

# Snow and Ice Control - Pilot Update

## Recommendation

That the June 26, 2019, City Operations report CR\_6851, be received for information.

## Executive Summary

Achieving a safe and reliable transportation network is the goal of the City of Edmonton's Snow and Ice Control Policy (C409J). Administration uses a number of control measures to achieve this goal, including anti-icing, de-icing, sand, salt as well as mechanical means depending on what tool is most effective based on road and weather conditions. These tools need to be adaptive to respond to the impacts of climate change, including more freezing rain and temperature fluctuations.

This report provides findings from literature reviews and jurisdictional scans about the effectiveness, benefits and trade-offs of different winter maintenance practices, as well as preliminary results from the various public and stakeholder engagement initiatives. Engagement results found that residents have concerns about winter road maintenance, especially in residential areas, and would like the City to provide better rationale about the application of different tools.

Learning from previous years' application of winter maintenance tools, Administration adapted the program for 2018-2019 to suit weather conditions, using significantly less liquid anti-icer and slightly more sand and salt than in 2017-2018. Preliminary environmental monitoring indicates the anti-icer and de-icer materials have no apparent impact on stormwater discharged into the North Saskatchewan River.

A review of similar jurisdictions found that most municipalities use some form of liquid brine; however, they generally do not collect detailed data for safety and infrastructure effects.

A follow-up report scheduled for August 21, 2019, Community and Public Services Committee will provide detailed results from the laboratory and field research about the benefits and trade-offs of the pilot program on road safety, infrastructure and the environment.

### Report

#### Background

With a changing global climate, Edmonton is experiencing increased fluctuations in winter temperatures, freeze/thaw cycles and higher instances of freezing rain. These findings are detailed in Attachment 1. With such weather patterns, Edmonton needs a robust winter maintenance program that uses a diverse set of tools focused on alternative strategies for snow and ice control.

Administration initiated a small-scale Snow and Ice Control (SNIC) pilot in 2016 aimed at continuous improvement in delivering safer, accessible, bare pavement conditions that aligns with the long-term goals of zero fatalities and serious injuries, as outlined in Vision Zero. In 2017, the pilot was expanded to include select arterial and collector roads, bike lanes, bus stops, multi-use trails, and sidewalks around seniors' centres.

Administration shared preliminary results from the 2017-2018 pilot in the July 4, 2018, report CR\_5033 Alternative Practices to Address Snow and Ice Control. The report noted improved accessibility of the mobility network through bare pavement, reduced operational costs, and significantly reduced sand application with use of anti-icers and de-icers.

On October 3, 2018, Administration presented additional results from the pilot including environmental monitoring and engagement surveys in the follow up report CR\_6320, also named Alternative Practices to Address Snow and Ice Control. The environmental study demonstrated that the pilot had no discernable impact on the quality of stormwater discharged into the North Saskatchewan River. Public engagement results showed a mixed response to the pilot.

#### 2018-2019 Snow and Ice Control Operations

Learning from the 2017-2018 pilot, Administration made operational changes to adjust the application rates for different materials for the 2018-2019 winter season. The focus was to use the right tool for the right conditions in order to achieve bare pavement. This included the use of a variety of methods such as anti-icing, de-icing, sanding as well as mechanical tools such as plowing depending on the overall conditions. Each method comes with its own benefits and tradeoffs (Attachment 2).

Key observations from the 2018-2019 SNIC operations were:

- The amount of brine used in 2018-2019 was significantly lower compared to 2017-2018.
- The amount of salt and sand used in 2018-2019 was slightly higher than 2017-2018 due to extreme weather conditions.

- The application rates for the sand-salt mix and the brine was reduced significantly in 2018-2019 compared to 2017-2018.
- Traction testing results from major snow events indicate that bare pavement provided better friction and reduced stopping distances on roadways.

Complete findings are outlined in Attachment 3.

### 2018-2019 SNIC Research and Monitoring

To further evaluate the benefits and tradeoffs of the pilot, Administration undertook a wide range of research and monitoring studies in 2018-2019.

#### Jurisdictional Review Results

Administration conducted a jurisdictional review to understand and compare the winter maintenance practices of different winter jurisdictions across North America. Eight municipalities provided information about their snow and ice control practices.

Administration also looked at winter maintenance practices of Alberta Transportation on provincial highways and ring roads, such as Anthony Henday Drive. The Province contracts all snow removal and ice control services. They have laid out material and equipment specifications for contractors that includes the use of mechanical means such as plowing as well as the use of sand, salt and liquid calcium chloride for treating sand. The material application rates vary based on location and weather conditions. Details on Anthony Henday snow and ice practices will be shared in the August report.

Attachment 4 summarizes the winter maintenance practices of the eight municipalities compared to Edmonton. Highlights include:

- Calgary has the highest road inventory at 16,000 lane kilometers (km) followed by Edmonton at 12,000 km.
- Montreal has the highest annual budget for snow and ice program.
- St. Albert has the highest service level for priority 1 snow clearing at 8 hours, but it is also the smallest municipality by population and size of road inventory.
- All eight municipalities, like Edmonton, use salt and sand in varying degrees of combination depending on the weather conditions.
- Except Regina and Montreal, all other municipalities use liquid brine in some form (calcium chloride, sodium chloride or magnesium chloride) for either pre-wetting sand and salt or for anti-icing.
- Most of the municipalities do not monitor the safety or infrastructure effects of their winter maintenance programs. Calgary monitors its bridges and St. Albert and Regina monitor collisions in some form. Edmonton is the only municipality that has a detailed monitoring program for safety and infrastructure.

- Calgary, Montreal, Regina and St. Albert monitor the environmental effects associated with winter maintenance practices either through snowmelt and water runoff testing, similar to Edmonton, or by monitoring groundwater or sewer water.

### Literature Review Results

Administration undertook a wide range of research and monitoring studies in 2018-2019 to evaluate the benefits and trade-offs of the different winter maintenance tools. These studies consisted of literature reviews, laboratory testing and field testing. Attachment 5 summarizes the literature review results. Highlights include:

#### *1. Safety effects of bare pavement:*

The majority of reviewed studies on the safety effects of snow and ice control methods track the relationship between crash frequency, road surface conditions, winter road maintenance operations, exposure, snowstorm events and weather. This literature review found that road surface condition has a significant correlation to crash frequency, and is also a major contributing factor to collisions during snowstorm events. The review also showed that prioritizing anti-icing (prior to snowfall) over de-icing (removing build-up after snowfall) can help reduce collisions. Most cities adopt strategies that aim for bare pavement conditions on high priority corridors.

#### *2. Impact of salt and brine on concrete:*

Most literature indicates that low concentrations of salt and brine have limited impact on concrete durability. Brine at high concentrations may negatively affect the long-term durability of concrete. Salt, when applied to concrete, has the highest absorption rate of all de-icers. Studies indicate that to combat potential anti-icing and de-icing damage, concrete should meet all design strength, maximum water/cement ratio, air void, and adherence to concrete placement, finishing and curing best practices and specifications. The use of sealants can also be an effective way to reduce chloride ingress in concrete.

#### *3. Impact of salt and brine on asphalt:*

The literature review of laboratory tests on asphalt showed varied test results under different lab conditions. The results show that exposure to salt and brine may have a detrimental influence on some asphalt mix properties in some circumstances. Other tests show no impact to asphalt durability when compared to water alone. Some experiments produced apparent increase in asphalt strength when subjected to salt and brine, others correlated in increased binder softening or a tendency to stiffen. This review needs to be qualified by the field studies currently in progress.

#### *4. Winter maintenance practices on bridge decks:*

A review of the bridge deck winter maintenance practices of other municipalities, provincial agencies and private roadway and bridge operators showed that most

jurisdictions surveyed use chloride products on bridges. The most common product is salt and/or calcium chloride brine; the application approach depends on the weather. The winter maintenance strategy used on bridge decks in other jurisdictions (combination of sand, salt and/or brine) is generally the same as the strategy for the adjacent roads. Bridge decks are monitored for any impacts associated with chloride usage and mitigation processes involves regular washing.

### *5. Impact of salt and brine on metals:*

Anti-icing and de-icing products are widely used for winter road maintenance in areas that experience icy conditions. Research and pilot programs worldwide have studied the impact of anti-icing and de-icing products on metal infrastructure. However, the results of research programs have been inconsistent. Both laboratory and field programs are highly dependent on several factors, such as metal type, temperature, humidity, amount of exposure. Literature review has shown significant variations between the corrosion effects of salt and brine. The field studies in progress will provide additional insight.

### *6. Effects of anti-icers, de-icers and abrasives on soft infrastructure and the environment:*

The literature review shows that excessive chloride may have a detrimental impact on soil and plant growth, but the vulnerability of plants to these effects varies widely between species. Chlorides may contribute to elevated salinity in rivers, streams and lakes if used in large quantities. Organic products used as corrosion inhibitors, in high concentrations, may temporarily deplete oxygen in the soil and water, leading to plant stress and harming aquatic ecosystems. Sand usage also has impacts, including the environmental footprint associated with quarrying, trucking, blending and handling, street sweeping and landfilling. The primary mineral in sand, crystalline silica, has potential effects on human health and air quality. Sand can also fill stormwater catch basins and negatively affect water quality.

### City Claims Data Analysis

Administration conducted an analysis of all claims made to the City related to snow and ice or winter maintenance over the last 10 years (2009-2018). The data was statistically evaluated to discover the nature, causes and trends of the claims.

The analysis included claims that were made to the City in a given year and not the claims that were validated by the City, as claims are not necessarily validated in the same year they are made.

#### Summary of claims data analysis:

- Claims related to abrasives damage - The analysis shows a decreasing trend in both the number of windshield and other vehicle damage claims caused by

abrasives between 2009 to 2018. There was a strong positive correlation between these claims and the quantity of abrasives used in a given year.

- Claims related to equipment damage - The analysis indicates a decreasing trend in the number of property damage claims attributed to the City's winter maintenance equipment between 2009 to 2018. There was a moderate positive correlation between these claims and the amount of snowfall in a given year.
- Claims related to slips, trips and falls - The analysis shows a fluctuating trend over the 10-year period, with an increasing trend 2014 onwards for the number of claims related to slips, trips and falls caused due to snow/ice on City property. There was a strong positive correlation between these claims and the amount of snowfall in a given year. There was no significant correlation between these claims and the hours of freezing rain during 2009-2016, but a moderate positive correlation during 2017-2018.
- Claims related to snow and ice damage - The analysis indicates a decreasing trend for vehicle damage claims caused due to snow and ice between 2009 to 2018. There was a moderate positive correlation between these claims and the amount of snowfall in a given year.

After the SNIC pilot began, seven claims were made to the City for property and vehicle damages caused by de-icing in 2017 and 2018. None of these claims were validated. Full findings of the overall claims data are available in Attachment 6.

### Environmental Monitoring Preliminary Results

As part of evaluating the SNIC pilot, Administration is conducting an environmental review. Preliminary results from this monitoring are provided below and the final report will be completed in Fall 2019, once the snow piles at the City's snow storage sites have fully melted. This preliminary evaluation includes:

- The 2018-2019 winter maintenance material inventories compared to historic usage (sand, salt and brine), and
- Water sample data at major outfalls to the North Saskatchewan River.

Snowmelt data for 2018-2019 was not included in this preliminary evaluation as melting began in May. Highlights of the preliminary environmental monitoring are:

- Of the total chloride applied to Edmonton roads for road safety in 2018-2019, 0.5 percent was due to the application of calcium chloride brine. During the previous winter season (2017-2018), 4.3 percent of the total chloride was from calcium chloride brine application
- The reduction of winter sand application during the pilot was accompanied by an increase in dry salt use
- Based on the data available at the time of reporting, the SNIC pilot has produced no apparent impact on the quality of stormwater that discharges to the North Saskatchewan River. The increase in dry salt application in 2017-2018

and 2018-2019 was not apparent in the data, potentially due to contributions of de-icers from other sources such as private businesses and citizens

The complete Preliminary Environmental Report is available in Attachment 7.

### Engagement

Administration undertook a range of engagement initiatives with the public, City staff and different stakeholders in winter 2018-2019 to get feedback on the SNIC program. Full findings are available in Attachment 8.

#### Public and Staff Engagement for Residential Snow and Ice Control

Administration collected feedback from the public and City staff on the current SNIC program in residential areas in order to better understand expectations for snow removal, service levels and parking bans. Input was gathered via 16 in-person events across the city (13 public and three internal staff events) and an online survey on the City website completed by more than 2,500 participants.

Overall, the public expressed concern that the quality of the winter road maintenance program in residential areas has decreased in recent years. Suggestions for improvement included:

- Greater focus on snow removal and maintaining full driving lanes, especially on larger roads.
- More attention on sidewalks – enforcing existing rules and the City holding itself to the same standards it expects of its citizens.
- Providing more budget to this program as the city grows.
- Better communication and education about not just “What” the program is doing, but also “Why”.
- Making parking bans mandatory in residential areas and moving to a “tag and tow” program or using odd/even house numbers to designate parking.

Similar themes emerged out of the engagement sessions with staff, calling for better awareness and communication about City and resident responsibilities, more proactive snow management and more effective parking bans.

#### Seniors' Centres Intercept Survey

Administration conducted an intercept (in-person) survey at four seniors' centres to evaluate the safety and accessibility of the sidewalks at these centres. Two of the chosen centres were City maintained and anti-iced, while two were neither maintained by the City nor anti-iced. The survey had 68 participants. Highlights included:

- Majority of the respondents from all the four centres felt that the condition of sidewalks is “somewhat to extremely icy” during a typical snow season. The proportion of respondents who found the sidewalks “extremely icy” was higher in non-City maintained centres compared to City maintained centres.
- Majority of the respondents who said that “they have slipped, tripped or fallen” on the sidewalks around the seniors’ centres due to snow and ice in the past two snow seasons are from non-City maintained centers.
- A larger proportion of the respondents from City maintained centres said they felt “very safe” on the sidewalks around the seniors’ centre compared to the respondents from non-City maintained centres.
- Overall, there was a common concern at all the four centres with the timing of snow and ice removal considering most of the respondents visit the centres in the mornings. At City maintained centres, there was a general concern around stains from the brine being tracked into the facility, while at non-City maintained centres there were concerns about the lack of resources for winter maintenance.

### Winter Walkways Symposium

Administration collaborated with the Edmonton Federation of Community Leagues to organize a Winter Walkways Symposium in April 2019 to explore innovative solutions for sidewalk clearing. About 40 different stakeholders attended this Symposium. The key themes identified were:

- Re-thinking how we prioritize streets and sidewalks by considering the safety of everyone rather than prioritizing one user type (motorists).
- City support for a community-based approach to encourage snow-removal equipment sharing and volunteering program between different communities.
- Better enforcement process and communication of responsibilities between the City and the residents, with the City taking on more responsibility.
- Learning from other cities and becoming innovators for design changes, especially for curb cuts and intersections.

### Direct Feedback from Stakeholders for the Snow and Ice Control Pilot

Administration engaged different stakeholders in the winter season of 2018-2019 to share information and gather anecdotal feedback on the SNIC pilot. This included the Canadian Home Builders' Association, Urban Development Institute, Concrete Alberta, Alberta Motor Association, Emergency Medical Services, Edmonton Police Service, Edmonton Fire Rescue Services, City's Fleet and Facility Services, Edmonton Transit Service and other organizations.

The overall feedback from emergency services was positive for the main roads along pilot routes, with some improvement noted in safety and snow clearing. They

expressed concerns about the poor conditions of residential streets and sidewalks, which affected their response times.

Some stakeholders raised concerns about the corrosion impacts of brine on vehicles as well as potential damage to driveways, garage pads, lawns and vegetation caused by brine. The City's Fleet and Facility Services did not observe any major impacts on trucks or shop floors, possibly due to regular washing and maintenance.

### Next Steps

The literature review and jurisdictional scan shows that every winter maintenance tool has benefits and trade-offs. Administration will continue to collect data to share in the report scheduled in August for Community and Public Services Committee's consideration. Up-to-date information in the next report will include:

- Preliminary results from the safety study that compares collisions data before and after the SNIC pilot on the pilot routes .
- Final results from the laboratory and field testing for the concrete/asphalt study.
- Final results from the laboratory and field testing for the corrosion study.
- Final results from the field testing for the soil study.

All qualitative and quantitative research outlined in this and the August report will inform any potential changes to the SNIC policy and program for next winter.

Administration will explore different strategies based on the feedback received from the engagement initiatives and make recommendations for a potential pilot for residential SNIC for winter 2019-2020. This residential pilot will not prioritize bare pavement or use of salt and brine. The recommendations will look into the key areas identified during the residential engagement, including:

- wider driving lanes through windrow free zones;
- partial parking bans; and
- greater awareness around the residential program.

Administration will also evaluate ideas from the Winter Walkways Symposium for potential trial, including a community equipment sharing program, volunteer program for sidewalk clearing and reprioritizing select walkways in the SNIC policy.

### Corporate Outcomes and Performance Management

<b>Corporate Outcome: Edmonton is a safe city.</b>			
<b>Outcome(s)</b>	<b>Measure(s)</b>	<b>Result(s)</b>	<b>Target(s)</b>

The City promotes improved mobility and traffic safety through the Snow and Ice Control pilot.	Average number of collisions (between October to March) during pilot years (2017-2019) on pilot routes compared to previous years.	TBD (In July)	TBD
<b>Corporate Outcome: The City of Edmonton has sustainable and accessible infrastructure.</b>			
The City promotes increased accessibility by adhering to established directives, policies and guidelines (Snow and Ice Control Policy C409J).	Average time from the end of a snowfall to when priority 1 arterials and freeways are cleared to bare pavement.	12-24 hours (2018-2019)	36 hours
	Average time from the end of a snowfall to when priority 1 bus stops adjacent to City property are cleared to bare pavement.	48 - 72 hours (2018-2019)	48 hours
	Average time from the end of a snowfall to when priority 1 sidewalks, trails and bike routes are cleared to bare pavement.	24 hours (2018-2019)	24 hours

### Attachments

1. Summary of Edmonton's Winter Climate Trends
2. Benefits and Trade-Offs of Different Winter Maintenance Tools
3. SNIC Operations Summary
4. Jurisdictional Review of Winter Maintenance Practices
5. Literature Review for Safety, Concrete, Asphalt, Bridges, Metals and Soft Infrastructure
6. Claims Data Analysis
7. Anti - Icing Pilot Project Preliminary Environmental Monitoring and Metrics Report 2018-2019
8. Engagement Results

### Others Reviewing this Report

- R. Kits, Acting Deputy City Manager, Financial and Corporate Services
- C. Owen, Deputy City Manager, Communications and Engagement
- A. Laughlin, Deputy City Manager, Integrated Infrastructure Services
- K. Armstrong, Deputy City Manager, Employee Services
- R. Smyth, Deputy City Manager, Citizen Services
- S. McCabe, Deputy City Manager, Urban Form and Corporate Strategic Development
- B. Andriachuk, City Solicitor