habitch	Martin	City of Ottawa
Hanneman	Dick	Private Citizen (formerly Salt Institute)
Hewitt	Chris	City of Calgary
Imhoff	Brian	Manitoba Infrastructure
Johnson	Paul	Wellington County
Kaltenecker	Georgina	Ontario Ministry of the Environment
Kelly	Michael	County of Grey
Leach	Geoff	The Miller Group
Lehmann	Shauna	Saskatchewan Ministry of Highways and Infrastructure
Lund	Steven	County of Huron
MacConnell	Jane	Nova Scotia Transportation and Infrastructure Renewal
MacKinnon	Robert	PEI Department of Transportation, Infrastructure and Energy
Crawford	Mark	Region of Peel

McClintock	Heather	Wood Environment & Infrastructure Solutions
McInnis	Joshua	New Brunswick Department of Transportation and Infrastructure
Merante	Anthony	World Wildlife Fund Canada
Murison	Lorna	Credit Valley Conservation Authority
	Nalidina	Innovative Surface Solutions
Olsen	Ken	Environment and Climate Change Canada
Ouellet	Annie	Comité de bassin de la rivière Chaudière (COBARIC)
Pelletier	Monique	New Brunswick Department of Transportation and Infrastructure
Perkin	Mary Ellen	Environment and Climate Change Canada
Pinet	Mark	III Intelligent Infrastructure Installations Ltd.
Robitaille	Jean-Philippe	Ministère des Transports Québec (MTQ), de la Mobilité durable et de l'Électrification des transports
Roussel	Marie-France	Environment and Climate Change Canada
Scaldwell	Ted	Earth Innovations Inc.
Singh	Amanjot	Credit Valley Conservation Authority
Sorichetti	Ryan	Ontario Ministry of the Environment, Conservation and Parks
Stackpole	Craig	Transportation Association of Canada (TAC)
Stone	Mike	University of Waterloo
Sutherland	Grant	K+S Windsor Salt Ltd.
Thompson	Bill	Lake Simcoe RegionConservation Authority
Toneatti	Victor	Compass Minerals
Vander Wal	David	City of Ottawa
Wineberger	Ben	City of Calgary
York	Steven	Halifax Regional Municipality
Zambri	J.	City of Toronto

Appendix E: List of reporting organizations

Organizations that have reported at least 4 out of the 5 years from 2015-2019:

Federal organizations	
Cape Breton Highlands National Park, Nova Scotia (Parks Canada)	
Fundy National Park, New Brunswick (Parks Canada)	
Kouchibouguac National Park, New Brunswick (Parks Canada)	
5th Canadian division Support Base – Gagetown, New Brunswick (Canadian Army)	
Parks Canada Agency	
Prince Albert National Park, Saskatchewan (Parks Canada)	
Public Works and Government Services Canada	
Riding Mountain National Park, Manitoba (Parks Canada)	
Terra Nova National Park, Newfoundland and Labrador (Parks Canada)	
The Seaway International Bridge Corporation Ltd., Ontario	
Waterton Lakes National Park, Alberta (Parks Canada)	
Provincial and territorial organizations	
Alberta Transportation	
British Columbia Ministry of Transportation & Infrastructure	
Manitoba Infrastructure & Transportation	
New Brunswick Department of Transportation and Infrastructure	
Nova Scotia Department of Transportation and Infrastructure Renewal	
Ontario Ministry of Transportation	
Prince Edward Island Department of Transportation, Infrastructure and Energy	
Saskatchewan Ministry of Highways and Infrastructure	
Yukon Territorial Government	
Municipal organizations	
Province	**Organization Name**
Alberta	Brazeau County
	City of Airdrie
	City of Calgary
	City of Edmonton
	City of Grande Prairie
	City of Lacombe
	City of Lethbridge
	City of Medicine Hat
	City of Red Deer
	City of St. Albert
	Clearwater County
	County of St. Paul No. 19
	Cypress County
	Lac La Biche County
	Lacombe County
	Leduc County
	Municipal District of Wainwright

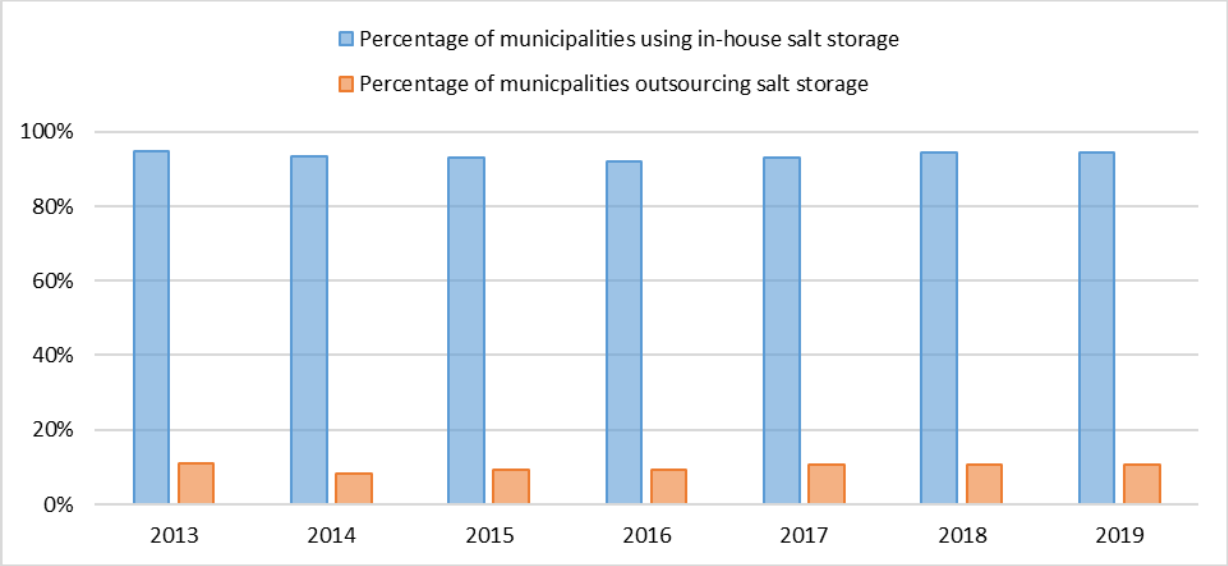
	Northern Sunrise County
	Rocky View County
	Strathcona County
	Town of Okotoks
	Westlock County
British Columbia	City of Chilliwack
	City of Colwood
	City of Kamloops
	City of Maple Ridge
	City of New Westminster
	City of Port Coquitlam
	City of Vancouver
	City of Williams Lake
	District of North Vancouver
	District of Saanich
	Village of Lumby
Manitoba	City of Winnipeg
New Brunswick	City de Dieppe
	City of Fredericton
	City of Moncton
	Town of Grand Bay-Westfield
	Town of Hampton
	Town of Quispamsis
	Town of Saint Andrews
	Town of Sussex
Newfoundland and Labrador	City of Mount Pearl
	Conception Bay South
	Town of Carbonear
	Town of Clarenville
	Town of Gander
	Town of Portugal Cove - St. Philip's
Nova Scotia	Cape Breton Regional
	Halifax Regional Municipality
	Town of Amherst
	Town of Berwick
Ontario	City of Greater Sudbury
	City of Markham
	City of Mississauga
	City of Oshawa
	City of Peterborough
	City of Pickering
	City of Sarnia
	City of Sault Ste. Marie
	City of Temiskaming Shores
	City of Thunder Bay

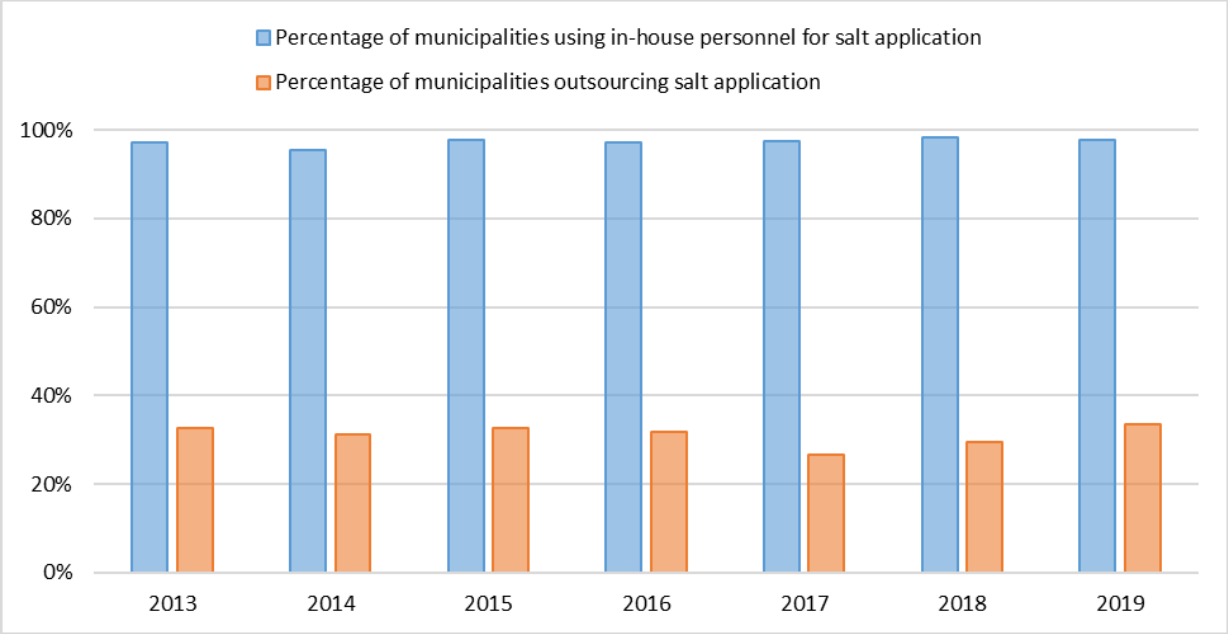
	City of Toronto
	City of Vaughan
	City of Windsor
	Clarington
	Corporation of the City of Barrie
	Corporation of the City of Belleville
	Corporation of the City of Brockville
	Corporation of the City of Cornwall
	Corporation of the City of Guelph
	Corporation of the City of Kitchener
	Corporation of the City of London
	Corporation of the City of North Bay
	Corporation of the City of Timmins
	Corporation of the City of St. Catharines
	Corporation of the City of St. Thomas
	Corporation of the County of Bruce
	Corporation of the County of Essex
	Corporation of the County of Lambton
	Corporation of the County of Lanark
	Corporation of the County of Northumberland
	Corporation of the County of Wellington
	Corporation of the Municipality of Halton Hills
	Corporation of the Municipality of Trent Hills
	Corporation of the Town of Bracebridge
	Corporation of the Town of Caledon
	Corporation of the Town of Collingwood
	Corporation of the Town of Fort Erie
	Corporation of the Town of Goderich
	Corporation of the Town of Gravenhurst
	Corporation of the Town of Newmarket
	Corporation of the Town of Pelham
	Corporation of the Town of Penetanguishene
	Corporation of the Town of Plympton-Wyoming
	Corporation of the Town of Tecumseh
	Corporation of the Town of The Blue Mountains
	Corporation of the town of Tillsonburg
	Corporation of the Township of Centre Wellington
	Corporation of the Township of Scugog
	Corporation of the Township of South Stormont
	Corporation of the Township of St Clair
	Corporation of the Township of Stone Mills
	Corporation of the United Counties of Leeds and Grenville
	Corporation of the United Counties of Prescott and Russell
	County of Elgin
	County of Haliburton

	Haldimand County
	Municipality of Central Elgin
	Municipality of Middlesex Centre
	Municipality of Mississippi Mills
	Municipality of Whitchurch-Stouffville
	Oxford County
	Region of Waterloo
	Regional Municipality of Durham
	Regional Municipality of Halton
	Regional Municipality of Peel
	Regional Municipality of York
	South Frontenac Township
	Town of Ajax
	Town of Arnprior
	Town of East Gwillimbury
	Town of Greater Napanee
	Town of Milton
	Town of Niagara-on-the-Lake
	Town of Oakville
	Town of Petawawa
	Town of Renfrew
	Town of Richmond Hill
	Town of Whitby
	Township of Admaston/Bromley
	Township of Bonnechere Valley
	Township of Dawn-Euphemia
	Township of Oro-Medonte
	Township of Puslinch
	Township of Selwyn
	Township of Sioux Narrows-Nestor Falls
	Township of South Glengarry
	Township of Springwater
	Township of Stirling-Rawdon
	Township of Tiny
	Township of Uxbridge
	Township of West Lincoln
Saskatchewan	City of Regina
	City of Saskatoon
Private organizations	
407 ETR Concession Company Ltd.	
Brun-Way Highways Operations Inc.	
Chinook Highway Operations Inc.	
Gateway Operations	
MRDC Operations Corporation	

Appendix F: Compilation of reported data

Training of personnel





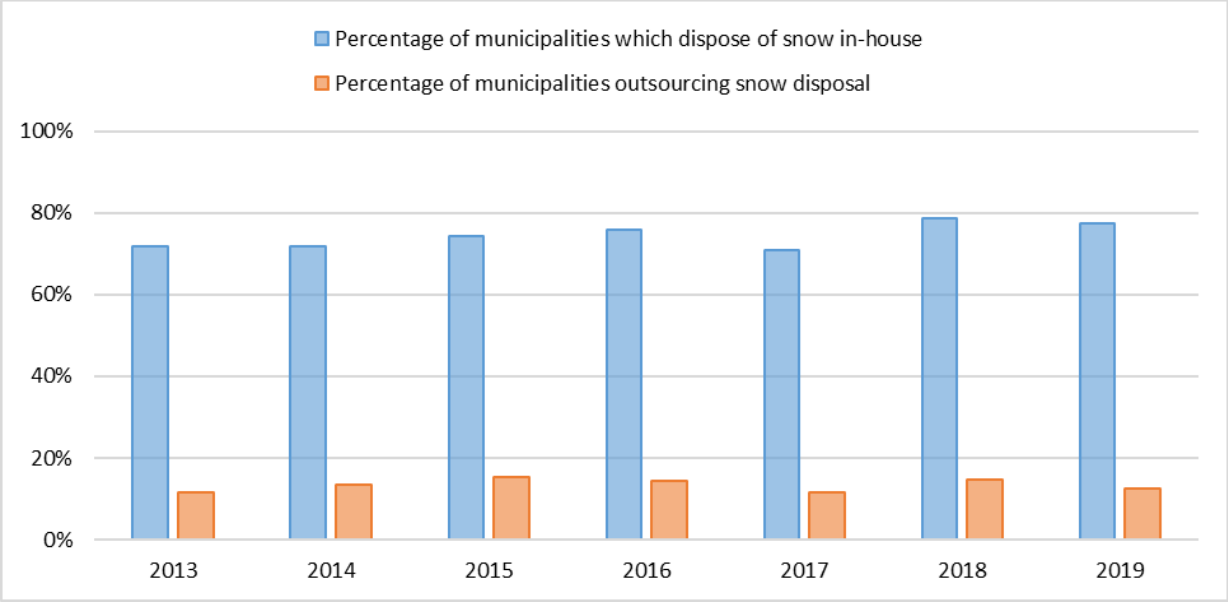
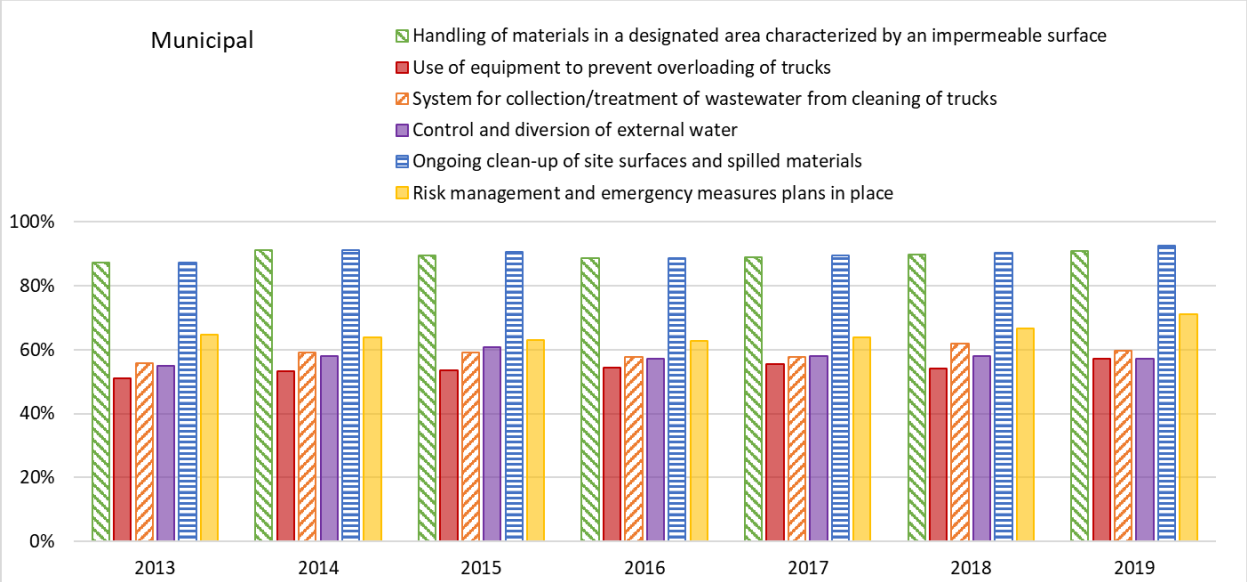


Figure A-1. Percentage of reporting municipalities that use in-house and/or outsourced contractors for their activities related to salt storage, salt application and snow disposal from 2013 to 2019

Storage site designs and operations



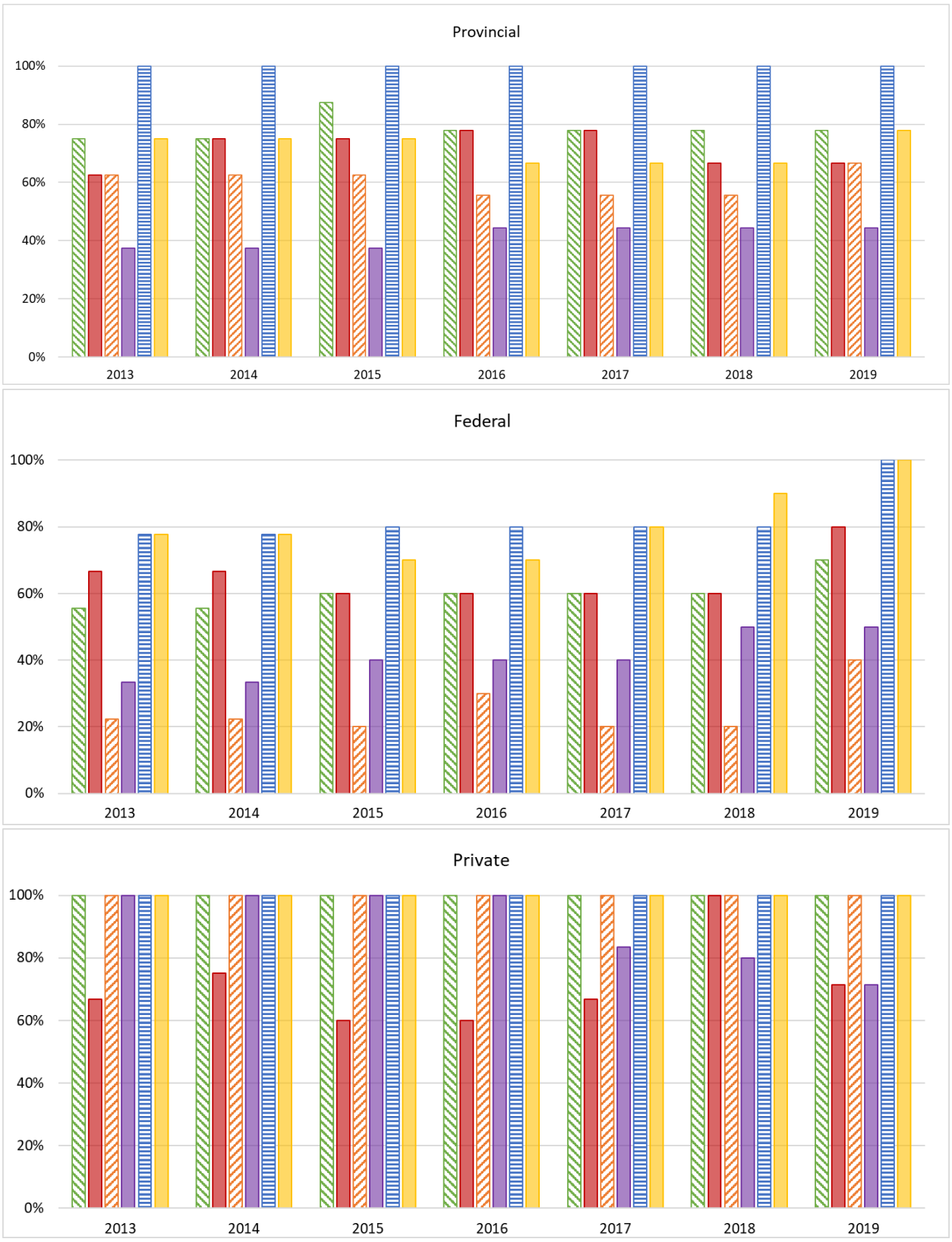


Figure A-2. Percentage of reporting organizations implementing the different best management practices at their storage sites, by organization type, from 2013 to 2019.

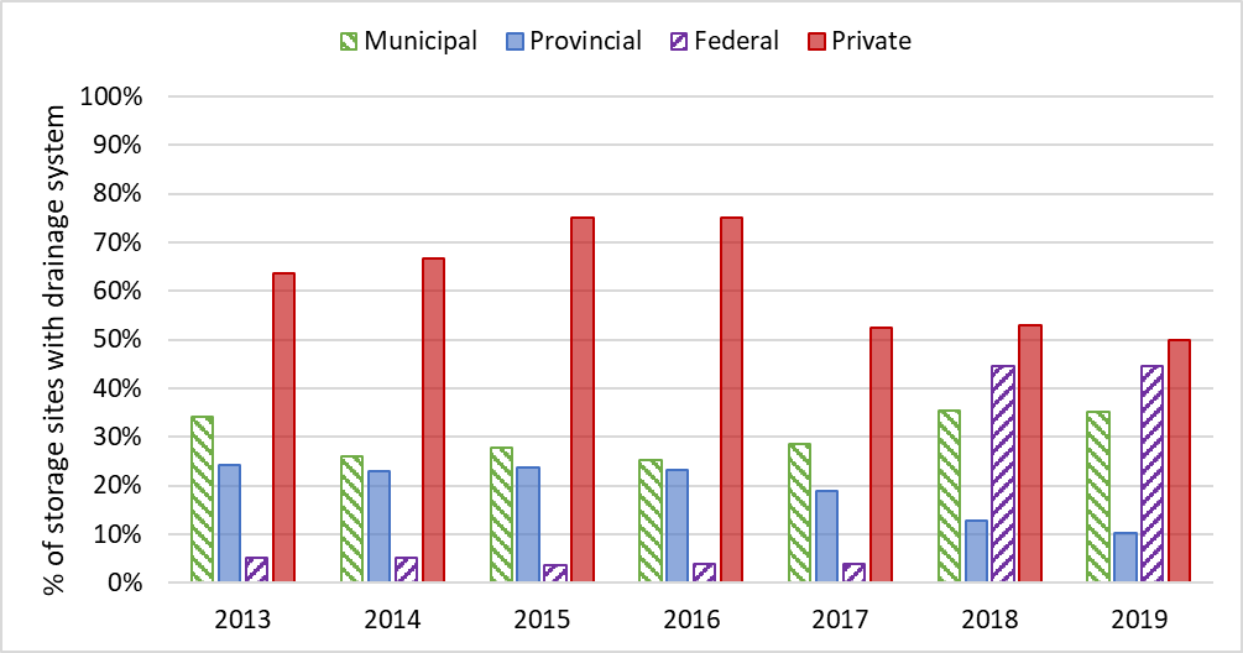


Figure A-3. Percentage of storage sites with drainage and collection systems for runoff of salt-contaminated waters, by organization type, between 2013 and 2019. The increase in 2018 for federal organizations is the result of 1 organization that started reporting his information in 2018 and all of their 10 storage sites have a drainage system in place).

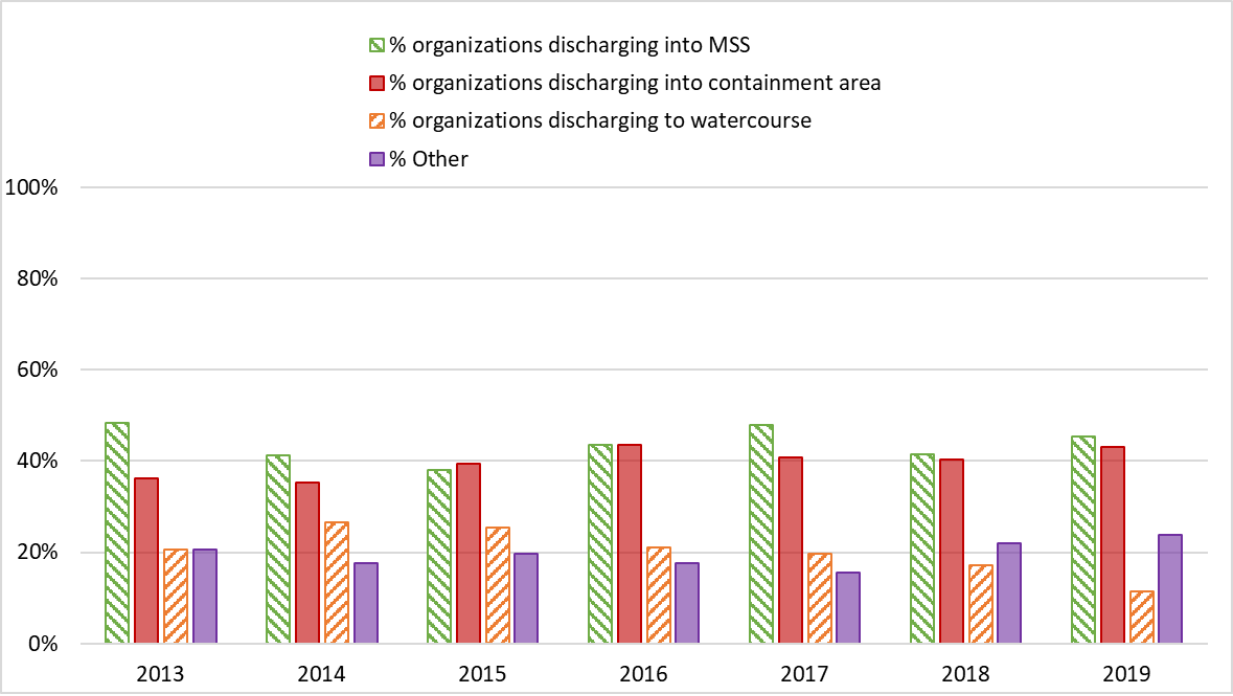


Figure A-4. Percentage of municipal organizations discharging salt contaminated waters from their storage sites into a municipal sewer system, a containment system for removal, a watercourse or another discharge point, by organization type. Only the organizations that reported having at least 1 storage site with a drainage and collection system in place are included in the analysis.

Salt application

Table A-1. Use of DLA by provinces over time

Province	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alberta	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
British Columbia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New Brunswick	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Newfoundland[1]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ontario	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nova Scotia	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Saskatchewan	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PEI	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Manitoba	No	No	No	No	No	No	No	No	No	No	No
Total	**5**	**5**	**5**	**7**	**7**	**7**	**7**	**8**	**8**	**8**	**8**

[1]Newfoundland and Labrador has not reported since 2011. As they reported having vehicles designed for DLA in 2010 and 2011, it is assumed that they are still using this technology.

Calibration of spreading equipment

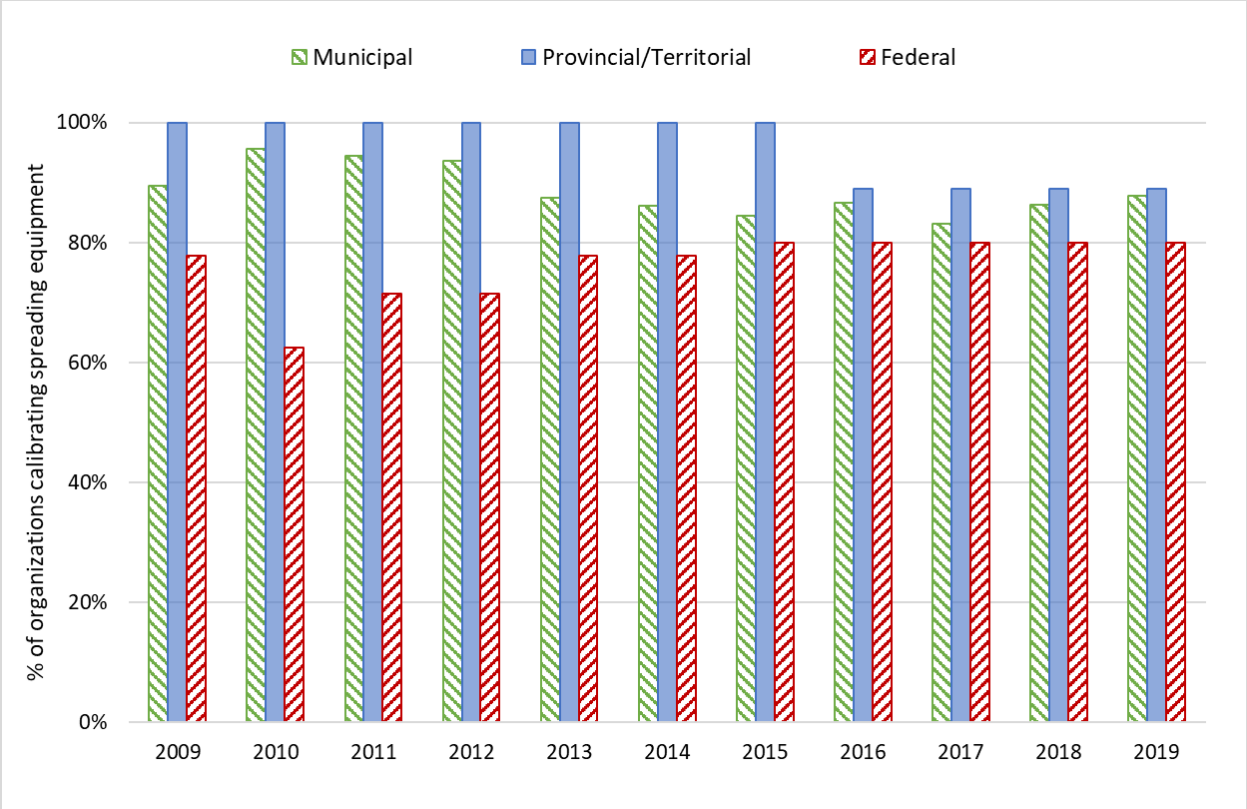


Figure A-5. Percentage of reporting organizations, by type of organization, calibrating their spreading equipment between 2009 and 2019.

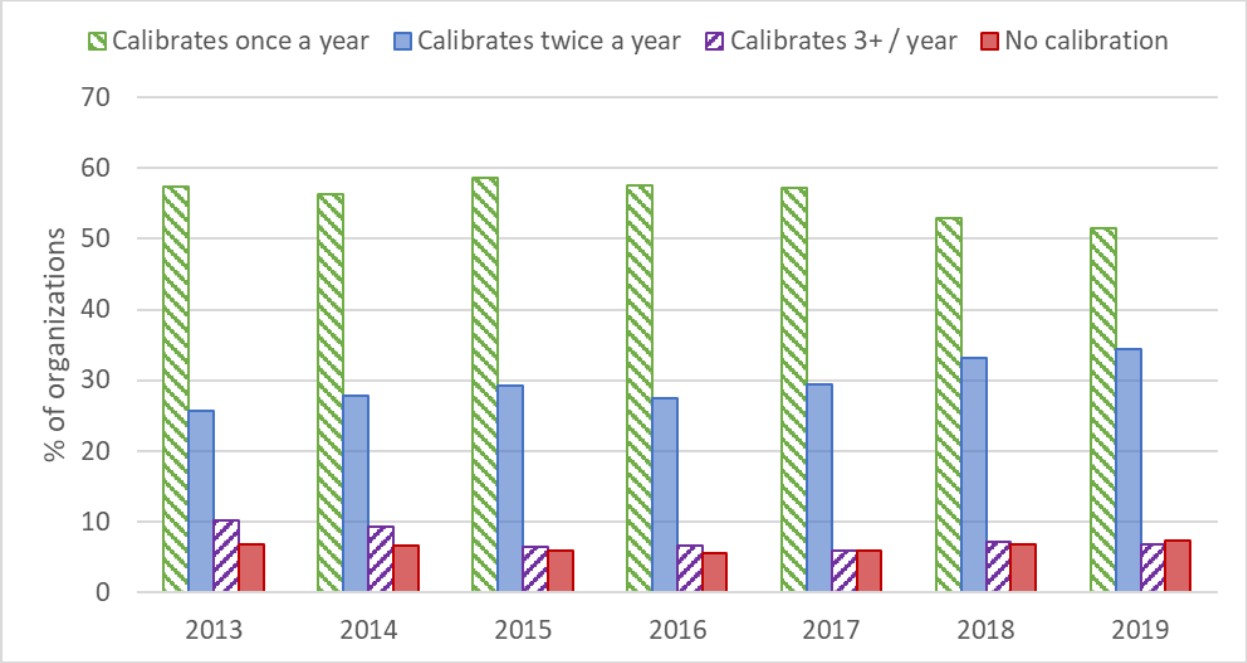


Figure A-6. Frequency of calibration of spreading equipment by reporting organizations between 2013 and 2019.

Use of pavement temperatures and road weather information systems

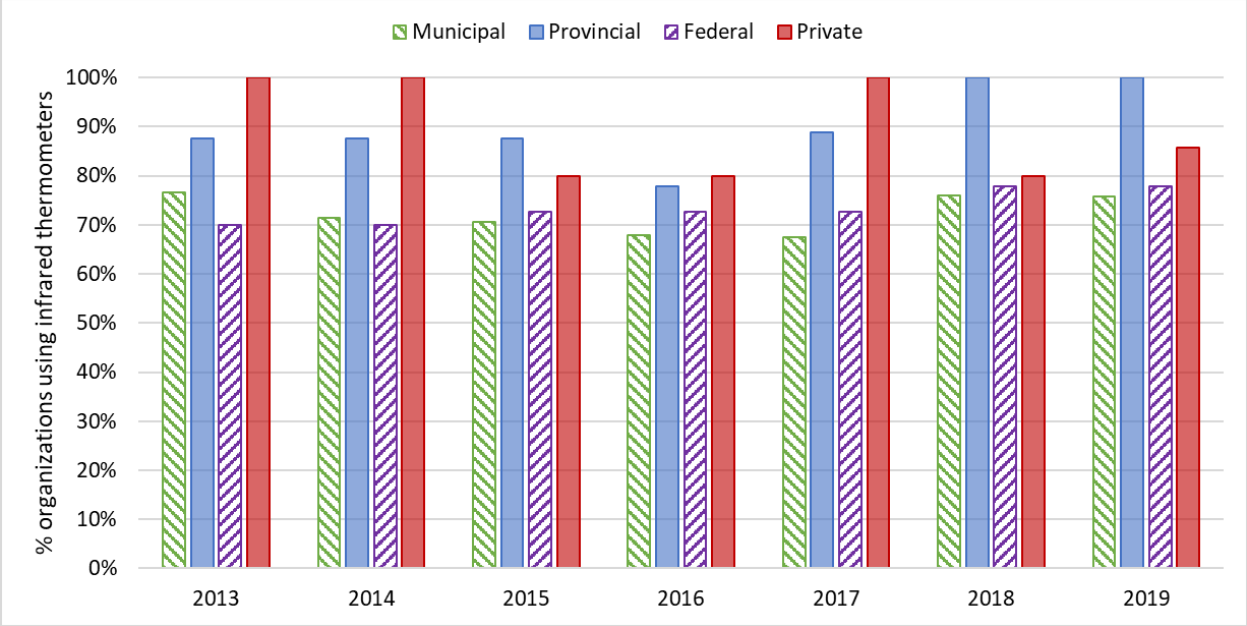


Figure A-7. Percentage of organizations that reported using infrared thermometers between 2013 and 2019.

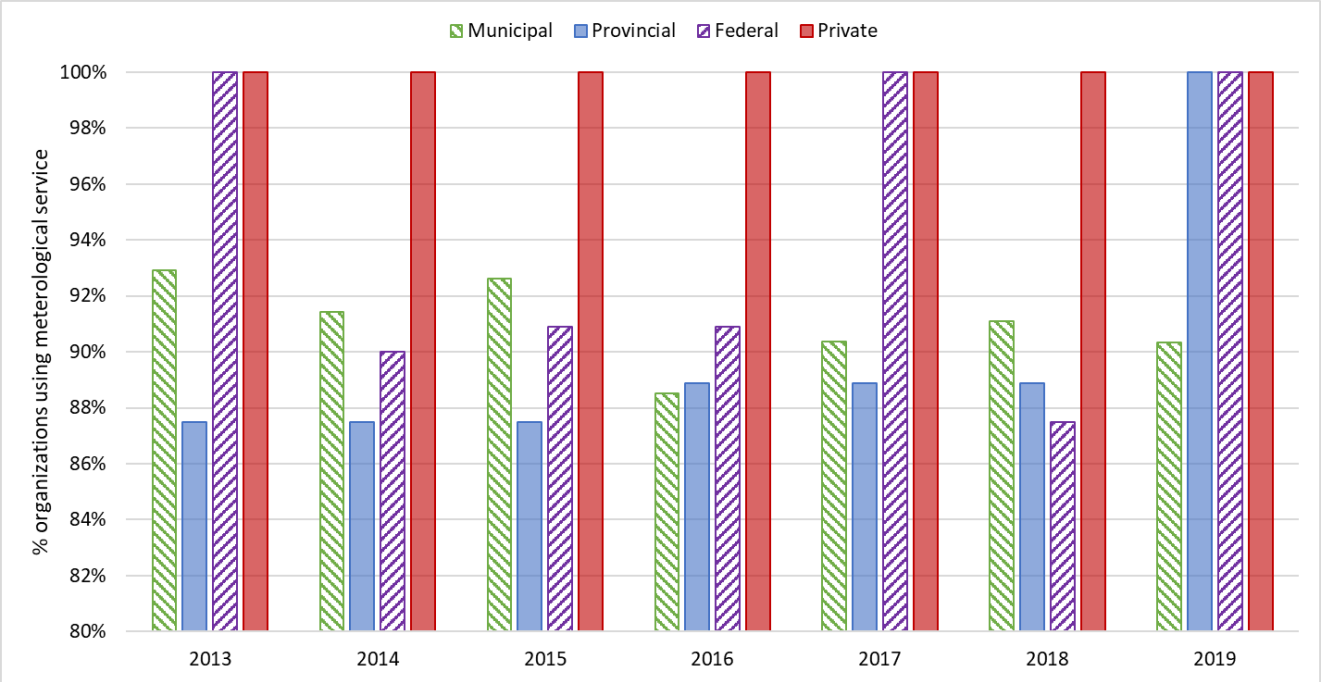


Figure A-8. Percentage of organizations that reported using the meteorological service between 2013 and 2019.

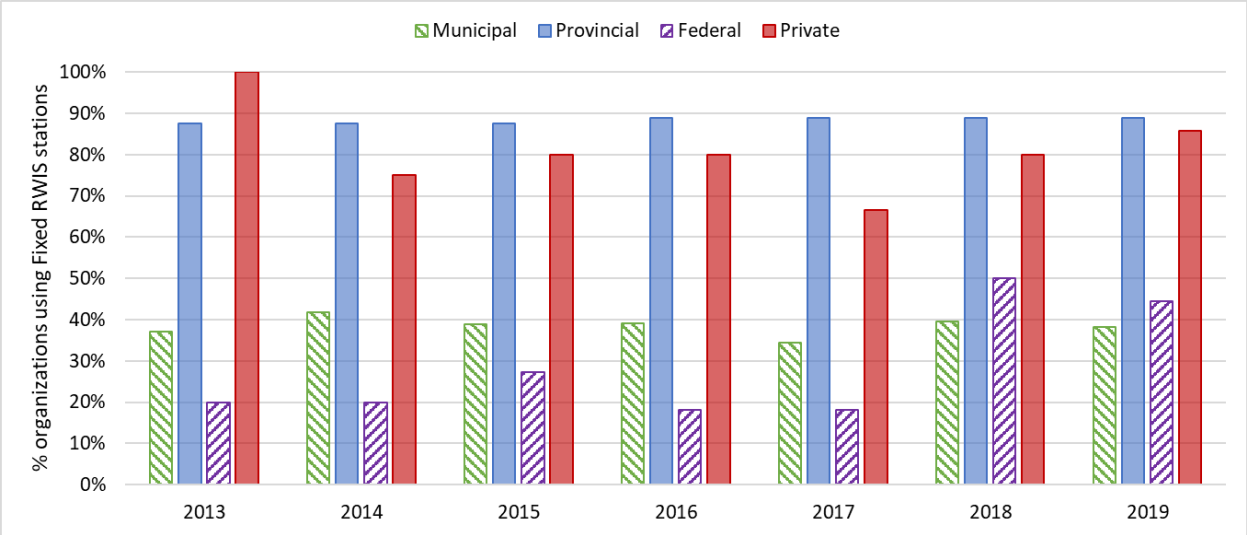


Figure A-9. Percentage of organizations that reported using fixed road weather information systems (RWIS) between 2013 and 2019.

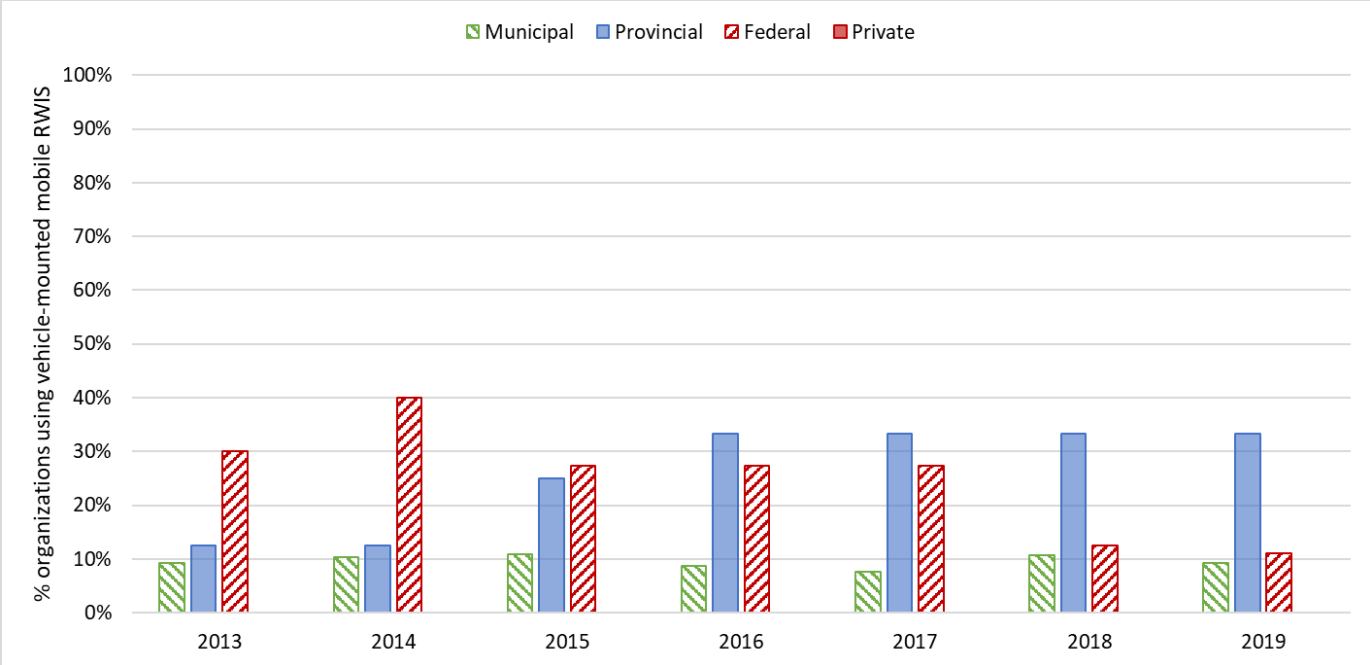


Figure A-10. Percentage of organizations that reported using vehicle-mounted mobile RWIS between 2013 and 2019.Other decision support systems

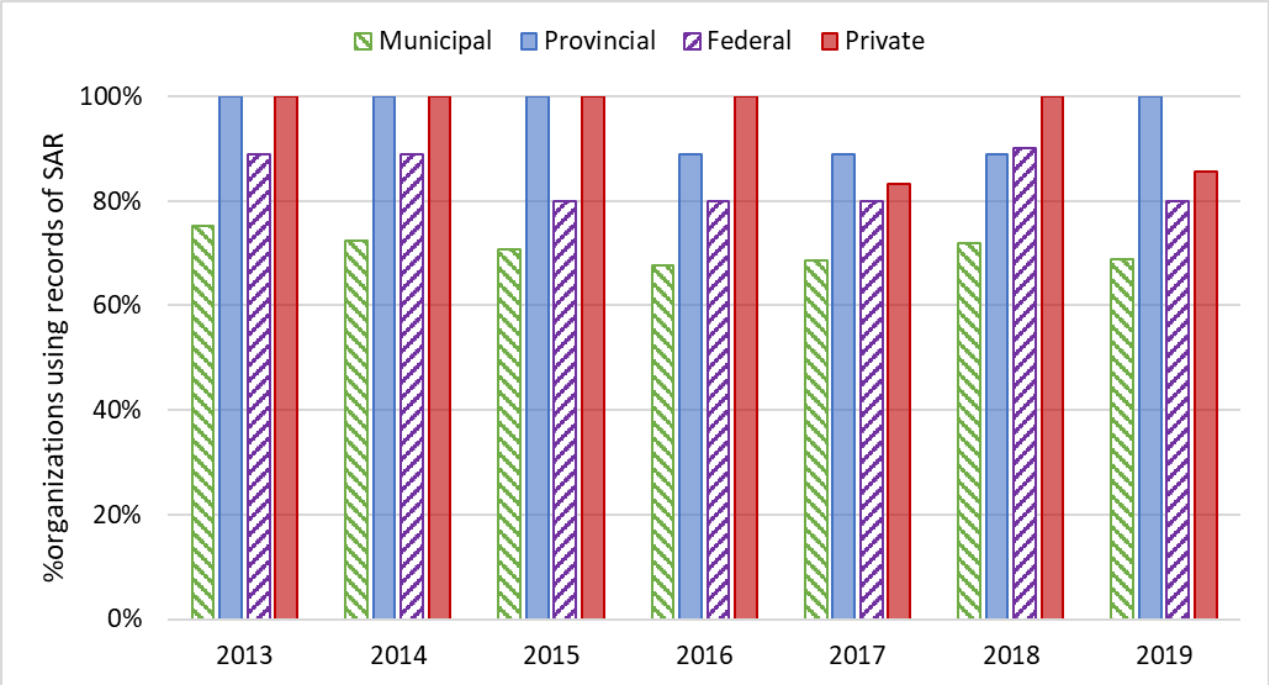


Figure A-11. Percentage of organizations that reported using record of salt application rates (SAR) between 2013 and 2019.

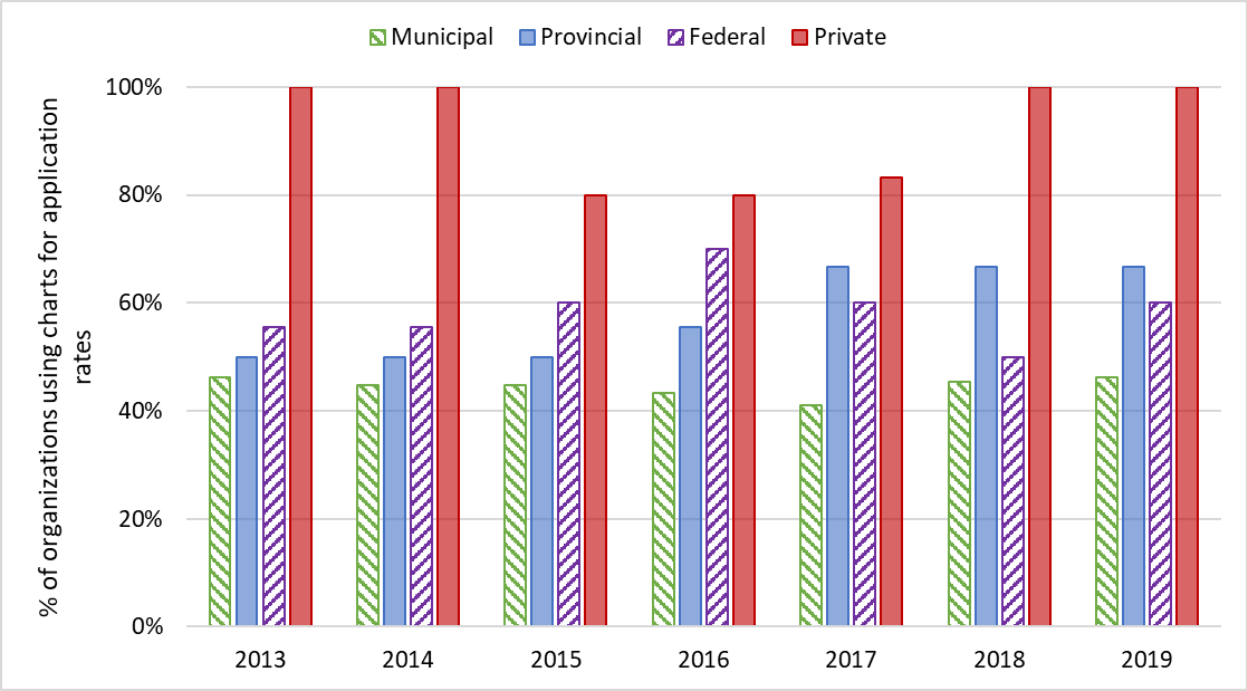


Figure A-12. Percentage of organizations that reported using charts for application rates between 2013 and 2019.

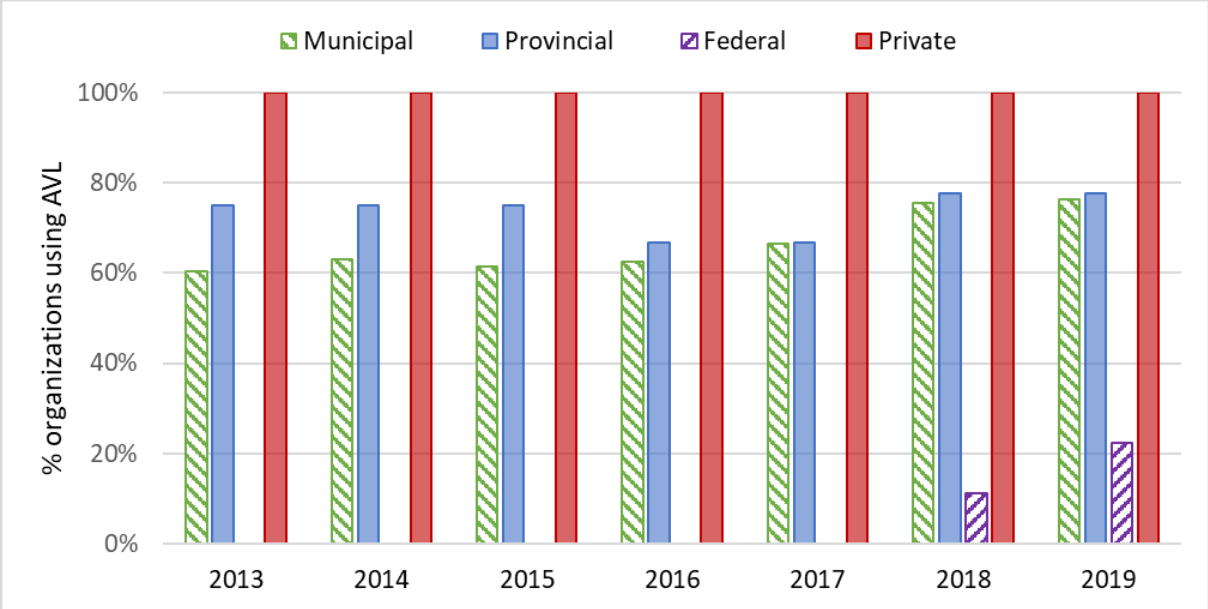


Figure A-13. Percentage of organizations that reported using automated vehicle location (AVL) between 2013 and 2019.

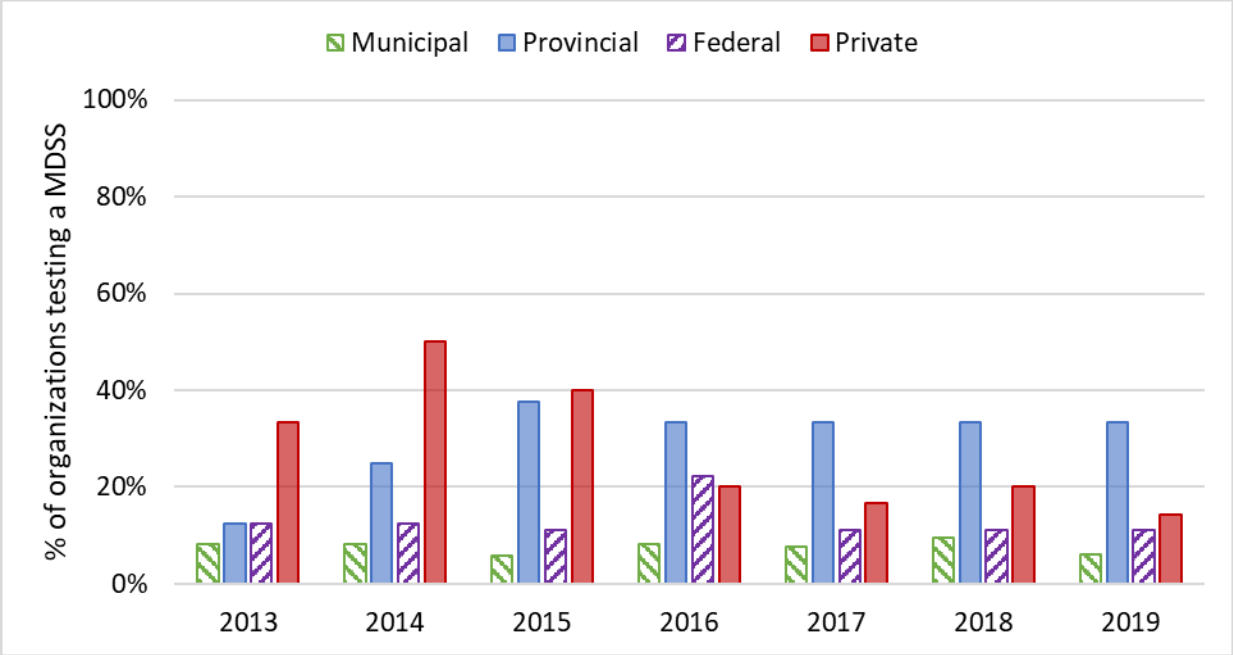


Figure A-14. Percentage of organizations that reported testing a Maintenance Decision Support System (MDSS) between 2013 and 2019.

Snow disposal sites

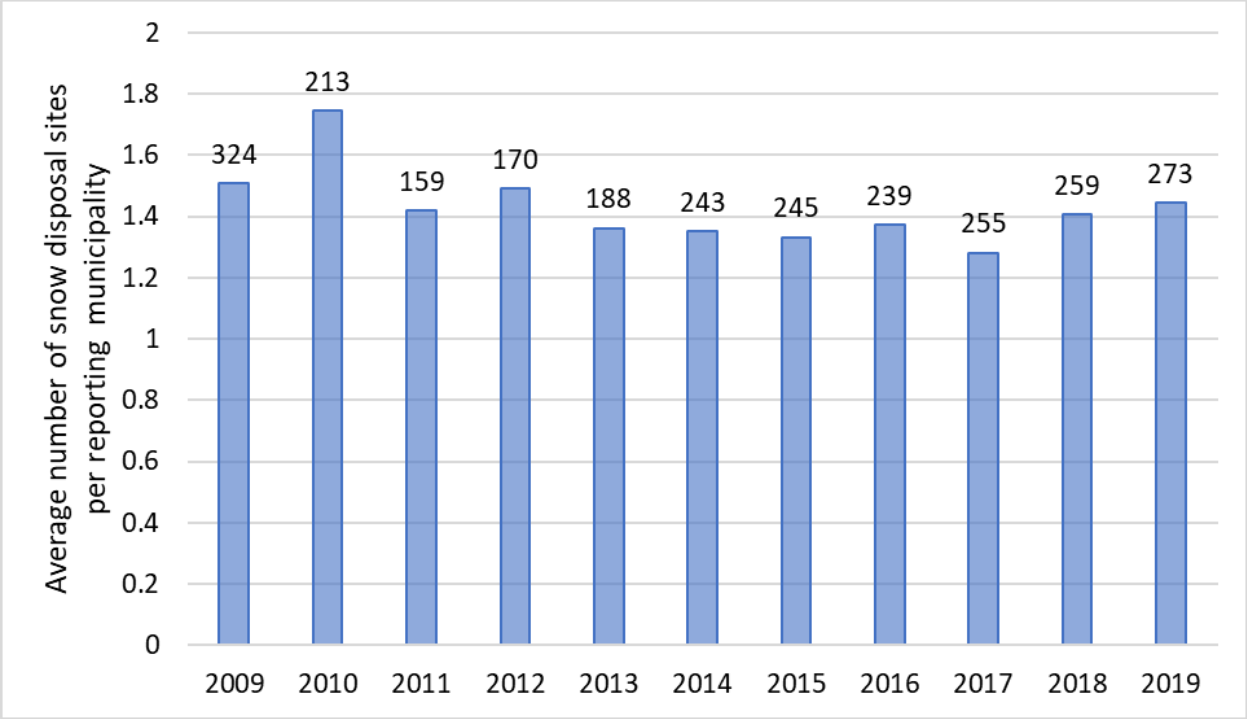


Figure A-15. The calculated average number of municipal snow disposal sites per municipality reported between 2009 and 2019. Values above the vertical bars indicate the total number of snow disposal sites reported by all municipalities in that year.

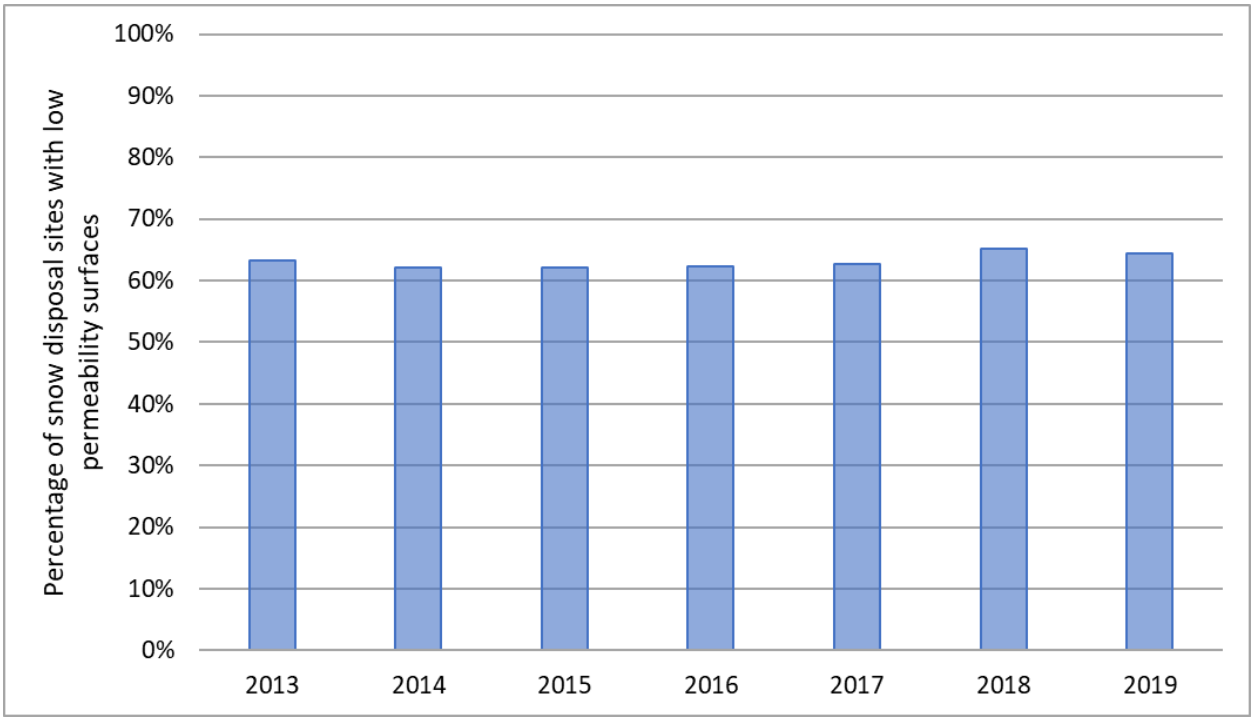


Figure A-16. Percentage of snow disposal sites reported from 2013 to 2019 where snow is disposed of entirely on a low permeability surface.

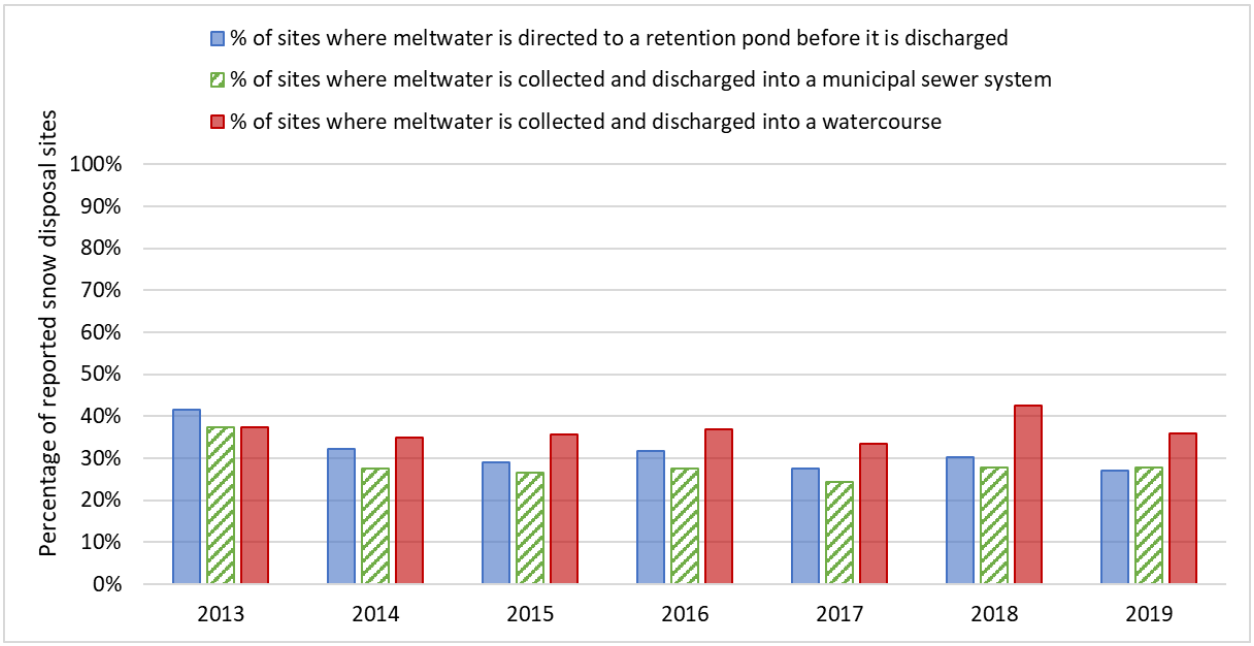
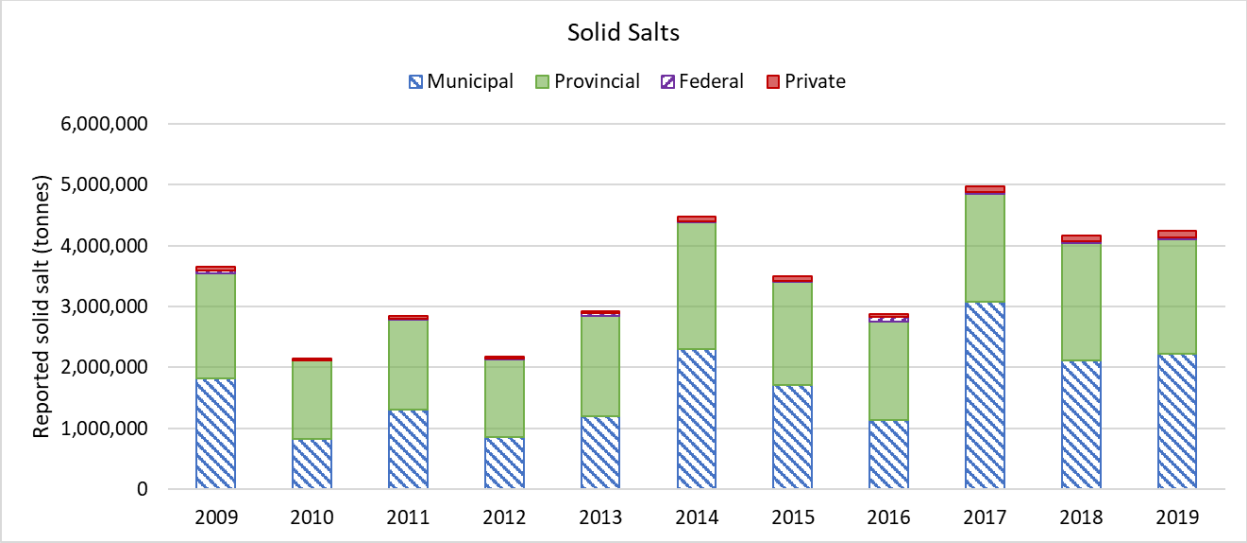
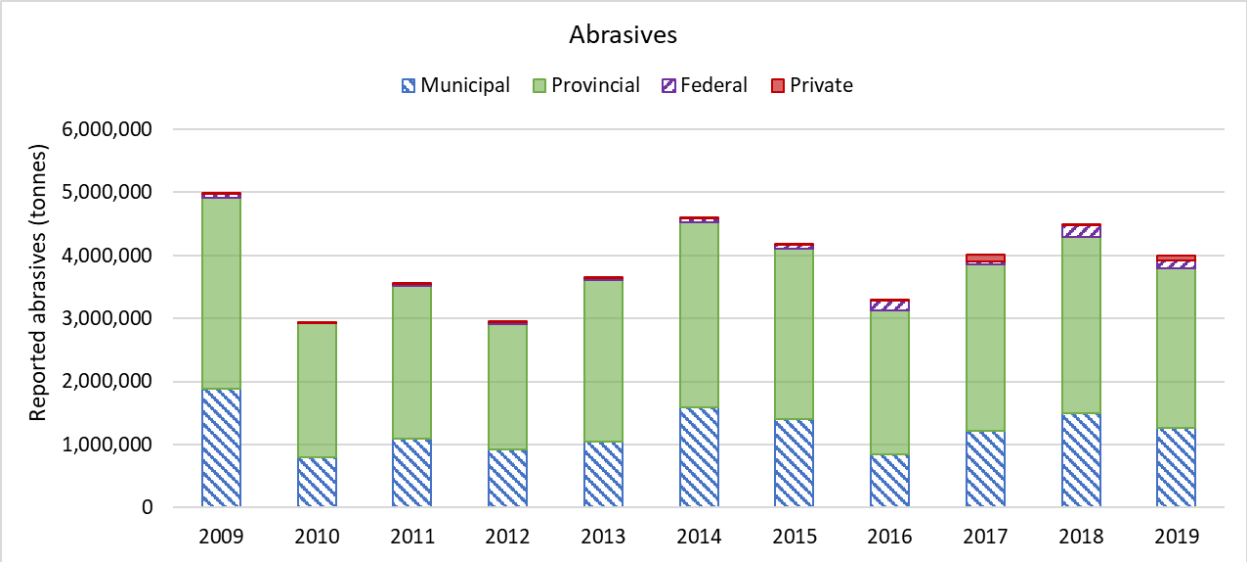


Figure A-17. Percentage of snow disposal sites reported from 2013 to 2019 where meltwater is directed to a retention pond before it is discharged, collected and discharged into a municipal sewer system (MSS), and collected and discharged into a watercourse.

Reported materials used





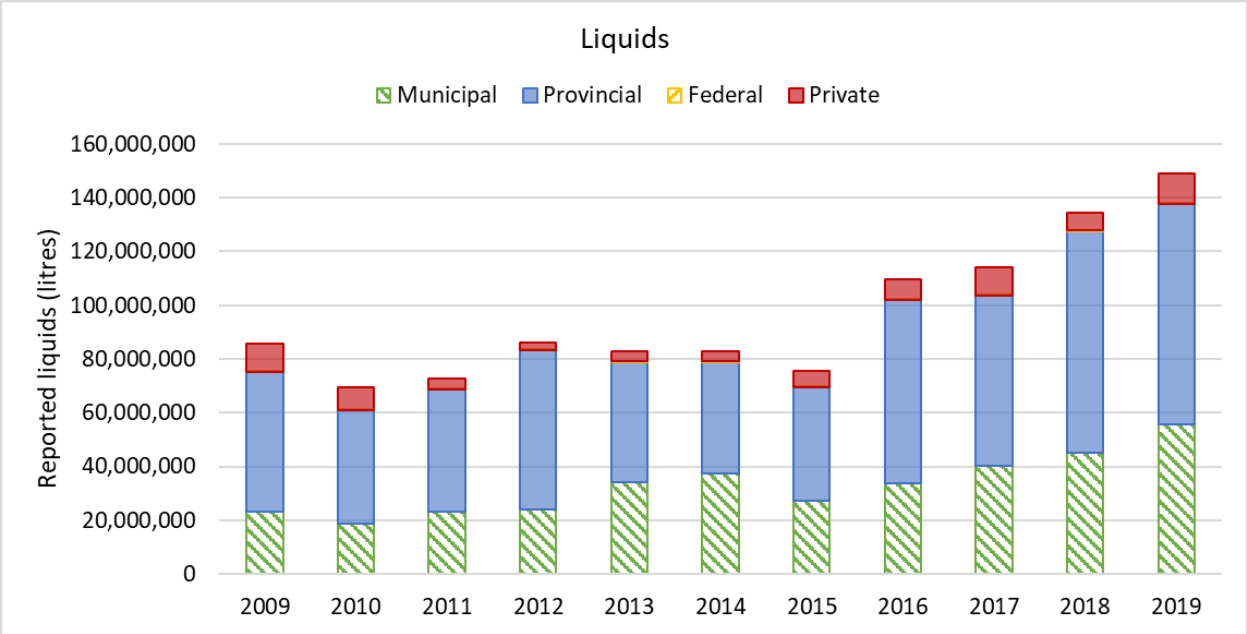


Figure A-18. Quantities of solid salt, abrasives and liquids reported by each type of organization between 2009 and 2019.