Sustainable Technologies
EVALUATION PROGRAM

TECHNICAL BRIEF

A comparison of two approaches for winter maintenance of a large commercial property

Background

LSRCA has been working with winter maintenance contractors on a large (~14.2 ha) commercial site in the Lake Simcoe watershed. Over the course of the study, there have been two different contractors responsible for winter maintenance; "Contractor A" from fall 2012 to spring 2018, and "Contractor B" for the period since the 2018/2019 season. LSRCA has been studying road salt use at the site and monitoring chlorides in stormwater since the 2014/2015 season as part of its efforts to better understand the issues related to winter salt use in the watershed. This case study compares the different approaches taken by the contractors to manage snow and ice hazards over the course of the study. Each approach focused on maintaining site safety using different management practices what was interesting with the corresponding environmental benefits of Contractor B's approach.

The main concerns for both contractors throughout their time at the site have been firstly to ensure that parking lots and walkway surfaces are sufficiently cleared of snow and ice to ensure the safety of patrons of the site, but secondly to ensure to the extent possible that their treatment of the site reduces their risk of being subject to complaints and particularly to slip and fall claims, which has become a significant concern for snow and ice contractors. This study will show how the use of best practices can benefit contractors in this regard. Failing to use these practices can result in issues including the freezing of melt water in drive areas, loose salt piles reducing traction, blowing snow, and reduced visibility, increasing the contractor's exposure to liability. Careful thought about the site and close monitoring of onsite weather conditions can reduce or eliminate these issues.

Figure: 1 Sources of salt in the Lake Simcoe watershed(2015).

Of course, there are environmental costs associated with using more salt to treat a site. High levels of chloride from winter salt can have a number of impacts on water resources and aquatic life. This site was ideal for a study of this type, as the entire site drains to a single stormwater pond, and LSRCA staff have been able to instrument the outlet of the parking lot to the pond and calculate the amount of chloride (from winter salt) entering the pond, and eventually the receiving watercourse, throughout the study period. While safety and liability were recognized as the main concerns for both contractors working at the site over the period of study, they each had different approaches in ensuring the safety

of the site. The two contractors were similar in that they both use equipment that is set at one rate and is only adjustable at the spreader, and they both use salt as their primary material, with no pre-wetting or sand used (except for a short period when salt was unavailable; this is discussed in the next section). The following sections highlight the differences between the approaches and their effect on salt use and safety. Contractor A, which worked on the site from 2012-2018, used more typical "one size fits all" approach for snow and ice removal, which involves applying salt at a high rate and applying more frequently. Contractor B cited research and training (through the Smart About Salt program) that contributed to an understanding of how salt can be properly used to reduce application. They used onsite supervision to monitor the actual conditions at the site, applied salt at a lower rate, and only when they deemed it necessary through monitoring weather conditions to achieve safe surfaces. As will be shown through this case study, while both approaches will remove snow and ice, and can limit exposure to liability, the appropriate use of salt or its alternatives for the conditions at the site can better help a contractor achieve their goal of safety, but with less impact to the environment, as well as savings for their client.

Salt Use on Study Site

As has been noted, the contractors each took a different approach to ensuring safe surfaces. The differences bear out in the data for the site over the years of the study. Figure 2 displays the average mass of salt applied per event over each season (as calculated by LSRCA through its instrumentation at the outlet), with Contractor A depicted in blue, and Contractor B in red, and Figure 3 shows the salt application rates for the two contractors. Contractor A applied an average of 12 t per event across all seasons, with an application rate of 81 g/m2, while Contractor B applied an average of 9 t per event at a slightly lower rate of 65 g/m2. Contractor A noted that they applied using the same rate regardless of what the conditions were and what weather was expected, while Contractor B noted tailoring their application rates to the conditions, including noting the expected duration of the event and the amount and type of precipitation that was expected, which enabled them to apply less salt in most circumstances. Also of note was the mild winter in 2015-2016, which may explain why the amount of salt applied was lower in this season than the contractor typically used; it appears that the drivers used some discretion in determining how much salt should be applied.

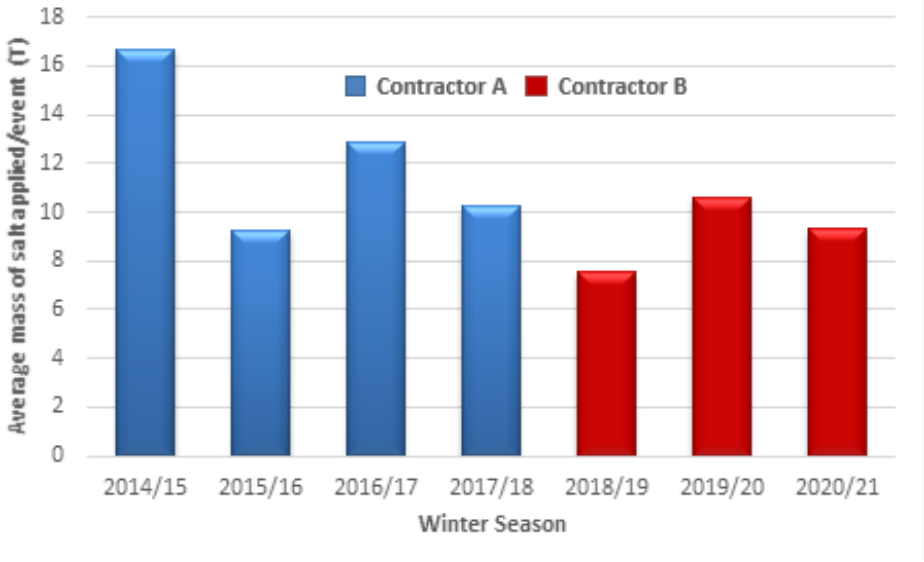

Figure 2 Average mass of salt applied per event (t) with Contractor A depicted in blue and Contractor B depicted in red.

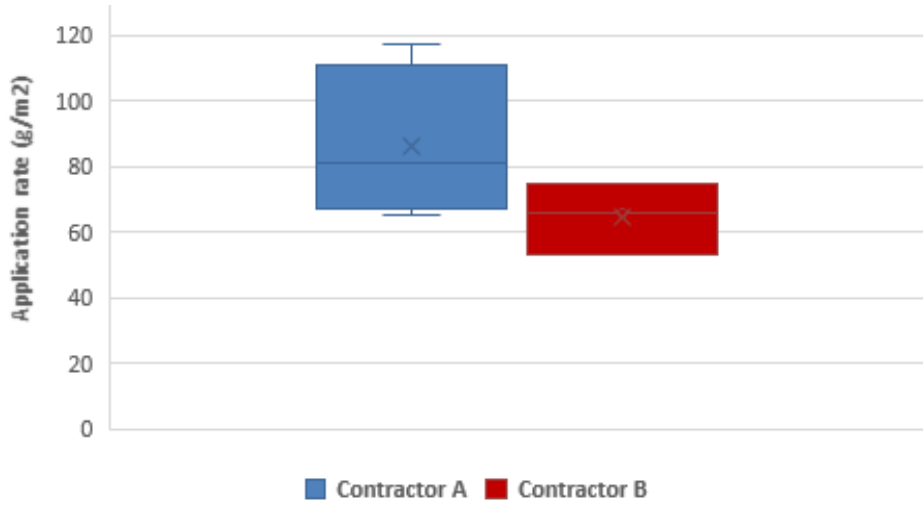

Figure 3 Box and whisker plot depicting the salt application rates (g/m2) for Contractors A and B.

The most notable area of difference between how the two contractors treated the site can be seen in the number of events responded to in each season (Figure 4). Contractor A had more events responded to in every season than Contractor B. Contractor A had an average of 66 event responses each season, while Contractor B had significantly fewer, with approximately 43. As can be seen in Figure 4, seasonal precipitation was not notably lower for the period that Contractor B has been managing the site and does not appear to be the

reason that they were able respond to fewer events. They were able to accomplish fewer applications at a time when municipalities in the area were increasing the number of applications undertaken each season. They attribute being able to respond to fewer events to keeping a close eye on the weather and conditions on the ground at the site, as widely available weather forecasts may not be accurate at a smaller scale.

Factors affecting salt application

There were some extenuating factors that affected the amount of salt applied and number of applications. The first, and most obvious factor is the weather. For example, 2015/2016 was a mild winter with fewer precipitation events and less precipitation. Because of this contractor A had slightly fewer applications, it appears that the drivers applied less salt given the conditions didn't warrant heavy applications. The other significant factor was the salt shortage of the 2017/2018 season. This was a North America-wide shortage that affected road authorities and contractors alike. Due to the shortage, Contractor A was not able to obtain as much salt as they normally would for the season, forcing them to reduce their application rates, eventually switching to the use of sand by the end of the season. The application rate and hence the volume of salt applied would have been higher had the shortage not occurred. These factors reduced the volume of salt used by Contractor A; were it not for the mild winter and the salt shortage, it would be expected that the difference between the two contractors would be even more pronounced than what was observed.

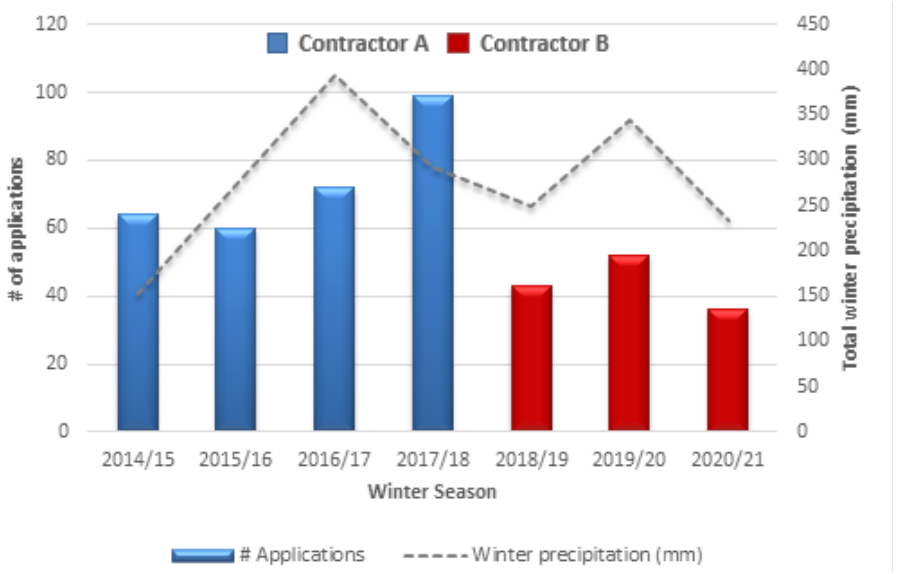

Figure 4 Number of applications undertaken during each winter season (Contractor A = blue, Contractor B = red). Total winter precipitation for each season, from November 15 to April 15 (mm) is shown on the secondary axis.

Lessons learned

This case study highlights the effectiveness of best practices and training programs in ensuring safety and reducing the amount of salt applied on the site to achieve these safe conditions. The potential benefits to the property owner and contractors who follow leading practice include savings to pass on to patrons and records demonstrating reasonable steps were taken to keep their patrons safe from winter hazards. While there were no slip and fall claims for either contractor for the duration of the study, Contractor B was able to manage this parking lot using 58% of the salt used by Contractor A, with the average seasonal application rate for the two contractors shown in Figure 5. The difference between the two contractors is due mainly to fewer applications, as well as lower application rates; this highlights the effectiveness of the steps that were taken.

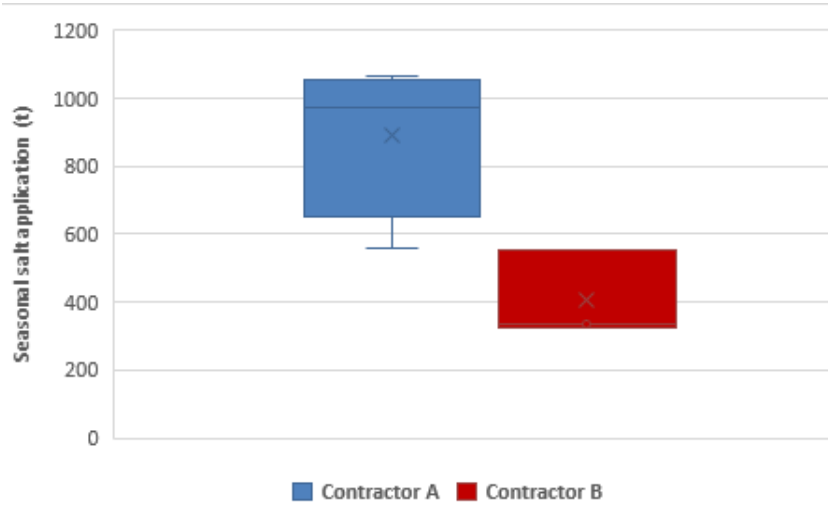

Figure 5 Box and whisker plot depicting total annual salt application (tonnes) for Contractors A and B.

There can also be financial benefits to the contractors by changing their practices and applying less salt. In addition to fuel savings from sending plows and salters out less often, less wear and tear on vehicles, and less employee time spent treating the site, further benefits can also be seen through cost savings on materials. As can be seen in Table 1, given the average number of applications and volume applied, the result is an annual savings in materials costs of over $40,000.

Table 1 Material cost savings achieved by Contractor B (assuming a cost of $100/tonne for salt)

Contractor	# events treated/ season	Mass/event (t)	Mass/season (t)	Cost/season ($)
A	66	12	792	79,200
B	43	9	387	38,700
			Cost Difference	40,500

As noted by Contractor B, training and an understanding of how to properly use salt in different conditions, as well as an understanding of the various best practices, is vital when working to improve your methods. To that end, contractors and their staff should be trained to ensure that they understand how the materials and the best practices work, so that they can ensure that they are applying the right material, in the right amount, at the right time. This training also provides helpful information on items such as proper snow pile placement to avoid creating problem areas from melt water refreezing (and requiring the use of additional salt), and applying less material to less travelled areas of the parking lot, which were also employed by Contractor B. Training courses are available for contractors in Ontario (e.g. Smart About Salt), and certification can also be obtained by contractors through these programs.

Figure 6 An example of a trouble spot due to freeze/thaw from improperly placed snow piles

Another important factor in ensuring that salt is only applied when necessary is a thorough understanding of the current and forecasted weather conditions, as well as the conditions on site. This can be accomplished in part through subscriptions to detailed weather forecasts. Technologies such as pavement temperature and friction sensors mounted to plows can also play an important role. Contractor B noted that they have a staff person check the site on days with weather or expected weather to determine the conditions and what actions may need to be taken; this person also decides whether further treatment is required after the initial treatment. While this may not be practical for all contractors, it is helpful in reducing person-hours and material costs in treating a site unnecessarily. On-site camera technology has evolved to a point that these can be used to perform the same function. Simple, on-vehicle technologies such as pavement temperature sensors and automated salt delivery systems that control application rates by vehicle ground speed are also important tools that can ensure that the right amount of material is being applied when it's needed.

Lessons learned

Contractor B's use of best practices and efforts to optimize salt use through focused site management activities has reduced the amount chlorides being carried by stormwater to local creeks. There are still some areas on the property where more can be done by contractors and property managers. Salt accumulation on many walkways is not being utilized to benefit safety, however it will eventually work its way into our waterways, and contributes to higher materials costs. Excessive salting of walkways by both contractors occurred at the site over the period of the study, and is a common theme among many commercial parking lots throughout southern Ontario, indicating that this may be a systemic issue that requires further education around best practices.

Other areas where salt is commonly over applied include at the entrance to a large, high traffic department store, and some low traffic walkways. Salt is often also applied to "orphaned" walkways (raised "sidewalk" areas in parking lots that don't lead to any of the businesses and therefore aren't typically used by pedestrians). Suggestions for seasonal closures of these surfaces, or improved design to eliminate this issue are included in LSRCA's Parking Lot Design Guidelines to Promote Salt Reduction (2017). Low traffic areas and orphaned walkways could be closed seasonally and not maintained to further reduce the amount of salt applied. Given that walkways are the areas of parking lots where slips and falls tend to happen, it is understandable that contractors feel the need to apply more salt; however, given that it has been shown that safety can be maintained with less salt being applied, effort should be made to further refine practices and apply only the amount that is needed to ensure a safe surface.

Figure 7 An example of an over-salted "orphaned" walkway

Conclusions

This study highlights the importance of training, knowledge of site conditions, and monitoring of the local weather conditions. This minimal effort results in savings not only in materials costs, including salt and fuel, as well as human resource and equipment costs, it also prevents huge volumes of salt from entering into and contaminating our water resources. These benefits can be realized with relatively little effort on the part of the contractor, and without sacrificing the safety of parking lot users and increasing exposure to liability. Training and best practices should be encouraged among private snow and ice management contractors; this could result in a substantial reduction in the amount of salt being applied to parking lots.

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