



cutting through complexity

The City of Ottawa

Winter Operations Review

Final Report

June 23, 2016

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Disclaimer and Limitations

This document has been prepared by KPMG LLP (“KPMG”) for the City of Ottawa (“City”) pursuant to the terms of our engagement agreement with the City dated June 10, 2015 (the “Engagement Agreement”) for the purpose of informing the City of Ottawa’s discussion and review of Snow and Ice Control Services on roads.

KPMG neither warrants nor represents that the information contained in this document is accurate, complete, sufficient or appropriate for use by any person or entity other than the City or for any purpose other than set out in the Engagement Agreement. This document may not be relied upon by any person or entity other than the City, and KPMG hereby expressly disclaims any and all responsibility or liability to any such person or entity in connection with their use of this document is hereby disclaimed.

Our procedures consisted solely of inquiry, observation, comparison and analysis of information provided by the City. It was augmented by limited research of publicly-available information and information from other cities. We relied on the completeness and accuracy of the information provided. Such work does not constitute an audit.

Through normal City processes, the City will be responsible for the assessment of our observations and the decisions to implement (or not) any findings and/or recommendations. Implementation will require the City to plan and test any changes to ensure that the City will realize satisfactory results in line with the services that the City desires for its residents and visitors.

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Mandate

This Review of Winter Maintenance Operations covers

- Roads Services Branch's winter operations
 - Snow and ice control on roads
 - Services include salting/sanding, plowing, snow removal, snow disposal/storage
- The goals of the project are to
 - Review levels of service related to winter operations
 - Find the lowest cost approach to achieve that level of service reliably
 - Identify mid to long-term changes that may be required due to growth, changing regulations
 - Over the course of the project, a number of areas were specifically excluded from the mandate as City staff assumed responsibility for the review. These included (but were not limited to):
 - Examining options for parking restrictions to support winter maintenance
 - Examining the potential to reorganize the areas to reduce management costs
 - The review of the role and distribution of Small Equipment Technicians, Maintenance Coordinators and Operations Technicians
 - Developing material specifications for liquid deicers that do not jam filters on trucks
 - Cul-de-sac snow storage approaches
 - Expanding GPS to sidewalk plows, 4x4s



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Executive Summary

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Executive Summary

Mandate

This review examines the service levels and delivery model of the Roads Services snow and ice control program (winter operations). The winter operations were reviewed to ensure that the services are being delivered using the lowest cost approach that will reliably achieve the service levels required

Approach

This review involved:

- Extensive interviews with operational, supervisory and support staff from the Roads Services Branch and parts of the Public Works department's management team
- The collection and review of documents related to the delivery of winter maintenance services
- Benchmarking of Canadian cities
- Development and analysis of a number of hypothesis
- A review of the preliminary findings with the management team
- Preparation of the final report

The review resulted in ten areas of in-depth review and analysis:

- Costs of Winter maintenance
- Benchmarking – comparison to other Canadian municipalities for best practices
- Current Levels of Service
- Deployment Approach
- Beat and Service Level Adjustments
- Snow Removal and Disposal
- In-House/Staffing
- Contracting
- Vehicles and Equipment
- Salt Use

Executive Summary

Background and Service Delivery

The City of Ottawa's winter operations is the responsibility of the Roads Services Branch of the Public Works Department. Winter operations typically runs from mid-November until mid-April and includes salting, plowing, gritting and snow removal to keep Ottawa's transportation network safe and passable.

The Roads Services Branch provides winter operations across the City from 17 yards that are divided into five areas. These areas are referred to as the West, Core, East, South and Special Operations (responsible for the transitway and Highway 174).

Approximately 614 staff are involved in Winter Operations. There are day and nights shifts during the winter that run from Monday to Friday. Overtime is required when winter events occur on weekends, or if staff must work longer shifts in order to deal with a major winter event.

The largest expenses related to the winter maintenance program is the application of winter materials on roads and snow removal.

There are 127 salt beats covering the major roads and collectors, generally served by "combo" units (salters with plows) that are likely to be deployed for 40 to 50 events each winter, anything from freezing rain to a major storm. Both day and evening shifts have staff (or contractor support) to operate the salt beats.

There are 195 plow beats, with graders or loaders with plows that service residential streets, although some are deployed as "echelon" plows to assist combos to plow on the major roads during storms. The plows are generally only required for the eight to 10 events annually that have more than seven cm of snow, and the related staff is only scheduled on the day shift. In addition there are contracted and in-house resources for the transitway, and Hwy 174 beats.

All data provided by the City of Ottawa, except snowfall data from :Environment Canada daily weather observation data, Ottawa airport

Executive Summary

Challenges for Winter Operations

Weather Impacts Service and Cost

Weather plays a significant role in the level of winter road maintenance activities and expenditures. Over a thirty year period snowfall has averaged 223 cm annually, but 2013 was a particularly difficult winter with over 272 cm of snow, and over the last 30 years, snowfall has ranged from a low of 111 cm to 374 cm. Thus the City must retain the capacity to handle the extreme winters (even if service levels cannot be fully achieved), while minimizing the cost of having resources on standby during the low snowfall winters. Even in low snowfall winters the combos can be busy dealing with freezing rain.

Budget Not Keeping Pace:

The 2015 budget was only 4.6% higher than the 2010 budget, yet there were 7% more roads and 11% more sidewalks to be maintained and costs had inflated by 10% (using the Consumer Price Index). The net impact is that the budget would appear to be \$7.6M lower than required to maintain 2010 service levels a key reason spending has exceeded budget in recent years.

	2010	2011	2012	2013	2014	2015	2015 Change over 2010
Mtce. Operations Budget (net of recoveries)	57,220,459	55,257,993	56,522,533	55,360,476	57,617,952	59,875,926	4.6%
Budget with Growth and Inflation *	57,220,459	60,727,154	62,076,287	63,869,304	66,104,518	67,495,621	18.0%
Budget Gap	-	5,469,161	5,553,754	8,508,828	8,486,566	7,619,695	
* Based 82% on growth of road inventory, 18% on growth of sidewalk inventory. Inflation based on Consumer Price Index.							

The 2016 to 2018 budget plan includes restoring this funding – but also assumes savings of \$8M per year will be achieved by the end of the three years. This document outlines some approaches to cost reduction that can contribute to these required savings.

All data provided by the City of Ottawa, except snowfall data from :Environment Canada daily weather observation data, Ottawa airport, and CPI information from Statistics Canada

Executive Summary

Actual Service Levels Exceed Requirements

The service levels approved by Council are significantly higher than those required by the province, and are higher than those provided in other cities. The approach used to deliver services is also resulting in service levels on the street that are even higher than those approved by Council, particularly on collector streets. Essentially all arterial streets, major collector streets and minor collector streets are receiving the same level of service as they are all on the same “beats” used for salting and plowing, even though the Council approved Maintenance Quality Standards (MQS) call for higher levels of service on the arterials than on the collectors, since the arterials carry far higher traffic volumes.

All data provided by the City of Ottawa

Executive Summary

Opportunities to Reduce Costs

The following sections provide potential options and subsequent efficiencies to be considered by the City.

Opportunities Consistent with Current Council Service Level Direction

There are opportunities to change service delivery while still achieving service levels consistent with the current Council approved MQS.

- **Changes to the beat structure** would eliminate the “over-servicing” of collectors roads. Creating two different kinds of beats, would allow some or all collector roads to be served at the frequency approved by Council (see page 67)
 - OPTION 1 (\$1.2M in savings)
 - Class 2 & 3 roads 3 hours for salting and plowing
 - Class 4 roads adjusted to 6 hours for salting and plowing
 - OR
 - OPTION 2 (\$1.3M in savings)
 - Class 2 roads at three hours for salting and plowing
 - Class 3 and 4 roads at four hours for salting and plowing
- **“Rideau Valley Approach”** (\$1.3 to \$1.6M in savings) - At the moment all salt beats are designed to be plowed in three hours. But when salting, salt trucks can generally salt two lanes at once, meaning they can salt the roads in less than 90 minutes. At least one zone (Rideau Valley) has a combination of in-house and contracted salt trucks. When there is only a need for salt application, they just use the in-house vehicles and do not call out the contracted salters. This still allows them to salt all roads in three hours as approved by Council, and lets them plow in three hours by calling in the extra resources. The same concept could be used by having some salt trucks staffed on both shifts, and some only staffed on the day shift. Either way costs could be reduced \$1.3 to \$1.6M. (see page 68).

All cost estimates included above are based on specific assumptions, sources and hypotheses that are outlined in the relevant sections of the main document

Executive Summary

Minor Service Level Changes With Significant Financial Impact

The City could also consider some changes to the current Council approved MQS that are consistent with approaches in other cities and that would have minimal impact on services in Ottawa, but which would reduce costs significantly.

- **Increase Standard to Start Plowing Residential** (\$1.0M in savings): Most cities plow their residential streets when there are 10 cm of snow on the ground. Ottawa plows when there are only seven cm, not enough to hinder traffic (any hills or other danger areas are salted and sanded when there is any accumulation of snow). Changing the standard to start plowing at 10 cm would not have significant effect on mobility, but could reduce costs by \$1.0M annually (page 73).
- **Increase Period for Completing Plowing of Arterial Roads** (\$2.4 to \$2.7M in savings): The province requires faster service for salting icy roads than it does for plowing, reflecting the increased danger to traffic when roads are slippery, but also recognizing plowing is slower and takes longer. The current MQS requires both salting icy roads and plowing snow accumulations to be completed in three hours. If the time permitted for plowing arterials were extended from three hours to just four hours, this would still be well below provincial requirements (6 hours) but would allow cost reductions of \$2.4M (pages 71-72).

Major Service Level Changes - Moving to Provincially mandated Minimum Maintenance Standards

It would also be possible to adopt the provincially mandated Minimum Maintenance Standards (MMS) (\$2 to \$4M in savings).

- The province allows up to 24 hours for plowing residential streets. Similarly the province allows up to six hours to plow arterials, and 12 to 16 hours to plow collector streets. There would be significant savings, up to \$4M on the arterials and collectors, but only about \$350K on the residential streets, despite the dramatic reduction in service levels (pages 69, 70)

All cost estimates included above are based on specific assumptions, sources and hypotheses that are outlined in the relevant sections of the main document

Executive Summary

Adjusting Service Delivery Model to Increase the Use of Contractors

- **Mix of In-House and Contract Resources:** The “Rideau Valley Model” could save \$1.3 to \$1.6M as mentioned earlier if resourcing varied with event intensity. The contracting of particular salt or plow beats to “hired” equipment is carried out in various zones, but not consistently. The review found that the costs of in-house and contracted salt beats is reasonably close on a per hour basis. However the “Rideau Valley” approach identified earlier, suggests some efficiencies from varying the resource level depending upon the severity of the event – using only in-house resources for a light event and calling in contract resources for heavier events. This is a good practice but can only work when a zone has a mix of contracted and in-house resources. Contracted units can also be more flexible in terms of starting to provide service at any time without the impact of regular hours on the Commercial Vehicle Operator Registration (CVOR) requirements (maximum driving and working hours).
- **Elimination of In-House Plowing** (\$500 - 600K savings): Plowing appears to be much more expensive done with in-house resources, about 54% more expensive by the hour when overhead and some allowance for low priority activity between events is considered. It is estimated that at least \$500-600K could be saved by eliminating in-house plowing (pages 141-142), although that would remove staff required for other functions between plow runs.
- **Area Contracts** *(\$220 - \$245K in savings): A number of different approaches to contracting some winter maintenance activity were examined, taking into account the overhead costs related to both in-house and contracted services, and the extent of low priority paid time for in-house services. The analysis showed some savings (\$220K to \$245K) from terminating the area contact in south Kanata (pages 143-144), or using hired equipment.

All cost estimates included above are based on specific assumptions, sources and hypotheses that are outlined in the relevant sections of the main document

Executive Summary – Additional Changes For Consideration

Other options for consideration by the City:

There are other options for the City to investigate further that have the opportunity to produce revenue or provide further savings:

- Consider setting a new (longer) service level for large storms to manage expectations realistically, and develop a corresponding communication plan.
- Consider allowing public access (with a fee) to selected snow disposal sites for limited hours.
- Ensure Planning and Development Services give adequate consideration to snow and ice control requirements in developing new standards for suburban development.
- Adjust contracting approaches to minimize costs and risks:
 - Reduce the guaranteed hours on the Hwy 174 contract
 - Engage all snow removal trucks on a lowest cost basis rather than a rotational basis
 - Ensure there are adequate tools to manage contractors when performance is suboptimal.
- Consider licensing the placement of “private” snow on the road right of way in defined circumstances.
- Consider requiring on-street parking permit holders to stay off a street until the parking lane has been plowed.
- Restrict parking on two sides of streets wherever this interferes with salting or plowing.



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Context

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Context – Population and Geography

- Ottawa's population was 883,391 at the 2011 census (951,727 estimated for 2014), an approximate population growth of 7.7%, while the road network grew approximately 7% in the same time frame and the sidewalk network by 11%. It is the second largest municipality in the province of Ontario and fourth largest in Canada. (Statistics Canada)
- Ottawa has a land area of 2,790 sq kms., giving it a very diverse set of conditions to handle, from a dense core to extensive rural areas. Operations need to address different requirements in:
 - Pedestrian malls and traditional mainstreet (BIA) areas
 - Byward Market
 - Downtown, older residential areas
 - Post-war suburban areas
 - Recent high density suburban development
 - Rural villages
 - Rural areas.
- In 2015 there were 12,459 lane kms of roadways (including 188 lane kms of Transitway) and 2,235 kms of concrete sidewalk that are winter maintained.
- Continued population growth is expected and growth continues to be focused in suburban areas, but some of it at higher densities, with decreasing snow storage opportunities.

Why Conduct a Review

The Winter Operations carried out by the Roads Services branch of the Department of Public Works had deficits of \$5M, \$23.9M and \$11.4M for 2012, 2013, 2014 (and subsequently \$7.5M in 2015).

The Department committed to conduct a comprehensive review of winter operations and report back to Transportation Committee by October 2015. (A preliminary report at that time resulted in an extended timeframe for completion of the full review.)

A number of specific questions were identified for consideration in the review:

- Has the weather changed? Is this the new normal, and are higher budgets required?
- Is the City delivering the approved service level – or perhaps a little more? Is the service level higher than the Minimum Maintenance Standards set by province?
- Is the City doing things the most effective and most efficient way? All the time? In all parts of the City?
- Does the City have the right tools, equipment, materials, facilities?
 - Anticipated to be small role in overall investigation
 - 2007 review looked at facilities
- Is the mix of in-house and contracted services right? Can the way the City contracts be improved?

Process

KPMG conducted interviews with members of the Public Works management team, and particularly the Roads management team, including the six area managers, their zone supervisors and support staff. Interviews were also conducted with Finance staff. A series of workshops were conducted with Roads Services employees, including operators involved in winter maintenance activities.

In addition KPMG reviewed documents and data including:

- Overall budgets by area and program
- Facility, Fleet and Staffing descriptions
- City and contract equipment allocation by area
- Beat maps and descriptions
- Sample daily log sheets
- Master Assignment Board (mini board and seasonal transition) staffing processes
- Winter staff training processes
- Snow removal and disposal sites (capacity, volumes, procedures)
- Ottawa Maintenance Quality Standards as well as Provincial Standards
- Sample winter parking and winter operations public communications
- Service Excellence Scorecard data on 311 calls and responses
- Contract provisions.

KPMG conducted analysis of the various data available, identified and examined hypothesis and held a series of meetings with the Steering Committee composed of Public Works departmental managers with support from Finance to explore the findings as they were identified.

Note that much of the work was completed in 2015 using 2014 and earlier data. Some elements have since been updated with 2015 data as it became available.

Context – Winter Precipitation

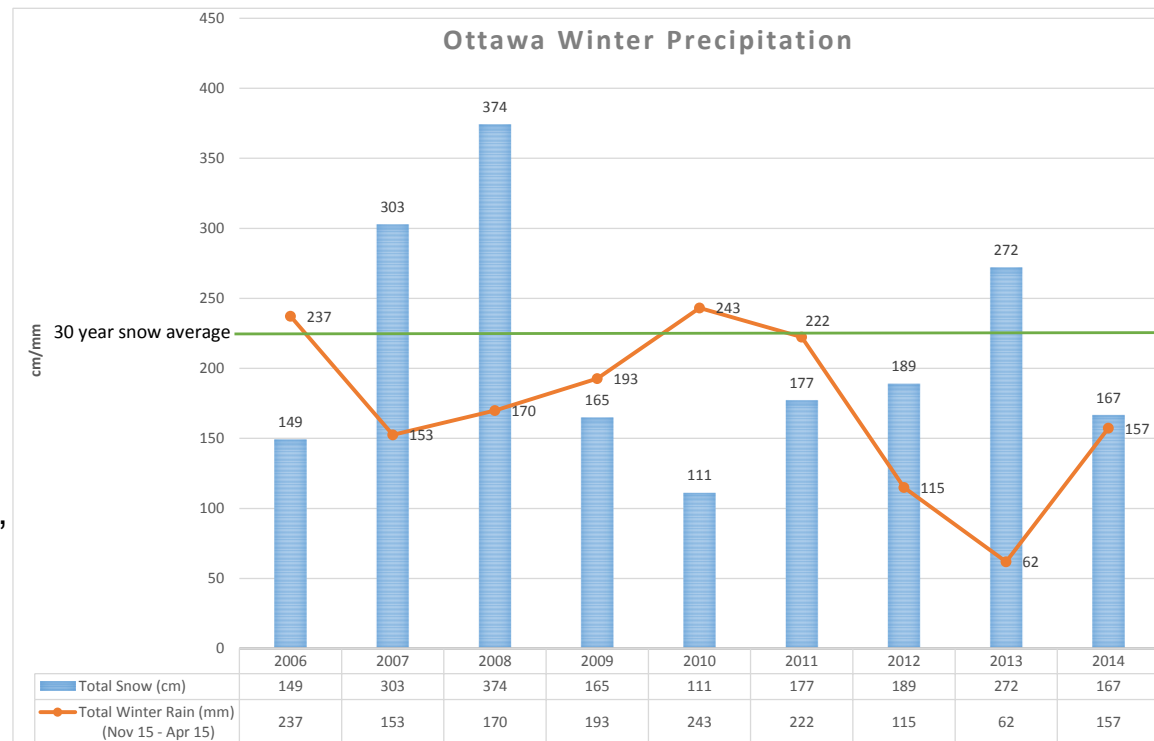
Ottawa	223 cm
Halifax	154 cm
St. John NB	240cm
Montreal	209 cm
Toronto	121 cm
Winnipeg	114 cm
Edmonton	123 cm
Calgary	129 cm
Quebec City	303 cm

Ottawa averages 223 cm of snow per year (30 year average) -more snow than most other major metropolitan centres in Canada, although Quebec City and some Maritime cities receive more.

There is a high level of variability, with snowfall ranging from 111 to 374 cm in different years. Winter rainfall also varies, generally inversely to the snowfall (i.e. total precipitation is more consistent than snowfall).

Winter rain does require a roads maintenance response whenever temperatures are low, but a different response than snowfalls.

The variability, particularly in snowfalls provides challenges. It requires the capability to handle a high snowfall winter, with the lowest possible “standby” cost in the low snowfall winters.



Source: Environment Canada daily weather observation data, Ottawa airport

Snow Season

- Winter operations run from November 15 to April 15.
- The Table below shows, on average, how often snowfalls of various depths occur in Ottawa. For example snowfalls of less than 5 cm occur most frequently, approximately 43 times. Snowfalls of 25 cm or more do not happen very often, but in recent years have occurred in years that also had a higher than average number of 10 to 25 cm snowfalls.
- According to the Maintenance Quality Standards (MQS) set by City Council, salt beats would be run for all 54 events in a typical winter. Full residential plow runs would be done an average of 8.4 times, and laneways 4.8 times.

	2010	2011	2012	2013	2014	Five Year Average
Less than 5 cms	37	46	40	49	44	43.2
>5 but <7 cms	0	5	0	5	1	2.2
>7 but <10 cms	5	3	2	1	7	3.6
>10 but <25 cms	1	5	5	8	3	4.4
25 cms or more	0	0	1	1	0	0.4
Total for year	43	59	48	64	55	53.8

Source: Environment Canada daily weather observation data, Ottawa airport



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Costs of Winter Maintenance

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Winter Maintenance Budget

The Winter Maintenance budget has increased from \$57.2M to \$59.9M over the last six years.

- The application of winter materials on roads – basically the operation of salt beats on major roads (often with blade down, so including some plowing) is the largest budget item at an average of \$25M. Snow clearing (additional plowing, generally on residential streets) costs another \$7.5M. Sidewalk winter maintenance takes another \$8M, plus \$0.8M for spring clean up. Snow removal is the other large piece, budgeted, on average, at about \$8M with an additional \$1.5M to operate the snow disposal sites. The recoveries and adjustments are made to the program totals and not to individual activity lines. They include recoveries from the sewer, parking, flood control accounts and revenues from the use of snow dumps by others. Year end adjustments in Fleet and labour costs that are charged to individual activities throughout the year are also included.

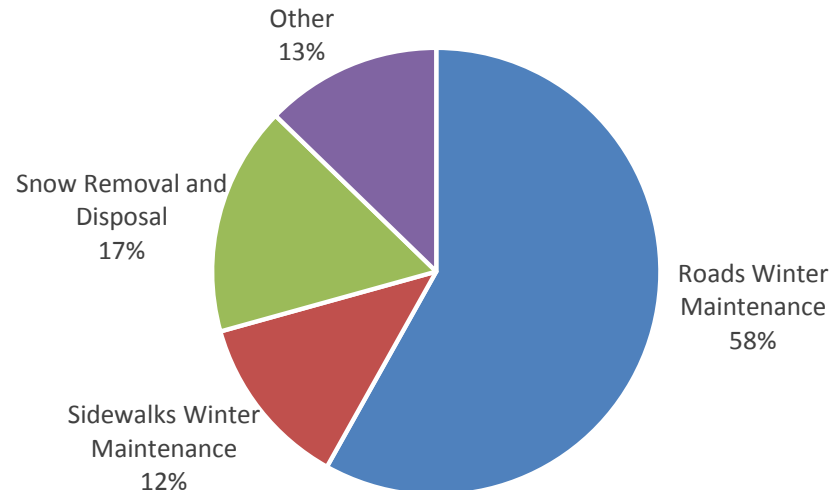
Budget	2010	2011	2012	2013	2014	2015
P90 - Roads Field Support Services	2,113,100	2,152,200	2,484,203	2,516,233	2,844,933	2,890,243
P91 - Roads Spring Clean-Up	2,427,806	2,499,606	2,306,506	2,320,066	2,346,966	2,362,466
P92 - Roads Snow Clearing	7,034,631	7,448,661	7,650,060	7,243,618	7,547,572	7,840,032
P93 - Roads Snow Removal and Disposal	8,381,724	7,676,824	8,038,531	8,039,571	8,193,881	9,277,981
P94 - Roads Application of Winter Materials	26,018,498	23,825,044	23,978,740	23,574,540	24,194,855	24,868,065
P95 - Roads Winter Drainage	1,159,307	1,187,607	872,000	882,760	903,960	915,960
P96 - Roads Snow Markers / Boards / Fence Mtce.	653,700	670,250	687,350	700,790	706,390	719,390
P97 - General Roads Winter Mtce.	3,227,494	3,273,794	3,383,851	3,465,081	3,565,648	3,643,962
P53 - Sidewalks Spring Clean-Up	745,900	770,150	792,365	804,935	826,535	840,935
P54 - Sidewalks Snow Clearing	4,489,550	4,607,474	4,870,459	4,611,449	4,785,619	4,859,549
P55 - Sidewalks Application of Winter Materials	2,430,749	2,732,649	2,782,849	2,741,889	2,818,699	3,015,099
P56 - General Sidewalks Winter Mtce.	160,700	174,800	179,500	182,870	186,370	190,470
P32 - Snow Disposal Facilities Mtce.	1,605,800	1,662,600	1,697,100	1,698,780	2,080,480	2,099,080
P33 - River Flood Control Program	381,600	381,600	381,600	381,600	381,600	381,600
Mtce. Operations Total Budget	60,830,559	59,063,259	60,105,114	59,164,182	61,383,508	63,904,832
Less Recoveries and Adjustments	57,220,459	55,257,993	56,522,533	55,360,476	57,617,952	59,875,926

Note that Financial account “P92 Roads Snow Clearing” is sometimes referred to as “Plowing” in this report, account “P94 – Roads Application of Winter Materials” may be referred to as “Salting”, accounts P54 and P55 and P56 may be referred to collectively as “Sidewalks”

Winter Maintenance Budget

- Roads maintenance activities (including plowing, salting and general maintenance) make up more than half the overall budget. Of this, salting is the largest component.
- Snow removal and disposal activities (including maintenance of the disposal sites) is the next largest budget item and sidewalk maintenance activities are the other major allocation.
- Other smaller budget items make up a smaller proportion of the overall budget and include things such as winter drainage, spring clean-up, field support services and “general” road maintenance, which includes the costs of having staff on call, or standing by when winter road maintenance may be required.

Winter maintenance activities -- average budget proportions



Actual Expenditures

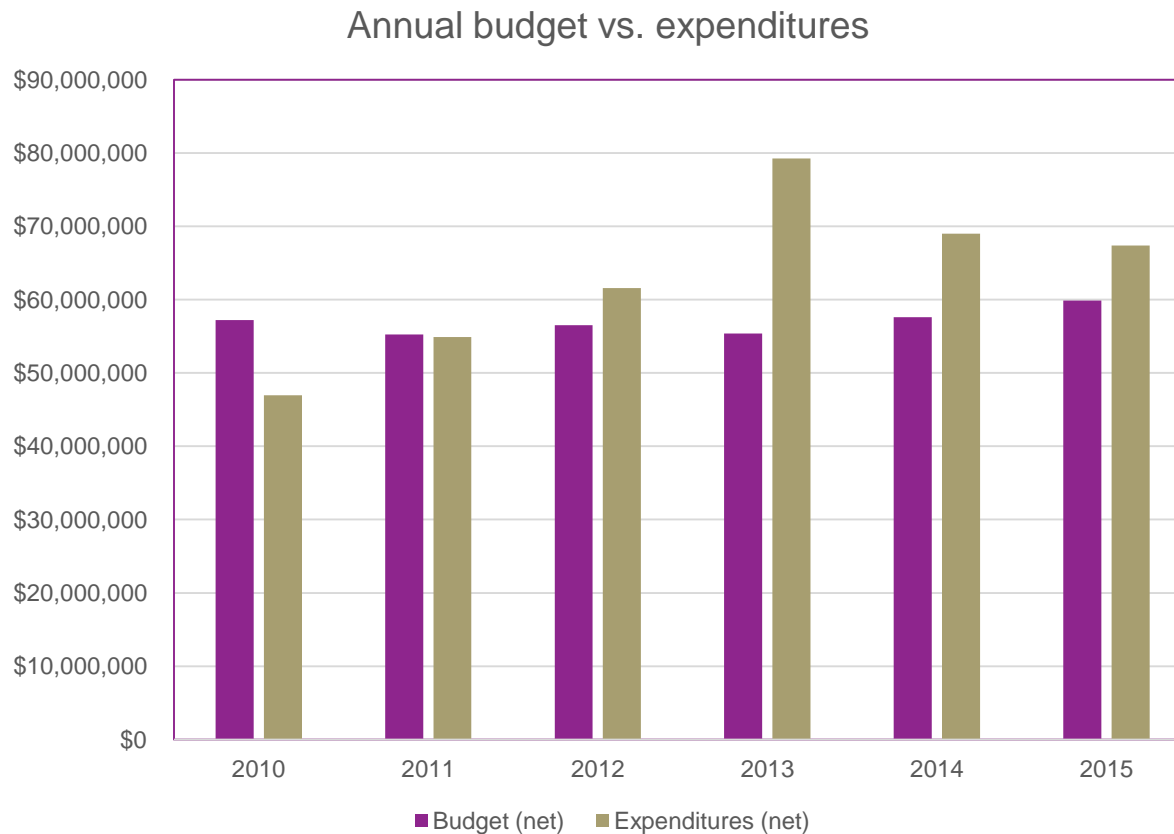
Expenditures on Winter Maintenance have varied substantially in recent years

- The actual level of expenditure is largely determined by the levels of service provided, the approach to service delivery – and by the weather. Management cannot “stick to the budget” in the usual way, it must respond when weather conditions require service. As a result, expenditures have ranged from \$49.6M in 2010 to \$83.1M in 2013 (\$46.9 to \$79.2 after recoveries). The expenditures have exceeded the budget for each of the last four years.

Actual Expenditures	2010	2011	2012	2013	2014	2015
P90 - Roads Field Support Services	3,391,276	3,567,508	3,261,874	3,172,270	3,503,912	3,798,860
P91 - Roads Spring Clean-Up	2,789,321	2,151,971	2,720,631	2,678,620	2,422,010	2,572,309
P92 - Roads Snow Clearing	3,124,794	4,456,830	5,648,629	6,153,568	4,028,767	4,682,362
P93 - Roads Snow Removal and Disposal	5,979,945	5,300,500	7,919,593	18,341,019	11,403,418	11,625,338
P94 - Roads Application of Winter Materials	21,312,680	24,445,478	26,839,466	32,532,136	29,032,183	27,706,967
P95 - Roads Winter Drainage	746,554	1,306,785	945,590	960,736	1,698,096	937,993
P96 - Roads Snow Markers / Boards / Fence Mtce.	489,736	562,288	623,801	744,348	702,527	731,553
P97 - General Roads Winter Mtce.	4,688,205	6,608,287	4,615,172	4,246,585	4,717,046	4,648,481
P53 - Sidewalks Spring Clean-Up	791,888	734,433	959,905	812,465	836,990	998,692
P54 - Sidewalks Snow Clearing	1,666,192	2,832,322	2,836,507	3,828,314	2,625,153	3,099,624
P55 - Sidewalks Application of Winter Materials	2,729,065	3,784,902	5,458,493	5,592,371	5,653,566	4,911,560
P56 - General Sidewalks Winter Mtce.	263,623	307,032	202,303	191,769	207,271	264,253
P32 - Snow Disposal Facilities Mtce.	1,383,577	1,118,435	1,441,759	3,066,442	2,038,807	1,990,120
P33 - River Flood Control Program	274,896	583,892	505,568	752,078	993,712	800,577
Mtce. Operations Total Expenditure	49,631,752	57,760,663	63,979,291	83,072,721	69,863,458	68,768,689
Less Recoveries and Adjustments	46,947,860	54,879,101	61,572,819	79,243,085	69,008,525	67,385,404

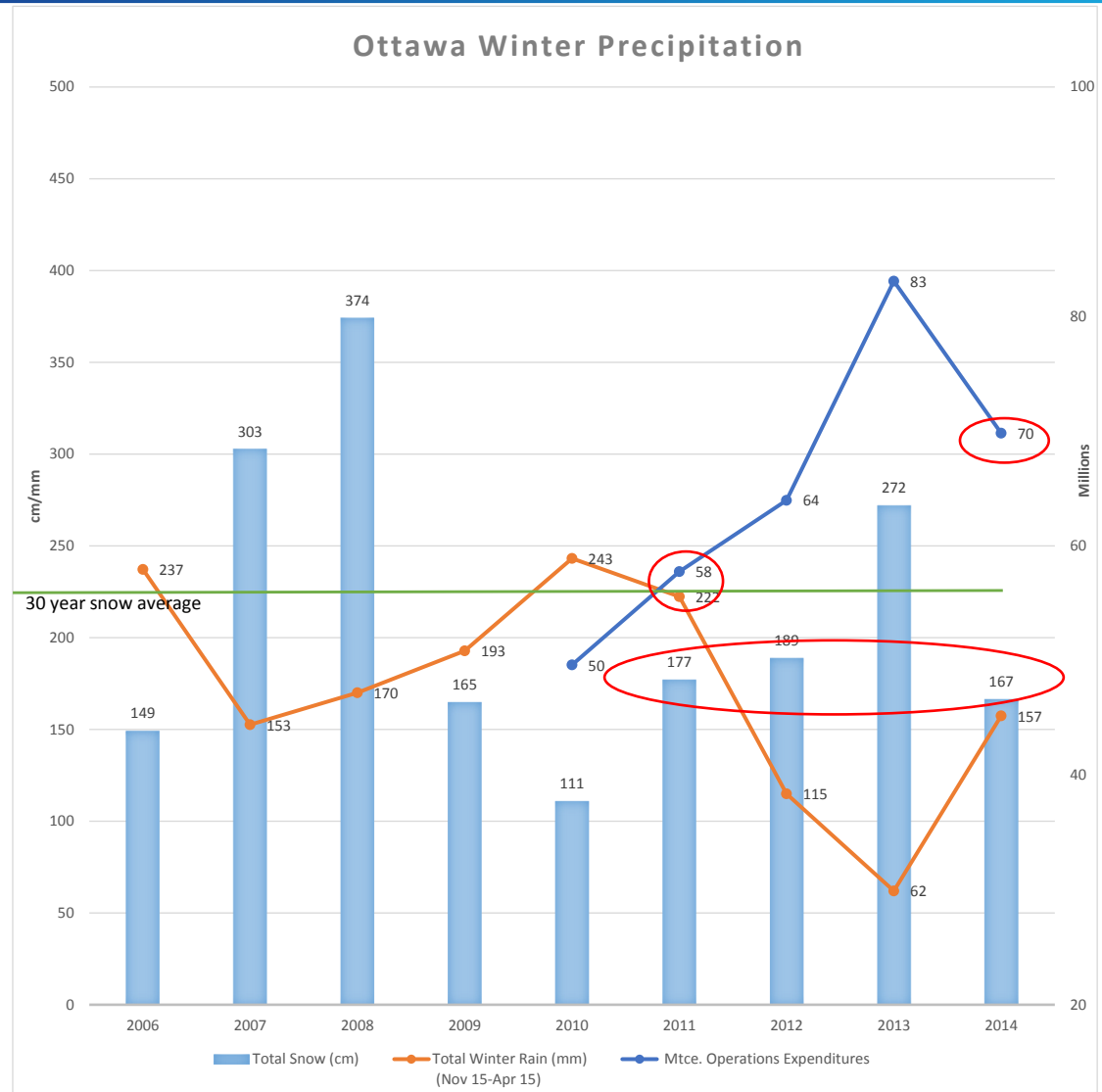
Actual Expenditures

- Traditionally the expectation was that spending would vary year over year depending on the weather, but would tend to average out at the budget level – but the last four years have all been above budget.



Costs of Winter Operations

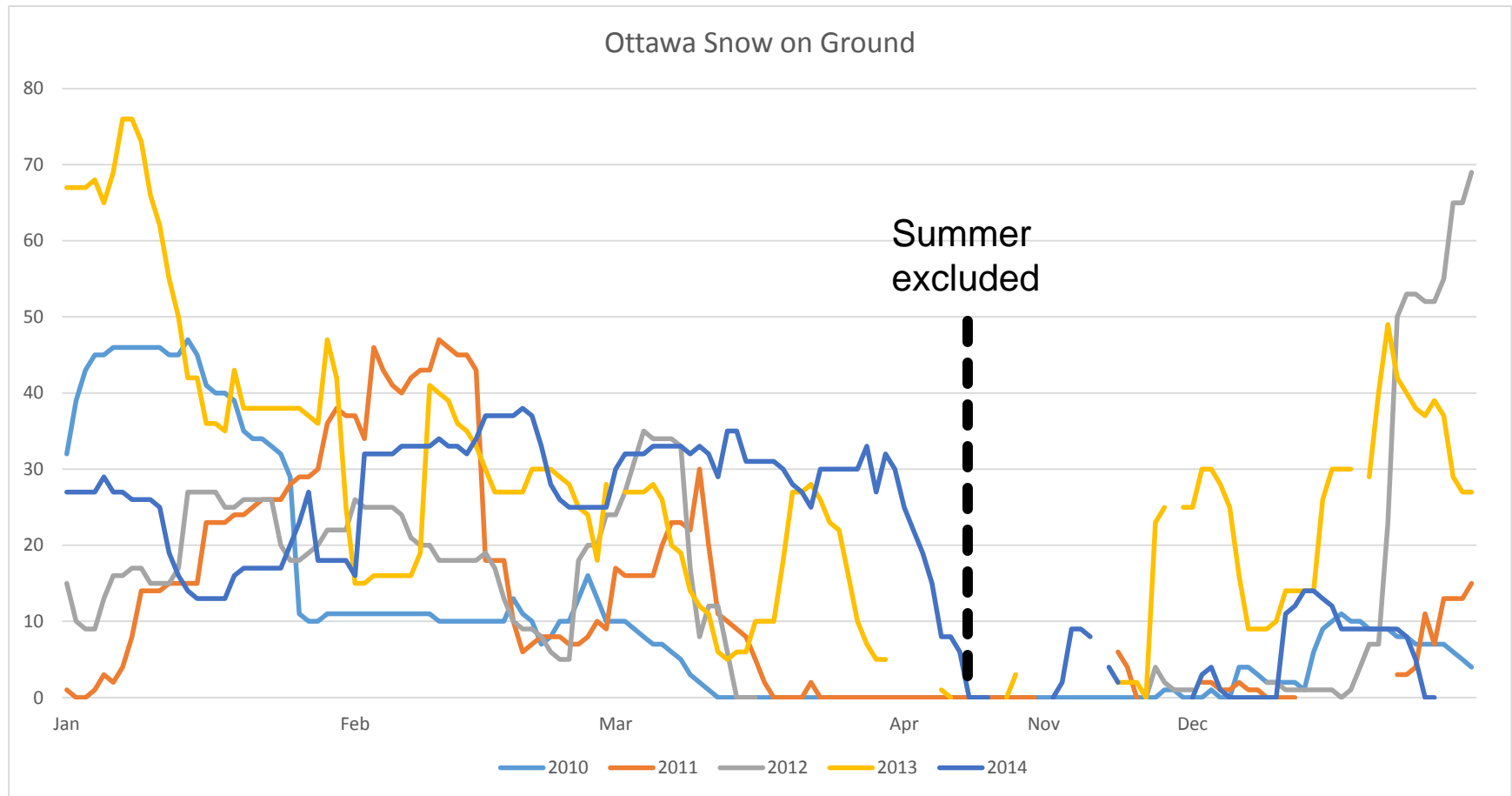
- Weather does help explain some of the difference between budget and actual expenditures.
- Expenditures were highest in 2013, when snowfall was also the highest.
- However in 2014, where snow amounts were comparable to 2011, expenditures were significantly more.
- This anomaly may be explained by the temperatures and the snow cover levels as shown on the following page.



Source: Environment Canada daily weather observation data, Ottawa airport

Costs of Winter Operations

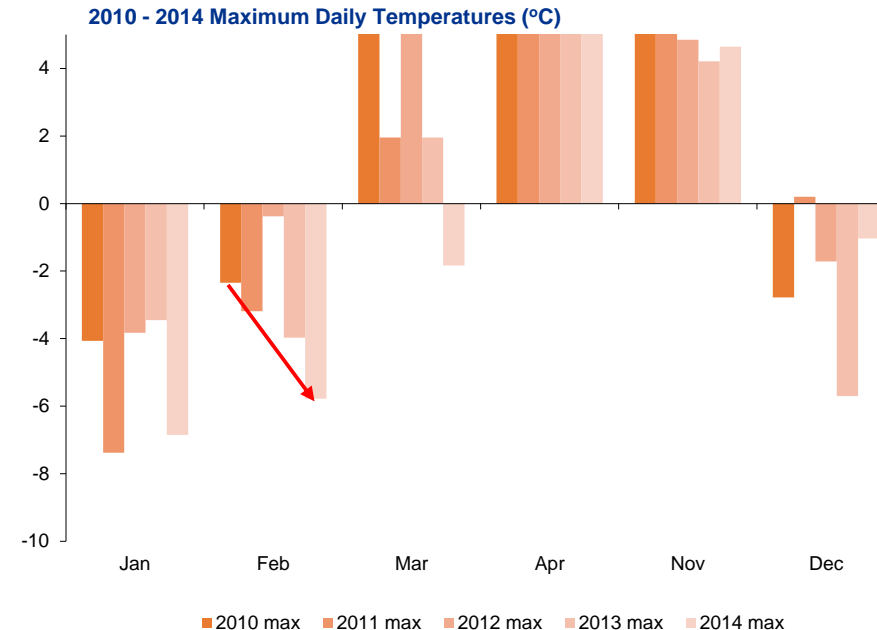
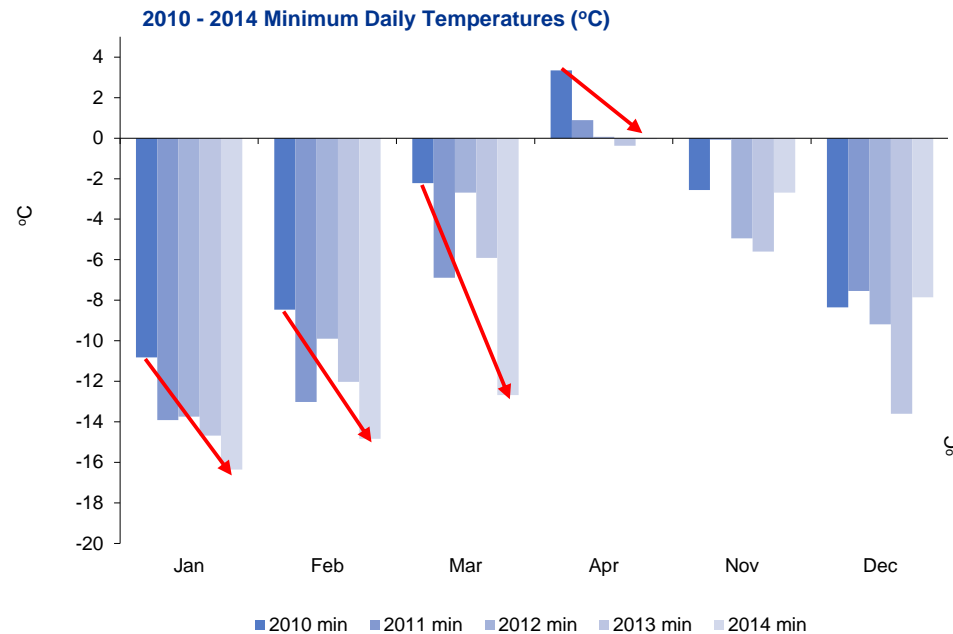
- 2014 did not have high snowfall, but the snow did stay on the ground longer, increasing costs such as snow removal. The chart shows the depth of snow on the ground, and through March and April the snow cover was higher than previous years.



Source: Environment Canada daily weather observation data, Ottawa airport

Costs of Winter Operations

- Over the five year period, minimum daily temperatures got colder over a number of months. The maximum daily temperatures in February also appear to be trending toward colder averages. These trends are too short term to suggest a “new normal”, but do help explain the recent high expenditures.

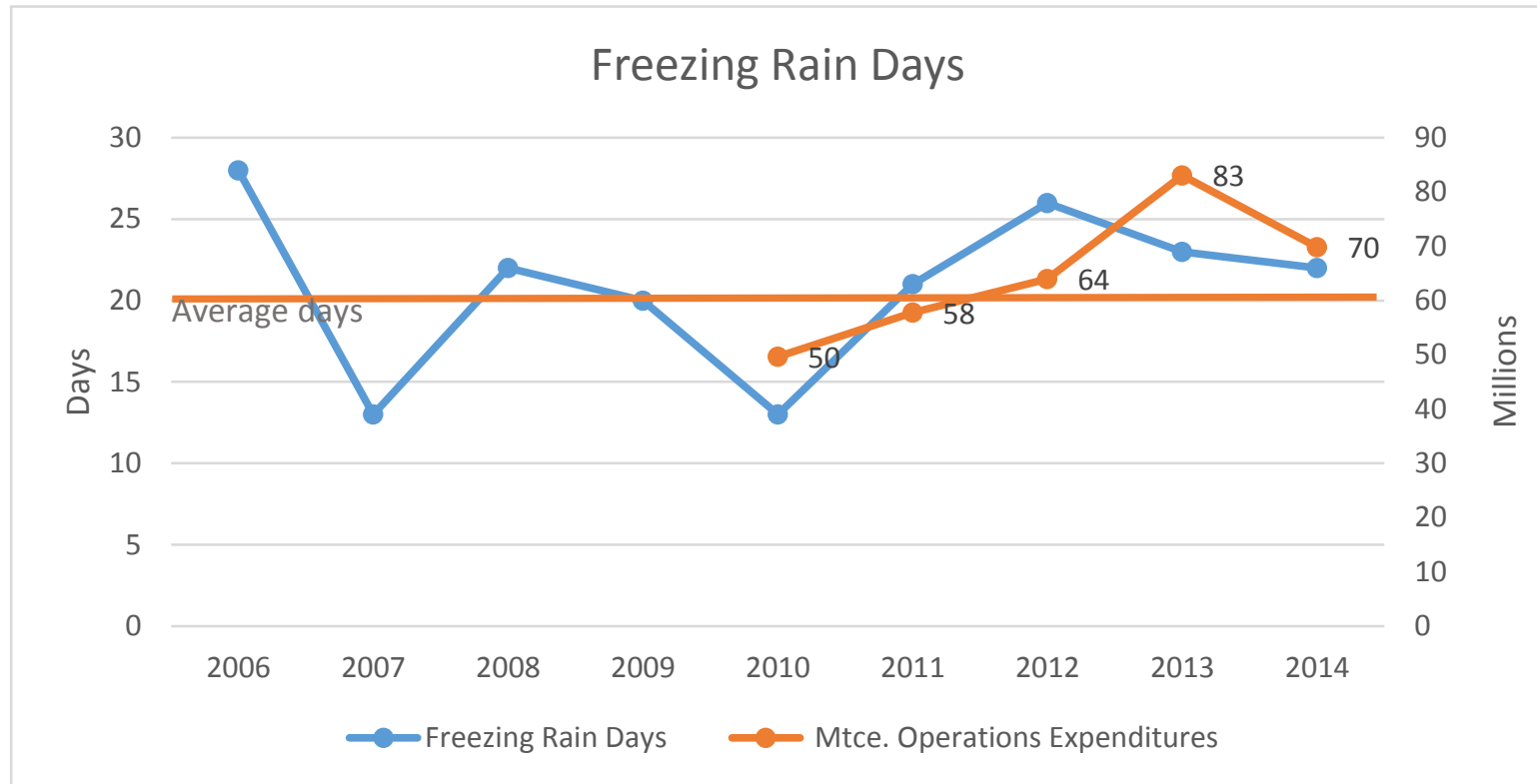


*2010-2014 straight line

Source: Environment Canada daily weather observation data, Ottawa airport

Costs of Winter Operations

- The average number of freezing rain events per year is approximately 20. Expenditures do not appear to correlate strongly to the number of freezing rain events, likely because freezing rain is generally a lower cost event than a snowfall.



*Using Environment Canada data, calculating the days where max. temps were >0 and min. temps were <0, and there was rain recorded that day.

Costs of Winter Operations

- However the weather conditions do not provide an adequate explanation of the recent deficits.
- A look at the growth in requirements (more roads and sidewalks to maintain) and the inflation of costs provides a clearer picture.

	2010	2011	2012	2013	2014	2015	2015 Change over 2010
Mtce. Operations Budget (net of recoveries)	57,220,459	55,257,993	56,522,533	55,360,476	57,617,952	59,875,926	4.6%
Roadway Lane kms	11,681	11,954	12,085	12,243	12,327	12,459	6.7%
Sidewalk kms	2,007	2,073	2,109	2,165	2,193	2,235	11.4%
Cost of Living Index	116.1	120.2	121.4	123	126.3	127.4	9.7%
Budget with Growth and Inflation *	57,220,459	60,727,154	62,076,287	63,869,304	66,104,518	67,495,621	18.0%
Budget Gap	-	5,469,161	5,553,754	8,508,828	8,486,566	7,619,695	
Actual Expenditures	46,947,860	54,879,101	61,572,819	79,243,085	69,008,525	67,385,404	

* Growth based on inflation plus growth in roads on 82% of expenditures and growth in sidewalks on 18% of expenditures.
18% represents the share of expenditures that is for sidewalks, plus a share of budget items that support both roads and sidewalks.

CPI Index is for June, Ottawa Gatineau, from Statistics Canada

- Budget amounts have decreased twice over the past five years and only the 2015 budget increase brought the total budget growth close to 5% over the last five years. Meanwhile the roadways to be maintained increased by about almost 7% over this period, and the sidewalks grew by over 11%. Bicycle lanes designated for winter maintenance have also grown. The Consumer Price Index also went up almost 10% over the five years.

Costs of Winter Operations

If the budget had been adjusted to reflect inflation and infrastructure growth, it would have been \$67.5M net of recoveries in 2015, about \$7.6M higher than it was - enough to cover 2015 expenditures. With the budget not providing for the effects of inflation or the growth in facilities to maintain, operations could only have met the budget if they had introduced efficiencies, or reduced service levels. However, there have been no substantial changes in operations that could be expected to produce substantial savings over this period.

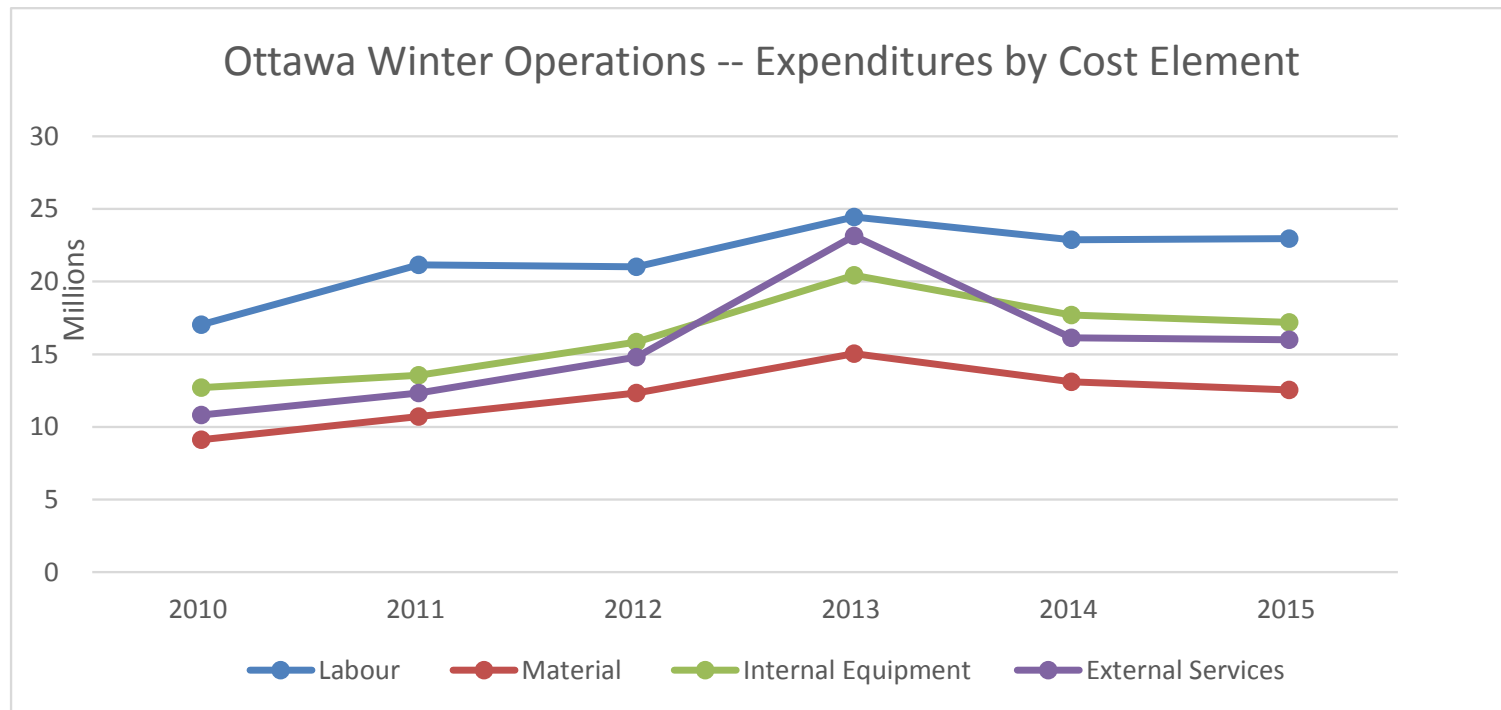
As a consequence, the 2016 budget has been increased by \$4.5M and further increases of about \$2M are planned for 2017 and 2018, which will address the 2015 deficiency, although not growth in the infrastructure over the period.

Further, the budget plan does include changes in operations that will produce savings of \$2.5 in 2016, an additional \$2.9M in 2017 and a further \$2.6M in 2018. Thus just to meet the current budget plan, the Department will need to achieve efficiencies of about \$8M per year to cover the planned savings in the next three budget years.

Consideration of efficiency and service options should therefore recognize that savings of about \$8M per year will be required over the next three years to meet the current three year budget plan.

Costs of Winter Operations

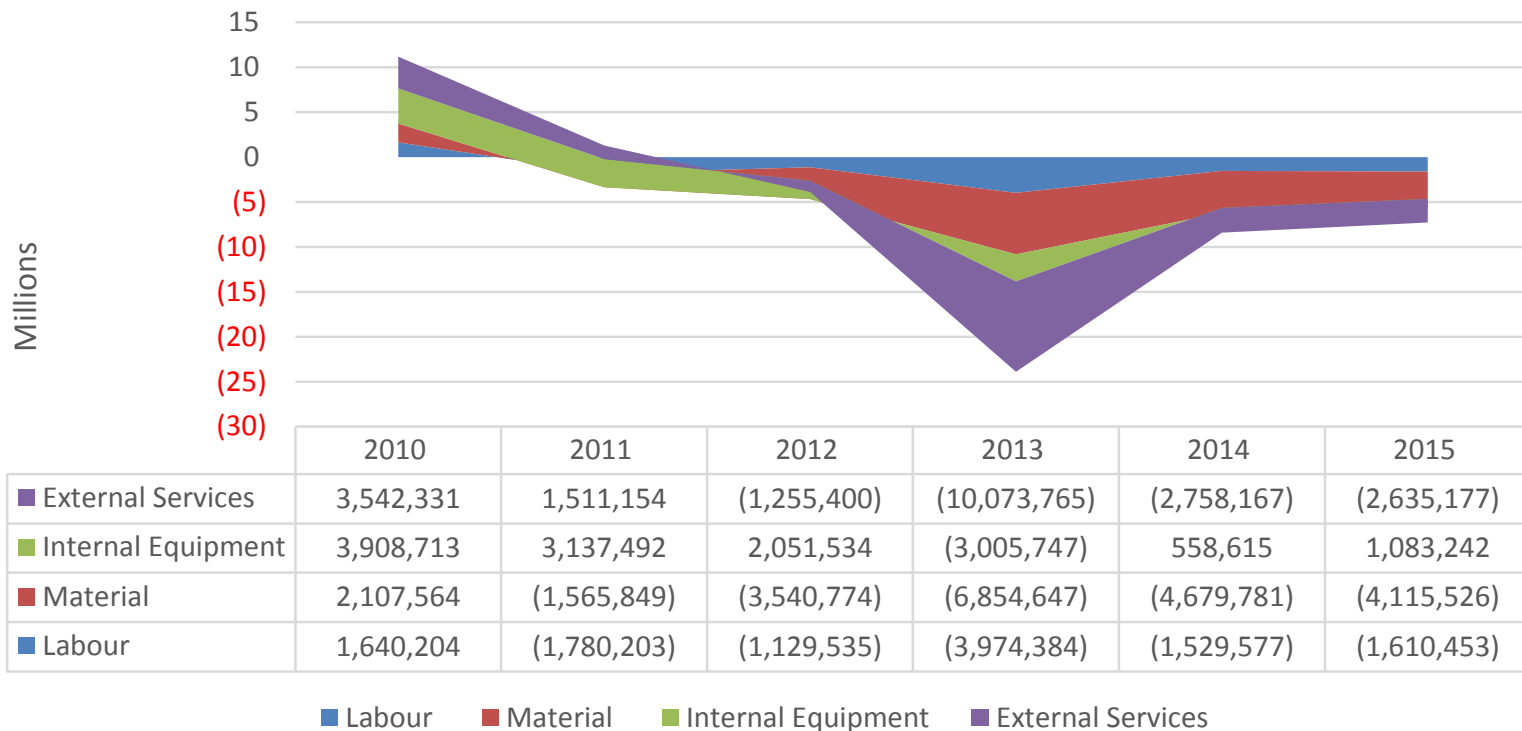
- The graph below shows the costs of Winter Control Maintenance Operations from 2010 through 2015. The biggest item is the cost of labour, followed by internal equipment, external services and then materials. Note that all expenditure categories increase in severe winters (2013), but the external services show the greatest volatility – increasing the most when weather is more demanding and decreasing the most when needs are less severe.



Costs of Winter Operations

- Expenditures have been over budget for the last four years. Materials costs (salt) are a large portion of the overage, while it makes up the lowest proportion of the overall budget. Overages for external services (predominantly contracted services) have also been significant, particularly in 2013.

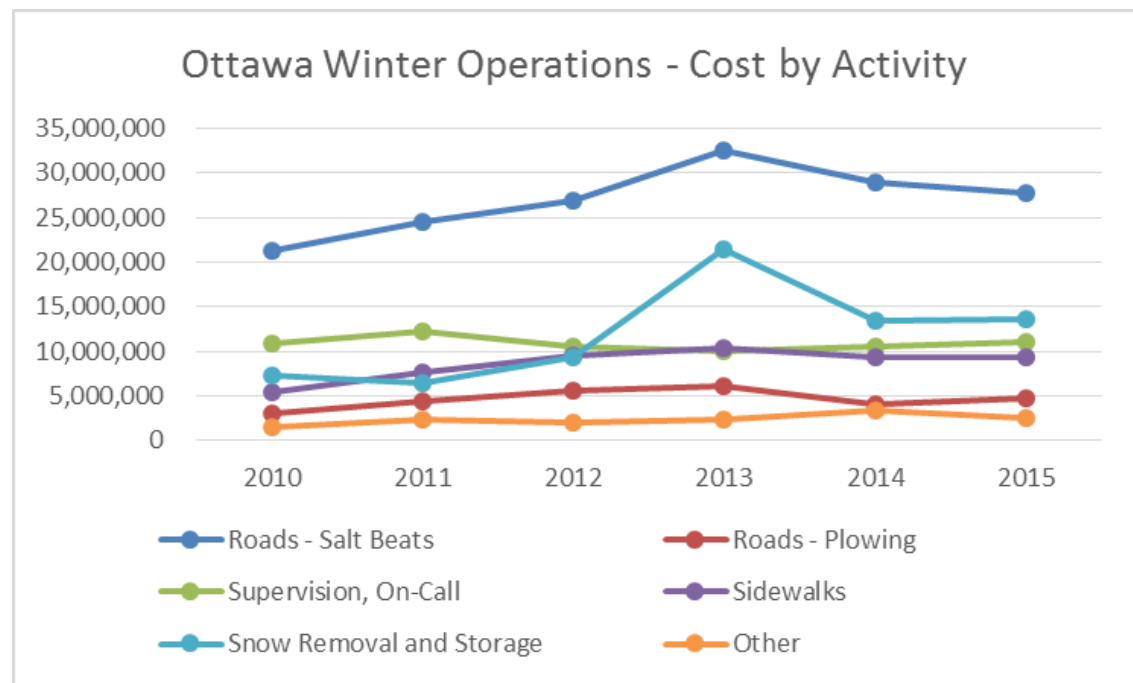
Winter Operations - Over/Under Budget



Costs of Winter Operations

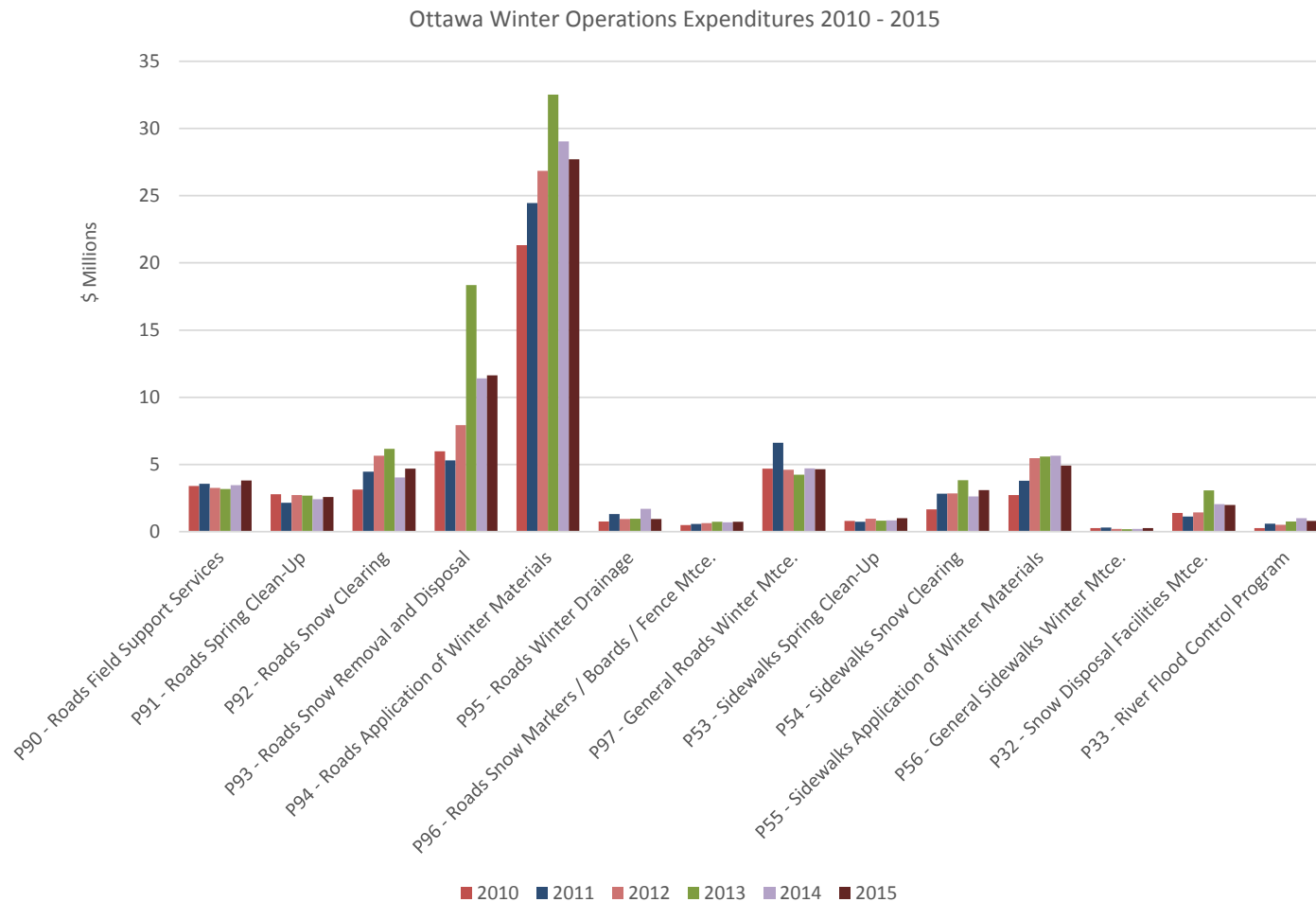
The table below shows the costs by major activity. The operation of the salt beats (including related plowing) on major streets is the most significant activity.

- The salt beats are run whenever there is any snow or wet roads and freezing or likely to be freezing conditions. When there is an accumulation of snow, it is plowed as well.
- The other activity that varies significantly by year is the snow removal. Much of this is conducted by contracted forces, one of the reasons contracting costs also vary with the weather.
- The “Roads-Other” category includes supervision and the costs of standby and on-call forces.
- The cost of sidewalk maintenance has been growing with the growth in sidewalks and service level expectations.
- The cost of residential plowing (Roads – Plowing in the graph) varies with the weather, but is relatively modest.



Costs of Winter Operations

- This chart looks at the activities in finer detail. Roads application of winter materials (salting) is the largest cost component, followed by snow removal and disposal. These program areas both vary significantly year to year.



Costs of Winter Operations

- Actual expenditures have increased more in some areas than others. Sidewalk maintenance (clearing and materials) and snow removal/disposal have increased significantly from 2010 levels (2010 was a relatively low cost year, so the average increase of 38.6% reflects different weather conditions).

Year-over-Year Percent Change in Expenditures						2015 change over 2010
	2011	2012	2013	2014	2015	
P90 - Roads Field Support Services	5.2%	-8.6%	-2.7%	10.5%	8.4%	12.0%
P91 - Roads Spring Clean-Up	-22.8%	26.4%	-1.5%	-9.6%	6.2%	-7.8%
P92 - Roads Snow Clearing	42.6%	26.7%	8.9%	-34.5%	16.2%	40.8%
P93 - Roads Snow Removal and Disposal	-11.4%	49.4%	131.6%	-37.8%	1.9%	94.4%
P94 - Roads Application of Winter Materials	14.7%	9.8%	21.2%	-10.8%	-4.6%	30.0%
P95 - Roads Winter Drainage	75.0%	-27.6%	1.6%	76.7%	-44.8%	25.6%
P96 - Roads Snow Markers / Boards / Fence Mtce.	14.8%	10.9%	19.3%	-5.6%	4.1%	49.4%
P97 - General Roads Winter Mtce.	41.0%	-30.2%	-8.0%	11.1%	-1.5%	-0.8%
P53 - Sidewalks Spring Clean-Up	-7.3%	30.7%	-15.4%	3.0%	19.3%	26.1%
P54 - Sidewalks Snow Clearing	70.0%	0.1%	35.0%	-31.4%	18.1%	86.0%
P55 - Sidewalks Application of Winter Materials	38.7%	44.2%	2.5%	1.1%	-13.1%	80.0%
P56 - General Sidewalks Winter Mtce.	16.5%	-34.1%	-5.2%	8.1%	27.5%	0.2%
P32 - Snow Disposal Facilities Mtce.	-19.2%	28.9%	112.7%	-33.5%	-2.4%	43.8%
Mtce. Operations Total Change in Expenditure	16.4%	10.8%	29.8%	-15.9%	-1.6%	38.6%

Costs of Winter Operations

- While the budget in total is low and has not grown with inflation or growth in the road network (in 2015 only 93% of expenditures), it is also misaligned by category.
- The snow clearing budget (largely plowing of residentials) is much higher than the costs, but the budget has gone up more than the total budget in the last five years.
- Sidewalk plowing also shows a higher budget than it needs, while sidewalk salting (application of materials) costs much more than was budgeted in 2015. This has been corrected in the 2016 budget.
- The support services and “general” costs tend to be under budgeted.

2015 Change over 2010	2015 Budget / Actual	% change in Budget	% Change in Expenditure
P90 - Roads Field Support Services	76%	37%	12%
P91 - Roads Spring Clean-Up	92%	-3%	-8%
P92 - Roads Snow Clearing	167%	11%	50%
P93 - Roads Snow Removal and Disposal	80%	11%	94%
P94 - Roads Application of Winter Materials	90%	-4%	30%
P95 - Roads Winter Drainage	98%	-21%	26%
P96 - Roads Snow Markers / Boards / Fence Mtce.	98%	10%	49%
P97 - General Roads Winter Mtce.	78%	13%	-1%
P53 - Sidewalks Spring Clean-Up	84%	13%	26%
P54 - Sidewalks Snow Clearing	157%	8%	86%
P55 - Sidewalks Application of Winter Materials	61%	24%	80%
P56 - General Sidewalks Winter Mtce.	72%	19%	0%
P32 - Snow Disposal Facilities Mtce.	105%	31%	44%
Total Change	93%	5%	39%

Costs of Winter Maintenance – Summary observations

- Winter maintenance activities have exceeded the budget for the last four years.
- Budget amounts have increased a total of 5% over the last five years while inflation and growth in the road and sidewalk networks would suggest a 18% increase would be required without improvements in efficiency or reductions in service levels.
- There have not been any substantial changes in operations that would create efficiencies and the continuing pressure is to improve service levels and provide services on the new facilities.
- The budget was therefore about \$7.6M short in 2015 (see page 28). The 2016 budget restores \$4.5M of this funding, with an allowance for inflation, but does assume new efficiencies of \$2.5M. Similar changes planned for the 2017 and 2018 budgets will add another \$4M to the budget to adjust for past deficiencies, but will also require another \$5.4M in savings. Thus improvements in efficiency or changes in service level will need to achieve about \$7M to \$8M in reductions in order to avoid further budget adjustments.
- The largest expenditures relate to the application of winter materials on roads – basically the salting and plowing of major roads.
- Winter maintenance activities on sidewalks and snow removal operations have significantly grown in expenditure compared to what was being spent five years ago.
- Colder temperatures and more snow on the ground contributed to increased costs in some particular years. The colder temperatures contradict the expected effects of global warming, and have occurred over a short period (three years) in terms of climate change. It is premature to conclude that there is any “new normal” for weather that will influence winter maintenance costs over the long term. For example, Environment Canada uses a 30 year average to define climactic conditions.



cutting through complexity

Benchmarking

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Benchmarking

A number of cities were identified as comparators for the purposes of benchmarking

- While none of the cities is “the same” as Ottawa, they each have some similar characteristics.
- Laval did not respond despite repeated requests for information.

City	Average Snow	Days of Snow ¹	Population	Rationale/Comments
Ottawa	223	63	883,391	Baseline
London	194	60	366,151	<ul style="list-style-type: none">▪ Similar average snow amount and days of snow▪ All urban area types▪ Target information on salt management
Edmonton	123	52	812,201	<ul style="list-style-type: none">▪ Similar population size▪ Colder and less snow but has comparable service levels
Winnipeg	114	53	663,617	<ul style="list-style-type: none">▪ Comparable costs for winter maintenance (OMBI three year average).▪ Wide range of contracting approaches
Laval	209	59	401,553	<ul style="list-style-type: none">▪ Similar average snow amount and days of snow▪ Target information on salt management
Quebec City	303	70	516,622	<ul style="list-style-type: none">▪ More snow and snow days
Gatineau	187	51	265,349	<ul style="list-style-type: none">▪ Smaller average snow amounts than Ottawa airport▪ Comparable weather patterns

^[1] <http://www.currentresults.com/Weather/Canada/Cities/snowfall-annual-average.php>

^[2] http://en.wikipedia.org/wiki/List_of_the_100_largest_municipalities_in_Canada_by_population, based on 2011 census

Financial Benchmarking

- The table at right shows the total expenditures for winter maintenance in a number of Canadian cities, while the table below compares the budget levels. The Ottawa data is for 2015 when spending was considerably above budget.

Actual Expenditures				Adjusted for snowfall	
City	Actual spend	Cost/capita	Cost/lane km	Cost/capita	Cost/lane km
Ottawa	\$ 68,768,689.00	\$ 77.85	\$ 5,519.60	\$ 0.35	\$ 24.75
Gatineau	\$ 15,414,000.00	\$ 58.09	\$ 5,322.15	\$ 0.29	\$ 27.02
London	\$ 15,400,000.00	\$ 42.06	\$ 4,426.30	\$ 0.22	\$ 22.82
Edmonton	\$ 64,798,629.00	\$ 79.78	\$ 6,118.27	\$ 0.65	\$ 49.74
Winnipeg	\$ 46,880,650.45	\$ 70.64	\$ 5,869.62	\$ 0.62	\$ 51.49
Quebec City	\$ 60,000,000.00	\$ 116.14	\$ 9,133.39	\$ 0.38	\$ 30.14
Calgary	\$ 34,240,945.21	\$ 31.22	\$ 2,445.78	\$ 0.24	\$ 18.99

*Ottawa actual numbers from 2015, Gatineau actual numbers from 2014, London actual numbers from 2014, Edmonton actual numbers from 2015, Winnipeg actual numbers from 2013, Quebec City actual numbers from 2013, Calgary actual numbers from 2009

- The data for cost per capita and cost/lane km shows Ottawa and Quebec, which receive the most snow, as being higher per capita than most, but Ottawa is similar in cost/lane km.
- The columns at right show adjusted figures to consider the amount of snow received by each City (costs are divided by the average cm of snowfall). On this basis Ottawa is on the low end, but Calgary and London are the lowest cost providers.,
- Calgary actually is the lowest cost provider, but this reflects a very low level of service, leaving landowners to clear sidewalks and relying on chinooks in residential areas.
- London is lower cost even allowing for snowfall. They do little snow removal (average temperatures are warmer), and have lower service levels.
- Quebec costs are higher than Ottawa's even when the costs are adjusted for snowfall.

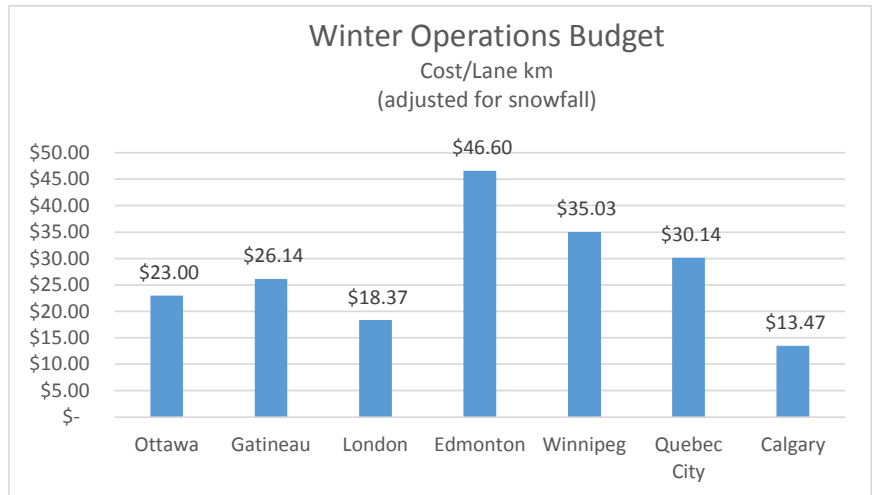
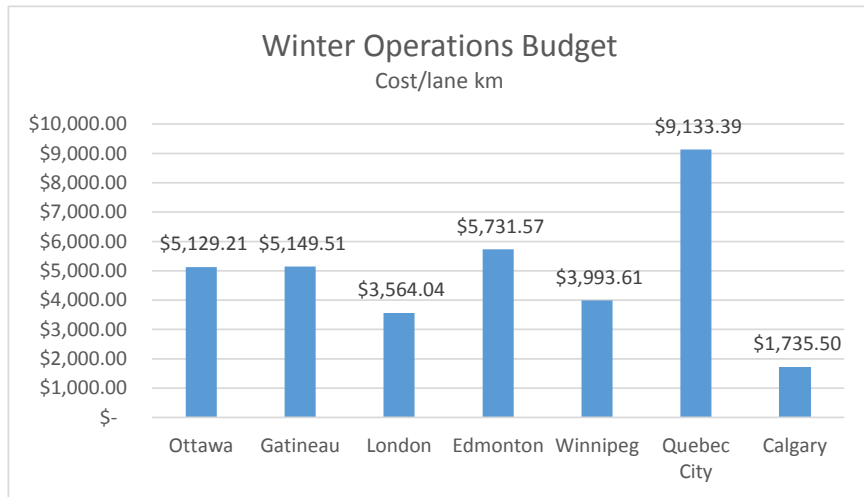
Budget				Adjusted for snowfall	
City	Snow budget	Cost/capita	Cost/lane km	Cost/capita	Cost/lane km
Ottawa	\$ 63,904,832	\$ 72.34	\$ 5,129.21	\$ 0.32	\$ 23.00
Gatineau	\$ 14,914,000	\$ 56.21	\$ 5,149.51	\$ 0.29	\$ 26.14
London	\$ 12,400,000	\$ 33.87	\$ 3,564.04	\$ 0.17	\$ 18.37
Edmonton	\$ 60,703,103	\$ 74.74	\$ 5,731.57	\$ 0.61	\$ 46.60
Winnipeg	\$ 31,897,000	\$ 48.07	\$ 3,993.61	\$ 0.42	\$ 35.03
Quebec City	\$ 60,000,000	\$ 116.14	\$ 9,133.39	\$ 0.38	\$ 30.14
Calgary	\$ 24,297,007	\$ 22.15	\$ 1,735.50	\$ 0.17	\$ 13.47

*Ottawa budget numbers from 2015, Gatineau budget numbers from 2014, London budget numbers from 2014, Edmonton budget numbers from 2015, Winnipeg Budget numbers from 2014, Quebec City budget numbers from 2013, Calgary budget numbers from 2009

Financial Benchmarking – Based on Budget

Ottawa's budgeted costs for winter operations are in the mid-range based on budget, but below the western cities when costs are adjusted for snowfall amounts.

Calgary is an outlier as it does not clear sidewalks or residential areas, relying on chinooks.



*Ottawa budget numbers from 2015, London and Gatineau budget numbers from 2014, Edmonton budget numbers from 2015, Winnipeg Budget numbers from 2014, Quebec City budget numbers from 2013, Calgary budget numbers from 2009, adjusted for inflation.

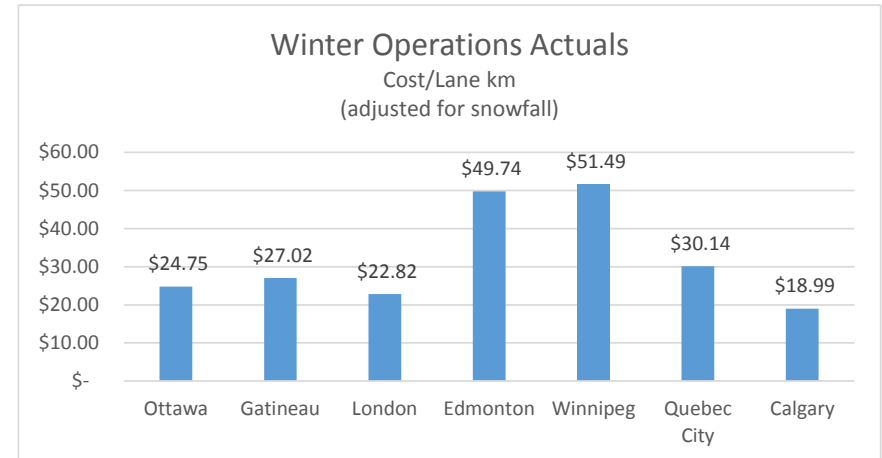
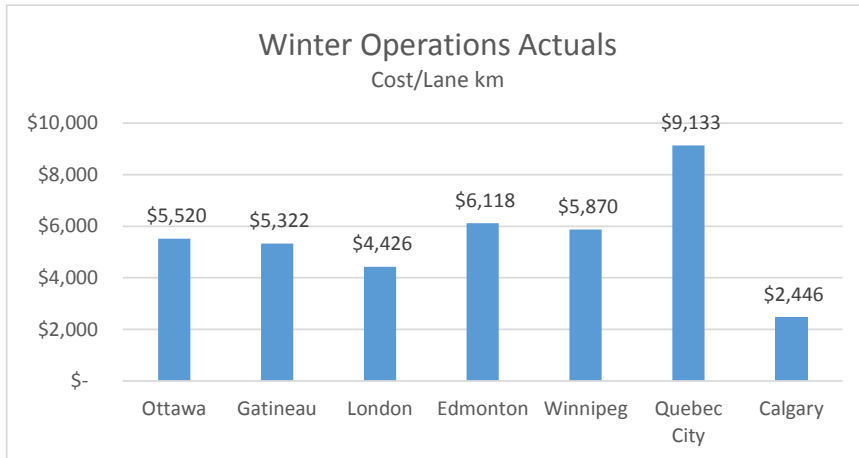
*All budget numbers have been adjusted for inflation to 2014 using the Bank of Canada inflation rates.

Financial Benchmarking – Actual Expenditures

The situation is similar when looking at actual expenditures.

However some differences exist:

- Calgary has very low service levels and the benefit of chinooks.
- London does very little snow removal.
- But Quebec City does good service levels, but is more expensive, even when adjusted for snowfall



*Ottawa actual numbers from 2015, London and Gatineau actual numbers from 2014, Edmonton actual numbers from 2015, Winnipeg actual numbers from 2014, Quebec City actual numbers from 2013, Calgary actual numbers from 2009 adjusted for inflation

*All actual numbers have been adjusted for inflation to 2014 using the Bank of Canada inflation rates.

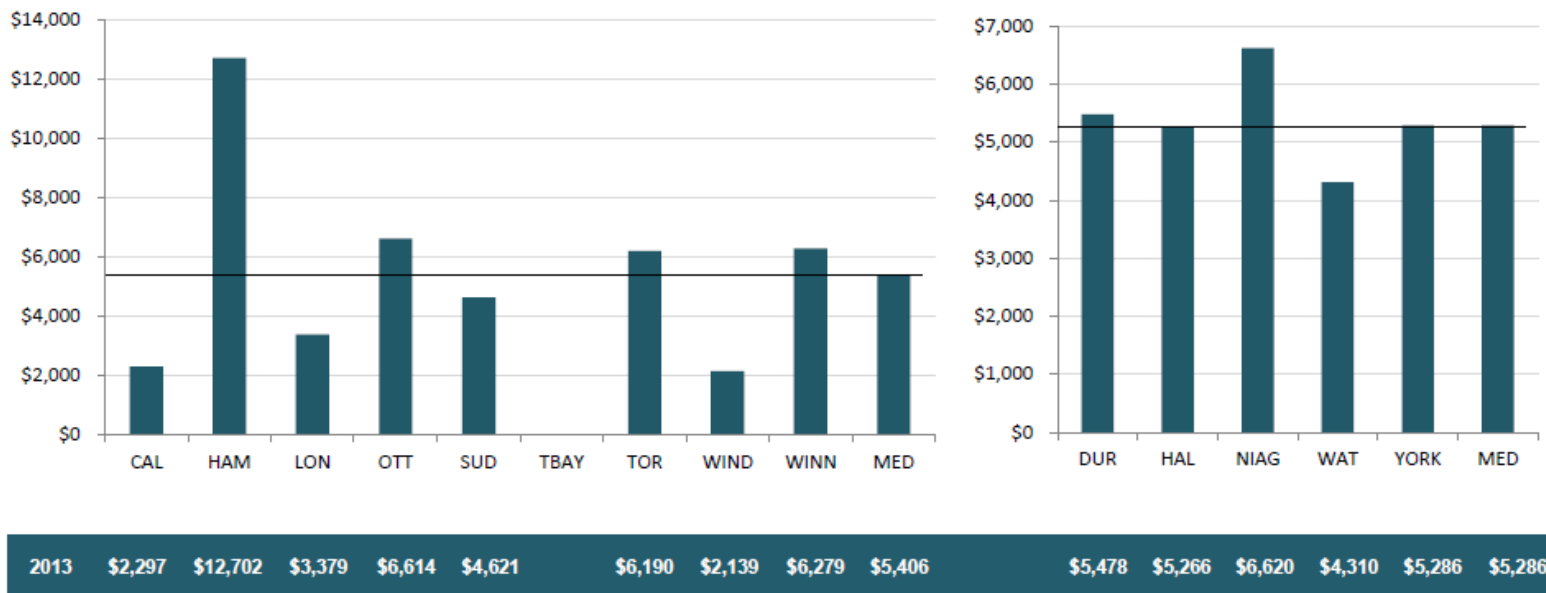
Financial Benchmarking

The Ontario Benchmark Initiative (OMBI) does provide some comparative data related to winter roads maintenance.

- The excerpt below is based on 2013 data, and shows Ottawa is more expensive than London, but comparable to Toronto and Winnipeg, despite the higher snowfall levels in Ottawa. Note that OMBI uses comparable data for all cities, but does not use the full winter maintenance budget as discussed in this report.

How much does it cost to maintain our roads in winter?

Fig 28.4 OMBI Total Costs for Winter Maintenance of Roadways per Lane Km Maintained (includes amortization)



Source: ROAD309T (Efficiency)

Financial Benchmarking – Summary Observations

The service levels and the various practices followed in other jurisdictions in delivering their services are reported in the relevant sections that follow.



cutting through complexity

Current Service Level Standards

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Levels of Service

Policy Framework

The Levels of Service for Winter Maintenance are set out in the Maintenance Quality Standards (MQS), a policy document formally approved by Council in 2003. The MQS is summarized in this section.

- The MQS indicate the City will perform winter maintenance on all City roads, including adjacent shoulders, bicycle lanes where designated as City cycling routes and sidewalks, pathways, bus stops and pedestrian malls designated for winter usage.
- The MQS designates roads and sidewalks by primary classification that weights three variables (functional classification, speed and traffic volume) to prioritize delivery of maintenance. Further classification is used to define a secondary maintenance class to identify specially designated areas (primary employment centres, cycling routes, steep grades/curves) and essential service areas (hospitals, fire and police stations).
- The Province of Ontario has defined Minimum Maintenance Standards (MMS) that municipalities must meet if they wish a defence against claims (slippery roads, sidewalk slip and falls). The MQS exceeds these standards as shown on the next page.

Levels of Service - Roads

MQS Table 103.01.01 Snow and Ice Control on Roads

The snow and ice control standards for roads are identified in the MQS (and provincial MMS) as:

Road Maintenance Class (See next page for details on A, B, C secondary classes)		Road Type	MQS Minimum Depth of Snow Accumulation for Deployment of Resources (Depth as per MMS)	MQS Time to Clear Snow Accumulation From the End of Snow Accumulation or Time to Treat Icy Conditions	MMS		Treatment Standard		
					Time to Clear Snow Accumulation From the End of Snow Accumulation	Time to Treat Icy Conditions	Rare	Centre Rare	Snow Parked
1	A, B	Transitway / Hwy 174	As accumulation begins (2.5-8 cm depending on class)	2 h	4 h	3 h	√		
2	A, B	Most Arterials		3 h	6 h	3 h	√		
3	A, B	Most Major Collectors		4 h	12 h	8 h	√		
4	A	Most Minor Collectors	5 cm (8 cm)	6 h	16 h	12 h	√		
	B							√	
	C (Gravel)								√
5	A (Paved), C (Gravel)	Residential Roads and Lanes	7 cm (10 cm)	10 h	24 h	16 h			√
	B (Lanes)		10 cm (not defined)	16 h	Not defined	not defined			√

*MMS refers to Ontario Regulation 239/02, Minimum Maintenance Standards for Municipal Highways. Definitions of the Road Maintenance Classes A, B and C are provided in Appendix A.

Levels of Service - Roads

Maintenance Quality Standards for Roads

Table 101.01.01 – Road Maintenance Classification

Primary Class		Secondary Class		
		A	B	C
1	Highest Priority Roads	Freeways (4-lane section of 174)	Transitway	N/A
2	Arterials	Roads within Special Designated Areas, or with Essential Services, Schools, Transit, Steep Grades, or with designated City cycling route, NCC Parkways	All other paved Class 2 roads	N/A
3	Major Collectors	Roads within Special Designated Areas, or with Essential Services, Schools, Transit, Steep Grades, or with designated City cycling route	All other paved Class 3 roads	N/A
4	Minor Collectors	Roads within Special Designated Areas, or with Essential Services, Schools, Transit, Steep Grades, or with designated City cycling route	All other paved Class 4 roads	Gravel roads
5	Residential Roads and Lanes	Residential and Subdivision Roads	Lanes	Gravel roads

Special Designated Areas are:
 - Downtown business district, ByWard Market, Rockliffe Park Heritage district, primary employment centres, tourism areas

Essential Services are:
 - Hospitals, Fire Stations, Police Stations, Ambulance Stations

Levels of Service - Sidewalks and Pathways

MQS Table 103.02.01 Snow and Ice Control on Sidewalks and Pathways

The snow and ice control standards for sidewalks and pathways are identified in the MQS as:

Sidewalk/ Pathway Maintenance Classification		Minimum Depth of Snow Accumulation for Deployment of Resources	Time to Clear Snow Accumulation From the End of Snow Accumulation or Time to Treat Icy Conditions	Treatment Standard	
				Bare Surface	Snow Packed
1	<ul style="list-style-type: none"> Downtown business district ByWard Market large employment centres special tourism areas 	2.5 cm	4 h	√	
2	<ul style="list-style-type: none"> downtown/urban residential neighbourhoods where sidewalks are only safe place to walk sidewalks in Villages pathways that serve as main community links or to access transit services sidewalks along roads with transit service, emergency facilities, public facilities or retail/commercial frontages pathways designated as part of City cycling routes 	5 cm	12 h	Sidewalks directly adjacent to arterial roads	All other locations
3	<ul style="list-style-type: none"> sidewalks along rural and suburban collector and residential roads paved pathways in rural and suburban neighbourhoods (pathways that are winter maintained) 	5 cm	16 h		√
4	<ul style="list-style-type: none"> unpaved pathways and trails paved pathways that are not winter maintained 	Not winter maintained			

Levels of Service – Comparison to MMS

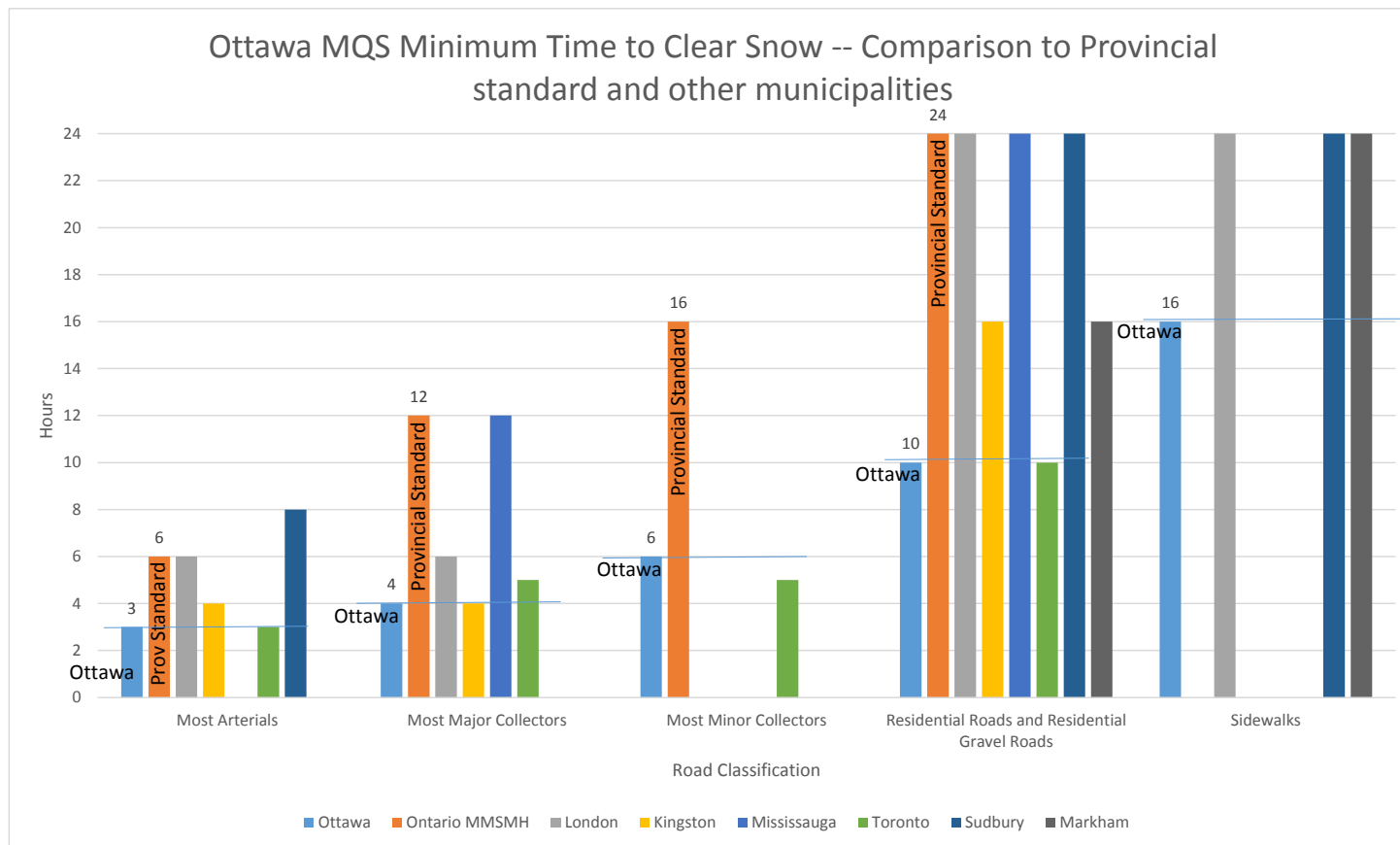
- Ottawa's Winter Maintenance Quality Standards (MQS) exceed the minimum standards set by the Province, both by starting activities earlier and completing them quicker.
- Service levels for the time to treat icy conditions (applying material to the roadway) is in alignment with the provincial standards for Class 1 and Class 2 roads at two and three hours respectively (MMS is three hours for both).
- However, for Classes 3-5, Ottawa's time to treat icy conditions is much less than specified by the province:

Road	Ottawa MQS (Hours)	Provincial MMS (Hours)	
		Ice Control	Plowing
Class 2	3	3	6
Class 3	4	8	12
Class 4	6	12	16
Class 5	10	16	24

- Ottawa MQS sets the same time frame for completing snow plowing after snow fall stops as it does for treating icy conditions. The province allows much longer to plow snow than it allows for treating icy conditions, so there is a very large gap between plow standards set by the province and those set by the City.

Levels of Service – Other Cities

Most cities in Ontario are closer to the provincial standards, particularly for the time required to complete a plow run after a snow fall ends, particularly for residential streets and sidewalks. Toronto is the only city studied that has comparable times, while London, Kingston, Mississauga, Sudbury and Markham all have lower standards than Ottawa.



Levels of Service – external comparables

City	Ottawa service level (by comparison)	Description
Quebec City	comparable	The minimum depth for clearance of priority roadways is 5cm, but starts salting as soon as event starts. Residential roadways in Quebec are maintained at a clearance of 10cm, Standards for time to clear appear to be tighter for Quebec, with standards for road clearance of four hours for precipitation of up to 14.9cm, six hours for up to 21.9cm, and eight hours for more than 22cm.
Gatineau	comparable	The City of Gatineau begins snow clearing and de-icing operations as soon as there is any precipitation on the main arteries and collectors. Gatineau side streets, are cleared once five cm have accumulated on the ground. Once precipitation has ended, Gatineau allows 16 hours to complete all snow clearing if less than 25 cm have fallen.
London	Exceeds	The City of London allows for clearance of all priority roads to be completed within eight hours after the end of a snowfall event, with other city streets to be cleared within 24 hours. Sidewalks plowed after eight cm, once roads are completed
Winnipeg	Exceeds	The City of Winnipeg allows for 36 hours for the clearing of regional roads. Minor collectors in Winnipeg are set to be cleared within 36 hours. Residential roadways in the City of Winnipeg are to be cleared within 120 hours.
Edmonton	Exceeds	The City of Edmonton allows 36 hours for the clearing of arterials, major collectors are allowed 48 hours. Other Industrial and Residential roads in Edmonton are provided five days for clearance. Edmonton's times are for plowing after end of snowfall with sanding occurring more frequently.
Calgary	Exceeds	The City of Calgary operates what they call "The Seven Day Plan." The City of Calgary allows for 24 hours for the clearing of arterials (Day 1). The major collectors are allowed 48 hours to be cleared (Day 2) in Calgary. Other Industrial and Residential roads in Calgary are provided 96 hours (Day 3), or in excess of 96 hours for clearance.

Levels of Service – Summary Observations

Cities with lower snowfall levels (Calgary, Edmonton, Winnipeg) tend to have lower service levels than Ottawa

Most Ontario cities also have lower service standards than Ottawa, generally closer to the provincial MMS standards

- Toronto's standards for roads are closest to those in Ottawa, but it does not clear all sidewalks as Ottawa does.

Quebec and Gatineau are close to Ottawa in standards, but with specific differences

- Quebec does not start to plow residential streets until there are 10 cm of snow (7 in Ottawa) and the service levels vary with the amount of snowfall – larger snowfalls take longer to clear.
- Gatineau gives 16 hours to complete plowing (10 in Ottawa) and also indicates larger snowfalls (> 25 cm) will take longer to clear.



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Deployment Approach

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Deployment Approach

Ottawa staff is scheduled in two shifts, five days a week:

- The night shift has staff for “salt beats” (covering Class 1 to 4 roads) and for Priority 1 sidewalks.
- The day shift is larger, with staff for all salt beats and all plow beats (generally covering residential streets) and for Priority 2 and 3 sidewalks.

When weather events are anticipated:

- Management will review weather forecasts to determine when to mobilize resources, depending upon the anticipated nature, severity and timing of the event. The result may be to call in one of the shifts early, or to keep a shift late, or to call staff in on the weekends.

When slippery conditions begin (start of snow or dropping temperatures on wet roads) or are imminently anticipated:

- The City deploys “combos” (mostly tandem salt trucks with front mounted blades and wings) on the salt beats to spread salt on priority roads (Class 1, 2, 3 & 4) and depending upon the nature of the event, may also salt priority sidewalks.

Deployment Approach

When snowfall begins to accumulate:

- The combos continue their routes, and lower their plows to move snow accumulations.
- Sidewalk plows are deployed on Class 1 sidewalks as snow accumulations begin.

When snowfall exceeds five cm:

- Class 2 and Class 3 sidewalk plows are deployed to plow, and depending upon conditions, to salt or sand (note that Class 3 sidewalks are generally only plowed by the day shift).

When snowfall exceeds seven cm:

- A full “residential plow run” is conducted. Class 5 residential streets are plowed, with abrasives applied as required. Depending upon the timeframe of the snowfall, the day shift may be called in early to start the plow run before the morning rush hour. Operations continue on the Class 1-4 roads and sidewalks.
- If snowfall exceeds 10 cm the maintained laneways are addressed.

Deployment Approach

When snowfall stops:

- All routes have a complete plow run conducted, with salt generally deployed on priority roads. Operations continue until the prescribed condition (bare, centre bare or snow packed depending upon the class of roadway) is achieved.
- Bus stops and crosswalk locations are cleared, cul-de-sacs are cleaned up with loaders (generally tidying the pile in the middle of the turning circle).
- Snow removal needs are identified and snow removal conducted, by priority of roadway. Snow removal will continue until all needs are addressed, or a new event occurs.

After the event:

- Some staff will continue on snow removal and cleaning up areas where parked cars, etc. have interfered with plowing for some time.
- As they complete their snow and ice control activities, staff are reassigned to other work, including pothole patching, litter collection and management and other road maintenance activities as required.

Beats

Activities are arranged in “beats”, generally based on the volume of activity that can be managed within the target timeframe.

- “Salt Beats” cover the priority roads (Class 1, 2, 3, and 4). They are typically maintained with salt to achieve bare pavement conditions in response to snow and freezing rain events.
- “Plow Beats” primarily cover residential streets, but also include some “echelon” beats where at least two vehicles are required to cover multiple lanes (see March Road). They are typically maintained by graders, loaders or plow trucks.

Typical Salt Beats



Typical Plow Beats



(Different colours represent different beats)

Beats

- Sidewalk Beats cover all sidewalks and pathways that are winter maintained.
- Bus Stops are not organized into beats, but all stops in each zone are identified, along with all cul-de-sacs. Bus stops are cleared after snowfall once the sidewalks and roads have been plowed into the bus stop waiting areas. Cul-de-sacs require particular attention as it's often required to pile the snow in the middle of the court when there isn't room to distribute it on the City boulevards. Both operations are carried out by loaders.

Typical Sidewalk Beats



Bus Stops and Cul-de-sacs

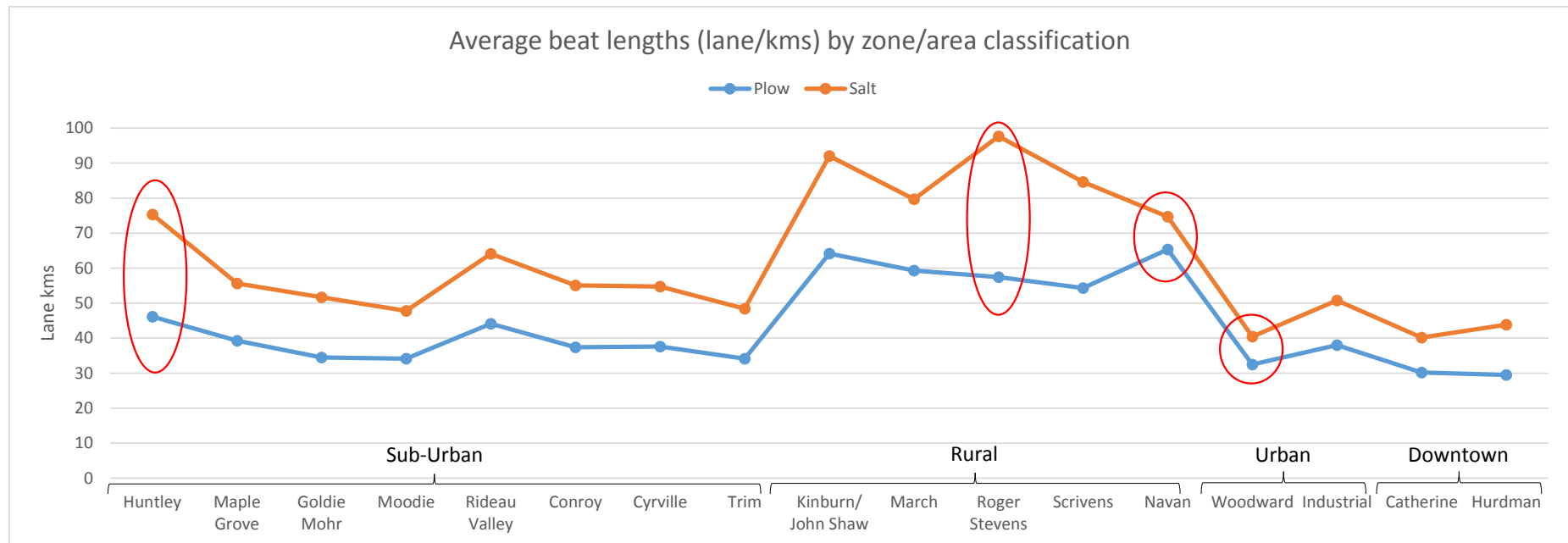


(Bus stops are triangles, cul-de-sacs are circles)

Beats

The chart below shows the average length of salt and plow beats in each zone.

- Salt beats are generally longer as they tend to be on higher speed roads and do not require the slower equipment (loaders and graders) used on many residential plow beats.
- The zones are grouped based on the type of area they cover (e.g., urban vs. rural) as different conditions impact speeds and hence the beat length that can be covered in a given period of time. Zones where the ratio between plow and salt beats is higher or lower than similar zones are circled.
- Some zones (e.g. Rideau Valley) include a mix of areas so the classifications are approximate, but the need for some of the differences in length is not obvious.



West	Classification	Ratio Plow/Salt
Huntley	Suburban	1.6
Kinburn/John Shaw	Rural	1.4
Maple Grove	Suburban	1.4
March	Rural	1.3
Goldie Mohr	Suburban	1.5
Core		
Catherine	Downtown	1.3
Hurdman	Downtown	1.5
Woodward	Urban	1.2
South		
Moodie	Suburban	1.4
Rideau Valley	Suburban	1.5
Roger Stevens	Rural	1.7
Scrivens	Rural	1.6
East		
Conroy	Suburban	1.5
Cyrville	Suburban	1.5
Industrial	Urban	1.3
Navan	Rural	1.1
Trim	Suburban	1.4

Ratio of Salt beats to Plow Beats:

- The average salt beat is 1.4 times longer than a plow beat.
- Urban and downtown salt routes are typically the shortest, followed by suburban routes, and rural routes are the longest.
- Anomalies are noted below:
 - East Area: Navan zone has five plow beats and seven salt beats with the average length of beats being almost equal.
 - South Area: Roger Stevens zone has five plow and four salt beats with the salt beats significantly longer than the plow beats.
 - West area: Huntley zone has nine plow and seven salt beats with the highest ratio in a suburban area.
 - Core area: Woodward zone has 22 plow and nine salt beats with the average length of beats being almost equal.

Beats and the Levels of Service

- The same “salt beats” are used to plow all Class 2 to 4 roads (Class 5 – residential streets are generally on different beats although some with hills or other conditions requiring salting are included in the salt beats).
 - This means all Class 2, 3 and 4 roads are plowed in under three hours – the prescribed time for Class 2 roads. The Council policy requires Class 2 roads be plowed (or salted) in three hours, but indicates Class 3 roads should be completed in four hours, and Class 4 roads in six hours. Thus the Class 4 roads are receiving twice the level of service approved by Council.
- The same beats are used for both ice control (salting) and snow plowing.
 - The beat is designed to allow plowing to occur in less than three hours.
 - Salting (ice control) can generally be done twice as fast as vehicles can salt two lanes at a time. This means that the actual time to treat icy conditions on all Class 2-4 roads is less than 1.5 hours; half the time prescribed by Council for Class 2 roads and one-quarter of the time prescribed for Class 4 roads.

Deployment Approach – Summary observations

- The approach to deploying winter maintenance activities is consistent across areas, with standardized work shifts, coordinated deployment procedures across zones, and formal communication activities taken to inform the public about snow operations.
- Beats are adjusted annually to incorporate new roads, but there are some anomalies in the average beat lengths and the average ratio of salt beats to plow beats which should be addressed in the next reconfiguration exercise.
- Because of the approach taken to design of the beats, the actual services provided are at a higher level of service than those set out in MQS, particularly on Class 3 and Class 4 roads. Options to address this are discussed in the next section.



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Beat and Service Level Adjustments

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Beat and Service Level Adjustments

- A variety of reductions in service level could be considered, based on comparisons to other municipalities, to provincial MMS requirements – or by reducing the actual service levels to something closer to those approved by Council. No service reductions for sidewalks were considered.
- The current beat configuration requires 127 salt beats to handle events with less than seven cm, and 322 total beats (127 salt beats and 195 plow beats) to handle seven cm or more, where all roads, including the Class 5 residentials, are plowed.
- To test the impact of service level changes, the average cost of each of the beats was determined, using 2014 and 2015 data.

Cost of Average Beats (Excluding Materials)					
2015	Budget	Actual	Beats	Budget/Beat	Actual/Beat
Salting	16,911,665	16,153,479	127	133,163	127,193
Plowing	7,802,232	4,657,662	195	40,011	23,885
Sidewalks	7,452,248	7,380,536	112	66,538	65,898
2014	Budget	Actual	Beats	Budget/Beat	Actual/Beat
Salting	16,475,455	16,978,190	127	129,728	133,687
Plowing	7,509,772	4,009,336	195	38,512	20,561
Sidewalks	7,197,918	7,591,783	112	64,267	67,784

Beat and Service Level Adjustments

Opportunity Modelling

- Then a model was built to test the impact of service level adjustments on the number of winter maintenance beats as follows:
 - The five major road maintenance classes were retained.
 - Class 1 – Transitway/Hwy 174 (excluded from analysis)
 - Class 2 – Arterials
 - Class 3 – Major Collectors
 - Class 4 - Minor Collectors
 - Class 5 -- Residential
- The number of lane kms of roads, by road Class (1,2,3,4,5) and road environment (urban, suburban, rural) was established.
- An average vehicle speed for salt beats and for plow beats was established for each road Class (2,3,4,5) and road environment (urban, suburban, rural).
- A deadheading factor was applied to each beat configuration, different for each activity (salt or plow) and road class. These were estimated and confirmed with experienced City staff. An adjustment for unproductive time (lunch, breaks) was applied to all beat configurations.
- The model parameters were adjusted to develop a “current state” for baseline comparative purposes that equals the actual number of beats in use today.
 - The analysis assumes current service levels are three hours for “salt” beats and 10 hours for Plow beats (residential).
- The alternative configurations were then tested to see the impact on the number of beats required.
- The results are high level and will require further detailed work to achieve precise results.
- The data for the model came from the City, and results were reviewed with and validated by department staff.
- Further details on the model are provided in Appendix C.

Beat Configuration Modeling – Financial Impact

Savings from reducing the number of beats were estimated based on the average cost of beats, reduced as follows:

- With salt beats costing about \$130,000 per year (excluding the salt), savings were estimated at only 65% of this amount, \$84,000 per beat reduced, to allow for potential diseconomies of scale and to be conservative until the underlying assumptions of the model are proven by conducting detailed beat designs.
- With plow beats costing approximately \$22,000 per year, savings were only estimated as 10% of this amount (\$2,200 per beat removed) both to reflect the factors noted above, and to reflect the fact taking longer to plow does not reduce the kms. to be traveled or time required to complete the work. Thus fewer plow beats would require fewer trucks, but essentially the same labour and operating costs. (This is different than the changes in salt beats which generally would reduce the frequency some roads are salted, thus reducing the labour time and equipment kms travelled).
- Note that this section only looks at cost savings by reducing the number of beats. Alternatives to reduce the cost of servicing the beats are considered in a later section.

Beat configuration modeling – Existing MQS

Alternative beat configurations were tested that achieve the Current Council Approved Maintenance Quality Standards (MQS), but eliminate some of the “over-servicing” that exists today.

- Beat Option 1 – Would split the existing salt beats which cover Class 2, 3 and 4 roads into two different types of beats:
 - One type of beat would only cover Class 2 roads, and do it in three hours (like today).
 - The second type of beat would cover Class 3 and 4 roads (and those Class 5 roads that qualify for salting based on hills, etc.) within the four hours prescribed for Class 3 roads in MQS – reducing the service on the Class 3 and 4 roads from three hours to four hours.
 - This approach could eliminate the need for 14 of the 116 salt beats (excluding the 11 Class 1 salt beats), with potential savings of \$1.2M.
- Beat Option 2 takes a similar approach, creating two types of salt beats:
 - One type of beat would cover Class 2 and 3 roads in three hours (like today).
 - The other type would cover all Class 4 roads (and Class 5 with hills, etc.) and would have a six hour level of service – consistent with the MQS, but lower than the current three hour service level.
 - This approach could eliminate 15 salt beats, with potential savings of \$1.3M.

Beat configuration modeling – Existing MQS

- Beat Option 3 would double the length of the salt beats so that salting could be achieved within three hours as per MQS requirements. At present the “salt beats” are also the plow beats used on the Class 2, 3 and 4 roads. They are planned so the beat can be plowed within three hours, as required by the MQS for Class 2 (arterial) roads. However salt trucks can and do salt two lanes at once. That means all roads on the salt beats are actually salted within 90 minutes (assuming beats can be plowed in three hours) – far below the MQS standard.
- Salting two lanes at a time would satisfy the requirement for about half of the annual events (freezing rain or light snow requiring salting but not plowing), but the current number of beats would still be needed when plowing is required.
- At present there are enough staff on both shifts to salt or plow all salt beats that are not contracted. Option 3 could be achieved by reducing the night shift so that it has enough salt trucks to salt all roads within three hours (half as many as are on shift now). The additional resources called in when plowing is required could be from the current day shift – called in early to supplement an overnight plow run – or could be contracted salt trucks that would only be called in when plowing is required (the “Rideau Valley approach”). With 106 salt truck operators now on the night shift (and 10 contractors called in when a salt beat run is required), the savings could be substantial. Reducing staffing by 53 positions on the night shift could reduce total staff costs by about \$2.65M (individual Special Heavy Equipment Operators (SHEO) earn between \$40K and \$60K over the winter), although some of that may be required to support plow runs, so a saving of at least \$1.3M to \$1.6M could be achieved.

Beat configuration modeling – Using MMS (lower service standards)

The impact of moving to the provincially mandated Minimum Maintenance Standards (MMS) was tested – using each of the different beat configurations discussed above.

The provincial MMS requires a substantially lower levels of service than the Council approved MQS. The table below shows the change in service level that would result from adopting the provincial MMS requirements. For example the time required to deal with icy conditions on Class 2 roads (arterials) would stay the same, but the time available to plow the arterials would double to six hours. The time to plow Class 5, residential streets would increase from 10 hours after the end of snowfall to 24 hours.

Time to clear/time to treat icy cond.	Class 2	Class 3	Class 4	Class 5
Current MQS	3	4	6	10
Provincial MMS time to treat	3	8	12	16
Provincial MMS time to clear	6	12	16	24

Beat configuration modeling – Using MMS

Findings:

- Without any change in the beat structure, there would be no reduction in salt beat requirements as all salt beats would be governed by the same three hour requirement. However the number of beats required for a plow run (including the salt beats) would go down from 313 to 152 – largely because of the extended time available to plow – particularly to plow residential streets. However the plow runs would be operating for up to 24 hours instead of the 10 hours today, so the savings would only be about \$350K. The \$350K does not include any savings associated with the disposal of surplus equipment.
- The option to break the Class 2 roads out from the 3,4 and 5 roads for salt runs would have a much bigger effect, reducing the salt beats from 118 to 71, which could save up to \$4M. Again service on the Class 2 roads would remain the same, but it would take twice as long on the Class 3 and 4 routes.
- The option to combine Class 2 and 3 roads and have separate beats for the Class 4 roads and for the Class 5 roads would not be as effective for salt beats (94 required, with a potential saving of \$2M).
- Either approach would reduce the total beat requirements for a plow run from 313 to just 128, with the incremental saving of \$350K.
- The savings from delaying deployment on residential streets outlined on page 73 would also be available from switching to MMS.

Some Issues:

- The savings from extending residential plow beats to 24 hours – taking 24 hours after snow stops falling to be completed - would be very modest, given the need to plow the same amount of road either way, but the change in level of service would be very noticeable.
- The potential savings on the salt beats of \$2M to \$4M (depending upon beat configuration) would result in much slower service in salting collector roads and in plowing arterials and collector roads. By comparison, Options 1, 2 and 3 would result in substantial savings while still meeting current MQS standards.

Beat configuration modeling – Using Longer Plow Runs

The provincial MMS requires a substantially lower level of service than the current practice. The table below shows two possible changes in service levels that leave the time for salting the same, but allow longer for plowing, as does the MMS. This can work well because trucks can generally travel faster when salting than they can when plowing – and therefore cover more road more quickly.

Option A would retain the MQS standard for Class 2 roads (arterials) – with three hour service, whether to salt or plow. These are the major roads that people use to get around the city. For Class 3 and 4 roads, the major collector roads, this approach would extend the completion time for plowing to six or eight hours. The plow run for Class 5 residential roads would increase from 10 hours to 12 hours – still within the potential for a one shift operation (with overtime).

Option B would just extend the time for a plow run on Class 2 roads from three hours to four hours, leaving service levels of the other street classes alone.

Time to clear/time to treat icy cond.	Class 2	Class 3	Class 4	Class 5
Current MQS	3	4	6	10
Option A – Modified time to plow	3	6	8	12
Option B – Modified time to plow	4	4	6	10

Beat configuration modeling – Using Longer Plow Runs

Findings:

- Salt beats are currently designed to be plowed in three hours, allowing salting in less than three hours due to the higher roads speeds. If there is no change in the beat structure, Option A would not change the number of salt beats, as they would still need to complete a plow run in three hours. However the number of beats required for a plow run would go down modestly from 313 to 304, giving a potential saving of \$20K.
- Option B would allow the elimination of 29 salt beats as the beats could be extended so they take four hours to do the beat while plowing, which would still allow them to complete the beat while salting in under three hours. This could produce a saving of at least \$2.4M.
- Under Option A, changing the beat structure would give the same savings for salt runs as are available with the current MQS standards. The option to combine Class 2 and 3 roads and have separate beats for the Class 4 roads and for the Class 5 roads would reduce the beat requirements for a plow run from 313 to 256, increasing the cost reduction to \$92K. If the Class 3 and 4 roads were combined and given six hours to plow instead of four hours it would require 22 fewer vehicles to conduct the plow runs.
- Option B would apply the same plowing frequency to Class 2 and 3 roads. If Class 4 roads were on a separate beat system with six hour plow runs, it would be possible to remove another 4 salt beats, increasing the saving to \$2.7M.

Note: These estimates are based on the assumption that the current salt beats can actually be completed, as planned, in the 3 hour Class 2 time frame, and may vary based on further review.

Other Level of Service Options

One other significant difference between Ottawa's snow plowing standards and the Provincial MMS standards relates to the depth of snow before snow clearing (plowing) begins on Class 5 (residential) roads. Ottawa's MQS indicates plowing should start when snow accumulation reaches seven cm, while the provincial standard – used by most other cities, is to start plowing at 10 cm. The weather data provided earlier* shows that there are an average of 8.5 events per year when there are seven cm of snow or more, while there are, on average, only five times per year when 10 cm or more falls.

Snow plowing has cost an average of \$4.7M per year over the last five years. The potential savings could therefore be as high as \$1.9M, although it would likely be less, for example if two seven cm events occurred in a row, resulting in a total of 14 cm, requiring a plow run. Achieving at least half this amount as savings (\$1M), however, would appear attainable. It is very likely few people would notice the difference. Snowfalls below 10 cm do not typically limit mobility, and residents typically do not travel long distances on a residential street. As long as repeated events totaling more than 10 cm are plowed, this change should not cause a significant problem.

*Environment Canada weather data, five year average

Other Level of Service Options

Many other cities with heavy snow loads (Gatineau, Quebec, St. John's, Edmonton) have different service levels for large storms than they do for “normal” storms. Ottawa does not distinguish between storms after 10 cm of snow falls (when a plow run is required) – and applies the same standards of service regardless of how much snow falls.

This was a concern Dec. 29, 2015 when a particularly large snowfall hit Ottawa, and the public expected it to be handled like any other storm – and correctly so as the same service standards apply. But from a practical point of view, the same resources cannot achieve the same results with a 25 cm snow storm (or the 50 cm storm in February) as they do with a 10 cm storm.

A 25 cm storm only comes to Ottawa once every two years on average. Setting realistic expectations for service levels for a 20 or 25 cm storm may help manage expectations. This would not result in a savings, just a better understanding of what can actually be achieved.

Beat and Service Level Adjustments - Summary

There are clear advantages to adjusting the approach to structuring salt beats within the current Council approved MQS service standards:

- From the modeling, the two approaches (class 2 alone or Class 2 and 3 together) seem to have similar benefits. An appropriate next step would be to take sample areas (urban, suburban and rural) and develop actual beats with the two approaches to determine which is actually more effective in each type of area.
- The concept of longer salt beats, divisible when plowing is required, should be tested in sample areas.

A change in the MQS service level to start residential plow runs at 10 cm instead of seven cm would reduce costs without significant impact on visible services.

Consider setting a new service level for large storms to manage expectations realistically.

The financial implications of these approaches are outlined on the page that follows, along with the potential savings from other service level adjustments that are not recommended at this time.

Beat and Service Level Adjustments - Summary

While keeping the current Council-approved Maintenance Quality Standards:

- Change the way beats are organized to reduce the “over-servicing” of collector streets:
 - Either combine Class 2 and 3 roads at three hours, with Class 4 roads taking six hours or do Class 2 roads separately at three hours, with Class 3 and 4 roads at four hours (page 67). \$1.2 to \$1.3M
 - Reduce night shift to complete salt runs in three hours (page 68). \$1.3 to \$1.6M

While reducing Council Approved Maintenance Quality Standards:

- Keep salt beats on Class 2 and 3 roads at three hours, but extend plow runs to four hours (page 72). \$2.4M to \$2.7M
- Plow Class 5 residentials at 10 cm accumulation rather than seven cm (page 73). \$1.0M

A number of other service reduction options were examined, but are not recommended for consideration as the potential savings likely would not justify the lower service levels:

- Extending plow run timeframes on collector and residential streets by two hours (e.g. residentials move to 12 hours instead of 10) - incremental savings (page 72). \$20K to \$92K
- Extending service levels to the full provincial Minimum Maintenance Standard (e.g. taking six hours to plow arterials, 24 hours to plow residentials) - (alternative to the first and second items above) (page 70). \$2M to \$4M



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Snow Removal and Disposal

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Snow Removal

Snow removal is carried out in accord with MQS Table 103.03.01

Snow removal is carried out when the clear width between snow banks is less than specified in MQS – not based on the height of the snowbank as is often thought.

The snow removal standards are identified in the MQS as:

Road Maintenance Class		Road Type	Minimum Cleared Width	Time
1	Hwy 174	High Priority Roads	No encroachment onto travel lanes	16 hours
	Transitways			2 days
2	A, B	Most Arterials	Encroachment not to reduce width of any travel lane less than 3.3 m. <ul style="list-style-type: none"> Where a parking lane is provided, a clear width of 2.2 m is to be maintained. 	2 days
3	A, B	Most Major Collectors	<ul style="list-style-type: none"> Streets with high parking permit demand, or with meters or taxi stands on both sides are to have two parking lanes with a clear width of 2.2 m each. Roads with ditches and no curbs that have posted speeds greater than 60 km/hr are to have two parking/shoulder lanes with a clear width of 2.2 m each, where possible. 	8 days
4	A,B, C	Most Minor Collectors	Encroachment not to reduce clear width less than 6.0 m (2 lanes of 3.0 m). <ul style="list-style-type: none"> On streets with high parking permit demand, or with meters or taxi stands on both sides, the clear width is to be 8.2 m. 	14 days
5	A (Paved), C (Gravel)	Residential Roads and Lanes	Encroachment not to reduce clear width less than 5.0 m (2.8 m travel lane plus 2.2 m parking lane). <ul style="list-style-type: none"> On streets with high parking permit demand, or with meters or taxi stands on both sides, the clear width is not to be less than 7.2 m (2.8 m travel lane plus two parking lanes of 2.2 m each). 	14 days
	B (Lanes)		Encroachment not to reduce clear width less than 2.5 m.	

Snow removal – Other Cities

Other cities follow different approaches

Jurisdiction	Snow removal service levels
Ottawa	<ul style="list-style-type: none">• High priority roads are cleared to ensure no encroachment on travel lanes, time for clearance is within 16 hours and two days.• Most arterials and major collectors are cleared to ensure encroachment does not reduce the width of any travel lanes by less than 3.3 meters, with clearance between two and eight days.• Parking lanes and roads with ditches and no curbs with a posted speed greater than 60 km/h require a clear width of 2.2 meters, with clearance between two and eight days.• Most minor collectors ensure that encroachment does not reduce clear width to less than six meters, with clearance of approximately 14 days.• Residential roads and lanes ensure that encroachment does not reduce clear width by less than five meters, with clearance of approximately 14 days.
Quebec City	<ul style="list-style-type: none">• Remove snow from low density or rural areas after 30 centimeters of precipitation.• Remove snow in all other areas after 10 centimeters of precipitation.• These removal operations begin once continued clearing operations are not required.
London	<ul style="list-style-type: none">• Do snow removal in downtown (very little elsewhere) mostly aimed at improving conditions for on-street parking. Once there is a sizable windrow (half the height of the parking meters) will start to do removal.• Only snow removal outside downtown is at intersections, when visibility is an issue and they can't blow it back anywhere.
Winnipeg	<ul style="list-style-type: none">• Priority I and Priority II streets shall normally be maintained to bare pavement over the full pavement width.• Private crosswalks between the sidewalk and the curb shall be cleared to a width of 0.7 meters by City forces/Contractors.
Edmonton	<ul style="list-style-type: none">• Remove snow from arterial roadways when curb lanes are reduced to less than 3.2 meters in width by windrowed snow.• Remove snow from roadways in the designated windrow free zone adjacent to schools on both sides of the roadway, after every major snowfall when a full plowing cycle is completed.• Remove snow from other roadways "as required".
Calgary	<ul style="list-style-type: none">• Snow removal is conducted to ensure windrows are maintained at:<ul style="list-style-type: none">• One meter along major roadways• 600mm for business districts.

Snow removal – Other Cities

Jurisdiction	Snow removal service levels
Gatineau	<p>Snow removal is done by in-house crews dedicated to winter maintenance. When staff are not required for salting/plowing they are applied to snow removal.</p> <p>Snow removal occurs when:</p> <ol style="list-style-type: none">Lane is less than 3.5 meters, and then whenStorage capacity is insufficient for next storm. <p>In order of priorities, snow is removed from:</p> <ol style="list-style-type: none">Dedicated bus lanesSchools sector, churches, health centers, child care centersAreas with a sidewalk that s clearedA highly commercialized areasOverpassesThe streets where there is parking on the two (2) sidesEnsuring continuity of a path, that is to say fully clearing a street where there may be a blockage. <p>Speed of snow removal is varied based on volume of trucks hired to support in-house removal. There is no policy outlining this, the management decides based on its assessment of current and expected conditions when acceleration of snow removal is required.</p> <p>The city trying to identify snow storage capacity of different areas - e.g. downtown needs removal after 30 cm., some areas are OK after a meter. Will use to anticipate where to head next.</p>

The biggest differences from Ottawa's approach are in Calgary, Edmonton, London and Winnipeg

- Snowfalls in these cities are much less than Ottawa and/or they benefit from more melting in place.

Snow Removal Benchmarking Summary

The most frequently used measure is available width of travel lane:

- Ottawa uses 3.3m, Edmonton 3.2m, Gatineau 3.5m.
- Calgary uses width of windrow (.6 to 1.0m), not width of lane.
- London and Winnipeg use windrow height – aimed at on-street parking areas and they don't do much removal.
- Quebec bases the standard on amount of snow fallen (10 cm to 30 cm, depending upon area).
- Gatineau is working towards using the amount of snowfall – but targeted by street section based on local conditions (e.g. downtown needs removal after 10 cm) – but this is still a concept.

Others do not set a maximum time to complete snow removal:

- Gatineau has dedicated winter maintenance staff (no work on other road maintenance activities, such as patching) and this crew carries out snow removal activities whenever it has free time (after plowing and salting). They do not use contracted snow removal resources in most circumstances.

Snow removal – Unique conditions for removal

Some cities identify particular areas for higher level of service

- Quebec City - Quebec City does have areas that are designated as requiring a higher level of service, including a spreader on site before a snowfall event. There are also unique conditions that are managed by crews in the assigned areas. Such conditions can include; narrow sidewalks (manual snow removal), snow removal of hydrants (excavator or manual operation), art structures and areas (Manual snow removal), such as those conditions prevalent in Old Quebec.
- Edmonton - Edmonton treats their City Hall as a unique area, for which they provide additional services. City Hall requires hand shoveling, unique to the area. The assignment of City Hall is designated to whichever crew can incorporate the hand shoveling with their other assigned tasks, such as clearance of sidewalks and steps. There is no particular crew designated to the area, it is simply incorporated with the general schedule.
- Calgary – Calgary has classified their entire Central Business District (bounded by the Bow River to the north, Elbow River to the east, 17 Ave to the south, and 14 Street to the west) as Priority 1. Therefore their Central Business District, inclusive of the Stephen Avenue mall, is treated as a Priority 1, with no additional services provided. This impacts snow removal priority – but Calgary does not plow sidewalks.
- Gatineau – Downtown has shorter beats (road and sidewalk) providing same or better run times (given slower speeds) and sidewalk and road plows are out more often between events to tidy up.

Snow removal – Unique conditions for removal

A number of cities provide special snow removal services for winter festivals

- Quebec City - Quebec City is well known for their winter festival, Carnaval, which attracts thousands of tourists to the city every year. Despite the large draw to this winter festival, the Roads division for the City of Quebec does not provide consistent support for the winter festival. They may on occasion work in collaboration with festival organizers to provide snow and ice support, but these services are inconsistent and unique, falling under the “special events” category for the snow and ice policy for the city. If the road conditions are particularly icy, then the Roads division may work harder to ensure public safety on the streets during the event through increasing their de-icing services, though this is dependent on conditions and not a consistent service. The City does not handle snow removal for the off-street site of the Carnival.
- Winnipeg - Winnipeg’s Festival du Voyageur is relatively similar to Ottawa’s Winterlude. Throughout the Festival, the City’s Snow and Ice Policies remain unaffected, as the festival is responsible for their own snow clearance. However, if the City has capacity, they will sometimes bring snow to the fairgrounds for use by the Festival.
- Edmonton - Similarly, the City of Edmonton’s Roadway Maintenance Department does not bear any responsibility for winter festivals. However, they may provide ad-hoc support where they have the capacity.
- Gatineau – Has Winterlude snow removal beats completed in the two weeks leading up to event (and during if necessary) and the City lends Winterlude two snow blowers to assist in getting the park ready.

Snow Removal

The maps below show the frequency of snow removal in a typical suburban area (left) and downtown. (2014/15)

- The transitway, ByWard Market, Rideau and Sparks have removal most frequently. But even the residential areas built before WW II tend to have removal twice a year due to narrow streets, sidewalks both sides and small setbacks.
- Suburban areas have generally been handled by pushing snow back onto front lawns, and snow removal has tended to focus on the collectors where parking, bus routes and schools increase the need.



Snow Removal

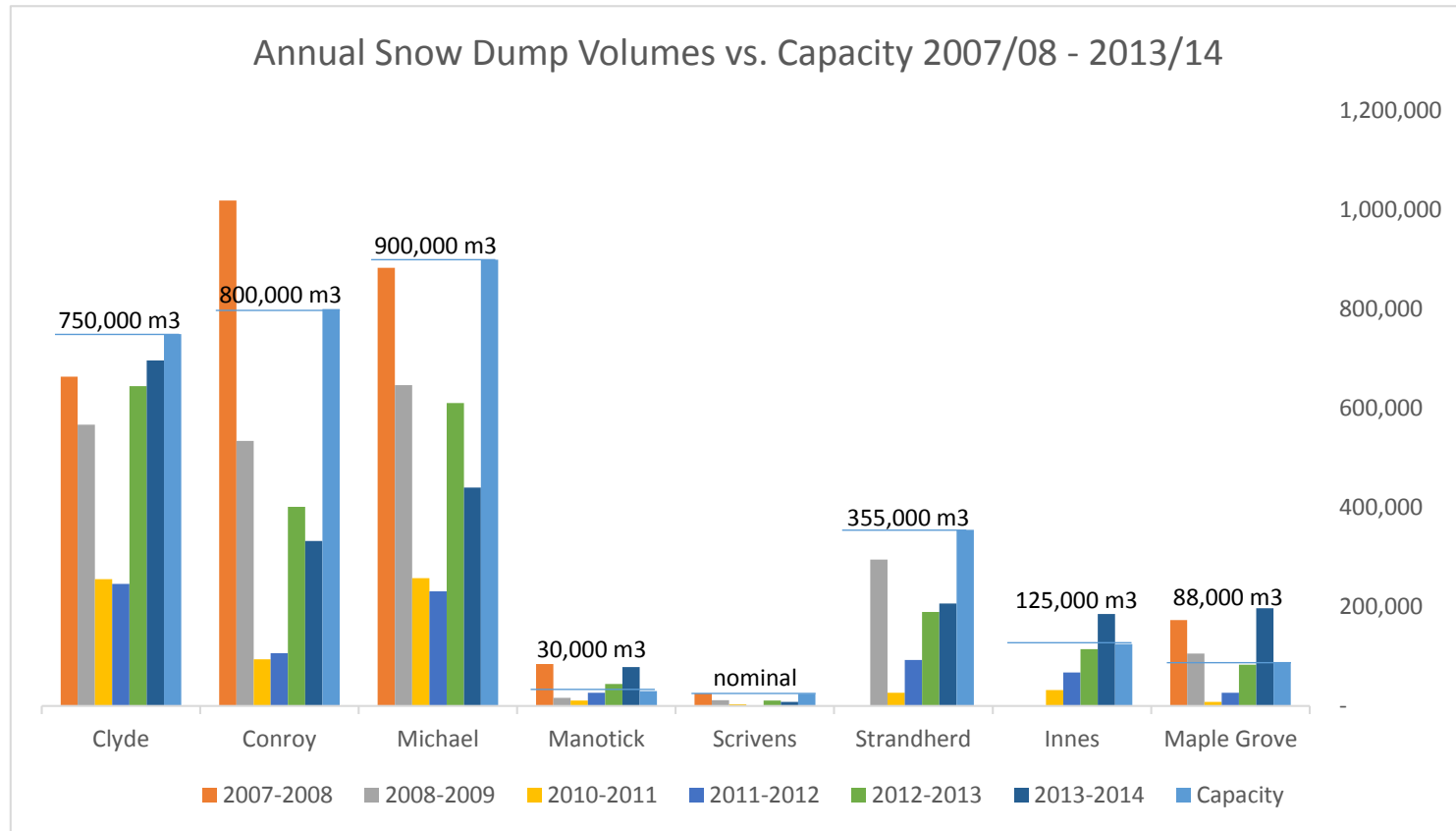
There has been increasing demand for snow removal in suburban areas caused by a variety of factors:

- New, denser urban design with less setback, narrower lots
- Increased vehicle ownership with more on street parking
- Wider driveways/less lawn frontage reducing snow storage areas
- More utilities, trees, signs, etc., installed in boulevard areas reducing snow storage and slowing removal operations
- Placement of sidewalks on both sides of the street
- Some particular designs have caused particular problems as they have garages and decks above very close to the road, leaving no opportunity for snow storage.

Snow Disposal

The vast majority of snow removed is stored at three main sites located inside the Greenbelt.

- The three major sites are generally not used to capacity (the horizontal blue lines in the chart below) while three of the smaller sites in suburban locations outside the greenbelt operate at or beyond capacity.



Snow Disposal

The cost of trucking from snow removal areas to snow disposal areas is a significant part of snow removal costs.

- As demand in the suburban areas increases, expanding the snow disposal capacity will be important – with permanent facilities in the west end (Kanata/Stittsville) and in the Orleans area required. Developments all now include storm water management facilities. The potential to design storm water management facilities to also serve as new disposal sites should be explored, to reduce capital costs, and to minimize the cost and environmental impact of trucking snow.

The snow disposal sites inside the Greenbelt appear to provide adequate capacity – in fact they are receiving far less than capacity most years (the 2007-8 winter was the only recent exception) .

- The sites were closed for private snow disposal in 2007 to preserve the capacity for city snow disposal.
- Clyde is the only facility in the west-central area and has operated closer to capacity than others in recent years.
- It would be possible to accept some private snow disposal at either or both of the Michael and Conroy facilities, which could help off-set some of the operating costs. The City could retain the option to close the facilities in any year where winter conditions by January or February suggest much higher needs than usual.

Snow Disposal – Summary observations

- Snow removal criteria are consistent with other cities with similar climate conditions. Continuing pressure from the community for more snow removal, and denser new development in the suburbs will continue to increase snow removal requirements.
- Snow disposal sites inside the Greenbelt have room to handle more volume, while those outside are over capacity.
 - There is an opportunity to accept “private” snow at one or two sites inside the Greenbelt (with a suitable charge).
 - There is a need to expand capacity outside the Greenbelt – recognizing the growth in demand.
 - Opportunities to combine snow storage with storm water management facilities could be explored.
- Future suburban development should be designed to accommodate snow clearing, in particular:
 - Ensure at least one side of every street can accommodate snow storage, with no sidewalks adjacent to or near the street, no parking on that side of the street and limited driveway accesses.
 - Planning and Development Services is currently reviewing approaches to suburban intensification.



cutting through complexity

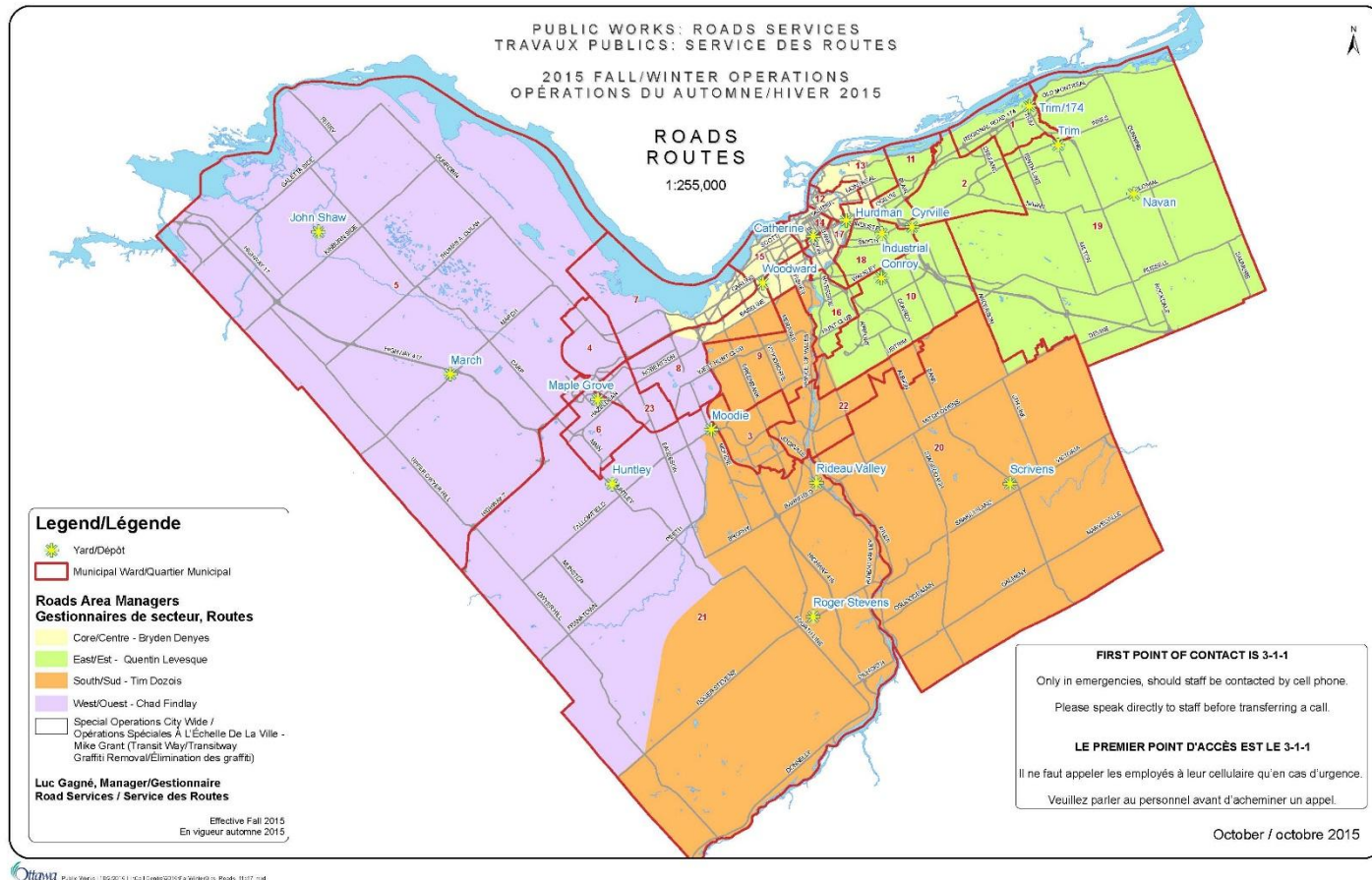
In-house/Staffing

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Staffing

City forces are organized in four geographic areas (shown on the next page) and the Special Operations group which handles Highway 174 and the transitways.

- Each area has a number of “zones” (generally based on a particular depot location).



Staffing levels

- Both day and night shifts consist of eight regular hours plus ½ hour lunch running from 7:00 a.m. to 3:30 p.m. for day shift and 10:30 p.m. to 7:00 a.m. for nights.
- The majority of operational staff are allocated to the day shift (58%) with 35% covering the night shift and the balance on a small 24/7 shift at the Hurdman Yard.
- Each area has the following:
 - 1 Area Manager
 - 1 Zone Supervisor for each zone (4-5 in each area)
 - 1 Operations Tech for each area (East Roads has two)
 - 1 Maintenance Coordinator for each shift. However, some zones have more staff supporting the day. Overall double what is staffed at night).
 - Total operators
 - 31 Crew Leaders
 - 320 Special Heavy Equipment Operators (generally salt truck operators)
 - 187 Heavy Equipment Operators (generally operate loaders or graders for plowing or sidewalk equipment)
 - 6 Small Equipment Technicians.
- During snow events, the eight hour shifts are extended to provide 24/7 snow clearing capability (hence the increased overtime costs when more storms arrive).

Winter operations staff are assigned to four areas:

Staff Category	Area				
	West	Core	South	East	Special Ops
Area Manager	1	1	1	1	1
Operations Tech	1	1	1	2	1
Zone Supervisor	4	4	4	5	2
Maintenance Coordinator					
Day Shift	4	7	5	5	1
Night Shift	3	4	3	5	2
Crew Leader					
Day Shift	2	7	3	4	
Night Shift	2	6	3	3	1
Special Heavy Equipment Operator					
Day Shift	47	37	54	47	6
Night Shift	24	35	29	35	6
Heavy Equipment Operator					
Day Shift	21	31	23	30	5
Night Shift	9	35	9	18	6
Small Equipment Tech		3		3	
Total Staff	118	172	135	158	31

Note: The Core area has a division of shifts that varies from all the other areas. Staff assigned to “A” shift and “B” shift within Core have been rolled in the general category of day or night. The afternoon shift has been rolled in the general category of day.

Staffing

Each area is broken down into zones, generally centred on a particular depot.

- The tables on this page show the staffing for each of the standard (suburban and rural) zones.
- The Special Heavy Equipment Operators are generally the combo operators, with night staffing based on the number of priority routes and day shift including operators for the plow routes.
- The Heavy Equipment Operators staff priority sidewalk routes at night and the other sidewalk routes, plows and other tasks in the daytime.

East Roads					
Staff Category	Conroy	Cyrville	Industrial	Navan	Trim
Area Manager		1			
Operations Tech		2			
Zone Supervisor	1	1	1	1	1
Small Equipment Tech	1	1	1		
Maintenance Coordinator					
Day Shift	1	1	1	1	1
Night Shift	1	1	1	1	1
Crew Leader					
Day Shift	1	1	1		1
Night Shift	1	1	1		
Special Heavy Equipment Operator					
Day Shift	12	9	10	8	8
Night Shift	9	6	7	6	7
Heavy Equipment Operator					
Day Shift	7	5	7	5	6
Night Shift	7	3	7		1
Total Staff	44	29	37	22	26
Total Area Staff			158		

West Roads				
	Huntley	Kinburn/ John Shaw	Maple Grove	March
Area Manager			1	
Operations Tech			1	
Zone Supervisor	1	1	1	1
Maintenance Coordinator				
Day Shift	1		2	1
Night Shift	1	1	1	
Crew Leader				
Day Shift			1	1
Night Shift		1	1	
Special Heavy Equip. Operator				
Day Shift	13	10	16	8
Night Shift	4	5	9	6
Heavy Equipment Operator				
Day Shift	5	1	12	3
Night Shift	3	1	4	1
Total Staff	30	20	49	19
Total Area Staff		118		

South Roads				
Staff Category	Moodie	Rideau Valley	Roger Stevens	Scrivens
Area Manager		1		
Operations Tech		1		
Zone Supervisor	1	1	1	1
Maintenance Coordinator				
Day Shift	2	1	1	1
Night Shift	1	1	1	1
Crew Leader				
Day Shift	2	1		
Night Shift	2			
Special Heavy Equipment Operator				
Day Shift	22	12	9	11
Night Shift	12	6	4	7
Heavy Equipment Operator				
Day Shift	12	6	2	3
Night Shift	6	1	1	1
Total Staff	62	29	20	25
Total Area Staff		136		

Staffing

These tables show the staffing for the two specialized areas, the Core and Special Operations Unit.

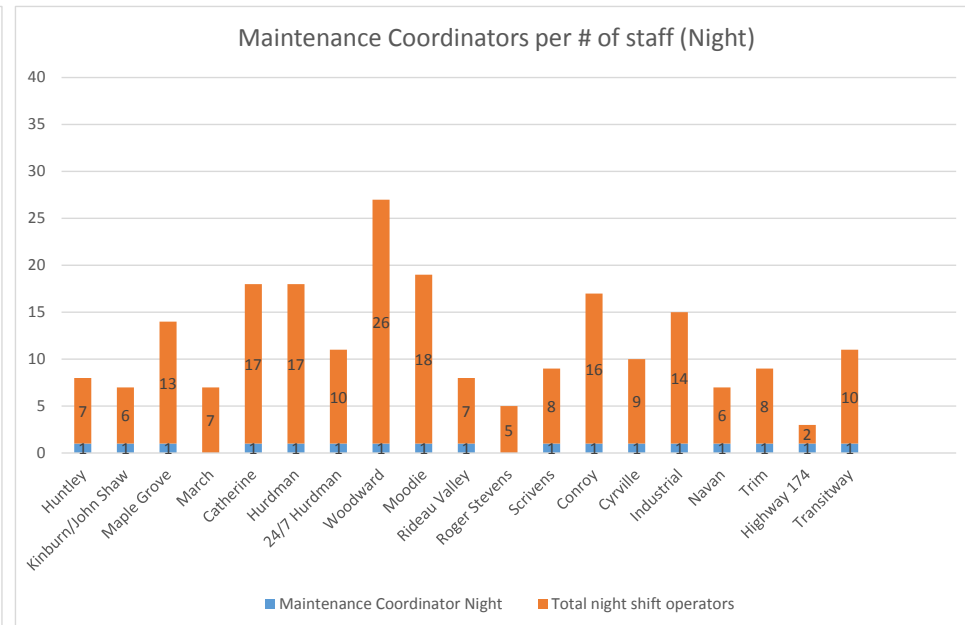
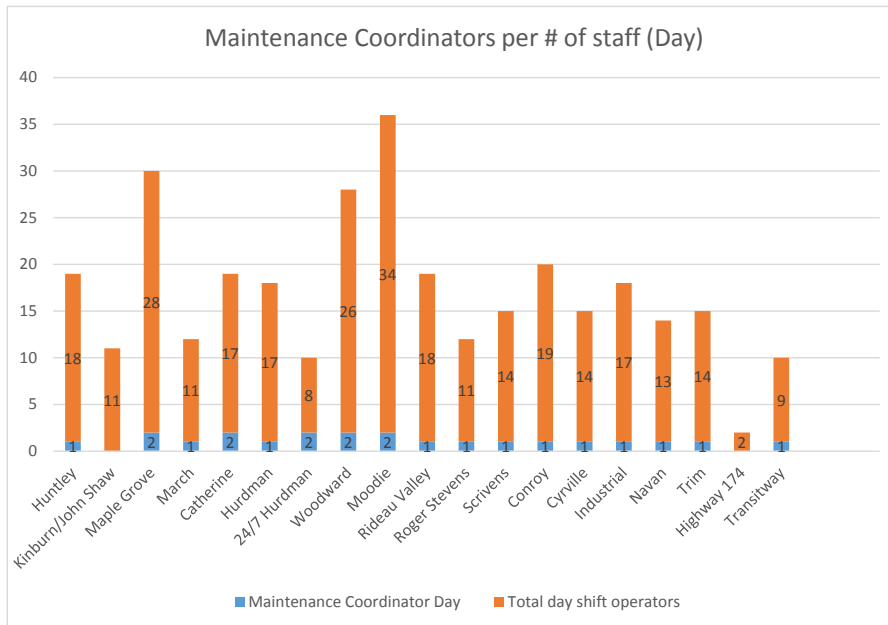
- Core Roads has the small 24/7, three shift operation at Hurdman. Note there is little difference between day and evening shifts in both groups as most routes are priority routes.

Special Operations Unit			
	Highway 174	East Transitway	West Transitway
Staff Category			
Area Manager	1		
Operations Tech	1		
Zone Supervisor	1		1
Maintenance Coordinator			
Day Shift		1	
Night Shift	1		1
Crew Leader			
Day Shift			
Night Shift			1
Special Heavy Equipment Operator			
Day Shift		2	4
Night Shift		2	4
Heavy Equipment Operator			
Day Shift	2	2	1
Night Shift	2	2	2
Total Staff	8	9	14
Total Area Staff	31		

Core Roads		24/7		
	Catherine	Hurdman	Hurdman	Woodward
Staff Category				
Area Manager		1		
Operations Tech		1		
Zone Supervisor	1	1	1	1
Small Equipment Tech	1	1		1
Labourer		1		
Maintenance Coordinator				
Day Shift	2	1	1	2
Afternoon Shift			1	
Night Shift	1	1	1	1
Crew Leader				
Day Shift	2	2		3
Night Shift	2	2		2
Special Heavy Equipment Operator				
Day Shift	6	9		18
"A" Shift			2	
"B" Shift			2	
Night Shift	6	12		16
"A" Shift			1	
"B" Shift				
Heavy Equipment Operator				
Day Shift	11	8		8
Afternoon Shift				
"A" Shift			2	
"B" Shift			2	
Night Shift	11	5		10
"A" Shift			4	
"B" Shift			5	
Total Staff	45	43	22	62
Total Area Staff	172			

Staffing

- Allocation of maintenance coordinators across areas and zones is not consistent. There does not appear to be a relationship to the number of staff.



- However, the allocation of crew leaders is fairly consistent across areas and zones with typically one crew leader for the day shift and one crew leader for the night shift. There is some sharing of crew leader resources between zones (e.g., March and Kinburn share a day crew leader and a night crew leader.)
- The exception is the core area where each zone has two crew leaders on during the day and two crew leaders for the night shift. Hurdman has additional crew leaders for the 24/7 zone.

Staffing

- There are only two areas that have Small Equipment Technicians on staff.
- All zones in the Core Area and three of the five zones in the East Area have Small Equipment Technicians.

		Small Equipment Technician
West	Huntley	
	Kinburn/John Shaw	
	Maple Grove	
	March	
Core	Catherine	✓
	Hurdman	✓
	Woodward	✓
South	Moodie	
	Rideau Valley	
	Roger Stevens	
	Scrivens	
East	Conroy	✓
	Cyrville	✓
	Industrial	✓
	Navan	
	Trim	
Special Operations	Highway 174	
	East Transitway	
	West Transitway	

Staffing – Commercial Vehicle Operators Regulations

Ontario's hours-of-service regulation governs the maximum driving times and minimum off-duty times of commercial vehicle drivers (bus and truck) who require a Commercial Vehicle Operator's Registration (CVOR). They are based on the National Safety Security Code Standard 9.

- The two shift system – with 12 hours per shift during winter events, meets the maximum hours driving (13) or working (14) requirement, and the 10 hours off-duty requirement.
- However the weekly limits on driving after 70 hours on duty in seven days, or 120 hours on-duty over 14 days can limit staff availability when winter events are protracted or repeated, particularly when weekend call-ins are required.

Staffing - Shift Structure in Other Cities

Jurisdiction	Staffing services
Ottawa	<ul style="list-style-type: none"> Two shifts (day and night), with the exception of the Core area that runs a 24/7 zone with three shifts (day, afternoon, night). Day shift is larger (covers all beats), night shift smaller (salt beats and priority sidewalks). Both day and night shifts consist of eight regular hours plus ½ hour lunch running from 7:00 a.m. to 3:30 p.m. for day shift and 10:30 p.m. to 7:00 a.m. for nights.
Quebec City	<ul style="list-style-type: none"> Quebec city maintains two shifts (day and night), with each shift being eight hours, similar to Ottawa. Standby crews are created based on weather expectations, though equipment is kept on standby 24/7.
Laval	<ul style="list-style-type: none"> Similar to Ottawa, Laval runs two eight hour shifts, a day shift and an overnight shift.
Gatineau	<ul style="list-style-type: none"> Similar to Ottawa, Gatineau runs two eight hour shifts. The day shifts cover all beats, while the night shifts cover 40% (salt and sidewalk runs). The weekends are considered overtime, if they are worked. The staff are scheduled depending on the weather reports, with some of the salt trucks being held on weekend standby as required.
London	<ul style="list-style-type: none"> London runs five shifts (24/7) for salting, and has one day shift for plowing crews.
Winnipeg	<ul style="list-style-type: none"> Winnipeg runs three shifts per day, with each shift being eight hours in length. Call-outs are split into two 12 hours shifts. Winnipeg keeps their hired equipment on stand-by.
St, John's	<ul style="list-style-type: none"> Three shifts, two with eight hours a day and one with 10 hours for four days. Arranged so there are two shifts on duty seven days a week, with overtime used to get 24 hour coverage during events. All shifts are identical in size, making this a more expensive approach.
Fredericton	<ul style="list-style-type: none"> Runs a single shift, with one operator “owning” one piece of equipment for one beat. Schedule is daytime, but called in as required for events. Very inexpensive despite lots of overtime for salt truck operators, but maximum driving hours can result in periods when no available capacity.

Staffing – Shift Structure

Some alternatives to the current shift structure were evaluated:

- The one shift system used in Fredericton would not be workable with Ontario's CVOR regulations and Ottawa's weather. Whenever there is a large storm or repeated small events, the salt truck operators would not be able to maintain the level of service without exceeded the permitted hours of driving or of work.
- The London model would mean creating four shifts of "critical" salt truck operators (with a little overtime to maintain 24/7 coverage). Each shift could have half the number of salt truck operators as the current two shifts, running salt beats twice as long as current beats (would still meet service standards). However whenever weather conditions required plowing due to an accumulation of snow (20 to 25 times per year), additional resources (staff on overtime or contractors) would have to be added to return the beats to their current length. This approach would essentially eliminate the need for on call time, and significantly limit the standby time. However it would require extending the length of salt runs so they take three hours to complete and would require additional resources for events when plowing is required. It would be more economical to reduce the night shift by half as described earlier. In either case there would be a need for additional resources to support a plow run.

Productive / Priority Time Analysis

The Issue

A Productive / Priority time analysis was conducted to assist with the evaluation of staffing and shift options. It was designed to determine what operators are doing when not engaged in snow and ice control, and by extension, whether significant value is produced. This analysis also supports the evaluation of contracting options and identifies some issues for management consideration.

Approach

- Time records for Roads in the winter of 2014 and 2015 were downloaded. Time records between April 1 and November 30 were excluded from the 2014 data set. Records from Roads units not engaged in winter control were also excluded from both data sets.
- Work codes were categorized into three priority groups.
- Activity data from both 2014 and 2015 was used for the analysis based on assumed priority:
 - Priority 1 = Activities that have to be done right away (e.g., application of winter materials, snow clearing, snow removal).
 - Priority 2 = Activities that have to be done but not immediately (e.g., asphalt patching, litter pick up).
 - Priority 3 = Activities that can wait to be done or are non-productive (standby, on call, yard duties).
- See Appendix B for list of codes in each category, and total allocated to each.

Productive / Priority Time Analysis

Observations

For 2015, most zones spend between 80% and 90% of time on P1 & P2 activities (average of 82%). Zones in the West and zones that are rural appear to be operating at the lowest levels and Maple Grove and Trim stand out as having lower rates than other urban zones.

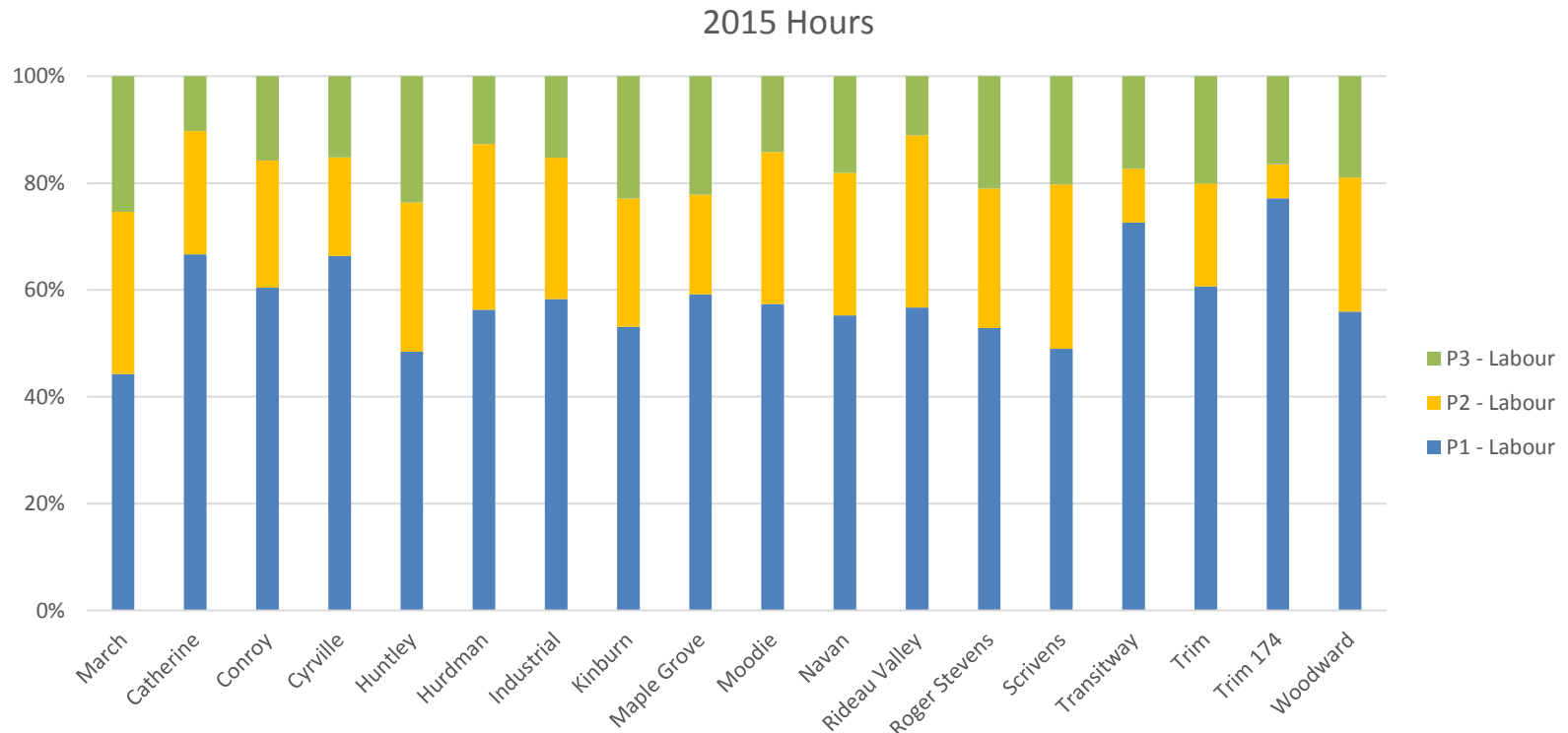
Zone	Total Hours (all internal activities)	Total Contract Hours (P1)	Total P1 Internal Hours	Total P2 Internal Hours	Total P3 Internal Hours	P1 & P2 as % of Total	P3 as % of Total
Catherine	46,611	16,054	31,080	10,768	4,763	89.8%	10.2%
Rideau Valley	33,557	4,695	19,019	10,837	3,701	89.0%	11.0%
Hurdman	77,694	14,799	43,748	24,064	9,882	87.3%	12.7%
Moodie	58,071	10,330	33,309	16,531	8,232	85.8%	14.2%
Cyrville	32,541	4,988	21,601	6,000	4,940	84.8%	15.2%
Industrial	37,593	6,674	21,915	9,942	5,735	84.7%	15.3%
Conroy	41,802	8,813	25,264	9,938	6,601	84.2%	15.8%
Trim 174	5,864	5,579	4,524	375	965	83.6%	16.4%
Transitway	29,867	1,764	21,695	3,000	5,172	82.7%	17.3%
Navan	23,570	1,674	13,022	6,292	4,257	81.9%	18.1%
Woodward	61,844	8,779	34,596	15,512	11,737	81.0%	19.0%
Trim	29,689	5,425	18,000	5,725	5,965	79.9%	20.1%
Scrivens	26,411	108	12,929	8,140	5,342	79.8%	20.2%
Roger Stevens	20,183	41	10,676	5,263	4,244	79.0%	21.0%
Maple Grove	47,913	7,494	28,343	8,959	10,612	77.9%	22.1%
Kinburn	18,734	598	9,954	4,493	4,288	77.1%	22.9%
Huntley	29,488	2,706	14,290	8,243	6,956	76.4%	23.6%
March	24,251	547	10,733	7,360	6,158	74.6%	25.4%
Total	645,679	101,064	374,695	161,437	109,547		
Average	35,871	5,615	20,816	8,969	6,086	82.2%	17.8%

Productive / Priority Time Analysis

Observations

Productivity analysis across zones indicates at least 83% of all time (regular, overtime and on call hours) was spent on Priority 1 & 2 activities during 2015. This result was similar for 2014 where 86% of all time was spent of Priority 1 & 2 activities. Note that the results vary by zone.

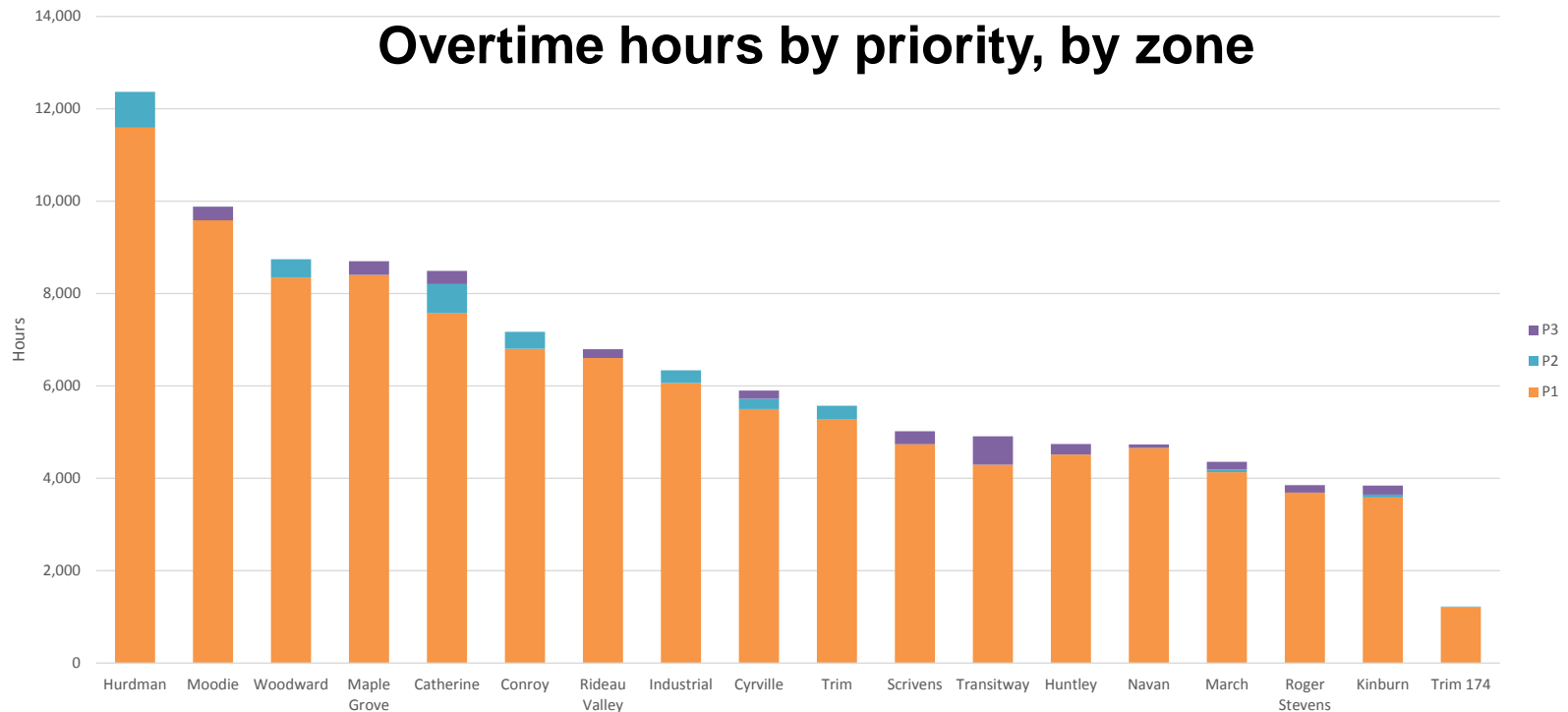
Percent of hours by priority, by zone



Productive / Priority Time Analysis

2015 overtime hours are mainly coded to P1 activities (95%), although 5% of total overtime hours are coded to P2 and P3 activities. By definition, P1 work is work that needs to be done immediately, hence overtime would be appropriate and the alternatives would be increased staffing or more contracting. 2% of total 2015 overtime hours coded are to P3 activities with the majority coded to standby time. Overtime incurred in 2014 was slightly different with a greater percentage coded to P2 and P3 activities, 7% and 5% respectively.

The same five zones incur the highest amounts of overtime in both 2014 and 2015. Hurdman is significantly skewed by flood control/ice breaking activities. Without this time, Hurdman is more in line with the next four.

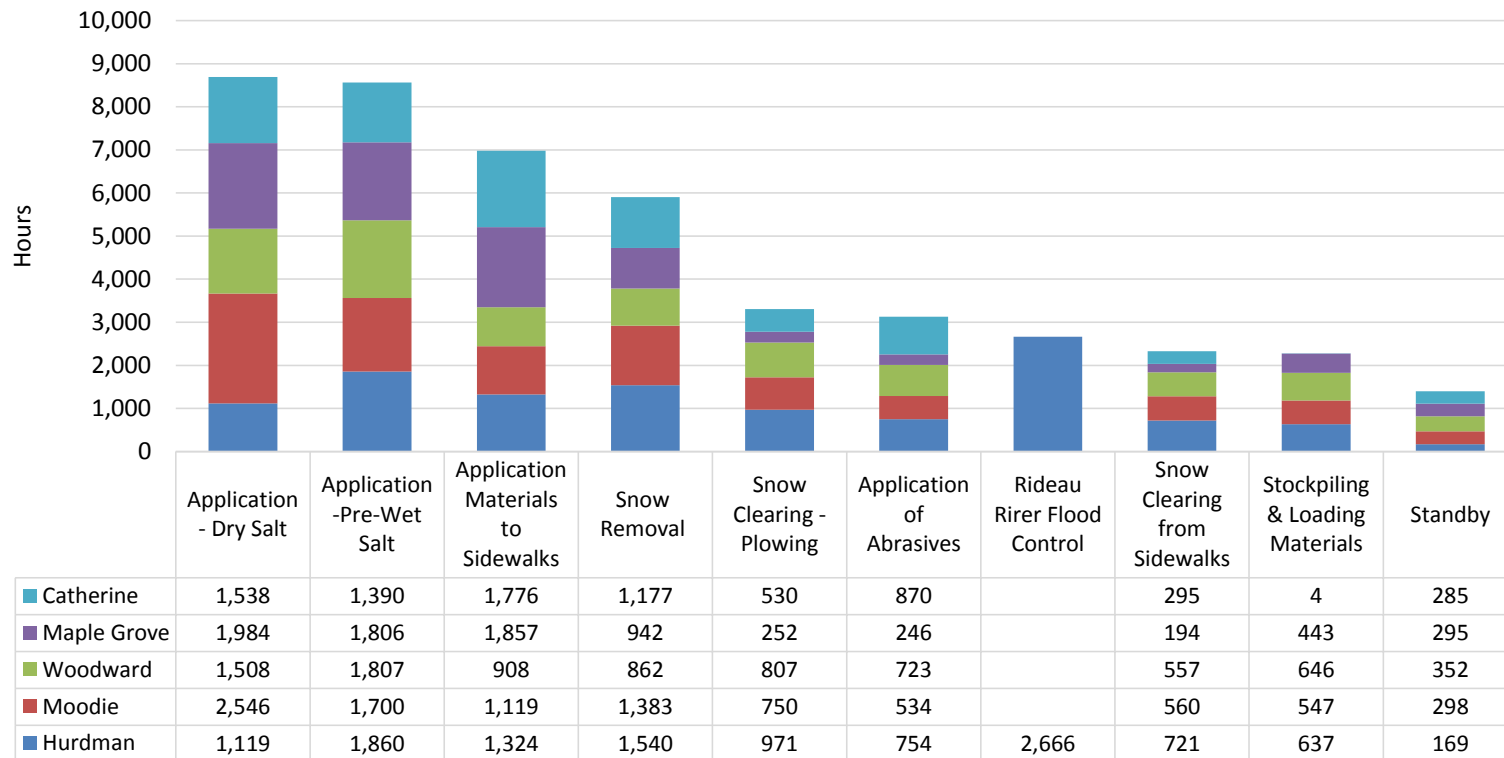


Productive / Priority Time Analysis

The activities requiring the largest amounts of overtime are all P1 activities related to winter road maintenance except for the last category – Standby time.

Salting (roads and sidewalks) are the activities with the highest amounts of overtime hours.

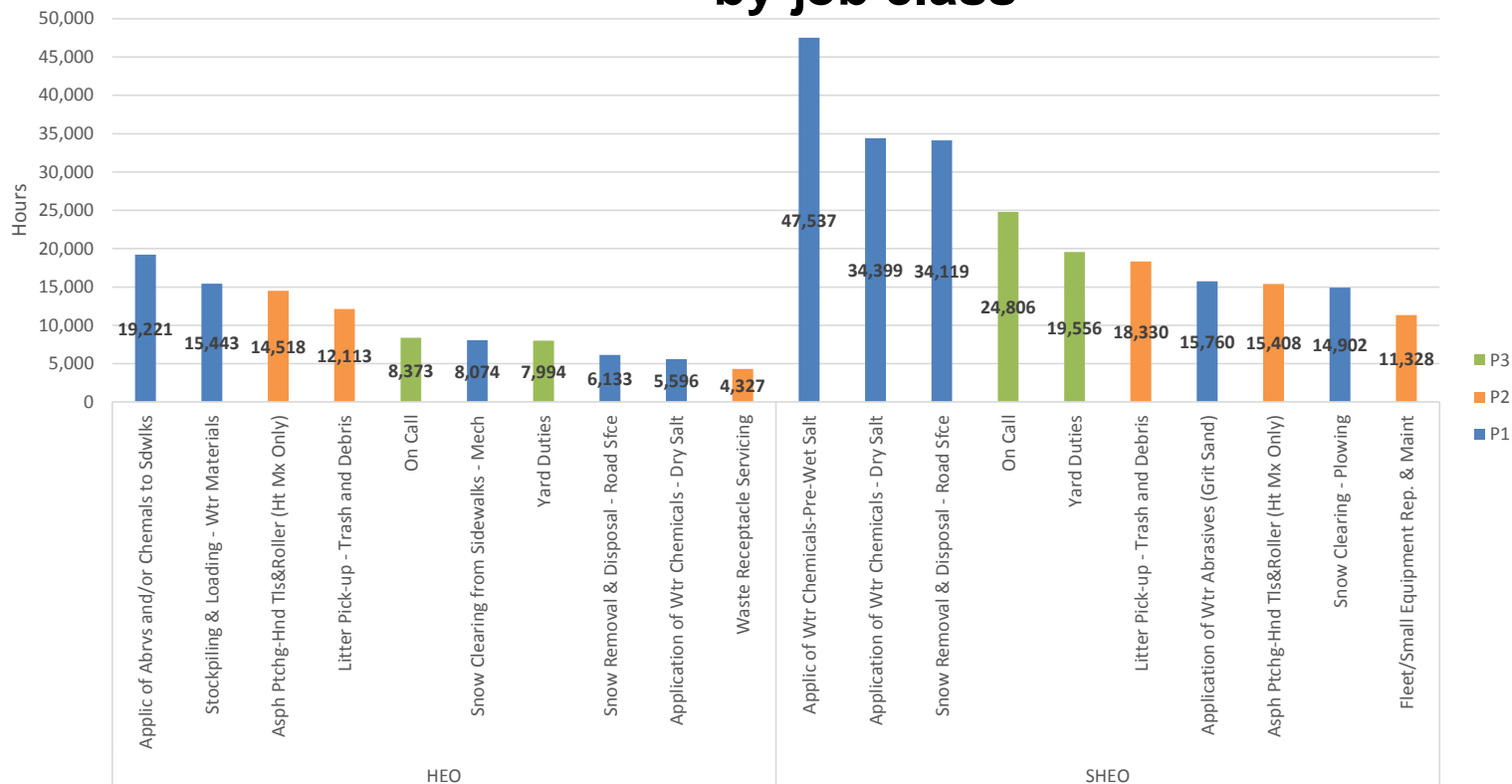
Top ten overtime activities by zones with most overtime



Productive / Priority Time Analysis

The top 10 work areas are a little different for Special Heavy Equipment Operators (SHEOs) and Heavy Equipment Operators (HEOs). On call and yard duty hours (P3 time) show up in both top 10 lists.

2015 Top 10 activities with most hours, by job class



Staffing – On call and Standby

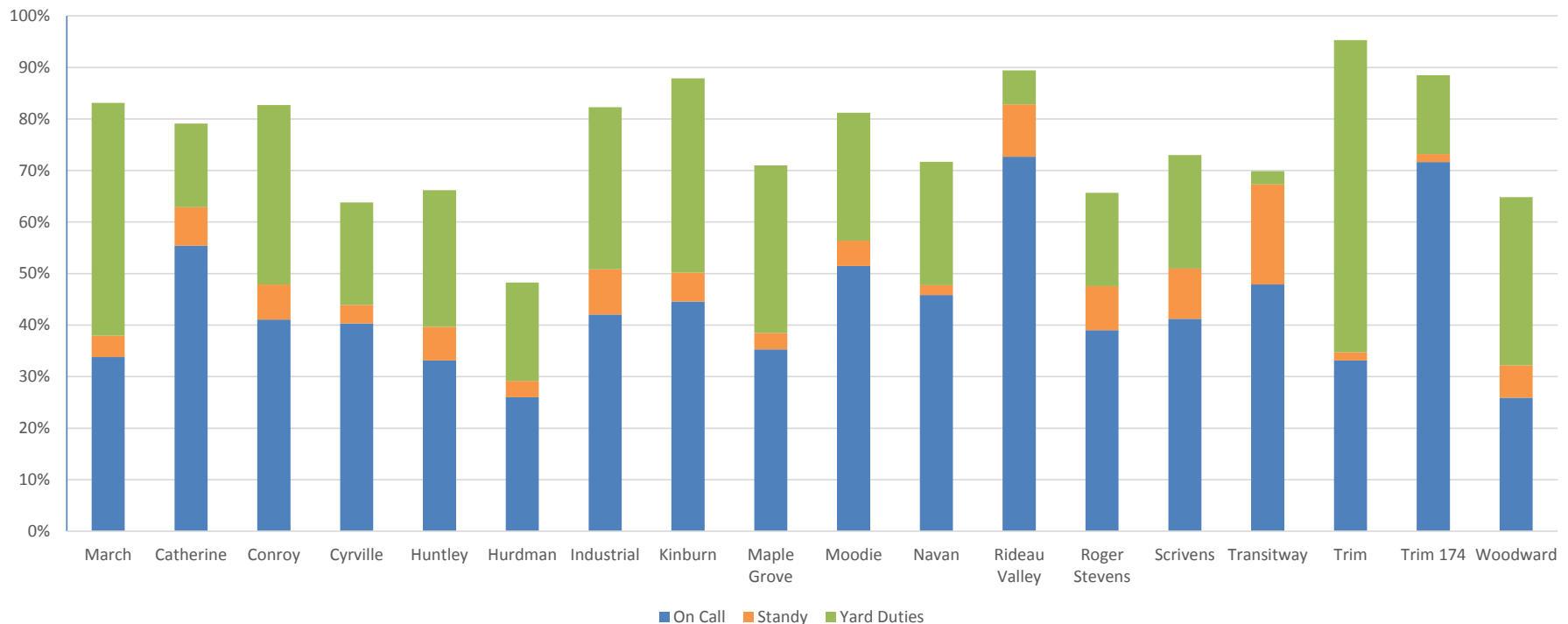
In order to ensure that staff is available for work as required:

- Certain employees may be placed “on call” for a Saturday, a Sunday, or for work during the week outside the normal shift (generally for an early arrival before the regular shift). The employee is compensated at three hours pay for the weekend or two hours pay during the week, and then at time and a half for work done if called in.
- Employees may also be asked to come to work outside their regular shift in the expectation that weather will require some service (usually starting with a salt run). This time is paid as “standby” time until the run begins.
- On call and standby time is the major element of the paid time that is not coded to priority 1 or 2 work.

Productive / Priority Time Analysis

The top three P3 activities are on call, yard duties and standby time. On call makes up 54% of the total of these three categories, followed by 38% for yard duties and 8% for standby time.

Proportions of on call, standby and yard duties as % of total P3 time), by Zone

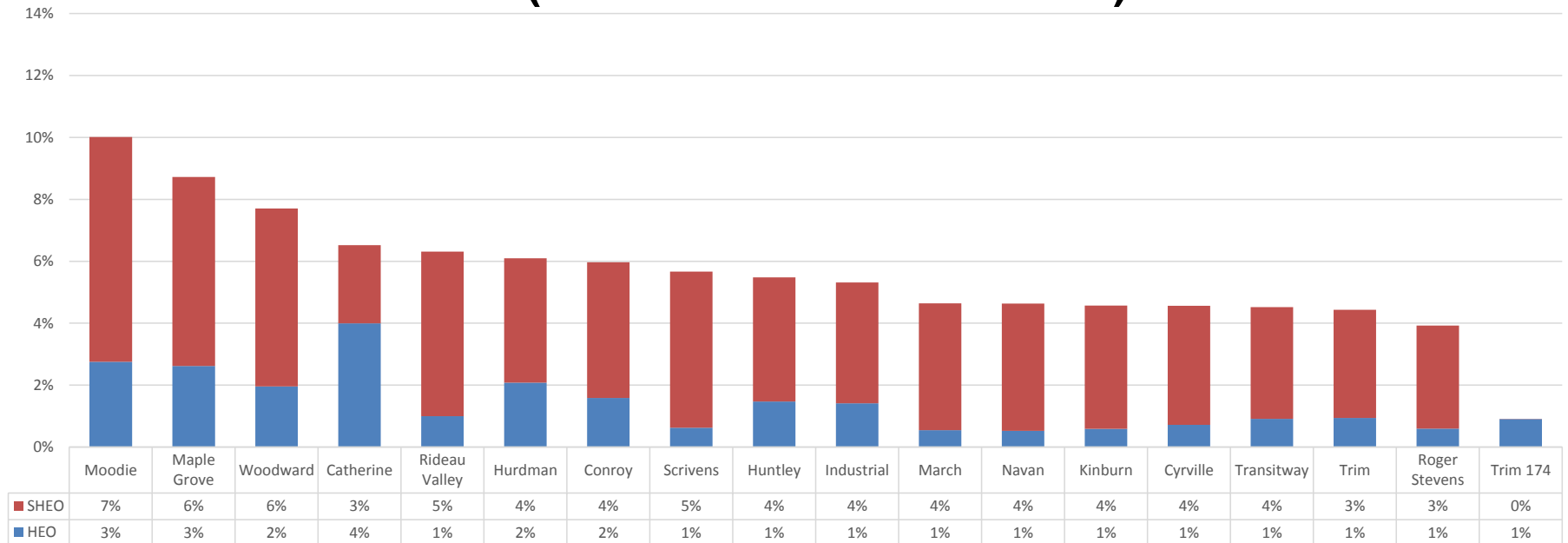


Productive / Priority Time Analysis

On-call time makes up the majority of all hours coded to P3 activities in 2014 and 2015. The SHEOs are most frequently required, with 75% of on call hours being recorded by this group. This is expected as this job Class is mainly responsible for application of materials to roadways – the first response to adverse weather conditions.

Moodie and Maple Grove log the highest amounts of on-call hours. This is consistent with the results from 2014.

2015 on call hours, by job class, by zone (as % of total on call hours)

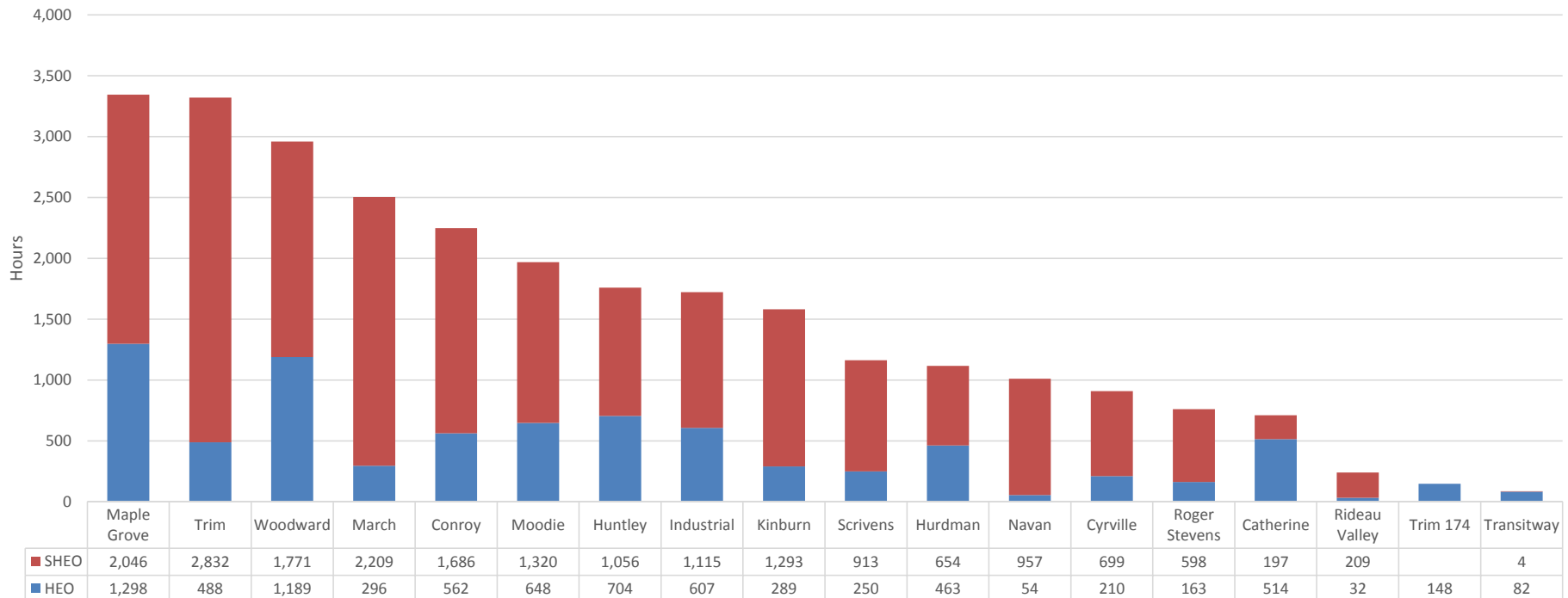


Productive / Priority Time Analysis

The second largest amount of P3 activity time is coded to yard duties. This was 17,378 hours for 2014 and 27,549 hours for 2015. This equates to 3.5% (2014) and 4.3% (2015) of all hours coded to all activities across all priority levels.

Maple Grove and Trim hold the greatest proportion of time allocated to yard duties in both 2014 and 2015.

2015 yard duties, by zone, by job class



Productive / Priority Time Analysis

For the most part, zones with high amounts of externally contracted service have the least amount of P3 time compared to those zones with a lower number of contracted hours. Lower rates of external service and higher P3 time appears in many of the rural area zones (yellow highlighting).

Three anomalies appear at Maple Grove, Trim and Huntley where P3 rates are higher than expected given the extent of contracting.

These factors should be further investigated.

Zone	Total Hours (all activities)	Total Contract Hours (P1)	P1 & P2 as % of Total	P3 as % of Total
Catherine	46,611	16,054	89.8%	10.2%
Hurdman	77,694	14,799	87.3%	12.7%
Moodie	58,071	10,330	85.8%	14.2%
Conroy	41,802	8,813	84.2%	15.8%
Woodward	61,844	8,779	81.0%	19.0%
Maple Grove	47,913	7,494	77.9%	22.1%
Industrial	37,593	6,674	84.7%	15.3%
Trim 174	5,864	5,579	83.6%	16.4%
Trim	29,689	5,425	79.9%	20.1%
Cyrville	32,541	4,988	84.8%	15.2%
Rideau Valley	33,557	4,695	89.0%	11.0%
Huntley	29,488	2,706	76.4%	23.6%
Transitway	29,867	1,764	82.7%	17.3%
Navan	23,570	1,674	81.9%	18.1%
Kinburn	18,734	598	77.1%	22.9%
March	24,251	547	74.6%	25.4%
Scrivens	26,411	108	79.8%	20.2%
Roger Stevens	20,183	41	79.0%	21.0%

Financial Implications of Alternative Shift Options

Four Shift Option

The four shift model would involve 24/7 regular time salt truck operators for “critical” salt truck operators (with a little overtime required to maintain 24/7 coverage). Each shift could have half the number of salt truck operators as the current two shifts, running salt beats twice as long as current beats (would still meet service standards). The day shift would retain the “other half” of salt truck operators.

Thus where there are currently four operators (two day, two night) there would be five operators (1 on each of four shifts, plus one on the day shift). However overtime currently adds about 15% to the work hours of SHEOs, and on-call and standby time adds about 14% to the paid hours of SHEOs. Thus for every four current salt trucks, the City is paying about 5.24 full time wages (4 times 1.14 times 1.15). The four shift system would still require some overtime, for those snow events that require plowing on weekends or otherwise outside the day shift. Assuming that might occur on half of an expected 20 events, the overtime might add 5% to costs (so five staff becoming 5.25).

Thus the four shift system would have costs very much like the current costs, and it would require moving to the longer salt beats. If the change in service level related to the longer salt beats is acceptable, simply reducing the size of the night shift would produce more substantial savings.

Productive / Priority Time Analysis

Findings:

- Most staff time is devoted to P1 or P2 activities – those that need to be done, and would have to be contracted if not carried out by staff. About 20% of paid time is P3 time, and the most important components of this are on call time, standby time and yard duties – some of which appears to be another way of recording standby time.
- Most overtime is spent on high priority winter activities. There is always value to managing overtime carefully, and there are small amounts of low priority overtime that could be reduced, but this does not appear to be a major area for new focus.
- Standby and on call time are significant – and vary considerably by zone. City staff are reviewing some options to reduce the amount of paid standby and on call time. Other options will be considered in the contracting section of this report.
- “Yard duties” vary considerably by location. It does not appear that time coded to yard duties is another way of indicating standby time, as some zones are high in both categories. Opportunities to reduce the low priority time in these zones should include options to adjust the staffing: contractor ratio.
- There is inconsistency in the allocation of maintenance coordinators and small equipment technicians that should be resolved before the winter of 2016-17. There is some uncertainty of the value of small equipment technicians and a review of this winter’s activity is being conducted by the Branch.



cutting through complexity

Vehicles and Equipment

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Vehicles/Equipment

Roads uses a variety of vehicles which are mostly city-owned assets

- 185 heavy roadway truck plows/spreaders make up most of the fleet used, with almost all vehicles being City assets (91%). These are mainly tandem combo or dump units or single axle dump vehicles.
- Grader plows and loader plows are the largest equipment group that has been outsourced. 63 are city-owned, 66 are contracted vehicles with contracted operators and 13 are leased pieces of equipment.
- Bucket loaders/tractors/backhoes are the next largest equipment group with 43 units. These contracts support bus stop snow clearing and other snow clearing/removal operations where snow banks restrict sightlines, travel widths, pedestrian/cycling traffic, or to relieve trapped water on roads or sidewalks.
- There are 107 Sidewalk Plows/Spreaders. This equipment group has the highest percentage of leased equipment (33% of total).
- Most equipment is multi-purpose with the ability to switch purposes with the appropriate attachment. There are various plow blades (front, wing, reversible for a truck, a loader or a sidewalk plow). There are blower attachments for loaders and sidewalk machines and spreader attachments for the sidewalk machines as well.
- The hired equipment listed includes equipment generally dedicated to winter operations, most often to running a particular salt or plow beat. It does not include trucks hired for snow removal on an as required basis.

Vehicles/Equipment

Total equipment by area (includes city, hired and leased)

	East	West	South	Core	Special Ops
Backhoe	13	9	7	4	0
Grader Plow	35	15	22	25	0
Heavy Spreader Plow	40	51	53	30	14
Light Plow	4	7	8	5	4
Loader Plow	14	4	11	14	3
Loader with Bucket	28	13	5	4	0
Sidewalk Machine	36	20	23	47	0
Tractor	3	4	4	2	1
Yard Loader	5	4	4	2	1
Total	179	123	144	155	24

Vehicles/Equipment

Equipment details by zone

West, South and East

	Pieces of Equipment
West	123
Huntley Rd, 2121	30
Asphalt Hot Box Trailer	2
Backhoe	1
Grader Plow	3
Heavy Spreader Plow	12
Light Plow	2
Loader Mounted Blower	1
Loader Plow	1
Sidewalk Machine	5
Tractor	2
Yard Loader	1
John Shaw Rd, 4127	17
Asphalt Hot Box Trailer	1
Backhoe	1
Grader Plow	3
Heavy Spreader Plow	10
Light Plow	1
Yard Loader	1
Maple Grove, 1655	57
Asphalt Hot Box Trailer	2
Backhoe	6
Grader Plow	5
Heavy Spreader Plow	20
Light Plow	3
Loader Mounted Blower	2
Loader Plow	3
Sidewalk Machine	14
Tractor	1
Yard Loader	1
March Rd, 2847	19
Asphalt Hot Box Trailer	1
Backhoe	1
Grader Plow	4
Heavy Spreader Plow	9
Light Plow	1
Sidewalk Machine	1
Tractor	1
Yard Loader	1

	Pieces of Equipment
South	144
Moodie Dr, 1159	68
Asphalt Hot Box Trailer	2
Backhoe	3
Grader Plow	12
Heavy Spreader Plow	19
Light Plow	3
Loader Mounted Blower	4
Loader Plow	8
Sidewalk Machine	15
Tractor	1
Yard Loader	1
Rideau Valley Dr, 4244	38
Asphalt Hot Box Trailer	2
Backhoe	2
Grader Plow	5
Heavy Spreader Plow	15
Light Plow	2
Loader Mounted Blower	1
Loader Plow	2
Sidewalk Machine	6
Tractor	2
Yard Loader	1
Roger Stevens Dr, 2145	15
Asphalt Hot Box Trailer	1
Backhoe	1
Grader Plow	2
Heavy Spreader Plow	8
Light Plow	1
Sidewalk Machine	1
Yard Loader	1
Scrivens Dr, 2481	23
Asphalt Hot Box Trailer	1
Backhoe	1
Grader Plow	3
Heavy Spreader Plow	11
Light Plow	2
Loader Mounted Blower	1
Loader Plow	1
Sidewalk Machine	1
Tractor	1
Yard Loader	1

	Pieces of Equipment
East	179
Colonial Rd, 2264	21
Asphalt Hot Box Trailer	1
Backhoe	1
Grader Plow	4
Heavy Spreader Plow	8
Light Plow	3
Loader Plow	1
Sidewalk Machine	1
Tractor	1
Yard Loader	1
Conroy Rd, 3100	42
Asphalt Hot Box Trailer	2
Backhoe	3
Grader Plow	9
Heavy Spreader Plow	9
Loader Mounted Blower	2
Loader Plow	4
Loader with Bucket	3
Sidewalk Machine	8
Tractor	1
Yard Loader	1
Cyrville Rd, 1951	36
Asphalt Hot Box Trailer	1
Backhoe	3
Grader Plow	3
Heavy Spreader Plow	7
Loader Mounted Blower	2
Loader Plow	5
Loader with Bucket	5
Sidewalk Machine	9
Yard Loader	1
Industrial Ave, 911	40
Asphalt Hot Box Trailer	2
Grader Plow	10
Heavy Spreader Plow	8
Loader Mounted Blower	2
Loader Plow	2
Loader with Bucket	5
Sidewalk Machine	10
Yard Loader	1
Trim Rd, 2035	40
Asphalt Hot Box Trailer	1
Backhoe	6
Grader Plow	9
Heavy Spreader Plow	8
Light Plow	1
Loader Mounted Blower	1
Loader Plow	2
SDF Dozer	2
Sidewalk Machine	8
Tractor	1
Yard Loader	1

Equipment

Equipment details by zone

Core and Special Operations

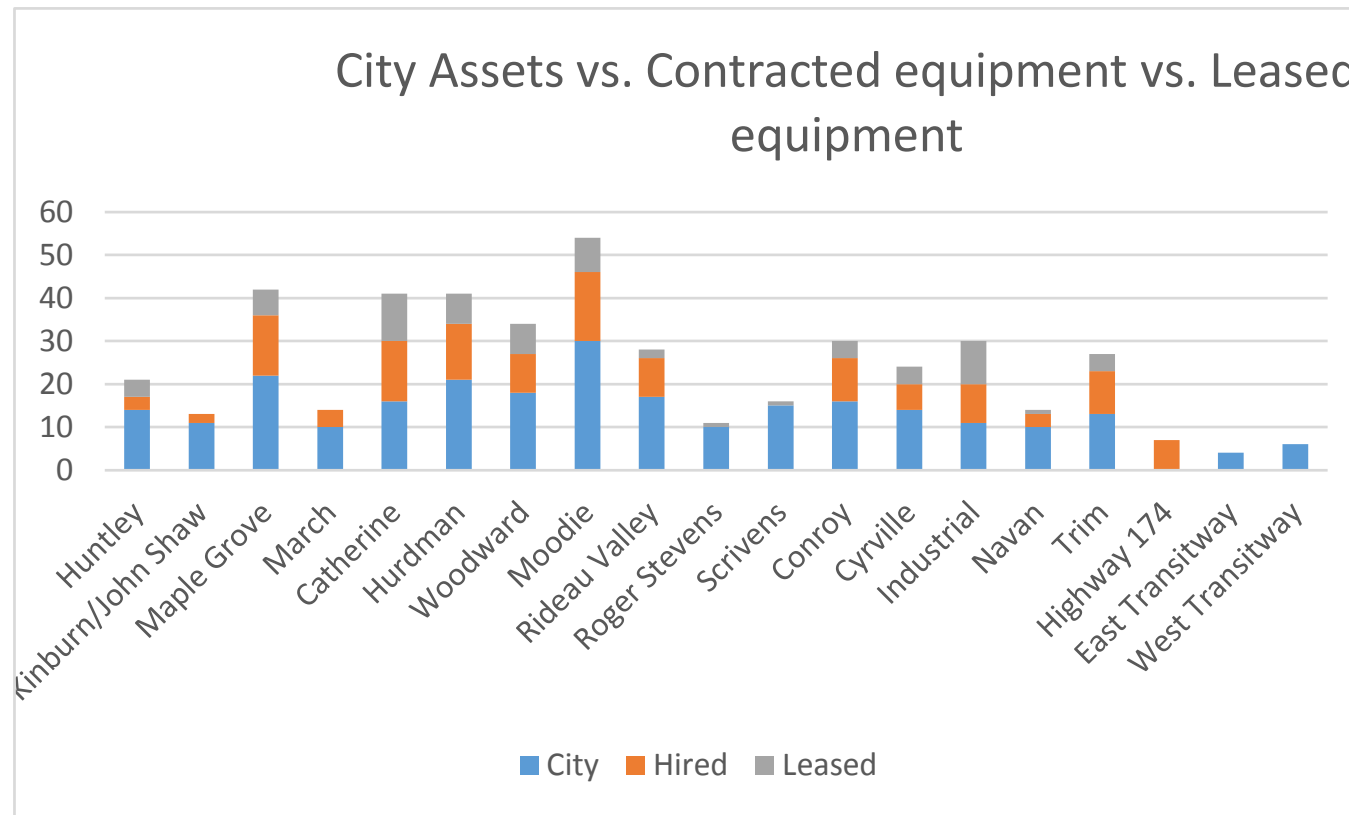
	Pieces of Equipment
Core	155
Catherine St, 380	53
Asphalt Hot Box Trailer	3
Backhoe	1
Grader Plow	9
Heavy Spreader Plow	10
Light Plow	1
Loader Mounted Blower	3
Loader Plow	3
Loader with Bucket	3
Sidewalk Machine	19
Yard Loader	1
Hurdman Rd, 29	54
Asphalt Hot Box Trailer	3
Backhoe	2
Grader Plow	7
Heavy Spreader Plow	10
Light Plow	2
Loader Mounted Blower	4
Loader Plow	7
Loader with Bucket	1
Sidewalk Machine	17
Tractor	1
Woodward Dr, 1683	48
Asphalt Hot Box Trailer	3
Backhoe	1
Grader Plow	9
Heavy Spreader Plow	10
Light Plow	2
Loader Mounted Blower	3
Loader Plow	4
Loader with Bucket	4
Sidewalk Machine	11
Tractor	1

	Pieces of Equipment
Special Ops	24
Industrial Ave, 911	5
Heavy Spreader Plow	3
Light Plow	1
Loader Plow	1
Moodie Dr, 1159	10
Asphalt Hot Box Trailer	1
Heavy Spreader Plow	5
Light Plow	2
Loader Plow	1
Tractor	1
Trim Rd / Hwy 174	9
Heavy Spreader Plow	6
Light Plow	1
Loader Plow	1
Yard Loader	1

Equipment

Most of the equipment used in snow clearing operations are City owned assets.

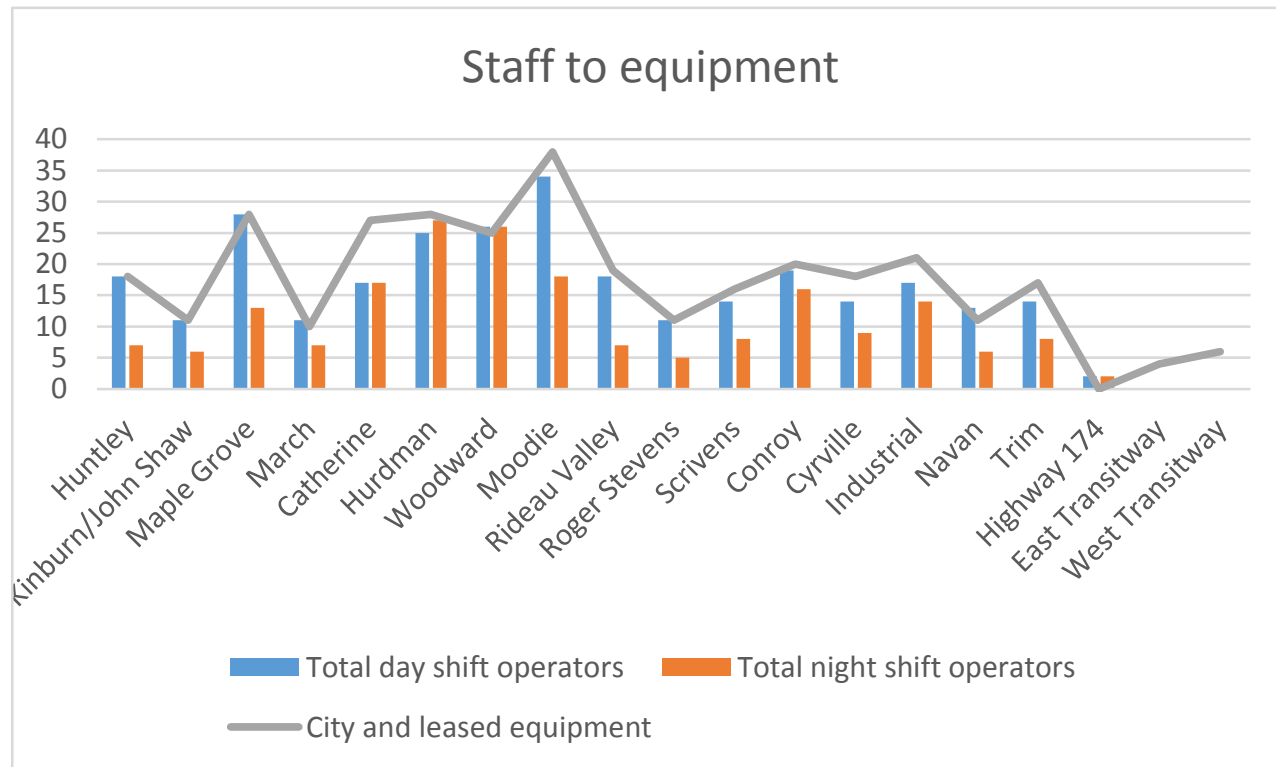
The leased equipment is also operated by City staff. There is little hired equipment use in the rural areas, none on the transitway and considerable in the central and east areas. Highway 174 is fully contracted.



*Excludes trucks hired for snow removal

Equipment

Across all zones and area classifications, there appears to be a balanced proportion of key pieces of equipment (spreaders, graders, loaders and sidewalk machines) to the number of staff in a location. There are very few dedicated “spare” machines, although most zones will have one of each key type, or will share one. In most cases when vehicles are down, vehicles assigned to low priority routes are diverted to higher priority routes and work on the low priority route not covered is shared out among other operators.



Vehicle Maintenance Regime

- Fleet Services is responsible for acquiring, preparing and maintaining vehicles and equipment. Equipment requirements and specifications are established in dialogue between Fleet and Roads – taking into account the budget approved. (Roads must have budget for new equipment, while replacements are funded by the annual contributions to the Vehicle and Equipment Reserve).
- All equipment requires an annual inspection to ensure it meets provincial standards. This ensures safety and operability, but it also must be outfitted and tested for its winter duties. This may involve switching attachments and ensuring hydraulics and controls work properly.
- Fleet endeavors to complete both these tasks over the summer and fall, with a view to having some of fleet available by November 1st and all of it available by December 1st. This has been a challenge in the past, particularly for vehicles that have other uses in the summer, and therefore cannot be pulled from service for the required work until the fall. Fleet and Roads have been working to improve the situation.
- During the winter, Fleet garages are responsible to provide service for any breakdowns or damage that occurs. Vehicles in the east and most of the core area are generally required to bring vehicles to Swansea for repairs. Garages at the Manotick, Moodie, Clyde and Iber Road facilities provide support to operations in the west and south, reducing the requirements for travel to repair facilities.

Vehicle Maintenance Regime

- Fleet Services mirrors Roads shifts in the winter, and when Roads staff is called in for operations on overtime, Fleet also tends to call in technicians to provide repairs for problems that develop during the event.
- There have been some issues with machines out of service for protracted periods, often reported as parts availability issues. We heard some comments that Swansea does not always provide priority to snow vehicles and repairs can take some time there. However generally speaking, both operators and management indicated Fleet Services is providing good support to Roads winter maintenance operations, and equipment is generally available to meet needs, and always available to meet priority needs.



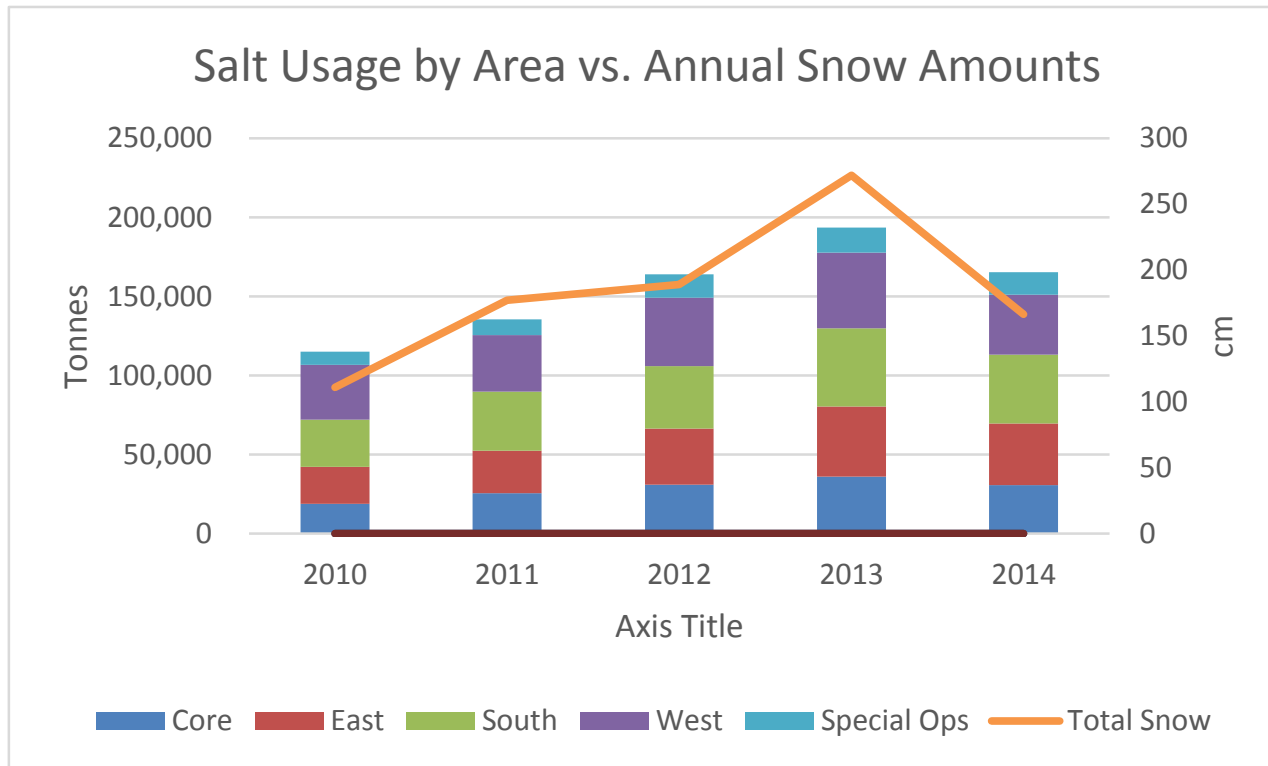
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Salt Use

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Salt Usage

Roads application of winter materials has been growing. The volumes do appear to correlate with the amount of total annual snowfall.



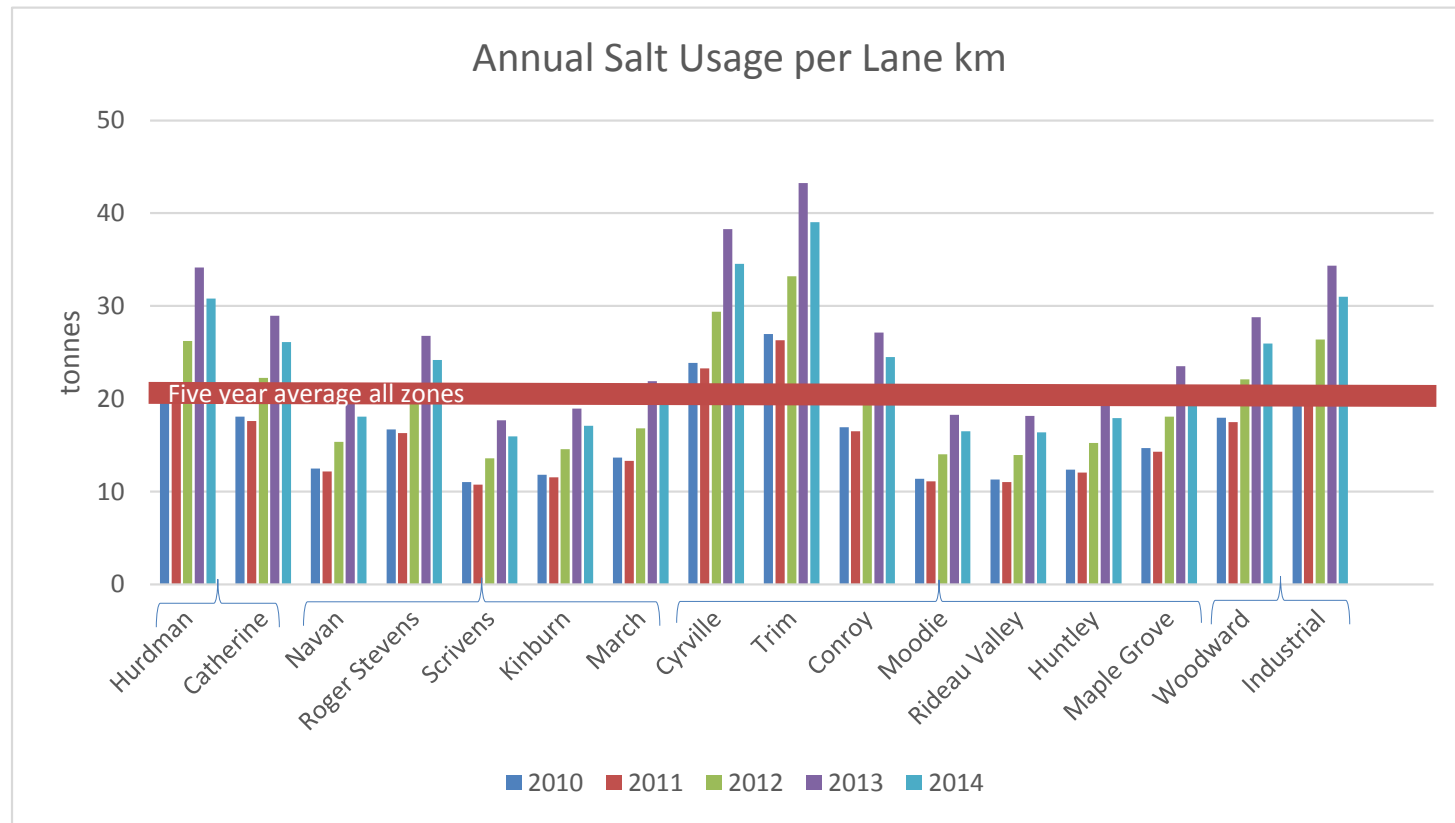
Salt use has been growing

The City has been working to minimize salt use in recent years.

- Salt application rates have been set in the Salt Management Plan.
- All combos (tandem trucks) used for salting have GPS systems that record where salt is applied, and at what rate.
- Combos are calibrated to ensure salt is actually distributed at the rate that is set, and the actual salt usage by each vehicle over each event is tracked and compared to expectations, so that combos that are dispensing too much or too little salt are identified relatively quickly.
- Staff from management through to operators seem aware of the issue and conscious of the need to stick to the plan. Operators do have the ability to “blast” particular areas, but this does seem to be used as intended, for hills and intersections.
- The cold temperatures in 2014 likely contributed to heavier salt use.
- Continuing pressure from the public and the growing expectation that roads will be kept bare at all times may be increasing the frequency of salt runs and salt use.

Salt Use by Zone

- The table below shows the salt user per lane km in each zone.
- All zones follow trend of increasing salt usage.
- Zones salting in the same type of area (i.e., rural and suburban) appear to use similar amounts except Cyrville and Trim. These zones are quite a bit above the average and are the heaviest users within the suburban areas.



***Does not include sidewalks**

Salt Inventory Management

Maintaining accurate inventories of materials used in winter maintenance operations can be challenging, and the Auditor General noted that the department was not able to accurately reconcile its salt usage.

Manual recording of material usage data may require operators to make assumptions about quantities used, and inconsistencies are often identified when trying to reconcile data recorded by operators or salt spreader controls with material stockpiles.

A review of salt measurement and reconciliation processes in other cities was conducted.

A majority of the roads organizations reviewed have adopted Environment Canada's Code of Practice for the Environmental Management of Road Salts and meet the reporting standards contained within. Quebec, however, has implemented an independent road salt strategy, the Environmental Management Plan under the Ministry of Transportation, based on the principles of the Code but does not report to Environment Canada.

We found three common ways for measuring use of salt:

1. Loader Bucket Count
2. Automated recording by Global Positioning System, Automatic Vehicle Location Technology
3. Spreader Control Readouts.

Salt Inventory Management

Loader Bucket Count

- This was the most frequently used method reported by the cities contacted. The largest issue with this method is that the actual volume of salt within the buckets may vary, resulting in inaccuracies when calculating based on a standard bucket volume.
- Some solutions to improve accuracy can be to employ loader ramps to reduce spillage, and loader scales to report actual weights, but variances are still expected when evaluating against year end inventory actuals.

Global Positioning System (GPS), Automatic Vehicle Location (AVL) Technology

- This is the method used most by the City of Ottawa, with the others are used for backup purposes.
- Winnipeg evaluates volume of salt use based on the distance travelled by operators in kilometers, and are in the process of re-implementing AVL tracking to be consistent with city-wide standards being implemented for city equipment.
- There continues to be a variance between the volumes estimated based on GPS and AVL technology, or distance covered, and the actual year end inventory amounts as changes in moisture and weight can effect the salt output on the roads. Winnipeg currently estimates annual variances of 5-10% between the weight delivered and the weight put onto the road. For this reason, the city relies on reporting their actual use on a monthly basis using the procurement invoices for actual salt and their actual inventory amounts.
- Gatineau tries to measure salt usage with daily reports from the salt trucks controllers (“Dickie John’s”) – but is still only getting reports from half the trucks, so doesn't know whether this approach will be successful.

Spreader Control Readouts

- Edmonton evaluated volume of salt used based on spreader control readouts from their equipment calibrations.
- Margin for error based on Spreader Control Readouts can be the lowest of the three methods of measurement, as long as calibration is conducted frequently and consistently. Despite a relatively low margin of error, the City of Edmonton continues to rely on invoices to report the actual volume of salt use for year end reporting.
- Additionally, the City of Calgary reports it employed the spreader control readout method previously, but found that the additional burden on operators made the practice highly inefficient, outweighing the benefits of employing it. They transitioned back to the Loader bucket count method.

Salt Inventory Management

Although a number of cities used some forms of measuring salt use, reporting was generally based on salt procurement with year end inventory assessments. Gatineau does send random supplier delivery trucks to a scale to test invoice accuracy – and has never identified a shortage.

None of the cities contacted have been able to reconcile salt purchases and salt use. The inaccuracies in measuring salt have been too significant regardless of measurement method employed.

The reporting conducted by Ottawa based on procurement and year end inventories is consistent with the majority of other jurisdictions, and abides by the standards set out within the Code.



Contracting

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Contracting

The use of contracting – measured in terms of expenditures, varies widely by area and by activity. Overall, 28% of winter maintenance expenditures (excluding materials) was spent on contract services.

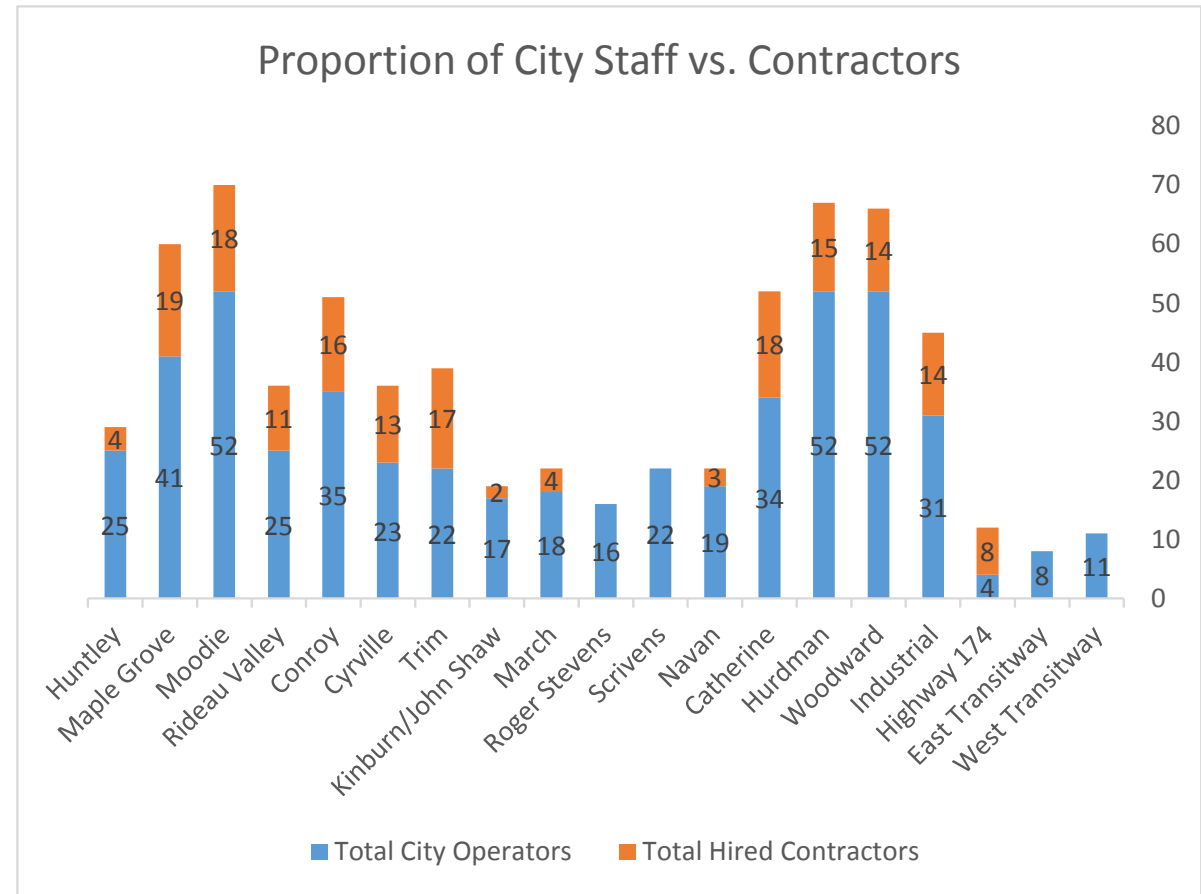
2015 Contracting as % of Expenditures (Excluding Materials)						
	Central	East	South	West	Spec Ops	Total
Salting	0%	4%	6%	20%	86%	12%
Plowing	45%	58%	42%	33%	n/a	48%
Sidewalks	37%	28%	31%	33%	n/a	33%
Snow Removal	64%	36%	24%	45%	62%	46%

- Salting is generally not contracted, except for the two area contracts, the contract in south Kanata and the Hwy 174 contract.
- There is significant contracted plowing in all areas, although as the next page shows, it varies widely by zone, within the areas.
- Sidewalk plowing is contracted to some extent in each area, but again, varies by zone.
- Snow removal is concentrated in the central area, where there is considerable contracting. Special Operations also relies heavily on contracting snow removal, both along the roadways and at the Park & Ride lots. The suburban areas have snow removal requirements that are easier to accommodate with in-house staff between events.

Contracting

The extent of contracting for salting, plowing and sidewalks varies considerably by zone.

- Maple Grove has an area contract in Bridlewood and Special Operations has an area contract for Hwy 174 (supplemented by some staff operations). Both are legacies from before amalgamation.
- The rest of contracted services are hired equipment – some of which are particular beats assigned to contractors, and a significant part is hired equipment, particularly trucks, to support snow removal operations.



Contracting

Some other cities do much more:

- Quebec City does about 45% of its services using area contracts. There are external contracts for entire areas (payable depending on snowfall), machinery rental (grader, guaranteed hours), trailers, personnel performing snow removal for parking, as well as manual removal (such as for stairs). In addition to all the services listed above, the operation of snow dumps is also performed by contract.
- London has a core of salt trucks and plows on staff, but expands with contractors for a full scale operation, with about 40% of the budget being spent on external services.
- Edmonton spends approximately 43% of their budget on external services, with these services including; hired graders and hired trucks for snow removal, hired loaders for sanders, contracted sidewalk plowing (50% of sidewalk plowing), hired dozers for snow storage sites, and contracted snow clearing at civic buildings.
- Winnipeg does about 20% of its services using area contracts. The city maintains 10 area snow contracts, which encompass all street priorities, with three (3) of the contracts including sidewalks. The city does not use contracting for sanding and salting, as they consider this a first response which they can respond to more efficiently internally than through the use of contractors.
- Gatineau contracts specific beats, with some contracted at a fixed annual price, and also leases equipment. In total, Gatineau spends approximately 15% of their budget on external services.

Contracting Analysis

This analysis looks at the cost of running salt and plow beats with in-house staff and compares with the cost of using contracted “hired” equipment. This approach requires the contractor to make the equipment available, including conducting all maintenance required, and to provide an operator for the equipment when required to run the beat. Contracts usually provide for a “standby” cost per day (within the winter season) that the equipment is available for use, plus a payment per hour for time when the equipment is actually in use.

Approach

The analysis uses a variety of approaches depending upon the data available in each case:

- 1) The salt beat analysis draws on the financial data for 2015 to identify average expenditures for contracted and in-house beats. It then uses the database of time and cost records to determine the number of hours worked by each category to allow an adjusted comparison.
- 2) The plow beat analysis uses the cost of in-house and contracted services in each zone as reported in the hour and cost database, to identify the unit costs.

Note that adjustments to allow for corporate overhead and for P3 paid time were included in the analysis as described on the pages that follow.

Contracting Analysis

Consideration of Overhead

- The 2014 “Allocation Workbook” provided by the Finance Services Unit (FSU) gives all corporate overheads and allocates the costs among departments and units.
- The amounts allocated to either Roads or to Winter Control where broken out, are shown at right.

	Roads	Winter
A/P	15,842	
A/R	-	
Budgeting (time)	52,308	-
Compensation Mgmt	204,905	72,505
Facility & Property	2,915,838	
Fleet (overhead)	2,004,628	
Fleet (vhicle rentals)	30,719,205	
Health & Safety	151,054	53,450
HR Counselling	32,485	11,495
IT App Delivery/Data Mgmt	2,555,803	
Infrastructure tool access (data/voice)	1,498,380	
Insurance/Risk Mgmt	15,883	603
Labour & Emp Relations	111,483	35,556
Mailroom	67,127	1,484
Payroll	359,329	
FSU	1,408,371	
Program Accounting	-	
Prm Specific Comms	537,288	
Pgm Legal Support (time)	212,822	25,254
Purchasing (transactions)	559,320	301,296
Records Mgmt	63,452	22,451
Staffing	714,810	

Contracting Analysis

Consideration of Overhead

- The table at right shows the approach used for allocating these costs to in-house activities and to contracted activities.
- Some costs are relative to the number of FTEs (compensation management) while others are shown as a percentage of total expenditure (FSU).
- Some overhead costs apply to contracts (FSU), while others do not (payroll).
- There are some overhead costs within the department (management, Program Support) but they apply equally to in-house and contracted services, so they can be ignored.
- The conclusion is that in-house costs should be marked up by 16.83% plus \$1,517.55 per FTE to cover corporate overhead. Contracted costs should be marked up 5.95% plus \$45.,48 per contract.

	In-House		Contracted	
	\$/FTE	% of cost	% of Cos	\$/contract
A/P				45.48
A/R				
Budgeting (time)		0.02%	0.02%	
Compensation Mgmt	242.49			
Facility & Property		4.75%		
Fleet (overhead)		6.53%	0.00%	
Fleet (vhicle rentals	actual cost			
Health & Safety	178.76		0.00%	
HR Counselling	38.44		0.00%	
IT App Delivery/Data Mgmt		1.09%	0.54%	
Infrastructure tool access (data/voice)		0.64%	0.64%	
Insurance/Risk Mgmt		0.01%	0.01%	
Labour & Emp Relations	118.92		0.00%	
Mailroom		0.00%	0.00%	
Payroll	314.10			0
FSU		2.29%	2.29%	
Program Accounting				
Prm Specific Comms		0.87%	0.87%	
Pgm Legal Support (time)		0.04%	0.04%	
Purchasing (transactions)		0.49%	1.47%	
Records Mgmt		0.10%	0.05%	
Staffing	624.83		0.00%	
	1,517.55	16.83%	5.95%	45.48

Contracting Analysis

Approach Concerning Time Productivity

This analysis looks at paid time that is spent on unproductive or low priority activities (see pages 100 to 110). Zones tend to have at least 10% of paid hours as P3 time, and as much as 25%.

The on-call and standby time is particularly relevant as it is not coded to salting and sanding activities included in the analysis, but it is a cost that must be incurred if in-house staff is used for these purposes.

When contractors do receive standby payments, the costs are included in the contract costs – so equivalent costs need to be included for in-house services.

The average zone has 13% to 14% on call, standby and yard duty time, and about 18% P3 time in total. The analysis that follows increases in-house costs by 15%, assuming that, on average, that amount of additional paid time could be avoided.

	On call/ standby and yard duties as % of total time	All P3 as % of total time
Min	6%	10%
Max	21%	25%
Median	13%	18%
Mean	14%	18%

Contracting Analysis – Salt Beats

The table below shows the analysis for salt trucks.

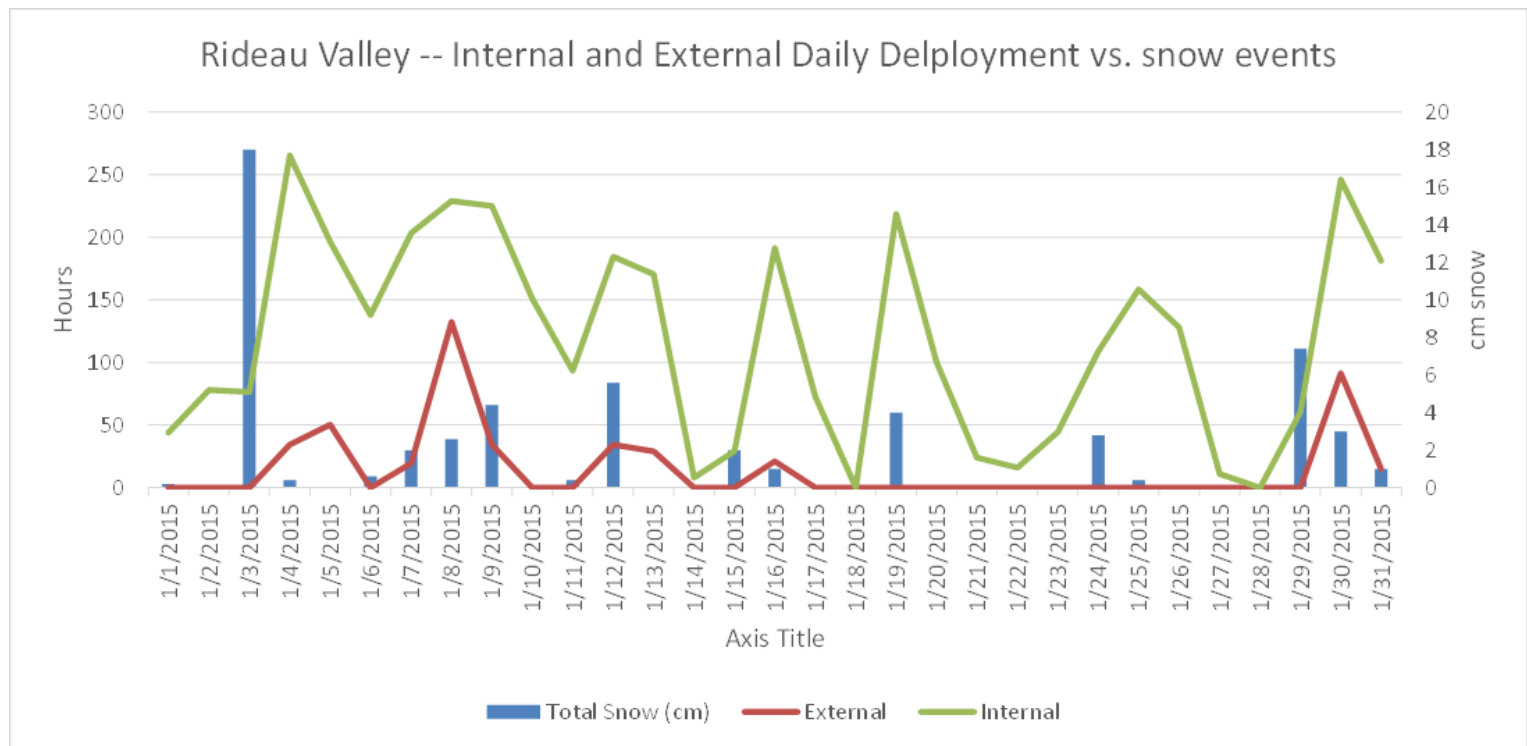
- Four zones had both contracted and in-house salt beats. The contracted salt trucks tended to be run only half as many hours as the in-house salt trucks. The graphs on the following pages suggest in Rideau Valley this is largely due to small weather events which are handled entirely in-house, while both in-house and contracted units are used for larger events. However at Huntley, the extra time seems to be a result of running beats longer (e.g. running them a second time after the event) using available time when there is little other activity to assign.
- The cost of contracted beats is much lower, but on a per hour basis, the cost after adjustments is essentially the same.

	In-House					Contracts				
Salt Trucks	Cost	Units	Hours	Cost / Beat	Cost / Hr	Cost	Units	Hours	Cost / Beat	Cost/ Hr
Huntley	694,921	4	6361	173,730	109	354,643	3	2303	118,214	154
Rideau	1,079,238	6	9973	179,873	108	196,545	3	1712	65,515	115
Navan	735,214	5	6606	147,043	111	137,559	1	1084	137,559	127
Kinburn	707,018	5	6400	141,404	110	96,454	1	664	96,454	145
Average/unit			1467	160,820	109.62			720	98,150	136.25
With Adjustments										
Overhead				188,492	129				104,036	144
P3 (Standby, etc.)				216,766	148				104,036	144

Contracting Analysis – Salt Beats

The chart below can help assess the importance of the difference in hours between contact and in-house forces.

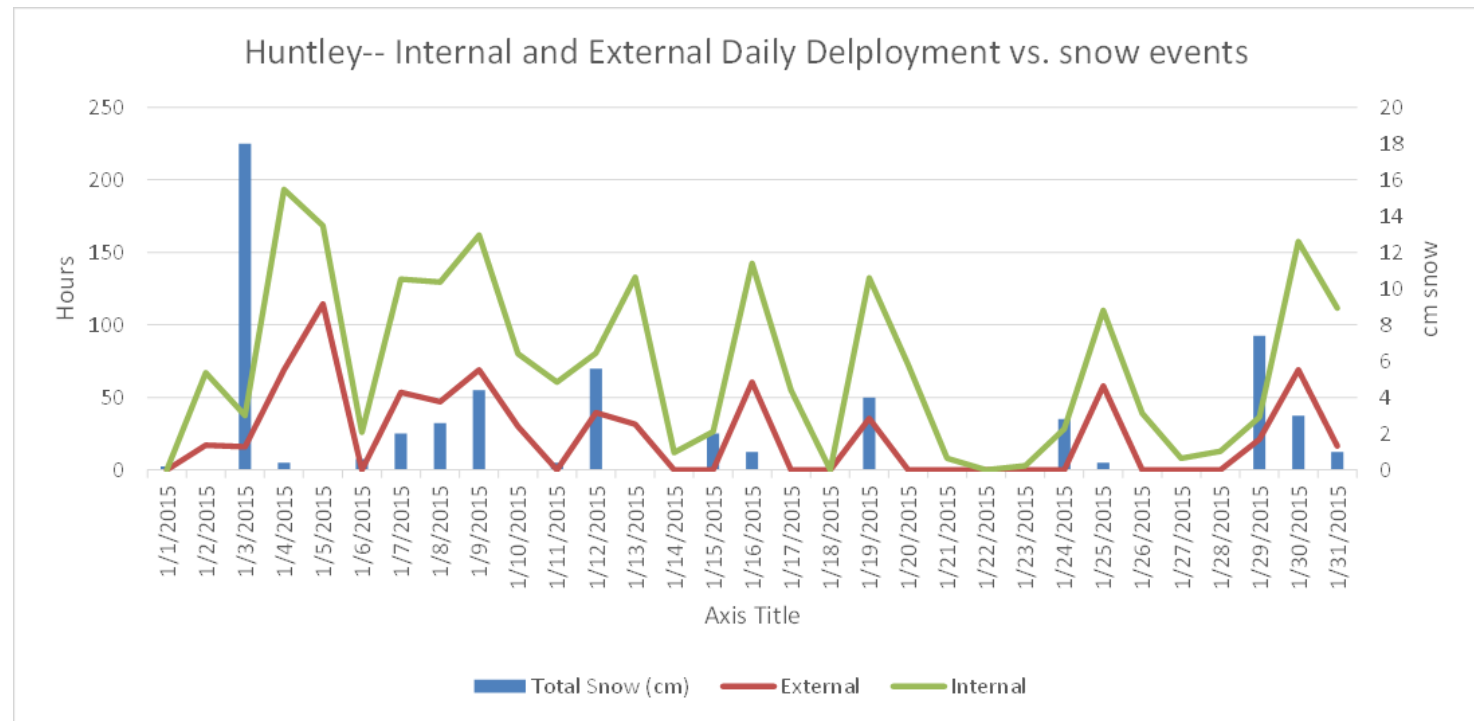
- At Rideau Valley some small events are only covered by the in-house resources (see January 19 to January 29) essentially using the approach of extending salt beats so all lanes are covered over three hours, but with fewer resources spreading two lanes at a time. The time shown is for six in-house units and three contracted units.



Contracting Analysis – Salt Beats

Huntley also has fewer hours on the contracted salt beats (graph shows four in-house units and three contracted units).

- However the contracted units are out for each event. It appears the in-house units either take longer to do their beats, or more likely, run them more than once, sometimes the day after an event (Jan 6, 17, 20, 26). With the high P3 time at the yard, it makes sense to run the beats and tidy up rather than sit idle, but the cost to run in-house and external units per hour is very similar, so running extra hours in-house does increase costs.



Contracting Analysis – Salt Beats

Contracting at least half of the salt beats in each yard would accommodate the Rideau Valley approach of handling some events in-house, while reducing the number of in-house resources that may be used for unnecessary runs. More than half the units in rural areas could be contracted, given the higher rate of low priority time – even without counting the extra runs identified on the previous page. There does not appear to be adequate non-plow/salt work to effectively engage in-house staff at rural yards like Huntley.

- 38 additional salt beats could be considered for contracting while keeping half the salt beats in-house. The approach would make it easier to implement the longer salt beat option under service levels. There will be additional savings through reduced duplicate runs, however those savings are hard to estimate as the practices vary by yard. In Huntley savings could be \$30K per route if the costs of in-house routes were reduced to those at Navan and Kinburn. Over-all potential savings may amount to \$10,000 per salt truck converted, or potentially \$380,000, although further work will be required to confirm the estimate.

A review of the salt truck contracts also identified:

- A wide range in quoted rates, with a number at \$135 per hour, and a number in the \$170 to \$178 per hour range.
- The Hwy 174 contract for five salt units provides a higher standby fee (\$150 per day vs. \$60 per day) and much higher guaranteed annual hours (1100 per vehicle vs. 400 hours) than the hired equipment contracts at some zones, but the cost per hour is still \$150, well above the \$135 rate charged by some contractors – although below the \$178 maximum.
- This suggests that efforts to create a more competitive market for supply of salt trucks could result in savings.

Contracting Analysis – Plow Beats

The table below compares contracted and in-house plowing using the database of work hours.

- The contracted plow units are much less expensive per hour (54% less expensive), although the average beat is more expensive. Contracted beats tend to be run more than twice as many hours, on average, as in-house plow beats, explaining the higher cost per beat – although there is wide variation between zones in terms of how many hours are run – and how much plow beats cost. The range of costs for the plowing contractors suggests some efforts to create a more competitive market could reduce costs.

	Plowing Contractors				Internal Plow Beats			
	# of units	\$/hour	With O/H & P3	Cost per beat	# of units	\$/hour	With O/H & P3	Cost per beat
March	3	\$108.06	\$114.49	\$14,521	2	\$101.95	\$137.81	\$34,710
Catherine	7	\$91.70	\$97.16	\$45,351	11	\$109.74	\$148.28	\$16,001
Conroy	6	\$90.88	\$96.29	\$44,267	6	\$122.32	\$165.19	\$46,461
Cyrville	3	\$85.62	\$90.72	\$39,583	5	\$127.80	\$172.54	\$36,757
Hurdman	4	\$106.54	\$112.88	\$38,152	16	\$121.99	\$164.74	\$24,643
Industrial	8	\$92.96	\$98.50	\$35,852	7	\$109.17	\$147.51	\$29,007
Maple Grove	4	\$119.64	\$126.76	\$43,224	7	\$127.18	\$171.71	\$16,250
Moodie	11	\$101.84	\$107.89	\$34,281	14	\$125.67	\$169.68	\$20,784
Navan	2	\$92.69	\$98.21	\$33,611	3	\$112.09	\$151.44	\$57,901
Rideau Valley	5	\$87.97	\$93.21	\$22,807	6	\$104.77	\$141.60	\$10,480
Trim	9	\$89.64	\$94.97	\$31,331	6	\$123.68	\$167.01	\$16,860
Woodward	4	\$84.98	\$90.04	\$38,739	18	\$114.79	\$155.06	\$21,298
Average	67	\$94.93	\$100.58	\$35,190		\$114.79	\$155.06	\$17,274
% Difference						21%	54%	

Contracting Analysis – Plow Beats

The database identifies \$2,442,000 spent on in-house plowing in 2015.

- Contracted plowing is about 35% less expensive than in-house plowing by the hour (in-house plowing is 54% more expensive).
- The plowing activity is less frequent than other winter activities, with hours per beat ranging from 100 to 400, and contracted beats tend to have more hours of service – in contrast to the salting beats.
- If the same hours of service were provided, but all in-house hours were carried out by contractors, the savings could be as high as 35%, or \$850,000, or about \$12,000 per beat.
- In practice, some in-house resources may be required for functions that cannot be performed during snow events, which would suggest using those resources for plowing rather than having them be idle, which would reduce the savings to the \$500,000 to \$600,000 range. However there is clearly no advantage to setting staff levels based on plowing requirements and then looking for other activities to fill downtime.

Area Contract Analysis

Area Contract Approach

The Department conducted an analysis which showed the costs of the Goldie Mohr contract compared to the costs of similar services provided by in-house resources (Department Summary Table shown at right, with comparative total added).

- The analysis does not consider the cost of corporate overhead or low priority time – which are included on the next page.
- Fleet costs and fully burdened wages are already included.

	Goldie Mohr Area Maintenance Contract		Maple Grove City Forces	
Roadway Beats	# of Beats	Lane KMs	# of Beats	Lane KMs
W2010-11	6	90.506	15	470.24
W2011-12	6	93.394	15	483.756
W2012-13	6	95.03	15	489.766
W2013-14	6	100.328	15	489.828
W2014-15	6	101.464	15	492.306
\$ Spent on Roadway Salting and Plowing Activities	TOTAL	\$ / Ln KM	TOTAL	\$ / Ln KM
W2010-11	431,684.64	4,769.68	1,101,522.36	2,342.47
W2011-12	470,388.34	5,036.60	1,012,164.66	2,092.30
W2012-13	562,420.36	5,918.35	1,064,363.64	2,173.21
W2013-14	529,837.50	5,281.05	1,076,814.50	2,198.35
W2014-15	465,515.25	4,587.98	1,227,042.75	2,492.44
Five Year Average		5,118.73		2,259.75
Sidewalk Beat Stats	# of Beats	Lane KMs	# of Beats	Lane KMs
W2010-11	4	65.6	9	171.47
W2011-12	4	67.74	9	188.78
W2012-13	4	73.14	9	192.45
W2013-14	4	75.48	9	190.71
W2014-15	4	75.48	9	190.71
\$ Spent on Sidewalk Plowing Activities	TOTAL	\$ / Lin KM	TOTAL	\$ / Lin KM
W2010-11	151,943.46	2,316.21	432,972.54	2,525.06
W2011-12	177,400.00	2,618.84	472,539.00	2,503.12
W2012-13	230,528.57	3,151.88	493,381.43	2,563.69
W2013-14	302,900.00	4,012.98	580,693.00	3,044.90
W2014-15	255,198.90	3,381.01	617,904.10	3,240.02
Five Year Average		3,096.19		2,775.36
# of Bus Stops *** 2014-15 Numbers	159		659	
\$ Spent on Bus Stop Activities	TOTAL	\$ / Bus Stop	TOTAL	\$ / Bus Stop
W2010-11	19,449.35	122.32	17,610.65	26.72
W2011-12	5,563.62	34.99	38,396.38	58.26
W2012-13	13,049.80	82.07	30,505.20	46.29
W2013-14	22,277.50	140.11	41,633.50	63.18
W2014-15	32,492.10	204.35	90,034.90	136.62
		116.77		66.22
Total Cost for Contract Scale of Work		771,634		449,296

Area Contract Analysis

- The table below adjusts the costs of the contract for Goldie Mohr to include the appropriate overhead allocation, and it adjusts the costs of the in-house operation to account for overheads and for the costs of P3 time. The on-call, standby and yard duties time averages about 13% of paid time, while the total P3 time averages 18%. The table below considers this range of P3 time. Note that actual P3 time at Maple Grove is higher, but this has not been factored in.

	Goldie Mohr Area Maintenance		Maple Grove		
	With Overhead	With P3 time	With Overhead	With 13% P3 time	With 18%
Roadway Beats (per lane km)	5,423.39	5423.39	2,658.57	3004.18	3137.11
Sidewalk Beats (per km)	3,280.41	3280.41	3,271.10	3696.34	3859.89
Bus StopActivities (per stop)	123.72	123.72	77.36	87.42	91.28
Total Cost for Contract Scale of Work	817,555	817,555	528,951	597,715	624,163

- Thus the contracted approach appears to be about 24% to 27% more expensive, even with an 18% allowance for standby and other P3 time.
- This difference largely relates to the contract terms. The table at right shows that the cost of equipment is much higher under the area contract than it is for hired equipment generally.
- There would be savings of about \$220,000 to \$245,000 to bring this work in-house, or about the same if the work was contracted out at rates equivalent to the average hired equipment rates.

Hourly Cost for Equipment (Before Overhead and P3)		
Activity	Goldie Mohr	Hired Equipment
Salting	\$217.97	\$136.25
Plowing	\$124.55	\$94.93
Sidewalks	\$103.79	\$95.44

Contracting - Summary

Extending the contracting of salt beats in areas where duplicate runs are filling available time may save \$380,000 (see page 140).

Converting all plowing to contracted resources could reduce costs by about \$850,000, however it may be necessary to retain some in-house resources for other tasks that cannot be performed during snow events, which could reduce the number of beats that are converted, so savings of \$500,000 to \$600,000 would seem more realistic (page 142).

The existing area contract with Goldie Mohr should be discontinued with potential savings of \$220,000 to \$245,000 per year. (page 145).

Efforts to improve the competitive market, bringing more hired equipment rates in line with the lower rates, and bringing the costs of the Highway 174 contract in line with terms of other hired salt truck units should reduce costs, although no specific estimate of savings can be provided without new tender figures.



Tender Approach

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Tender Approach

Issue

The approach to hiring trucks for snow removal has been evolving, but still does not provide the lowest cost solution possible.

Approach

The tender documents were reviewed.

Observation

The standing offer for hiring trucks to support snow removal has two different call out systems:

- a) For tandem trucks, call out is based on price – the lowest priced trucks are called first.
- b) For dump trucks, call out is based on seniority – the number of successive years the vendor has worked with the City. Every vendor whose price is within 5-10% of the average of prices (e.g. no more than 15% higher than the average) is included on the list and gets called out as frequently as anyone else.

As a consequence, there is no incentive to vendors to bid low as long as they are within 15% of the average cost. Higher priced dump trucks are being used when lower priced dump trucks may be available.

The contract is currently in its second extension year and a new contract will start in 2017.

Tender Approach

The table below shows the rates charged for various sized trucks – the lowest rate offered by any vendor and the highest rate charged by a qualifying vendor who was added to the supply list.

Truck Size (Cubic Metres)	Min Rate	Max Rate	2015-2016 Total	2014-2015 Total	2013-2014 Total	Previous 3 Year Total
12	\$68.00	\$71.00	\$0	\$0	\$6,055	\$6,055
15	\$72.00	\$83.67	\$10,974	\$22,432	\$65,899	\$99,305
18	\$75.50	\$92.95	\$21,760	\$72,096	\$140,539	\$234,395
20	\$75.00	\$96.50	\$586,661	\$1,451,384	\$2,224,376	\$4,262,420
26 to 39	\$97.00	\$125.00	\$6,234	\$8,648	\$20,650	\$35,532
40 to 49	\$87.00	\$135.59	\$35,693	\$22,078	\$76,564	\$134,336
50 to 59	\$100.00	\$128.00	\$45,859	\$90,047	\$142,679	\$278,585
60 to 69	\$114.00	\$130.00	\$236,159	\$634,452	\$705,080	\$1,575,692
70+	\$118.96	\$129.00	\$33,981	\$126,155	\$305,328	\$465,464
					3 Year Total:	\$7,091,783.82

In some cases the range between the lowest cost provider and the highest cost provider is as much as 56%. For the most frequently used category, the range is 29%. Thus taking the most senior bidder rather than the lowest price bidder could be costing the City 20% more than it need on expenditures of over \$2M per year. It is also likely the entire range of rates is higher than needed given the lack of incentive to bid low.

Tender Approach

Supervisors report some challenges managing some contractors:

- Supervisors reported that a small number of contractors, like some in-house staff, do not deliver all expected benefits on a timely basis. The issues may be equipment that is not available when needed, not showing up when required for service, or inexperience or inattention, producing claims for damages, etc.
- Supervisors noted that managing contractor issues is not much easier than managing in-house staff performance issues, and it should be easier if the contracts provide clear processes for disciplining or correcting poor performance, and when necessary for termination of contracts. There is always a need to encourage potential contractors to invest in equipment and to bid for the work, so contracts cannot be onerous, but clear processes giving the opportunity for improvement and perhaps some compensation for premature cancellation (e.g. offer to purchase equipment at depreciated value – for resale to a new contractor) may give managers better tools to manage contractors.

Tender Approach

Findings

The next tender for snow removal trucks should be designed to encourage lower prices and to use those bidders with lower prices more frequently, generally as often as possible.

- It should be noted that the dump truck owners are organized and have opposed changes in the approach in the past.

Hired equipment contracts should be reviewed before future tender calls to ensure managers have sufficient tools to achieve effective performance – while still encouraging contractor participation.



Public Role

All cost estimates included in this document are based on specific assumptions, sources and hypotheses outlined in the document. Implementation of opportunities for change will require the City to plan and test any changes to help make certain that it will realize any intended outcome. Final benefits realized from implementing any changes will be based on future events and decisions made by the City and will vary from the estimates included in this document. These variances may be material.

Communications to General Public

A variety of communications vehicles are used to advise the public of City winter maintenance activities:

- Winter services information through social and regular media on snow clearing, plow safety, winter parking, potholes and spring cleanup
- Special Advisory media releases (e.g. Snow Assist)
- Special operations advertised in local newspapers
- E-notifications for winter alerts and parking bans (Twitter, email, Facebook, Instagram)
- City's website including visual identification of parking bans with the use of green/red flags to symbolize if a parking ban is on or off
- Call centre (311) available 24/7/365 to handle all inquiries/complaints
- Community information posters on activities (river flood program, grit boxes).

Parking Restrictions

BY-LAW NO. 2003-530 Regulating Traffic and Parking on Highways

Winter Overnight Parking Regulations:

- Winter overnight parking restrictions are in effect throughout the city from November 15 to April 1. There is no parking on city streets between 1 a.m. and 7 a.m. when seven (7) cm or more of snow is forecasted in the Ottawa area by Environment Canada or the City's weather consultant. This includes any forecast for a range of snow of more than seven cm (for example, five to 10 cm).
- On-street parking permit holders are exempt from this restriction.
- All other vehicles can be ticketed, fined or towed, even if the street does not get plowed or we do not receive seven cms of snow as forecasted. Enforcement of winter overnight parking bans continue each evening until snow clearing is completed and the City issues an announcement indicating that the overnight parking restriction has been lifted.

Snow Removal and Street Sweeping Parking Restrictions:

- Snow removal/concentrated street sweeping may be planned during the day or night when no snowfall is forecast.
- Temporary "no parking" signs will be posted ahead of time to alert motorists; vehicles not removed in advance of snow removal operations/concentrated sweeping will be ticketed and towed to a nearby street.
- This restriction applies to all vehicles, including those with on-street parking permits.

Parking Restrictions

BY-LAW NO. 2003-530 Regulating Traffic and Parking on Highways:

- Tickets issued for violations are fairly consistent over the past two seasons.

Violation	2013-2014	2014-2015
Overnight ban tickets	11,647	12,025
Overnight ban warnings	12	0
Interfere with snow clearing tickets	33	389
Snow removal tickets	1,127	1,030
Snow removal warnings	144	177
Towing costs	\$260,821	\$209,746

Despite these provisions, problems remain:

- Parked cars during overnight restrictions inhibit plowing.
- Parked cars during the daytime are also a major problem during residential plow runs (a day shift activity, although it may start by calling staff in early).
- Cars with parking permits are allowed to remain parked during overnight bans – so some streets in areas with parking permits can never be properly plowed.
- Many landowners and contractors clearing snow deposit the snow on City streets and sidewalks, requiring repeat plow runs and accelerating the need for snow removal.

Some Specific Issues Worth Examining

There are some approaches that should be considered to reduce the impact of some of these issues:

1. The practice of landowners dumping the snow from their parking areas onto the street right-of-way is a significant problem in specific areas, generally areas with small front yards, extensive front yard parking and multi-unit buildings. The City has not been successful in preventing this habit, nor of catching and fining the perpetrators. The enforcement process is difficult, requiring clear evidence of who actually put the snow on the roadway – and where it came from. Furthermore, in many areas there is little realistic alternative. For a small parking area, perhaps four to six spaces, the economics of hiring a truck and loader to remove the snow just don't make sense – and the availability of equipment during or right after a storm is limited in any case. The most practical solution is to add the snow to the pile the City will remove when time permits. However there is no reason the City should be responsible for the costs of removing the snow – and for the costs of managing it in the meantime when it is placed in a way that blocks sidewalks or roadways. One option would be to consider licensing the placement of snow on the City right-of-way, charging enough for the license to recover the costs involved. The terms might excuse the individual homeowner handling their own snow, and focus on areas cleared by contractors, perhaps excluding the individual driveway, and likely setting an upper limit on how large an area can be cleared to the street right-of-way.
2. On street parking permits are designed to accommodate residents in denser communities built before adequate parking was a requirement. The current exemption allowing permit holders to remain on the street when a snow event occurs, however, results in the parking lane on a street being plowed in during a significant snowfall. Sometimes the parking lane is loaded to the point of becoming useless until there is a snow removal. However streets without parked cars are fully cleared, essentially curb to curb. The snow event parking ban is judiciously used, generally only for one night. City parking lots are available for free during these events, and it may be reasonable to require permit holders to avoid parking on a street during a snow event, at least until the first pass down the parking lane is completed. This would cause permit holders some inconvenience, but perhaps not as much as digging out the plowed in car and spending the next week or two with no parking available on the street.
3. Areas with parking allowed on both sides of the street should be signed to restrict parking on one side of the street during winter months. This should be carried out in any areas where winter maintenance crews have difficulty completing plow runs due to parked cars.



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Appendix A

Maintenance Quality Standards for Roads
Table 101.01.01 – Road Maintenance Classification

Primary Class		Secondary Class		
		A	B	C
1	Highest Priority Roads	Freeways (4-lane section of 174)	Transitway	N/A
2	Arterials	Roads within Special Designated Areas, or with Essential Services, Schools, Transit, Steep Grades, or with designated City cycling route, NCC Parkways	All other paved Class 2 roads	N/A
3	Major Collectors	Roads within Special Designated Areas, or with Essential Services, Schools, Transit, Steep Grades, or with designated City cycling route	All other paved Class 3 roads	N/A
4	Minor Collectors	Roads within Special Designated Areas, or with Essential Services, Schools, Transit, Steep Grades, or with designated City cycling route	All other paved Class 4 roads	Gravel roads
5	Residential Roads and Lanes	Residential and Subdivision Roads	Lanes	Gravel roads

Special Designated Areas

- Downtown business district, ByWard Market, Rockliffe Park Heritage district, primary employment centres, tourism areas

Essential Services

- Hospitals, Fire Stations, Police Stations, Ambulance Stations

Appendix B – Activities rated by priority P1

Work codes identified as P1: activities that have to be done right away

Activity	Activity Description	Priority
0100	Training - Equipment Trainers	P1
0101	Training - Equipment Operators	P1
0181	Vehicle Usage (Supervisory Staff)	P1
1013	Spring Clean Up Program	P1
1050	Spring Clean-Up - Manual Sweeping	P1
1051	Spring Clean-Up - Mech Sweeping	P1
1052	Spring Clean-Up - Disposal of Sweeping	P1
1053	Spring Clean-Up - Roadway Flushing	P1
1054	Spring Clean-Up - Contract Services	P1
1055	Spring Clean-Up - Litter Pick-Up	P1
1056	Spring Clean-Up - Enhanced Sweeping Prog	P1
1057	Sprg Clean-Up - Man. Swp'g (Bike Lanes)	P1
1058	Sprg Clean-Up - Mech. Swp'g (Bike Lanes)	P1
1088	Accident Clean Up	P1
1187	Graffiti Removal - No Tolerance Zone	P1
1520	Spring Clean-Up - Manual	P1
1521	Spring Clean-Up - Mechanical	P1
1522	Spring Clean-Up - Sidewalk Flushing	P1
1523	Spring Clean-Up - Enhanced Sweeping Prog	P1
2000	Snow Clearing - Plowing	P1
2001	Snow Clearing - Scarifying	P1
2002	Snow Clearing - Winging Back	P1
2003	Snow Clearing - Plowing (Bike Lanes)	P1
2004	Echelon Plowing	P1
2011	Snow Removal & Disposal - Road Sfce	P1
2012	Snow Removal and Disposal - Casting	P1

Activity	Activity Description	Priority
2014	Snow Rml & Displ-Cutting & Rml of Ice	P1
2015	Snow Rml and Disposa -Winging Over	P1
2016	Sw Rm&Disposal-Peds Crngs & Inter	P1
2017	Snow Rml & Disposa -Towg Pkd Veh	P1
2018	Pulling Snow	P1
2019	Snow Rml & Disp - Road Sfce (Bike Lanes)	P1
2020	Snow Rml & Disp - Casting (Bike Lanes)	P1
2030	Application of Wtr Abrasives (Grit Sand)	P1
2033	Application of Wtr Chemicals - Dry Salt	P1
2034	Applic of Wtr Chemicals-Pre-Wet Salt	P1
2035	Salt Beh. Snow Rem'l Oper'n - Dry Salt	P1
2036	Salt Beh. Snow Rem'l Oper'n-Pre-Wet Salt	P1
2037	Stockpiling & Loading - Wtr Materials	P1
2038	Anti-icing NaCl (Winter)	P1
2040	Salt Brine Plant Maint / Repairs	P1
2041	Calcium Chloride Plant Maint / Repairs	P1
2042	Applic of Wntr Grit or Sand (Bike Lanes)	P1
2043	Applic of Winter Dry Salt (Bike Lanes)	P1
2044	Applic of Wtr Pre-Wet Salt (Bike Lanes)	P1
2050	Drainage - Catch Basins	P1
2051	Drainage - Ditches and Culverts	P1
2052	Spring/Winter Flooding	P1
2070	Winter Damage Repairs	P1
2083	Road Patrol	P1
2087	Road Inspection (Winter)	P1
2098	Road Surf Gen'l Wntr Mtce. (Bike Lanes)	P1

Appendix B – Activities rated by priority P1 (cont'd)

Work codes identified as P1: activities that have to be done right away

Activity	Activity Description	Priority
2099	Road Surface Winter Mtnc - Other	P1
2100	Snow Clearing from Sidewalks - Mech	P1
2101	Snow Clrg from Sidewalks - Manual	P1
2103	Snow Clearing Bus Stops, School Bus, etc	P1
2104	Snow Clrg from Sidewalks - Bike Lanes	P1
2130	Applic of Abrvs and/or Chemals to Sdwls	P1
2131	Apply Wntr Abras. Bus Stops, School Bus, e	P1
2132	Applic of Winter Materials - Bike Lanes	P1
2280	Supervision of Snow Disposal Fclty Ops	P1
2300	Rideau Rvr Flood Control-Cutting Keys	P1
2301	Rideau Rvr Flood Control-Blast/Ice Break	P1
2302	Rideau Rvr Flood Control-Ott Blast/Break	P1
2303	Rideau Rvr Flood Contrl-Prep & Dismtling	P1
2398	Ottawa River Flood Control - Other	P1
2399	Rideau River Flood Control - Other	P1
4100	Facility Snow Plowing	P1
4101	Facility Snow Removal and Disposal	P1
4113	Park & Ride Lot Maint - Appl Winter Abra	P1
4110	Park & Ride Lot Maint - (Non Winter)	P1
4111	Park & Ride Lot Maint - Snow Clearing	P1
4112	Park & Ride Lot Maint - Snow Removal	P1
OC Transp	OC Transpo	P1

Appendix B – Activities rated by priority P2

Work codes identified as P2: activities that have to be done but not immediately

Activity	Activity Description	Priority
0102	Training - Health and Safety	P2
0103	Training - Other Int & Ext	P2
0130	Fleet/Small Equip Rep & Maint	P2
0140	Transport Equipment	P2
0182	Health and Safety Business	P2
0183	Community Events/Equipment Demos	P2
0198	Notification Investigations	P2
1000	Asph Ptchg-Hnd Tls&Roller (Ht Mx Only)	P2
1002	Asph Ptchg-Hand Tools (Cld Ptch Only)	P2
1016	Roadway Flushing	P2
1081	Stockpiling & Loading - n/w Mtls	P2
1099	Roadway Surface Mtnc - Other	P2
1100	Litter Pick-up - Trash and Debris	P2
1102	Litter Pick-up - Dead Animals	P2
1105	Litter Pick-up - Shopping Carts	P2
1110	Waste Receptacle Servicing	P2
1111	Waste Receptacle Serv (Contract)	P2
1112	Waste Receptacles Repairs & Mtnc	P2
1121	Blvd & Median Repairs (aspht/concrete)	P2
2013	Snow Rml & Disposal -Signs Mtnc	P2
2039	Transport Wntr Mat to Another Storage Lo	P2
2060	Snow Fence Maintenance	P2
2061	Snow Markers - Catch Basins	P2
2062	Snow Boards	P2
2063	Snow Markers - Edge of Road	P2
2081	Sand Box Containers	P2
2102	Snow Clrg from Sidewalks - Other	P2
2140	Winter Damage	P2
2200	Snow Disposal Facility Fall Prepr	P2
2201	Snow Disposal Facility Sprg Cleanup	P2
2202	Induce Melting of Snow Stockpiles	P2
2220	Snow Disposal Facility Maintenance	P2

Appendix B – Activities rated by priority P3

Work codes identified as P3: activities that can wait to be done or are considered unproductive

Activity	Activity Description	Priority
0120	Downtime	P3
0180	Yard Duties	P3
0199	Operations Services - Other	P3
1003	Disposal of Asphaltic Materials	P3
1004	Asphalt Resurfacing	P3
1006	Asph Ptchg-Spray Patching	P3
1010	Roadway Sweeping - Manual	P3
1011	Roadway Sweeping - Mechanical	P3
1012	Roadway Sweeping - Disposal	P3
1017	Roadway Sweeping -Machine Sweep Contract	P3
1018	Roadway Mechanical Sweeping (Bike Lanes)	P3
1030	Ironwork Adjustments	P3
1031	Ironwork Survey	P3
1032	Ironwork Adjustments - Contract	P3
1034	Underground Chamber Cover Retrieval	P3
1040	Shouldering	P3
1041	Shoulder Grading	P3
1042	Shoulder Washout Repairs	P3
1082	Road Patrol - Non-Winter	P3
1083	Base Washout Repairs	P3
1085	Environmental Spills	P3
1089	Road Inspection (Non-Winter)	P3
1103	Roll Off Containers	P3
1104	Tire Disposal	P3
1130	Grass Cutting	P3
1132	Sodding or Seeding	P3

Activity	Activity Description	Priority
1134	Weed Trimming at Guide Rails/Structures	P3
1150	Street Furniture	P3
1180	Syringe (Rdsde) - Pickup & Disposal	P3
1181	Poster Removal from Utility Poles	P3
1182	Graffiti Removal	P3
1185	ROW Brushing	P3
1186	Poster Collar Program	P3
1188	Tree Limb Removal/Hedge Trim	P3
1198	Rural Pathway Mtce. (railway corridor)	P3
1200	Gravel Road Patching	P3
1201	Grading	P3
1202	Gravel Road Resurfacing	P3
1280	Dust Control	P3
1299	Gravel Surface Mtnc - Other	P3
1300	Ditching (Rdsde & Offtke) - Mech	P3
1302	Culvert Mtnc - Rdwy and/or Entrnc	P3
1303	Culvert Flushing	P3
1304	Culvert Maintenance - Cross Road	P3
1312	Curb and/or Gutter Mtnc Discont	P3
1313	Disposal of Concrete	P3
1314	Curb and/or Gutter Maint - Contract Serv	P3
1380	Summer Rainstorm	P3
1399	Drainage and Structures - Other	P3
1400	Cabled Guide Post Mtnc	P3
1410	Flex Beam Guide Rail Mtnc	P3
1420	Permanent Dead-End Barricade Mtnc	P3

Appendix B – Activities rated by priority P3 (cont'd)

Work codes identified as P3: activities that can wait to be done or are considered unproductive

Activity	Activity Description	Priority
1430	Concrete/Metal Bollard Repairs	P3
1480	Fence and Sound Barrier Mtnc	P3
1481	Temporary Barricades	P3
1499	Safety Devices - Other	P3
1500	Concrete Sidewalk Replacement	P3
1502	Asphalt Sidewalk Replmt/Repairs	P3
1503	Asphalt Bus Pad Repairs	P3
1504	Decorative Sidewalk / Ped Crosswalk Mtnc	P3
1505	Concrete Sidewalk Replac - Contract Serv	P3
1508	Sidewalk Patching	P3
1509	Conc Sdwalk Cut'g Restor'n - Cont. Serv.	P3
1514	Sidewalk Sweeping - Manual	P3
1515	Sidewalk Sweeping - Mechanical	P3
1580	Sidewalk Survey/Inspections	P3
1599	Sidewalk Maintenance - Other	P3
1600	Bridge Structure Maintenance	P3
1601	Retaining Walls Maintenance	P3
1605	Pretoria Bridge	P3
1607	Pedestrian Safety Railing Maint	P3
1608	Sweeping and Flushing Bridge Decks	P3
1699	Structures Maintenance - Other	P3
2082	Standby	P3
2084	On Call	P3
2085	Change of Shift	P3
2199	Sidewalk Winter Mtnc - Other	P3
2299	Snow Disposal Facility Mainten. - Other	P3
Culvert	Culvert	P3
Bike Rack	Bike Rack	P3
Zamboni	Zamboni	P3
9001	EOY Inventory Adjustment	P3

Appendix C – Summary of Assumptions

Original Data

- The budget and actual expenditure figures provided by the City are accurate as reflected in the report.
- The staffing levels, vehicle and equipment information, operating parameters such as beat data and the work order data covering time and costs of operations provided by the City are accurate as reflected in the report.

Benchmarking / Leading Practice

- The data provided by or sourced from other cities is accurate as reported.

Comparing budgets levels with requirements over time

- The roadway lane kms maintained in the winter have grown 7% between 2010 and 2015 .
- The kms of sidewalk lane maintained in the winter have grown 11% between 2010 and 2015 .
- That the increase in the Ottawa-Gatineau CPI from 116.1 in June 2010 to 127.4 in June 2015 (9.733%, rounded to 10%) is reflective of cost pressures on winter maintenance operations.

Financial Impact of service level adjustments

- The Cost of Average Beat (excluding materials) (page 64) was calculated using the total cost of activity “P94-Roads Application of Winter Materials” for the salt beats, activity “P92- Roads Snow Clearing” for plow beats, and “P54-Sidewalk Snow Clearing” plus “P-55 – Sidewalks Application of Winter Materials” for sidewalk costs. In each case the cost of materials was excluded in the expectation the use of materials would remain the same. These figures were divided by the number of active beats as provided by the City to derive the costs per beat. Note these costs do not include overhead or other costs that may be included in other accounts, so they may understate total costs.
- When the potential savings from reducing the number of beats was calculated, the cost of the average beat was adjusted as follows (page 66):
 - For salt beats, the average cost of about \$130,000 was discounted by 35% and the potential savings calculated based on \$84,000 per beat to be conservative and allow for diseconomies of scale.
 - For plow beats, the \$22,000 average cost of a plow beat was reduced by 90% to \$2,200, recognizing that most costs are time and distance based, so having fewer, longer beats would not reduce costs substantially.

Appendix C – Summary of Assumptions

Financial Impact of service level adjustments

(Elaboration of the model described on page 65). The following factors were used to determine how many beats would be required in each scenario:

- The lane kms. of road to be maintained, are as follows:

	Class 2	Class 3	Class 4	Class 5
Urban Plow		347.1	242.3	1,066.7
Suburban Plow		257.4	199.8	2,272.3
Rural Plow		8.3	661.3	797.7
Urban Salt	782.6	343.3	229.8	27.9
Suburban Salt	1,059.3	1,348.1	503.8	113.6
Rural Salt	237.1	1,266.8	929.9	105.4

- The average speed of salting and plowing operations is as follows:

Salt Speed (km/hr)	Class 2	Class 3	Class 4	Class 5
Urban	19	19	19	19
Suburban	25	25	25	25
Rural	35	35	35	35
Plow Speed (km/hr)				
Urban	9	9	9	9
Suburban	14	14	14	14
Rural	25	24	24	20

- That on average salt and plow beats experience deadheading time loss and have non-productive time as follows:

	Today	Options (Classes covered)			
Salt Beats (Road Class)	2/3/4/5	2	3,4,5	2,3	4,5
Deadheading	15%	10%	25%	12.5%	25%
Non-productive (lunch/breaks)	11.8%	11.8%	11.8%	11.8%	11.8%
Plow Beats (always class 5)					
Deadheading	30%	30%	30%	30%	30%
Non-productive (lunch/breaks)	11.8%	11.8%	11.8%	11.8%	11.8%

- The level of service in terms of the hours required to salt and the hours required to plow used with each service level option are identified below:

Hours to salt - plow	Today	Options (Classes covered)				
Road Class	2/3/4/5	2	3,4,5	2,3	4,5*	5
MQS Stays As Is	3 - 3	3 - 3	4 - 4	3 - 3	6 - 6	n/a - 10
MQS Modified for Class 2 plowing	3 - 4	3 - 4	4 - 4	3 - 4	6 - 6	n/a - 10
MQS modified for Class 3,4,5 plowing	3 - 3	3 - 3	4 - 6	3 - 3	6 - 8	n/a - 12
Provincial MMS requirements	3 - 6	3 - 6	8 - 12	3 - 6	12 - 16	n/a - 24
* Only Class 5 roads identified for salting because of hills, other factors						

- Using these factors, the number of beats required to meet the service level concerned was calculated. The reduction in the number of salt beats and plow beats was multiplied by the savings per beat factor shown on the previous page to determine the potential savings from making the change.

Appendix C – Summary of Assumptions

The Contracting Analysis assumed:

- Overhead costs for in-house services add 16.83% to over-all costs, plus \$1,517.55 per FTE. Assumes .25 FTE per beat (page 134-135).
- Overhead costs for contractor add 5.95% to over-all costs plus \$45.48 per contract (page 135).
- Paid time allocated to other budget lines and not included in the department's calculation for in-house staff was generally calculated at 15%. (page 136)
- There was no contractor cost allocated to accounts other than the salting, plowing and sidewalk accounts (and hence no contractor costs excluded from the analysis.
- The costs were divided by the number of beats to derive a cost per beat. The average hours of service were derived from the database of time and costs records and used to identify a cost per hour. Overhead and P3 costs were applied as described above.
- Based on the similarity of hourly costs and significant difference in cost per beat, and noting the approach in Rideau Valley it was estimated that assigning additional contracted salt trucks to those yards which have fewer than half their salt beats contracted would save at least \$10,000 per beat.
- 38 additional salt beats could be contracted producing a saving of \$380,000 over-all.

For salt beats (pages 137-140)

- Zones with both contract and in-house salt beats were examined. The 2015 costs were taken from the financial records, using "P94 - Roads Application of Winter Materials". Material costs were ignored. "External Services" costs were assigned to the contracted beats and the "Labour – Total", "Internal Equipment" and "Internal Services" (generally zero) were assigned to the in-house beats.

Appendix C – Summary of Assumptions

For plow beats (pages 141-142)

- Zones with both contract and in-house plow beats were examined. The 2015 costs and hours of service were taken from the database of time and costs records as the account in the financial records has other activities included. Overhead and P3 costs were applied.
- The total cost of in-house plowing was identified and multiplied by the % contracted plowing is less expensive than in-house to identify the maximum possible savings.
- Recognizing it may not be possible to eliminate all in-house plowing without impacting other activities, the suggested savings range was reduced by about 30% to 40%.

Area Contract Analysis (page 143-144)

- The initial departmental analysis (as amended) was used as the core data and assumed to be accurate.
- The overhead and P3 time adjustments were made.
- The estimated savings is the difference between the cost of the contract and the cost of equivalent in-house services.
- The hourly rates for equipment under the contract and hired equipment were compared to identify how both sets of analysis could be true – e.g. changing some in-house work to hired equipment and changing this area contract work to in-house (or hired equipment) could both reduce costs.

Appendix C – Summary of Assumptions

Option to reduce size of night shift (page 68) assumes:

- Salting can be accomplished in half the time plowing takes.
- 106 staffed positions currently on day shift and on night shift and 10 pieces of hired equipment to operate 116 salt beats.
- Staffing for 53 salt beats on evening shift (assuming each beat is twice as long to cover all roads) would eliminate 53 positions on night shift, each assumed to cost \$50,000 per year. (Assumes contracted salt trucks continue as before).
- On average there are 50.3 events per year (page 18). 43 of these have 5 cm. or less. It is likely many of the 43 events will not require plowing, but in any case some of them will occur when the day shift is currently responding and all day shift staff would remain. The estimate therefore assumes 25 events at most would require further intervention to assist the reduced night shift with plowing the beats. The cost of this intervention (whether overtime for day shift or hired contractors) is estimated to cost \$145/hour (page 137) and may require 4-6 hours per event on average (recognizing that the day shift would still be staffed with sufficient operators to plow all beats). These costs are assumed to reduce savings from \$2,650,000 to between \$1.3M and \$1.6M.

Plowing Class 5 roads (residential) streets when 10 cm accumulates rather than current 7 cm (page 73), costing assumptions:

- Plowing operations currently cost \$4.7M per year.
- 7 cm falls 8.5 times per year on average while 10 cm falls 5 times per year on average (Environment Canada data).
- Eliminating 3.5 of 8.5 plow runs would reduce costs by \$1.9M, however it is assumed some runs would occur when two or more snowfalls resulted in an accumulation of over 10 cm, using half the savings, reducing the net saving to \$1.0M.