

Review of Winter Maintenance of Roads

In April 2007, when Council reviewed Toronto's 2005 Performance Measurement and Benchmarking Report, Council requested in the future that the City Manager annually select one target improvement area where the City's performance is found to be within the fourth quartile, and to develop a remediation plan for consideration by the Executive Committee and the Budget Committee.

Scope of the Review

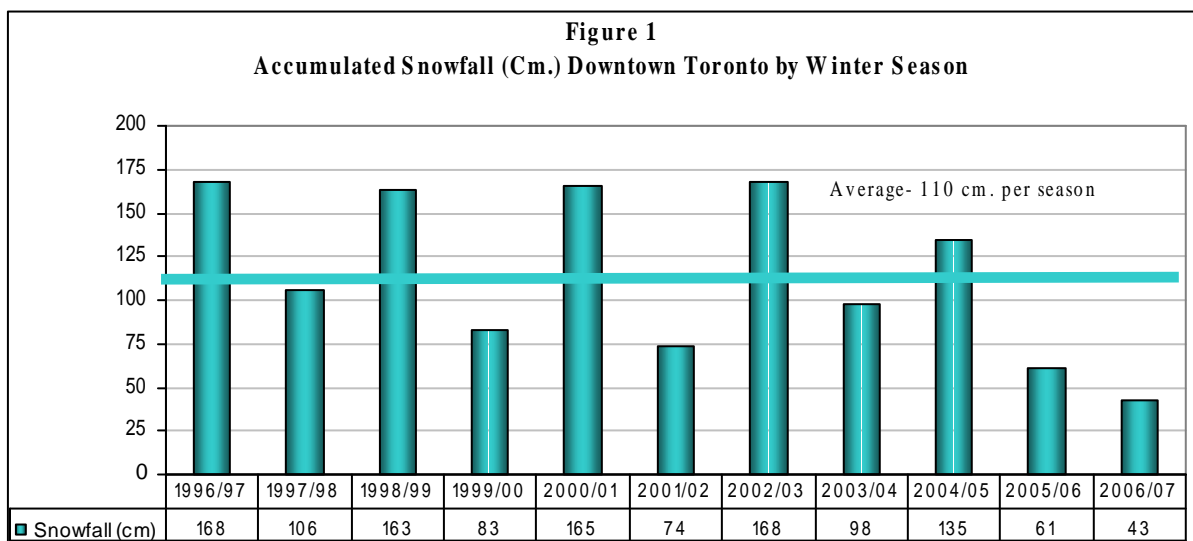
The area selected for this review was the winter maintenance of roads where Toronto's costs have historically been higher than those of other municipalities.

This review was not limited to just costs, but also included other aspects of service delivery, specifically in the following areas:

- Current winter maintenance processes, resources and standards.
- Collision data during the winter months to determine if the roads are safe for motorists and pedestrians.
- Factors that increase Toronto's costs in relation to those of other municipalities.
- Actions taken by staff to reduce costs and the impact of salt usage on the environment.
- Additional work staff will be taking in the future to improve the efficiency and effectiveness of operations.

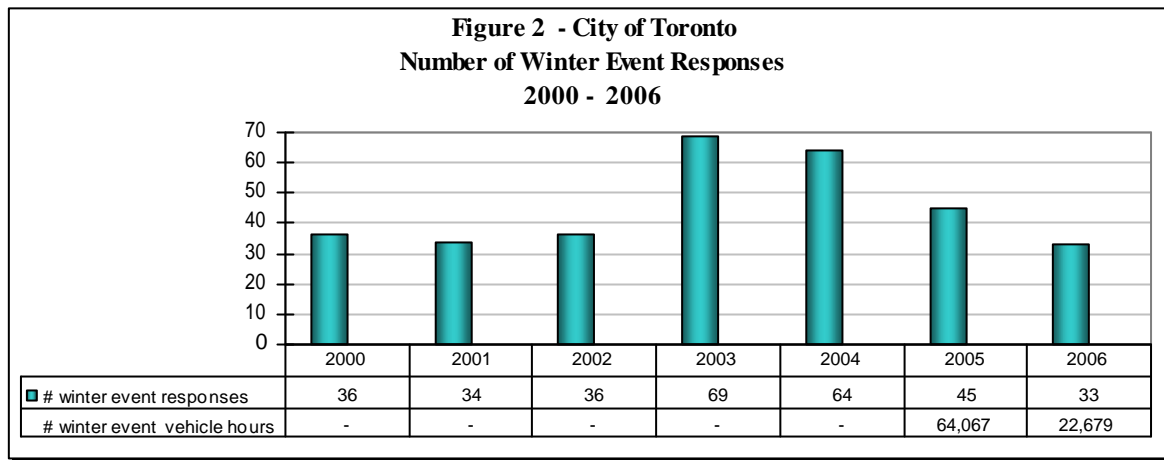
How Much Snow Does Toronto Get Each Winter Season?

Figure 1 below summarizes the total accumulated snowfall in downtown Toronto by winter season (from November to March) over the past ten seasons with an average snowfall of 110 cm. per winter season.



Toronto's costs, as well those of other municipalities, will vary from year to year depending on number of winter events requiring an operational response, and the severity and duration of those events. The winter of 2008, for example has seen much higher levels of snowfall than normal and costs will accordingly be higher.

Figure 2 below reflects the number of winter event responses, by calendar year, between 2000 and 2006. The City started tracking the number of vehicle hours involved in these winter responses starting in 2005, which provides better information on the extent of winter operations.



Generally, there has been a decreasing trend in the amount of snowfall in Toronto, with fewer large single snowfalls requiring ploughing, but a more frequent need for salting to deal with slippery or icy conditions on roads and sidewalks.

What are the Key Objectives of Winter Maintenance Operations?

Toronto's winter maintenance standards for its road network, have been established to ensure roads are safe for motorists and pedestrians and to assist, to the greatest extent possible, the continuous movement of traffic during and after snow events. The key users of Toronto's road network include:

- emergency vehicles
- citizens in automobiles and public transit vehicles travelling to and from homes, workplaces, schools, and cultural, recreation and entertainment venues
- the commercial and industrial sector for the transport and movement of goods and services

What are Toronto’s Winter Maintenance Standards for Roads?

The salting of roads prevents ice-build up and slippery road conditions, during periods of light snowfall, which can often be combined with freezing rain or drizzle and temperatures hovering around the freezing point.

The table below summarizes Toronto’s current standards for the salting of roads in winter, by classification of road.

Salting Standards by Road Classification

Road Classification	Typical	Winter (1) Service Levels	De-Icer	Application Rate Kg./Lane-Km.	Time Frame (4) to Complete De-icer Operations
Expressways	DVP / FGGE	Bare Pavement	100% Rock Salt	70 / 140 / 180(5)	Up to 2.5 cm of snow 1-2 hrs
Arterials (minor / major)	Yonge St. / Sheppard Ave.	Bare Pavement	100% Rock Salt	70 / 140 / 180(5)	Up to 5 cm of snow & continuing 2-4 hrs
Collectors	Main Streets through sub-division	Centre Bare Pavement (3)	100% Rock Salt	70 / 90 / 180(5)	Up to 8 cm of snow & stopped 4-6 hrs
Locals	Residential (2)	Safe and Passable Pavement	100% Rock Salt	70 / 90	Up to 8 cm of snow + stopped 8-12 hrs
Laneways		Safe and Passable Pavement	100% Rock Salt	180	24 hrs

Notes:

- (1) This is the desired condition of the pavement surface. However, it is necessary to have sufficient traffic volumes to activate and improve the characteristics of the de-icer, the time to achieve this condition will vary with the time, duration and intensity of each storm.
- (2) Local roads that have >10% truck traffic shall be given a higher priority.
- (3) One lane open in the direction of traffic.
- (4) For accumulations greater than as noted, refer to Table 2, *Conditions for winter maintenance operations of March 24th, 1999 UEDC report “Winter operations – road de-icing and ploughing”* in Appendix A.
- (5) Where salt is pre-wet using 23% salt brine, these application rates shall be reduced by 10%.

Anomalies

If any link has one or more of the following anomalies present, the winter service level is bumped-up according to the next highest road classification:

- Ball bank reading >12 at posted speed
- Slope >4%
- Presence of emergency services (i.e. Police, Fire or Ambulance Station, Hospital)
- TTC bus route including turnaround loops

The ploughing of roads is triggered by accumulated snowfall reaching specified depths during a winter event, as indicated in the table below.

Snow Ploughing - Standards and Conditions for Initiation and Completion by Road Category

Road Category	Pavement Condition After Sanding /Salting	Start of Ploughing After Accumulation of (cm)	Time to Completion Ploughing (Hours) After the End of Snowfall			
			STORM TYPE 1 30-40 per year (5cm)	STORM TYPE 2 3-6 per year (5-15 cm)	STORM TYPE 3 Once/2-3 years (15-25 cm)	STORM TYPE 4 Once 10/years (over 25cm)
Expressways	Bare pavement	2.5 to 5.0 and still snowing	2-3 ⁽¹⁾	2-3 ⁽¹⁾	2-3 ⁽¹⁾	2-3 ⁽¹⁾
Red (arterial roads, streetcar routes)	Bare pavement	5.0 and still snowing	-	6-8	8-10	12-14+ ⁽²⁾
Blue (bus routes, collector roads, local streets with hills)	Centre Bare	5.0-8.0 ⁽³⁾	-	8-10	10-12	14-16+ ⁽²⁾
Green (local streets)	Safe and Passable	8.0 ⁽³⁾	-	14-16	18-20	24-36+ ⁽²⁾
Yellow (local streets without boulevards and with long term on-street parking)	Safe and Passable	8.0 ⁽³⁾	-	14-16	18-20	24-36+ ⁽²⁾
Dead Ends (or cul-de-sacs) with limited or no snow storage	Safe and Passable	8.0 ⁽³⁾	-	14-16	18-20	24-36+ ⁽²⁾
Laneways	De-ice as necessary to maintain passable conditions	Ploughing and/or removal, subject to localized laneway conditions	-	-	-	50

Notes:

- (1) Ploughing on Expressways is continuous for bare pavement conditions
- (2) Completion of ploughing under Type 4 Storm conditions is dependent upon total snow accumulation
- (3) Snowfall to be substantially completed prior to ploughing operations commencing (except for heavy snowfalls)

The City also initiates snow removal operations when windrows reach volumes that create a nuisance or hazard to pedestrians and motorists. This is done to maintain capacity for subsequent snowfalls, or after a designated Type 4 storm (over 25cm). Snow removal operations involve the use of in-house mobile and stationary melters, snow blowers, belt loaders, front-end loaders and trucks in conjunction with contracted truck fleets and the City Hired Equipment Registry.

Toronto’s standards and guidelines associated with snow removal are summarized in the table below.

Snow Removal – Standards and Guidelines for Initiation and Completion

Road Category	Net Snow Accumulation For Removal to Start	Type of Operation	Time to Complete Removal
EXPRESSWAYS	20 to 30 cm	Full operation (Overtime if required)	3 Days
RED [Selected sections] *Without or small Boulevard *Commercial on-street Parking	20 to 30 cm 30+ cm	Partial Operation (8 hr shifts) Full Operation (Overtime if required)	2 Weeks
BLUE Bus Routes Collector Roads Local Streets with hills	20 to 30 cm 30+ cm	Partial Operation (8 hr shifts) Full Operation (Overtime if required)	2 Weeks
GREEN Local Streets	-	(Only required for sight lines, etc.)	-
YELLOW Local Streets without Boulevards and with long term on-street parking	30+ cm	Full Operation (Overtime if required)	2 Weeks
DEAD ENDS (or cul-de-sacs) -with limited or no storage space for snow	20 to 30 cm	Full Operation (Overtime if required)	1 Week
LANEWAYS	30+ cm	Full Operation (Overtime if required)	3 Weeks

What Are the Activities and Scope of Toronto’s Winter Maintenance Operations?

The major activities related to winter maintenance are:

- Salt and sand storage
- Salt/sand spreading
- Windrow clearing program for residential driveways
- Snow ploughing (roads, sidewalks, laneways)
- Snow removal and disposal from City streets
- Snow removal at bus stops

These winter maintenance activities are provided over Toronto's road network of 5,590 centre-line kilometres or 13,317 lane-kilometres. One kilometre of a four-lane road is equivalent to four lane kilometres.

Toronto's road network is comprised of:

- 125.6 km (293.2 lane-km) of expressways
- 739.8 km (3,062.3 lane-km) of major arterial roads
- 358.2 km (1,222.5 lane-km) of minor arterial roads
- 811.0 km (1,823.6 lane-km) of collector roads
- 3,236.4 km (6,505.3 lane-km) of local roads
- 318.8 km (410 lane-km) of laneways

Toronto also provides mechanical sidewalk snow clearing in areas of the City where physical features of the area make it feasible. This currently applies to approximately 5,500 of the 7,100 kilometres in the City's sidewalk network. Salt/sand mixtures are used as required after ploughing to provide grit and traction on sidewalks.

In general, mechanical clearing of sidewalks is not possible in areas with:

- streets less than 8 metres wide
- sidewalks less than 1.5 metres wide
- sidewalks adjacent to the street
- long-term parking adjacent to the sidewalk
- boulevards having obstructions like utility poles, planters or retaining walls adjacent to or within the sidewalk

In areas of the City where sidewalks can't be mechanically cleared, seniors and disabled persons can apply to the City to have this work done at no charge to them.

What Resources Are Used to Provide Winter Maintenance Operations in Toronto?

Toronto's winter maintenance resources are a blend of city staff and equipment as well as contracted vehicles and operators. The current external contract is five years in length and expires in April 2008.

The external contract provides the contractors with a daily standby pay in order for their vehicles and operators to be available to the City when required for winter maintenance operations. When these vehicles are called in by the City for winter maintenance operations, the contractors are paid for salting vehicles by the kilometres travelled and for ploughs and other equipment by the hours they are in operation.

For City staff, standby pay is paid to a specified number of management and union staff in the Transportation Services Division. There are three levels of storm probability and severity, which determines the number of management staff (2 hours of standby pay per day) and unionized staff (3 hours of standby pay per day) receiving this standby pay.

This blended model of City and contracted resources has a number of advantages including:

- the capability and flexibility to use primarily City staff and vehicles for minor winter events
- the ability to call on contracted vehicles and operators on an as needed basis for larger winter events
- eliminating the opportunity costs the city would have if it owned more specialized snow vehicles such as salters, that would be idle in the off season – the contractor factors these costs into their contract
- the provision through contracts, of additional licensed operators of salters and ploughs without the responsibility to find alternative work during the off-season

There are a total of 1,176 pieces of equipment and 1,604 personnel used to provide winter maintenance operations consisting of:

- Road ploughs – 633 (619 contracted and 14 City-owned)
- Sidewalk ploughs – 325 (313 contracted and 12 City-owned)
- Salt trucks – 211 (178 contracted and 33 City-owned)
- Snow melters – 7 (two portable stationary melters and five mobile melters)
- City staff – 536
- Contracted staff – 1,068

Snow blowers are also used, and if snow removal from streets is required, front-end loaders and up to 600 contracted dump trucks are utilized.

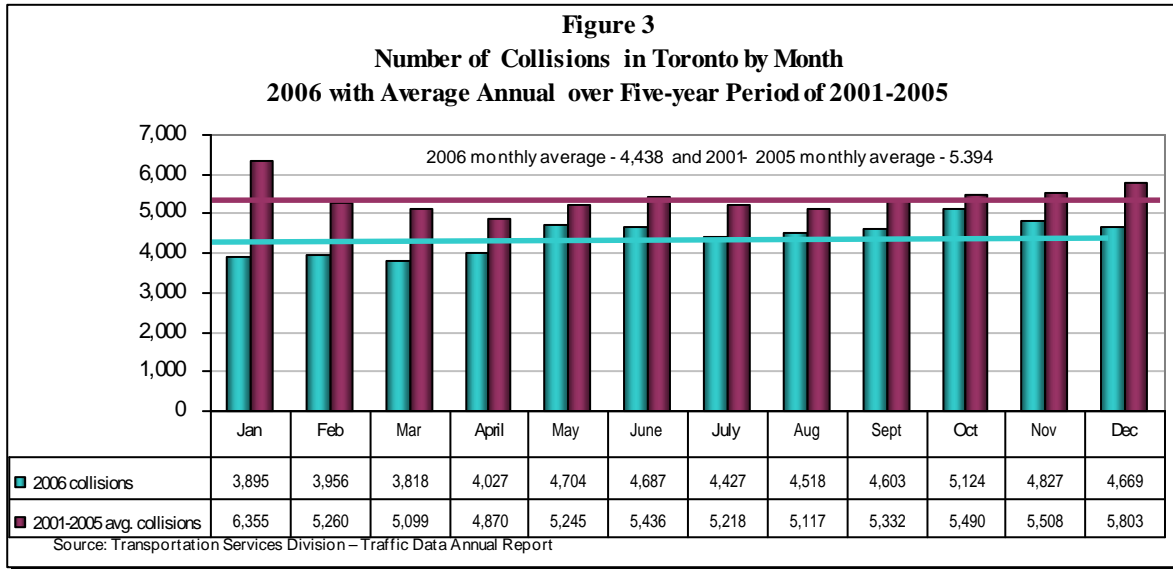
Toronto's 2006 winter maintenance costs, including support costs, was \$51.7 million for roads and \$12.5 million for sidewalks. Standby pay for roads in 2006 was \$19.6 million for the contractors and \$1.6 million for City staff.

As previously noted, these costs will vary from year to year depending on winter conditions.

Are Toronto's Roads Safe During Winter Events?

With one of the primary objectives of winter maintenance of roads being the safety of motorists and pedestrians, the rate of collisions during winter months provides one method of assessing if winter maintenance expenditures are being used effectively in achieving this objective.

Figure 3 on the next page provides the number of collisions in Toronto per month in 2006 as well as the average collisions by month for the preceding five-year period from 2001 to 2005.



These results indicate that there are no unusual spikes in the number of collisions in what would be termed as the winter months from November to March.

An alternative way of looking at the collision statistics is to identify the number of collisions that occur at a time when the road surface condition could be considered as covered in loose snow, packed snow, slush or ice, and calculate these collisions as a percentage of all collisions throughout the year.

The table below summarizes these collision statistics for the calendar years of 2004 to 2006, the percentage of collisions, by type of collision, that occurred during the entire year when there were road surface conditions described as of loose snow, packed snow, slush or ice.

Calendar Year	% of Annual Collision by Type With Winter Road Surface Condition of Loose or Packed Snow, Slush or Ice			
	Fatalities	Personal Injuries	Property Damage	All Collision Types
2006	0.0%	1.4%	1.9%	1.8%
2005	1.9%	5.8%	9.8%	8.9%
2004	6.7%	6.0%	10.0%	9.0%

Considering that the winter season runs from November to March or approximately 40% of the year, these percentages are very low and indicate that Toronto’s winter maintenance standards are keeping the road surface condition safe for motorists and pedestrians during and after winter events. The overwhelming majority of collision in 2006 for example occurred when the road surface was dry (80.5%) and another 17.2% when the roads were wet.

The following table provides more detail on the number of collisions from 2004 to 2006 that occurred during each of the different winter road surface conditions of loose snow, packed snow, ice and slush.

**Number and Percentage of Collisions Occurring
During Winter Road Surface Conditions (Loose Snow, Slush, Packed Snow and Ice)**

Road Condition at Time of Collision	Type of Collision			Total Collisions
	Fatalities	Personal Injuries	Property Damage	
2006 Calendar Year				
Loose snow	0	60	295	355
Slush	0	32	87	119
Packed Snow	0	11	59	70
Ice	0	68	323	391
Sub-total – winter road conditions	0	171	764	935
Annual Total – all road conditions	57	12,551	40,647	53,255
% Collisions occurring during winter road conditions	0.0%	1.4%	1.9%	1.8%
2005 Calendar Year				
Loose snow	1	289	1,752	2,042
Slush	0	170	899	1069
Packed Snow	0	97	527	624
Ice	0	169	1,016	1,185
Sub-total – winter road conditions	1	725	4,194	4,920
Annual Total – all road conditions	52	12,540	42,698	55,290
% Collisions occurring during winter road conditions	1.9%	5.8%	9.8%	8.9%
2004 Calendar Year				
Loose snow	1	309	1,780	2,090
Slush	1	207	989	1,197
Packed Snow	1	107	672	780
Ice	1	161	868	1,030
Sub-total – winter road conditions	4	784	4,309	5,097
Annual Total – all road conditions	60	13138	43,288	56,486
% Collisions occurring during winter road conditions	6.7%	6.0%	10.0%	9.0%

Source: Transportation Services Division – Traffic Data Annual Report

Another example of winter safety of road surfaces on City bridges was a 2004 study of an automated system of dispensing liquid de-icer directly on bridge decks. This study of the FAST system (Fixed Automated Spray Technology) found that the City’s existing de-icing practices on bridge decks were working well with no increase in collisions on bridges during winter events. The additional cost of installing the FAST system was therefore not warranted.

To keep road conditions safe for motorists and pedestrians and to keep traffic moving, eleven service depots are located throughout the City in order to provide an immediate response to winter events as they develop.

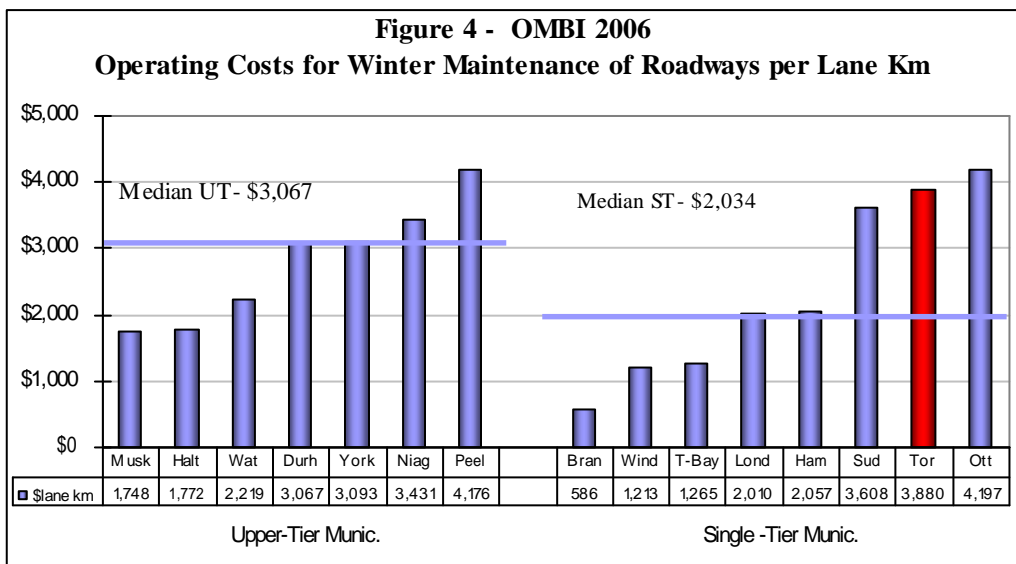
To provide this immediate response, there are 120 contracted salt vehicles and operators stationed at these depots on a 24-hour basis and the contracts stipulate that the first salting vehicle must respond within 5 minutes of the city’s request and each successive salter within 3 minutes thereafter.

There are additional costs associated with providing this type of immediate response capability, however, it can be viewed as a form of insurance to maintain road safety if and when this equipment and operators are required.

There may be periods of time when there is no inclement winter weather forecasted, and these contracted salt vehicle operators could be idle. There is the possibility that during these idle periods, when there is a very low probability of salting activities, these contracted operators could perform other services for the City. However, management of the Transportation Services Division and Employee & Labour Relations would need to review this issue further to ensure that any such services do not contravene the Local 416 collective agreement.

Why Are Toronto’s Costs for Winter Maintenance of Roads, Higher Than in Other Municipalities?

Comparisons of Toronto’s winter maintenance costs per lane kilometre of roads have shown Toronto’s costs to be higher than those of other municipalities, in 2006 and in prior years. In 2006, Toronto’s costs ranked seventh of the eight single-tier OMBI municipalities as shown in Figure 4, below.



Municipalities have been grouped to reflect different service delivery responsibilities for different classes of roads. The first group includes upper-tier or regional municipalities that usually have responsibility for major road types such as arterial and collector roads, but don’t

have responsibility for local roads, which are the responsibility of lower-tier municipalities. The second group, which includes Toronto, are single-tier municipalities who have responsibility for winter maintenance of all road types.

The key factors that contribute to Toronto's higher costs are:

- Higher service standards in Toronto for accumulation of snow and ice, before sanding, salting, ploughing and snow removal operations commence, and for how quickly the work is completed. Because many of Toronto's roads are so heavily traveled, the service standards (and associated costs) are high, particularly for arterials and expressways, in order to maintain public safety.
- The windrows program (removal of snow at end of residential driveways left behind by ploughs) is a program unique to Toronto and results in higher costs that other municipalities will not have.
- Depending on the time of day that snow events occur, congestion on roads in Toronto is a major factor impacting the speed (and associated costs) at which ploughs and salters can travel. Other less congested municipalities would not face these challenges.
- Narrow streets and on-street parking in the downtown core of Toronto make it essential to do snow removal from these roads in order to maintain traffic flow. These snow removal operations are generally not required in other municipalities, especially if they have wide enough roads or boulevards where the snow can be stored.

In 2005, the OMBI municipalities recognized that the number of times a municipality has to respond to a winter event and the volume of traffic (congestion) on a municipality's road system were two key factors that could significantly impact the costs of all municipalities.

Some analysis was done to normalize the unadjusted 2004 costs per lane km., using weighting factors that considered the number of winter event responses and the degree of traffic congestion in each municipality. After adjusting municipal results for these factors, Toronto's normalized costs of winter control per lane km. of roads were very comparable to those of the other single-tier municipalities.

How Do Toronto's Winter Maintenance Standards Compare to Other Municipalities?

As part of this review, staff approached other municipalities to obtain their service standards for salting, ploughing and snow removal from roads. This information was not available in time to be included in this report, however based on the limited information we were able to obtain, a general observation is that Toronto's winter maintenance standards are very detailed and tend to involve an earlier response to winter events and completion of the response in a shorter time period.

Toronto's Windrow Clearing Program is a service that other municipalities do not provide and is discussed in the next section.

What Does it Cost to Clear Windrows From Residential Driveways?

Transportation Services currently opens or clears driveway windrows (snow left behind at end of driveways after ploughing), where mechanically possible, on all classifications of roads in the City of Toronto for residential single-family properties. This program clears windrows from approximately 262,000 residential driveways that are eligible for this service in areas of the City where it is mechanically feasible.

It is not possible to clear driveway windrows in areas of the City that have the following characteristics:

- Long-term on-street parking.
- Narrow streets (less than 8.5 metres wide)
- Boulevards with limited snow storage space

Windrows are only cleared when they reach heights of 25 centimetres and it is usually done through the use of a second piece of specialized equipment that follows the initial plough, or through the attachment of additional equipment to ploughs. The driveway windrow is opened to the extent that a car may pass safely (i.e., to a width of about 3 metres), but does not clear snow down to the pavement surface or across the entire driveway width, in order to minimize damage to driveways and adjacent boulevards.

Costs of the windrow program vary from year to year according to the amount and frequency of snowfall, but it approximates \$6.2 million per year, which equates to \$24 a year for each of the 262,000 residential driveways eligible for the service. A typical homeowner would likely consider this to be of good value in relation to what it would cost them to hire a private snow clearing service to do this work.

It is our understanding that the clearing of driveway windrows is unique to Toronto and it is very rare for this service to be provided elsewhere by Canadian municipalities. If the cost of the windrows program was removed, Toronto's 2006 winter maintenance costs would drop from \$3,880 to \$3,415 per lane kilometre, however, Toronto's costs would still rank sixth highest of the eight single-tier municipalities in OMBI.

What Actions Has Toronto Taken to Improve the Efficiency and Effectiveness of Winter Maintenance Activities?

After each winter season the Division holds a de-briefing session to review operations and to identify what activities worked well, which ones could be improved, and what aspects of operations should be changed. This spring for example the Division will review procedures for winter maintenance of streets in the inner City where parked cars can hamper operations when there is an accumulation of snow.

The current five-year winter maintenance contract with external contractors expires in April 2008. This five-year contract realized significant savings over the previous three-year contract. Council has recently approved the Transportation Services Division's recommendation to extend the next winter maintenance contract to cover a seven-year timeframe. Extending this contract

from five to seven years is expected to generate savings, as contractors are likely to feel more confident in making investments in equipment with the knowledge of a longer-term commitment of work from the City.

To predict and prepare for winter event responses and mobilize the appropriate level of resources the City:

- Uses a private forecasting service, Pelmorex (the commercial weather forecasting section of the Weather Network) which provides much more detailed forecasts than public forecasts. If different snowfall levels are expected across the City, resources can be rationalized between districts. Effective use of weather forecasts can also allow the City to take advantage of expected warming trends or milder temperatures, which are carefully considered before incurring significant expenditures for additional clearing or removal of snow.
- Uses patrol vehicles with infrared thermometers that travel along the road network to monitor air and pavement temperature to aid in decisions on when to salt roads. Because pavement can retain heat absorbed from the sun, roads can be warmer (above a freezing temperature) than the ambient air temperature and accordingly, road salting may not be required.
- Uses two Remote Road Weather Information Systems (RWIS), which involve the embedding of puck sensors in roads with an antenna at the side of the road providing detailed information that is accessible through the internet, This enables staff to make more informed decisions on if and when to apply salt. Four additional RWIS stations will become operational in 2008.

During a winter event, City staff take a number of steps to co-ordinate operations and communicate with the public. This includes:

- Conference calls held during storm events to co-ordinate response across districts
- The issuance of snow advisories every three or four hours during ploughing events
- Strong co-operation with the media to communicate with the public. Divisional staff can be heard on radio and seen on television providing information and advising the public on:
 - when to stay off the roads to allow for winter maintenance equipment operators to complete their work more quickly and efficiently
 - keeping parked cars off local streets, which can hamper ploughing and snow removal
 - managing expectations of the public as to when they can expect their streets to be ploughed, which can reduce the level of complaints received

The Transportation Services Division's policy for standby pay has been revised effective January 2008. This new, more flexible model is expected to reduce costs by 50% or \$800,000 per year when fully implemented.

Prior to December 2007, the policy for standby pay was to grant it to eligible management and unionized road operations staff engaged in winter operations, on a wholesale basis, for the period December 1 through March 31, regardless of the probability of a storm. The Division's new structure of standby pay for City staff is more flexible and varies depending on the likelihood and significance of a forecasted winter event. It includes three levels of storm probability and severity, each of which requires different numbers of management staff (2 hours of standby pay per day) and unionized staff (3 hours of standby pay per day) to be on standby.

In 2007, an internal review was done by management staff with Local 416 that looked at the possibility of having City staff assume the salting of side streets in North York after an external contract expired. All other districts use City resources and staff to salt local roads.

The review found that on the basis of operating cost only, the City's operating costs were slightly higher than those of external contractors. However when the capital costs to bring the work in-house of \$2.4 million (purchase of the twelve salting vehicles required each at a cost of \$200,000) were also considered, results showed that the external contractor could provide the operation at a more favourable price.

Global Positioning Systems (GPS) have been installed on all salting and patrol vehicles and will be installed on all ploughs (roads and sidewalks) and other vehicles in the next contract. The use of GPS systems assists in:

- Contract management to ensure vehicle routes are completed, and on a timely basis
- Identifying where the winter maintenance fleet is located at any given time
- Reducing liabilities from insurance claims by being able to prove that specific roads were salted at specific times

In the winter of 2002/2003, the city introduced Direct Liquid De-icer Applications (DLA) for anti-icing on bridge decks and "trouble spots" around the City.

Through the salt management plan discussed in the next section, the Division has been able to reduce volumes and costs associated with using road salt and minimize the impact on the environment.

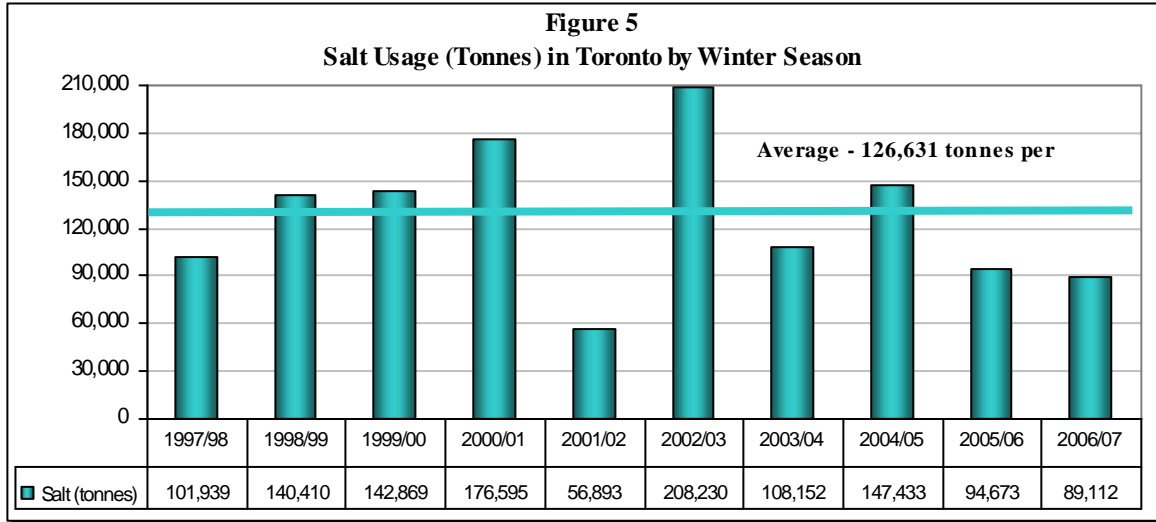
How Has the Salt Management Plan Reduced Costs and the Impact on the Environment?

Although there is ongoing research in Toronto on the use of alternatives to road salt (sodium chloride) for winter maintenance, salt continues to be the most cost-effective de-icer in use across Canada.

Reducing the use of salt on roads has the dual benefit of both decreasing costs and minimizing the impact of runoff on the environment. City staff have been taking steps for a number of years to reduce salt usage, and this was recognized in 2006 when the City won a gold award at the Public Sector Quality Fair for its Salt Management Plan.

Through salt handling practices, the use of new techniques to dispense salt from salting vehicles, and the optimization of application rates, a 10% reduction has been achieved in the volume of salt used on roads in any given winter season.

Figure 5 on the next page, summarizes the tonnes of salt used on city roads over the past ten winter seasons that runs from December 1st to March 31st. At the annual average of 126,631 tonnes of salt used over the past ten years and a cost \$66 per tonne, this can amount to annual savings of approximately \$836,000.



The methods and techniques used to reduce salt usage have included:

- Changing the method of paying contractors for the salting of roads to be based on the route kilometres the salters travel, as opposed to the tonnes of salt applied
- The fleet of salt trucks, both city owned and contracted, have been upgraded so that all of them have electronic spreader controls that are regulated to ground speed for applying salt more accurately and consistently. Calibration of the equipment is checked and maintained during the winter season and salt usage data from the electronic controllers is downloaded, reviewed and attached to daily log sheets
- Pre-wetting of salt, using salt brine, before it is applied to roads, enables it to be used more effectively by reducing bounce and keeping more of the salt on the roadway, as well as activating the salt more quickly
- The use of patrol vehicles with infrared thermometers and remote road weather information stations embedded in pavement, allows for the monitoring of air and pavement temperatures and conditions. Because pavement can retain heat absorbed from the sun, roads can be warmer (above a freezing temperature) than the ambient air temperature and accordingly road salting may not be required and could be needlessly wasted
- All salt is now stored in salt domes at eighteen locations throughout the City. Salt contracts specify that all salt delivery vehicles must use tarps and the deliveries must be during periods of dry weather so that there is no shrinkage during transportation and unloading and any environmental impact is minimized.

A number of procedures have also been implemented that manage the melting of snow (which includes a salt component), to minimize impact on the environment. These include:

- When snow windrows accumulate to the point that removal is required for safety reasons, the City uses its seven snow melters wherever possible to melt the snow either onsite or as close to the site as possible, as opposed to using snow disposal sites.
- A snow disposal study was undertaken in 2002 to examine the thirty sites that had been used in previous years for snow disposal. Some of these snow disposal sites resulted in some melt water or run-off, entering watersheds. The study findings reduced the number of snow

disposal locations to ten primary sites (two of which are for snow melters) along with six other emergency snow disposal sites. The study also identified modifications to these sites that improved the management of runoff and litter.

- The Transportation Services Division has initiated better handling and equipment washing practices at all City facilities that minimizes discharges to the environment. Vehicle washwater contains sodium, chlorides, oil, grease, and grit. If allowed to discharge to ditches or within the yards and depots, these contaminants could have adverse effects on the environment.
- On sidewalks, the salt component of salt-sand mixes is being reduced while ensuring traction and sufficient de-icing is maintained.

Other Initiatives Being Examined to Improve Efficiency

One of the most promising opportunities in the near future for efficiency savings is the introduction of more versatile winter maintenance equipment. The Request for Quotations to be issued for the new seven-year winter maintenance contracts, will include a component that introduces combination units (approximately 70) that are trucks capable of both ploughing and/or salting.

The advantage is that one of these more versatile combination units could do the work of two specialized pieces of equipment used in the past (a separate plough and a salter) requiring less equipment, fewer vehicle runs (sanding and salting can be done together in one pass when necessary) and less stand-by pay.

Staff also continue to look for more cost-effective ways of maintaining roads in the winter, some of which are:

- Global Positioning Systems (GPS) will be extended to all ploughs (including sidewalk ploughs) and other vehicles in the next contract and automated record keeping on vehicles is being examined
- A review of options for reducing breakage and replacement costs for blades on ploughs. These options include:
 - The possibility of using blade segments so only part of the blade needs replacement as opposed to the entire blade
 - The possibility of using springs with blades to make them more flexible and reduce breakage rates
 - If ploughing techniques can be improved (down to bare pavement), it could reduce the need to salt after ploughing and accordingly reduce costs
 - The number of remote RWIS (road weather information stations) embedded in road surfaces, will be expanded to better monitor road and weather conditions
- Participation in the Ontario Road Salt Management Group, which meets regularly and shares ideas and experiences especially regarding new technology
- The Winter Maintenance Co-Ordinating Committee, which does ongoing research on new technologies. For de-icing alternative liquids with freeze points lower than traditional road salt are being studied and piloted.

Conclusion

Toronto's winter maintenance costs for roads are higher than other municipalities on a per lane kilometre basis, however the key driver of these costs appears to be high service standards for the ploughing and salting of roads, physical characteristics of streets in the core area of the City, as well as the Driveway Windrow Clearing program, which is unique to Toronto.

The Transportation Services Division has and continues to take steps to reduce costs such as amending the policy for standby pay for City staff to be based on storm probability, and reductions in salt usage. After each winter season, the Division holds a de-briefing session to review operations and to identify what procedures should be changed. This spring for example the Division will review procedures for winter maintenance of streets in the inner City where parked cars can hamper operations when there is an accumulation of snow.

New alternatives to salt are being studied for de-icing activities and there will also be a greater use of technology to better predict and plan for winter events through remote road weather information stations embedded in pavement, and the use of GPS on all winter maintenance vehicles.

Winter control costs should not be examined in isolation, but must also consider the effectiveness of winter operations in terms of road safety, traffic flow, and environmental impacts from salt usage.

When rates of collisions are examined over the winter season it is evident that collision rates are no higher on Toronto roads in the winter months than during the good weather months, which shows our roads are safe.

To provide immediate response to winter events there are 120 contracted salt vehicles and operators stationed at 11 depots throughout the City on a 24-hour basis. There may be periods of time when there is no inclement winter weather forecasted, and these contracted salt vehicle operators could be idle.

There is the possibility that during these idle periods, when there is a very low probability of salting activities, these contracted operators could perform other services for the City. However, management of the Transportation Services Division and Employee & Labour Relations would need to review this issue further to ensure that any such services would not contravene the Local 416 collective agreement.

From an environmental perspective, new procedures and salt management practices have been implemented that have reduced the application rate of salt by 10% without compromising road safety. This has both reduced costs and minimized the impact on the environment. When snow accumulates to the point that it must be removed from streets, snow melters are used on-site and if snow disposal sites must be utilized, they have been placed in areas of the City away from watersheds and where runoff and residual litter can be retained.

Future work will focus on the establishment of new external contracts that will be extended to cover a seven-year period to give contractors more certainty about work, making it more attractive for them to invest in new equipment. This is expected to benefit the City through a greater number of bidders and lower costs. The new contracts will also introduce the use of new and more versatile equipment (combination units) that will have the capability to both plough and/or salt, which is also expected to generate savings for the City.

It is recommended that the General Manager of Transportation Services report back to the Public Works and Infrastructure Committee after the seven-year winter control contracts have been awarded, on any savings or increased effectiveness that are expected to be realized in the future from these contracts.