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Roads Winter Maintenance Quality
Standards Review and Development of
Maintenance Quality Standards for
Specialty Spaces and Streets
Phase 1: Current State and Best
Practices Review

October 30, 2020

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Chad Findlay
Area Manager, Roads & Parking Services
City of Ottawa
100 Constellation Drive, 5th Floor
Ottawa Ontario
K2G 6J8
T: 613-580-2424 x21004
E-mail: Chad.Findlay@ottawa.ca

Dear Mr. Findlay

**Re: Phase 1 Report
Roads Winter Maintenance Quality Standards Review
and Development of maintenance Quality Standards for Specialty Spaces and Streets**

Thank you for the opportunity to work with you and your team to review and update your Winter Road Maintenance Quality Standards (WMQS) and develop Maintenance Quality Standards (MQS) for your Specialty Spaces and Streets (SSS). We have worked closely with you now for several months reviewing your existing standards, undertaking a fulsome review of your extensive background material, conducting an Internet-based environmental scan of relevant best practices, interviewing numerous key internal staff and interviewing peer municipalities.

This report summarizes the key findings from Phase 1 and provides direction for the development and evaluation of viable alternatives in Phase 2. The breadth of this review also identified several additional opportunities which, while outside the scope of this project, are worth noting for your future consideration.

Sincerely:

Reviewed by:



Heather McClintock, P.Eng.
Director / Project Manager

Ted Reeler, P.Eng.
Project Director



Roads Winter Maintenance Quality Standards Review and Development of Maintenance Quality Standards for Specialty Spaces and Streets
Phase 1: Current State and Best Practices
Review

Prepared for:

Chad Findlay
City of Ottawa

Prepared by:

Wood

10/30/2020

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Executive summary

The City of Ottawa is Canada's Capital and home to slightly over 1 million people. The population is expected to grow to 1.4 million people by 2046. To keep Ottawa's citizens and visitors safe and moving for work, recreation, and tourism purposes the City needs to ensure the transportation network is efficient, inclusive, and sustainable.

The City of Ottawa (City) established Maintenance Quality Standards (MQS) for roads and sidewalks in 2003 to provide safe and passable facilities. The City would like to review and update the Winter MQS (WMQS) to ensure they are reflective of current priorities and showcase Ottawa as a world class destination. The Class 1-3 WMQS's have recently been reviewed. This study focuses on the WMQS's for:

- Class 5 roads.
- Class 4 roads with pedestrian generating facilities that do not currently have pedestrian facilities such as schools, recreational facilities, employment centres etc.
- Active Transportation facilities including:
 - Sidewalks.
 - Connecting pathways.
 - Multi-use pathways.
 - Cycling facilities.

In addition, the City is currently in the process of defining its Specialty Spaces and Streets (SSS) and does not have Maintenance Quality Standards established. This study will review industry best practices and develop year-round MQS's for the City's unique SSS.

Phase 1 of this study involved a detailed review of the current MQS and background material (media, Committee and Council reports, Policy, Plans, Service Requests, claims). A wealth of information emerged with six cross-cutting themes focussing on mobility, accessibility, healthy livable communities, asset management, climate change and sustainability.

A municipal peer review was also undertaken to identify innovative opportunities and benchmarking with other similar and progressive municipalities across Ontario, Canada, United States and Europe. While many municipalities have the same population, climate and fiscal challenges as Ottawa, there are certainly some unique solutions available.

This Phase 1 report provides the framework for the development of three alternative scenarios in Phase 2. A Moderate alternative will incrementally build on the current WMQS utilizing current technologies and proactive approaches to optimize the value of maintenance operations. A Progressive alternative will build on the Moderate alternative and increase the priority of Active Transportation and start to align Ottawa with their future plans. The Aspirational alternative will again build on the Progressive alternative and further drive the City forward towards their 2050 goals for growth, sustainability, and climate change.

While undertaking the extensive background review for Phase 1, several additional opportunities were identified, and while beyond the scope of this project, it is prudent to acknowledge them. Strong communications plans are helpful to increase public knowledge of maintenance levels of service to be expected, keep the public informed during winter events and reduce complaints. Most municipalities have challenges plowing and removing snow around parked cars and there are a couple of unique approaches being used by peer municipalities that are quite successful. In addition, most municipalities are concerned with the environmental impact of winter maintenance operations and continue to review materials and methods to maximize sustainability.



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1.0 Background

The vibrant City of Ottawa is Canada's Capital and home to slightly over 1 million people. To keep Ottawa's citizens and visitors moving for work, recreation, and tourism purposes on its 12,700 km of roads and 2,300 km of sidewalks, the City employs over 500 maintenance operators utilizing nearly 600 pieces of winter control equipment. Ottawa strives to be a world class city with effective maintenance operations which respects diversity and fiscal responsibility.

The City of Ottawa (City) established Maintenance Quality Standards (MQS) for roads and sidewalks in 2003 to provide safe and passable facilities. The City would like to review and update the Winter MQS (WMQS) to ensure they are reflective of current priorities and showcase Ottawa as a premier tourist destination meeting the following objectives:

- To enhance the appearance and the health of the community through well-maintained public spaces and rights-of-way where the risk of mobility-related trauma is minimized.
- To protect the natural environment.
- To provide adequately safe, dependable, consistent, and affordable service levels.
- To preserve infrastructure assets, by avoiding physical damage and chemical degradation.
- To identify key winter control performance indicators to control costs, demonstrate accountability and highlight accomplishments in a transparent manner.
- To ensure that best practices are being utilized and that Ottawa's levels of service are comparable to peer municipalities.
- To improve communications with elected officials and the public, and to manage their expectations around winter control.

This study will focus on the following MQS components for winter snow and ice control for the following road and Active Transportation facilities:

- Class 5 roads.
- Class 4 roads with pedestrian generating facilities that do not currently have pedestrian facilities such as schools, recreational facilities, employment centres etc.
- Active Transportation facilities:
 - Sidewalks.
 - Connecting pathways.
 - Multi-use pathways.
 - Cycling facilities.

The City is currently in the process of defining its Specialty Spaces and Streets (SSS) and does not have Maintenance Quality Standards. All maintenance currently undertaken is through informal collaboration between the Public Works and Environmental Services Department (PWESD) and the



Planning, Infrastructure and Economic Development (PIED) teams. This study will review industry best practices and develop year-round MQS's for the City's unique SSS.

This project will:

- Define the priorities and levels of service which best meet public requirements, in consideration of their safety, mobility, accessibility, equity, and inclusion needs.
- Present a comprehensive business case that provides fiscal certainty and ensures the long-term financial sustainability of winter control operations and Specialty Spaces and Streets.
- Establish the most efficient and cost-effective end-to-end service delivery model calibrated to meet those requirements.
- Embrace broader public and societal requirements by recognizing and being responsive to issues of accessibility, equity, gender, sustainability, climate change resilience, injury prevention, healthy living (including pandemic countermeasures such as social distancing) and the importance of place-making and place-keeping as it relates to Specialty Spaces and Streets in the achievement of a healthy and liveable city.

This study will be undertaken in three (3) Phases. Phase 1 reviewed Ottawa's current MQS, background material (media, Committee and Council reports, Policy, Plans, Service Requests, claims) and industry best practices from other similar municipalities from May to August 2020. This Phase 1 report summarizes the findings and identifies opportunities for the City to optimize their MQS and other findings for Ottawa's consideration. These findings will facilitate the identification of three (3) alternative scenarios in Phase 2 along with associated costs will be developed for each alternative from September 2020 to January 2021. These alternatives will be presented to stakeholders and the public in January 2021 soliciting feedback to aid in the identification of a recommended solution for each facility type by April 2021. Phase 3 will develop the approved solution in detail and prepare a Business Case for Council in the fall of 2021.

2.0 City of Ottawa Maintenance Quality Standards

The City of Ottawa has Maintenance Quality Standards (MQS) for roads, sidewalks, and pathways. The MQS's were implemented in 2003 to harmonize service levels following the provincial amalgamation initiative. Ottawa has a harsh winter climate with the second highest population in Ontario; the MQS were established to ensure the safety and mobility of residents and visitors. The MMS were updated in 2016 at which time the City reviewed the changes including new cycling requirements. No changes to the MQS were made at that time. The MQSs still to this day exceed all the current Minimum Maintenance Standards (MMS) for Municipal Highways in Ontario, Regulation 239/02 (See Table 1: City of Ottawa Maintenance Quality Standards: Snow and Ice on Roads, 2003

Table 2: City of Ottawa Maintenance Quality Standards: Snow and Ice on Sidewalks & Pathways, 2003).

However, there has been an increased focus on accessibility, mobility, equity, the environment including the use of road salt, Climate Change and Active Transportation (AT). In 2018 the City



committed to reviewing the MQS's for sidewalks and pathways and subsequently added Class 5 residential roads and Class 4 roads without sidewalks adjacent to schools and public attractors to the review.

MQS's have been informally undertaken for the Specialty Spaces and Streets (SSS) in Ottawa. The development of a formal MQS for SSS was also incorporated into this project.

Table 1: City of Ottawa Maintenance Quality Standards: Snow and Ice on Roads, 2003

Table 103.01.01 – Snow and Ice Control on Roads						
Road Maintenance Class	Road Type	Minimum Depth of Snow Accumulation for Deployment of Resources (Depth as per MMSMH)	Time to Clear Snow Accumulation From the End of Snow Accumulation or Time to Treat Icy Conditions (Time as per MMSMH)	Treatment Standard		
				Bare Pavement	Centre Bare	Snow Packed
1	A	High Priority Roads	2 h (3-4 h)	✓		
	B			✓		
2	A	Most Arterials	As accumulation begins (2.5-8 cm depending on class)	✓		
	B			✓		
3	A			Most Major Collectors	4 h (8-12 h)	✓
	B	✓				
4	A	Most Minor Collectors	5 cm (8 cm)	✓		
	B				✓	
	C					✓
5	A, C	Residential Roads and Lanes	7 cm (10 cm)			✓
	B		10 cm (not defined)			✓

Notes: - Refer to Table 101.01.01 for description of road maintenance classes.
- MMSMH refers to Ontario Regulation 239/02, Minimum Maintenance Standards for Municipal Highways.



Table 2: City of Ottawa Maintenance Quality Standards: Snow and Ice on Sidewalks & Pathways, 2003

Table 103.02.01 – Snow and Ice Control on Sidewalks and Pathways					
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			

Winter Maintenance Quality Standards

Ottawa’s WMQS have stood the test of time. Developed in 2003, the MQS still exceed the current Minimum Maintenance Standards for Ontario Municipalities. However, over the years, there has been a shift in demand for increased maintenance to support accessibility, mobility, equity, the environment, Climate Change and Active Transportation facilities including sidewalks, cycling facilities and multi-use paths. Along with increased public pressure to provide higher levels of service on all facilities, it is



prudent to update the MQS to ensure the standards are inclusive and clear for both the public and winter maintenance service providers. This will facilitate delivery of a consistent level of service for similarly prioritized infrastructure, manage expectations and be fiscally responsible.

In 2019 / 2020 the City increased its winter maintenance activities adding additional staff, plowing sidewalks day and night, investing in icebreaker technology and new ice blades, creating catch basin heat maps and enabling supervisors the discretion to undertake operations in a proactive fashion. While this winter was relatively mild in comparison to a typical winter in Ottawa, these changes did yield beneficial results.

With the review and update of the WMQS there is an opportunity to address some of the gaps and inconsistencies and to streamline operations across Ottawa including:

- Some of the current WMQS provide different levels of service in different areas of the city for snow removal from roads and sidewalks which were established prior to the municipal amalgamation and rolled into the current City of Ottawa.
- Snow removal is undertaken on a priority basis, however, the WMQS does not specify which factors and magnitude of importance should be considered in evaluating priorities.
- Patrolling operations need to reflect the full infrastructure.
- Class 5 roads are not fully incorporated into the WMQS. Patrolling of Class 5 roads and snow removal are not defined.
- There are a variety of terms used to designate Active Transportation facilities including sidewalks, bike lanes, bike paths, cycling facilities, City cycling facilities, non-City bike lanes, multi-use paths, pathways, and connectors.
- Active Transportation facilities are maintained by Roads and Parks during the winter, however, only the facilities within the road right of way are maintained by Roads and Parks during the summer.
- On road bike lane WMQS are currently included in the road WMQS, however, cyclists require an enhanced level of service to ensure safe operations.
- Sidewalks along arterial roads have relatively low pedestrian volumes. However, these sidewalks are cleared to a higher level of service than some sidewalks with significantly higher pedestrian volumes.
- Sidewalk clearance does not specify an effective width to be available for use.

Specialty Spaces and Streets

Ottawa does not have a formal framework for SSS including maintenance quality standards and funding. Winter maintenance operations of SSS are undertaken in conjunction with the roads, however, they need more specific requirements to manage their unique infrastructure and function year-round. During the development of Ottawa's first MQS for SSS, the City identified the current ad-hoc operations being undertaken such as plowing, snow removal, furniture setup, take down and repairs. The SSS MQS will build on this base and incorporate the following components:



- A clear definition as to what constitutes a Specialty Space and a Specialty Street.
- Patrolling operations.
- Current maintenance operations including surface repairs, seasonal change-over and cleaning, litter pick up, graffiti removal, surface cleaning and winter maintenance including snow storage and removal.
- Looking ahead, SSS require an elevated standard of ongoing maintenance and repair. These priority areas, which feature specialized and/or unique finishes and design treatments, require certain specialized service levels, including:
 - specialty lighting (nonstandard pedestrian lighting).
 - Specialized snow removal - small equipment / hand shovelling.
 - Specialized surface treatment repairs – Paver repair / replacement, application of polymeric sand, and no asphalt patching.
 - Landscaping (Trees, plantings, mulch, watering).
 - Deep surface cleaning (concrete, pavers, etc.).
 - Furniture repairs and maintenance (i.e. sanding, staining).
 - Seasonal installations / removals.
 - Maintenance of water features (mistifiers, irrigation, fountains etc.).
 - General asset repairs (tree guards, benches, waste receptacles, bike racks, bollards).
 - Specialized electrical requirements.

3.0 City of Ottawa and Background Literature Review

The City of Ottawa assembled well over 100 background documents (Appendix A) for review ensuring a fulsome appreciation of all aspects of the Ottawa’s maintenance requirements were considered in this MQS review. The documents included Federal and Provincial legislation, City policies, standards, guidelines and practices, Committee and Council reports, Service Requests, legal claims, media reports, along with the City’s current and in-development Official Plan, Transportation Master Plan, Pedestrian Plan, Cycling Plan, Older Adult Plan, Accessibility for Ontarians with Disabilities Act Plans and related plans and Climate Change Plans. Wood also reviewed documents from the Transportation Association of Canada’s international library and researched North America’s WMQS, AT and SSS standards and innovations.

From this wealth of information, a series of cross-cutting themes relevant to Winter Maintenance Quality Standards (MQS) and Specialty Spaces and Streets (SSS) were extracted and are summarized below in the following categories:

- Mobility.
- Accessibility, Equity, and Inclusion.
- Healthy Livable Communities.
- Efficient and Effective Asset Management.



- Climate Change.
- Sustainability.

All the City's plans and guidelines clearly identified the need for integrated and efficient transportation facilities, reducing the dependence on personal cars, and supporting sustainable transportation options including transit, walking, and cycling.

The new Official Plan provides a vision of the future growth of the City and a policy framework to guide its physical development to the year 2046. By 2046, the population of Ottawa is expected to increase by 400,000, reaching a total of 1.4 million people. This level of growth will open new opportunities for the City and its residents but will also bring enormous change and new challenges.

This Plan sets a policy framework for managing growth in ways that will reinforce the qualities of the City that are most valued by its residents: its distinctly liveable communities, its green and open character and the landmarks and landforms that distinguish Ottawa from all other places. The Plan also recognizes Ottawa as a capital city, as a meeting place for Canadians and international visitors, and as host to Canada's most significant political, cultural, social, and economic institutions.

Official Plan policies are proposed to help achieve the goal of most trips being made by sustainable transportation by 2046. Achieving such a major shift in mobility habits and patterns, especially for a North American city with a long winter, requires an acknowledgement that there is no automobile-centered solution to maintaining livability while growing to 1.4 million and beyond. Roadway widenings or expansion is in direct contradiction with the place-making, livability, public health, air quality social equity, objectives and many other considerations that need to remain the primary drivers of city-building in the context of redeveloping or new neighbourhoods. Therefore, the City's multi-modal approach to transportation planning, will emphasize transit and improvements to Active Transportation during all times of the day and all seasons.

The new official plan will also place importance on the recognition and creation of SSS as key elements of city building. The associated policy framework for design priority areas which include SSS is evolving and will need to be considered in future recommendations for SSS identification and maintenance.

Mobility

Ottawa's vision is to be a world-class city where an equally vibrant and functional pedestrian realm encourages people to walk all year-round. The guiding principles are to provide attractive, safe, accessible, and popular places to enjoy the outdoors. Ottawa targets an increase in walking trips of 9.5 to 10% with a focus on shorter trips to school and transit. Over 32,000 citizens list walking as their main mode of transportation.

Statistically, more men commute by car, while women are more likely to walk, bike or take public transport. Women take more trips by transit because of lower incomes and higher levels of responsibility at home for childcare, household responsibilities such as grocery shopping, parental care etc., and are thus more disadvantaged by mobility impediments caused by snow and ice accumulation on sidewalks and bus pads. Citizens would like to see gender inequality addressed in the transportation network.



Ottawa's Transportation Master Plan, Pedestrian Plan and Cycling Plan support an increase in transit ridership for longer trips with increases in walking and cycling for shorter trips to meet long-term growth needs. Transit needs to be convenient, frequent, and fast. Walking and cycling require dedicated facilities, well-connected to transit stations and other community destinations such as schools, employment, shopping, and recreation.

Transportation Master Plan

The Transportation Master Plan (TMP) indicates that, for the City to achieve its long-term goals, population and employment growth needs to be supported by public transit for longer trips and Active Transportation for shorter trips. Transit needs to be convenient, frequent, and fast, with growth areas served by rapid transit stations connecting the City's wider transit network with reliable local bus services. Walking and cycling require dedicated, physically separated pedestrian and cycling facilities that are well-connected to transit stations and other community destinations such as schools, employment, shopping, and recreation.

The 2013 Transportation Master Plan included the needs supporting winter maintenance for Active Transportation networks. The Commuter Attitude Survey had 32% of residents identifying snow removal as the pedestrian-related service most in need of improvement. Key findings included the following:

- The allocation of additional funds to cost-effectively increase the winter maintenance priority of pedestrian linkages within 600 metres of rapid transit stations, 200 metres of high-frequency transit corridors, and 300 metres of schools.
- Identifying the importance of proper maintenance for on-road and off-road facilities is fundamental to safe and comfortable cycling. Cyclists are more susceptible than motor vehicles to surface irregularities, and they risk injury from cycling over potholes, road cuts and cracks, and debris. Other municipalities have had success in reorganizing maintenance priorities which can contribute to the safety and popularity of cycling, even though it may delay service in other areas or add time and operating costs.
- The City prioritizes spring street clean-up maintenance operations on cross-town bikeways followed by spine routes. Cyclists are vulnerable road users most affected by debris, grit and sand used for winter maintenance. The spring clean-up should be initiated as early as possible at the end of winter.
- Maintain a cycling network through the winter to support winter cycling focused in the core area and along the East-West Bikeway where cycling rates are highest.
- Test and expand the winter cycling network as cycling volumes increase and there are more separated cycling facilities.

The City is currently working on the 2020 Plan. Since 2013, sustainable transportation trips have increased. Over a third of commuter trips are made by sustainable modes like walking, cycling and transit, however, most trips in Ottawa are still made by auto drivers. Cycling has continued to increase in popularity, particularly in the city core and residents want more cycling options that connect to jobs and activities.



The recent public survey undertaken in form the 2020 TMP highlights several barriers to getting around the city including the following:

- Winter conditions were a concern on many fronts, whether it related to walking and cycling paths, road clearing, transit service, and accessibility for seniors, families with strollers and people with mobility challenges.
- Gaps in walking and cycling network.
- High traffic speeds and volumes when walking or cycling.

The public identified the need to:

- Prioritize sustainable transportation over single occupant vehicle use. This was perceived to be the most effective means to address climate change and to reduce congestion.
- Measure transportation equity using distinct data collection methods that provided detailed equity information and a better understanding of populations in different areas, such as rural and urban.

The top ranked mobility issues heard at meetings included:

- Traffic congestion.
- The need for safer and more comfortable walking and cycling.
- The need for expanded transit service.
- Concerns with climate change and the need for improved air quality.

Building on the public input, the new vision and guiding principles of the Transportation Master Plan are expected to include:

- A reduced dependence on the automobile by prioritizing public transit, walking, and cycling over the automobile. Make walking and cycling more attractive than driving for short trips and promoting more sustainable travel choices.
- Barrier-free transportation networks with an integrated system of multi-modal facilities. Providing an acceptable level of service for each mode seeking economic, environmental, and social sustainability.
- Promote public health and safety supporting Active Transportation.
- Protect the environment and enhance the economy by reducing the transportation energy use, greenhouse gas emissions and improving air, water, and land. Maximize greening within transportation rights of way and minimize the need for new road infrastructure.
- Deliver cost-effective services with consideration of life cycle capital and operating costs and provide adequate funding.



Ottawa Pedestrian Plan

Ottawa’s Pedestrian vision is to transform Ottawa into a world-class pedestrian city where an equally vibrant and functional pedestrian realm encourages people to walk all year-round. The realization of this vision will support several important dimensions of a more livable Ottawa.

An equitable city: Walking is the only form of transportation that is universally affordable, and allows children, the elderly, and people of all abilities to travel independently. The City strives to make walking a viable option for all citizens. Unnecessary interruptions such as physical obstructions and unfavourable vehicle-oriented policies will be minimized to the greatest extent possible, and sufficient resources will continue to be allocated to maintain safe and accessible pedestrian spaces year-round.

A healthy city: Walking is a proven method of promoting personal health and well-being. It is the most popular form of leisure time physical activity, with one third of adults reporting walking four or more times per week. Walking can reduce the overall risk of a host of chronic conditions. Pedestrian routes that link popular destinations such as transit, schools, employment, and local services contribute to increases in utilitarian walking, which promotes healthy, active lifestyles for all ages.

A sustainable city: Pedestrian-oriented land use patterns reduce automobile dependency, land consumption and emissions. The City recognizes that the pedestrian environment is valued space that encourages sustainable modes of transportation and should be protected when designing for other users. Pedestrian facilities will be continuously enhanced to reflect the intensity of pedestrian use.

A safe city: An environment in which people feel safe and comfortable walking increases community safety for all. By creating vibrant, well-lit, and highly visible public spaces throughout the city, safety will be enhanced for all pedestrians.

An integrated city: Walking is a part of most trips. Through integrating an attractive pedestrian environment with cycling and transit networks, walking and other modes become a viable alternative to automobile travel.

Pedestrian facilities need to be connected, convenient, comfortable, safe, easily navigable, continuous, and barrier-free leading directly to transit and activity centres.

Ottawa Cycling Plan

Cycling has many of the same community benefits identified in the Pedestrian Plan including creating an equitable, healthy, sustainable, and safe city. Ottawa’s Cycling plan vision is to ‘develop a city-wide, connected network of cycling facilities actively used by all types and ages of cyclists to meet their transportation needs. This network will be supported by policies and programs that establish Ottawa as having one of the best cycling networks in North America, while maximizing the synergy between transit and cycling. Cycling facilities will be selected to complement local land uses and match the needs of all areas of the City. Sixteen (16) million cycling trips are made annually in Ottawa. The cycling target is to reach 8% of the mode share inside the Greenbelt and 5% city-wide. The current (2016) mode share for cycling City-wide is 2.5%.

All the critical dimensions outlined in the Pedestrian Plan are also key to the Cycling Plan including having an equitable city, a healthy city, a sustainable city, a safe city, and an integrated city.



A properly designed, constructed, and maintained surface is an important feature of cycling infrastructure. Proper maintenance is imperative to providing cyclists with a safe and reliable level of service. Bicycles are more susceptible to irregularities in roadway conditions than motor vehicles, and deterioration of the roadway surface such as potholes, road-cuts, cracking, and debris near the curb increases the risk of injuries to cyclists.

Ottawa has been moving forward with servicing critical cycling corridors throughout the winter season promoting year-round cycling. Ottawa currently maintains about 40 km of cycling facilities in the winter. Approximately 21 km were already winter maintained and the incremental cost of maintaining the full 40 km winter cycling network is estimated at \$200,000 per winter season.

The plan recommends the City and the National Capital Commission strive to develop similar standards and usage policies to promote as seamless an environment for cyclists as possible. It would also be beneficial for cyclists if the City of Gatineau extended their winter maintained cycling network connection to the Portage Bridge to complement the Ottawa plan.

Accessibility, Equity, and Inclusion

The accessibility, mobility, equality and respect theme encompasses human rights, individual rights and freedoms, the importance of equality and equity amongst all persons, a commitment to accessibility for all (including for those with disabilities) and continuing the effort to remove accessibility barriers.

In the background documentation Ottawa identified strong support for road users, residents, visitors, and tourists who are customers and consumers of City services and should all be treated respectfully and equally. Ottawa's Human Services Plan characterizes Ottawa as a caring and inclusive city where access and mobility opportunities need to be inclusive and equitable. Communities should be easy to get around, safe and free of barriers for all users. Particular attention should be made to support mobility and access to services for all vulnerable users regardless of gender and inclusive of disabilities and older adults.

Accessibility

There are quite a few pieces of legislation that municipalities must follow with respect to complying with the Canadian Human Rights and Accessibility requirements. This summary will focus on issues related to maintenance operations.

The Accessibility for Ontarians with Disabilities Act defines a "barrier" as anything that prevents a person with a disability from fully participating in all aspects of society because of his or her disability, including a physical barrier, an architectural barrier, an information or communications barrier, an attitudinal barrier, a technological barrier, a policy or a practice. The Ontarians with Disabilities Act requires municipalities to prepare an accessibility plan and report annually on the plan. The plan must include the identification, removal, and prevention of barriers to persons with disabilities in the municipality's by-laws and in its policies, programs, practices, and services. The City's current plan is for 2016 to 2020 and the 2020 to 2024 plan is in development. At the time of this report, the public engagement feedback report has just been completed for input into the 2020 to 2024 plan.



The accessibility programs focus on pavement infrastructure to mitigate challenges with uneven surfaces such as cracks and potholes which may cause barriers. However, winter maintenance is not addressed. The City has an Accessibility Working Group and Accessibility Advisory Committee which have a keen interest ensuring accessibility during the winter months. Winter transportation barriers result in challenges acquiring and keeping meaningful, steady employment. OC Para Transpo offers specialized transportation services for eligible customers who are unable to take transit during the winter months when conditions restrict their travel. This service is funded by the City.

The Older Adult Plan identifies specific needs of Ottawa's older residents. Improved conditions of sidewalks in areas highly frequented by older adults and better access to bus stops and public transit stations are needed to improve accessibility for older adults and persons with disabilities.

The City funds the SnowGo and SnowGo Assist programs. The programs are coordinated and delivered by local community support agencies to assist low income older adults and people with disabilities who are unable to clear snow independently from their driveways. Residents that meet the eligibility criteria are provided a service that matches them to a snow removal contractor and access to financial assistance, if needed. In the 2017/2018 winter season:

- The SnowGo program, responded to over 700 calls and referred over 370 residents to snow contractors.
- The SnowGo Assist program responded to over 1,130 calls and assisted 495 older adults and individuals with disabilities and provided \$64,000 in subsidies.

Consultations for the 2020-2024 plan highlight the following public concerns:

- Accessibility at intersections and crosswalks can be improved. Curbs still present barriers. Potholes in roads and sidewalks present safety issues for people with disabilities. Accessible Pedestrian Signals may be blocked by trees, lampposts, snow, bushes, or installed on the grass off the sidewalk.
- People continue to face barriers in the winter relating to snow removal. Bus stops are not always accessible in the winter and snowbanks may prevent Para Transpo access.
- Construction of multi-use pathways (MUPs) and cycling paths should be standardized and consistent. MUPs should have better signage, including the identification of types of usage, so there is no confusion.
- Keep working towards washroom accessibility. Ensure accessible washrooms are gender neutral and stalls can accommodate a person, their support person or service animal and a mobility device. Accessible, bilingual signage is also important.

Equity and Inclusion

The City of Ottawa has an Equity and Inclusion Lens tool to enable the City to be systematic, consistent, and coherent in its efforts to promote equity and inclusion in all areas of municipal activity. This tool enables the City of Ottawa to operate in a manner that embraces the spirit of equity and inclusion in the development and implementation of policies, programs, and services (Equity and Diversity Policy), intended to achieve service excellence.



The Equity and Inclusion Lens reflects the vision of services that respect and value the diverse population that the City serves. The Lens is a systematic way of considering the concerns of the full diversity of residents. It builds upon many inclusive practices already underway in the city, while responding to concerns raised by residents who have experienced exclusion or inequities. The Lens focuses on eleven (11) equity seeking groups who experience systemic barriers including:

- Five (5) equity seeking groups identified in the City of Ottawa’s Equity and Diversity Policy – Aboriginal persons, women, persons with disabilities, visible minorities, and GLBT individuals.
- Six (6) groups who are at risk of exclusion: recent immigrants, francophones, youth, seniors, people living in poverty, low-income people, and rural residents.

Equity and inclusion are important to the transportation network to develop a transportation system that works for everyone addressing the different needs and experiences of people. It helps connect more people to jobs, recreation, services, school, shopping, and other activities helping to narrow disparities in access across the city.

Healthy, Liveable Communities

Ottawa’s Human Services Plan identifies the City as caring and inclusive with a focus on ensuring:

- All people have access to the basic needs including income, food, clothing, housing, transportation, health services and recreation.
- Communities are easy to get around and barrier-free for the disabled. There are wide sidewalks and recreational pathways; there is frequent and accessible transit service.
- Traffic and safety plans aim to reduce injury and death.
- Personal safety and security are high, and all people feel safe in their homes and communities.
- The growing senior population promotes successful aging through healthy, independent living. Seniors have access to community services that respond to their needs.

The Official Plan supports healthy livable communities with a focus towards reducing reliance on personal cars to improve the air quality, providing pathways to encourage Active Transportation, and fostering the development of Complete Streets. The concept of Complete Streets is to balance the multiple roles of roads to ensure the best possible outcome as a public resource. The overriding principle of Complete Streets is to offer safety, comfort, and convenience to all users (pedestrians, cyclists, transit riders and motorists) regardless of their age or ability. Complete Streets help build sustainable communities by reducing pollution caused by traffic, ensure that more people can easily get to work and attractions and improving the lives of people with mobility impairments or disabilities.

The transportation sector is again a critical element in supporting this vision. Ottawa wants to strengthen the health and sustainability of communities by prioritizing transit and Active Transportation (walking, cycling) over the use of the private vehicle. People in Ottawa are making more trips using sustainable modes: over a third of commute trips are made by sustainable travel modes like walking and transit. However, most trips in Ottawa are still made in personal cars. Ottawa’s goal is to have most trips made by sustainable transportation by 2046. The connectivity between Active



Transportation, transit, and places of interest such as schools, shopping malls, sports facilities etc. is critical to achieve this goal.

Safe alternatives are a key component of choosing sustainable options of walking, cycling and transit over the personal car. Ottawa Public Health identified the number of slip and fall incidents on snow and ice over the last 3 years. Emergency department visits range from 2,300 to 3,500 annually (Figure 1: Emergency Department Slip and Fall Visits) with hospitalizations ranging from approximately 200 to 300 (

Figure 2: Hospitalizations due to Slip and Falls). Specific winter cycling visits to the emergency department are approximately 40 each winter compared to about 250 during the summer months (

Figure 3: Emergency Department Visits due to Cycling).

Figure 1: Emergency Department Slip and Fall Visits

Month	2016/17	2017/18	2018/19
December	549	321	839
January	639	698	837
February	569	1,011	1,010
March	549	289	882
Total	2,306	2,319	3,568
Monthly Average (Dec-Mar)	577	580	892

Figure 2: Hospitalizations due to Slip and Falls

	2016/17	2017/18	2018/19
December – March Total	206	186	324
Monthly Average (Dec-Mar)	52	47	81

Figure 3: Emergency Department Visits due to Cycling

Month	2016/17	2017/18	2018/19
December	40	18	9
January	3	5	6
February	16	9	9
March	24	9	13
Total	83	41	37
Monthly Winter Average (Dec-Mar)	20	10	9
Monthly Summer Average (May-Sept)	248	274	258



Ottawa wants people to have a range of mobility choices with accessibility options. Ottawa would like a higher-priority maintenance level of service for these facilities, year-round, to support usage and safe access of all users.

Efficient and Effective Asset Management

City transportation infrastructure planning and design strategies acknowledge the need to include operations and maintenance requirements to optimize the overall efficiency and cost-effectiveness of assets over the entire lifecycle.

Design Considerations

Ottawa seeks attractive communities with open spaces and integrated transportation networks and has numerous policies and guidelines to incorporate these concepts. The City wants land use planning to build better, smarter communities reducing the need for travel by car and additional road infrastructure. Transportation networks should be transit-oriented with seamless transitions to Active Transportation networks for all citizens.

Ottawa supports a Complete Streets approach to road design where sidewalks, cycling facilities, multi-use paths, intersections and transit stops are integrated enabling seamless access for all users. Design solutions should be practical, functional and include consideration of long-term operations and maintenance requirements. The life cycle cost, including winter maintenance operational needs, should be evaluated during the design process to ensure safe, efficient, aesthetically pleasing and fiscally responsible operations are feasible throughout the life of the asset.

Specialty spaces and streets, which form part of the City's public realm, are key to establishing community identity, local character, and a sense of place. A well-planned and maintained public realm can boost community identity, promote physical and mental well-being, enhance public safety, encourage private investment, and allow citizens to embrace and celebrate their places and spaces. As the Nation's Capital, Ottawa's public realm also plays an important role in supporting both tourism and economic development.

To achieve world-class standards that are sustainable from both design and maintenance perspectives, the City of Ottawa design standards should consider how both the form and function of its public realm can support an enhanced maintenance framework. More specifically, what product and material offerings are available that can both achieve desired standards of designs while enabling an equally effective maintenance and preservation standard.

Construction

Construction is a challenge to balance cost, quality of the work and public impact. Ottawa seeks to reduce construction disruptions across the transportation network. In particular, citizens want better provisions for pedestrians and cyclists through construction zones. Ottawa also has a focus to preserve and conserve existing infrastructure where it is practical. A stronger focus on transit and Active Transportation is prioritized over personal vehicle usage.



Operations and Maintenance

Ottawa currently experiences a high level of winter maintenance services which exceed the Minimum Maintenance Standards as outlined in the Municipal Act. The City had KPMG review their winter maintenance operations in 2016 seeking operational efficiencies to reduce costs while considering city growth and future needs. Recommendations to reduce the level of service were not well received by the public. The City subsequently reverted to the 2003 MQS.

Maintenance operations are undertaken primarily with in-house staff with a few private sector contracts.

Winter maintenance challenges are experienced along urban streets where sidewalks and bike lanes are adjacent to the road. Snow is typically plowed from the road and bike lanes towards the sidewalk while snow from the sidewalk is typically plowed towards the road and bike lanes. Further challenges are experienced with pedestrians and cyclists using these facilities while winter maintenance operations are underway. Winter maintenance in specialty spaces and streets frequently try to avoid daytime operations when more people are about for safety reasons, however noise complaints are received when working at night and the window to complete the work is very short.

Winter maintenance operations are challenging in the smaller restricted areas. Equipment that is efficient on the primary roads is not efficient in subdivisions, rear lanes and specialty spaces and streets. Right-sizing equipment facilitates getting the job done in one pass, minimizing infrastructure damage particularly within SSS, reducing, or eliminating reversing operations which significantly helps increase efficiency and safety. Other factors that help winter maintenance operations efficiency include wider rights-of-way, adequate snow storage areas, reducing on-street parking conflicts and adequate clearance around street scaping and furniture.

Assets that are kept in good condition without ruts, potholes, etc. enable efficient winter maintenance operations and increased safety. Pavement that is in good condition prevents water from infiltrating weak areas causing further damage, ponding, and refreezing. Salt is diluted in these ponding areas reducing its effectiveness and resulting in icy conditions.

Ottawa is a vibrant city and is respectful of the environment with a focus on sustainability. As such, there is a desire to reduce the amount of salt used while ensuring fiscal responsibility, mobility, and safety for all users.

Ottawa's 2016 census indicates that over 15 per cent of the city's population was over 65 years of age, and that number is projected to rise over the coming years, reaching an estimated 20 per cent by the year 2031. The Snow Moles, a group of senior volunteers, monitor and post sidewalk conditions for the public to aide in making safe travel decisions.

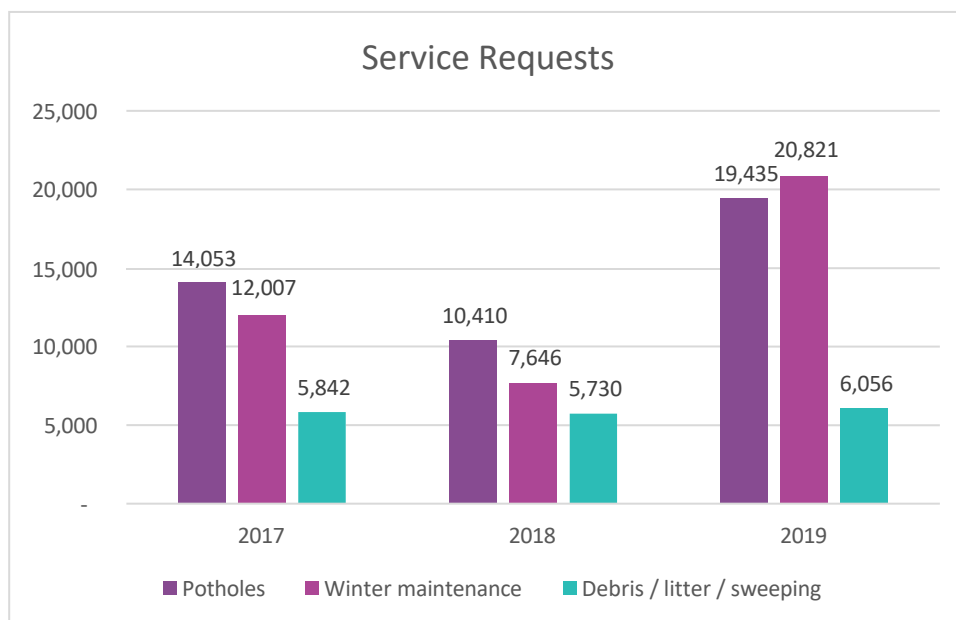
People with disabilities have a strong voice in the media demonstrating mobility challenges during winter conditions. People have been stranded in their wheelchairs due to deep snow, inability to activate pedestrian crossing buttons etc. When sidewalks are unsafe Ottawa provides Para Transpo services at a cost of \$64,000 annually. However, many disabled people still feel trapped in their homes not wanting to risk going out.



Ottawa citizens have concerns specifically with the condition of the infrastructure in the winter and the impact on safety and mobility. Ottawa experiences frequent snow, freezing rain, significant cold and a high number of freeze thaw cycles making winter maintenance operations and mobility challenging.

Service Requests have fluctuated from 2017 to 2019 with over 54,000, 37,200 and 64,000 in each of the three years, respectively. The highest number of complaints are for potholes, winter maintenance and debris. These maintenance related complaints have increased in percentage from 56% in 2017, 64% in 2018 and 72% in 2019. Figure 4 below details the maintenance related Service Requests.

Figure 4: Service Requests



Service Requests focus on the following issues:

- Sidewalks are not cleared in timely manner making them slippery and uneven.
- Water pools around uneven pavement, potholes and frozen catch basins which refreezes and becomes slippery.
- The Canal and other multi-use paths have water ponding which refreezes and becomes slippery.
- Narrow streets became narrower with snowbanks making it challenging for passing vehicles, emergency services and winter maintenance activities.
- It is difficult for seniors to clear plow windrows across their driveway.
- Snowbank height restricted vehicle visibility.
- Deep ruts in the road surface, and snowpack damage cars.



Citizen suggestions, captured in the media, to resolve winter maintenance challenges include:

- Winter maintenance operations:
 - Snow removal should start before accumulations reach Ottawa’s MQS.
 - Sidewalks and the downtown area should receive prioritized winter maintenance operations.
 - There is a need for a new strategy to keep catch basins flowing preventing water from ponding, refreezing, and becoming slippery.
 - Increasing winter maintenance operations to reflect climate change.
 - Increase the number of ice breakers.
- Budget:
 - Increase the winter maintenance operating budget.
 - Developers / owners should pay for snow removal around tall buildings.
 - Identify the hospital savings associated with an increase in the Level of Service for winter maintenance operations. Solicit the province to reimburse the City for the extra cost to deliver the higher Level of Service.
- Winter parking on streets should be banned to enable equipment to better clear the snow and ice.
- Garbage should be placed away from plow routes.

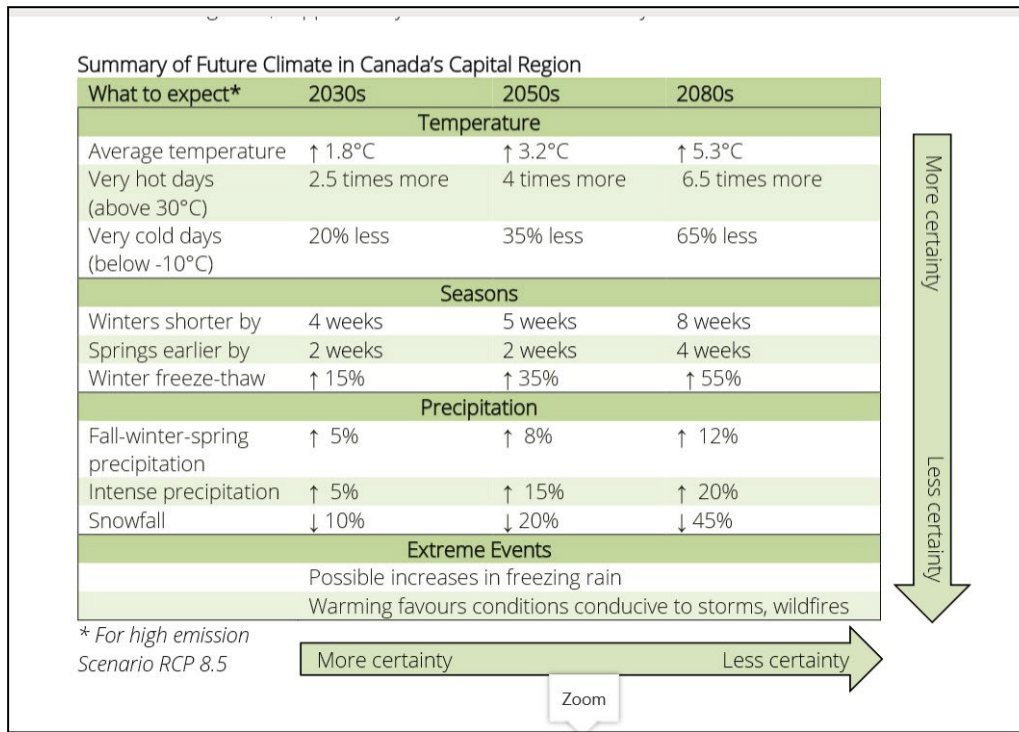
Climate Change

The City of Ottawa’s Climate Change Master Plan is an overarching framework to reduce greenhouse gas (GHG) emissions and respond to the current and future effects of climate change. The plan aims to transition Ottawa into a clean, renewable, and resilient city reaching the Greenhouse Gas (GHG) emission reduction target of 100% by 2050. As identified in public consultations for the Transportation Master Plan 2020, 75% of stakeholders believe the City should address climate change and reduce GHG emissions from transportation. The climate change elements pertinent to winter maintenance (temperature, precipitation, snow, freezing rain) trend in the same direction for 2030, 2050 and 2080 outlooks (Figure 5: Climate Change *in Ottawa*) with only the magnitude of the change increasing. This report focuses on the climate change forecasts for 2030 to align with the project scope and City Plan timelines.

By 2030 winters are expected to be 4 weeks shorter than they currently are with an average increase in temperature of 1.8°C and 20% fewer cold days (cold days are colder than -10°C). Snowfall quantities are expected to drop by 10%, however, there is an overall increase in precipitation and intense precipitation by 5% which is expected to be in the form of rain and freezing rain. The increase in temperature results in an increase in freeze-thaw cycles by 15%. Overall, these climate changes should reduce the harshness of the winter. However, the increased freezing rain and freeze thaw cycles will require increased attention for maintenance operations to ensure mobility.



Figure 5: Climate Change in Ottawa



Ottawa seeks better planning, design, construction, operations, and maintenance opportunities to reduce, eliminate or preferably reverse the impacts of their carbon footprint and Climate Change implications. Ottawa supports:

- Open spaces with trees and other features increasing oxygen production and decreasing carbon dioxide.
- Reducing waste associated with construction and maintenance activities.
- Using recycled materials where feasible.
- Reducing salt use.
- Storm water infiltration opportunities for retention of water to support living materials.

Sustainability

Ottawa is Canada's Capital, and as such, there is a passionate civic responsibility to ensure the city is sustainable socially, environmentally, and economically.

Ottawa emphasizes reducing the transportation sector's impact on air quality, Greenhouse Gas emissions and the carbon footprint by reducing the dependency on private vehicles and developing a more equitable balance with increases in Active Transportation and public transit alternatives. Ottawa's Official Plan estimates that every \$1 invested in Active Transportation saves \$5 in health care costs. Canada wide, a 10% increase in physical activity rates would save \$150 million dollars annually equating to roughly \$5 million dollars for a city the size of Ottawa. In addition, increased Active

Transportation is expected to yield environmental cost reductions of over \$14 Billion dollars across Canada equating to \$500 million dollars for the City of Ottawa. Ottawa’s Official Plan’s goal is for most trips to be made by sustainable transportation by 2046.

The Greenspace Master Plan also supports the City’s sustainability objectives to provide adequate greenspace for community needs while maintaining natural systems, habitats, and biodiversity. Greenspaces will be linked to provide both public access and species movement. Greenspaces will be maintained as naturally as possible minimizing the need for human intervention supporting natural processes.

Ottawa needs its transportation infrastructure to be financially sustainable to build and maintain. While there is the desire to minimize costs, there is an understanding that adequate funding is required to efficiently maintain the viability of all the transportation assets. The City spends approximately \$63 million dollars on winter maintenance annually. The City is accountable to the public for expenditures while ensuring an appropriate level of service is provided that is safe, reliable, and equitable to all users.

Ottawa is a very environmentally responsible city and wants to mitigate the environmental impacts of winter maintenance activities while ensuring the safety and mobility for all users and being fiscally responsible. Ottawa uses an average of 185,000 tonnes of salt each year. The public would like the City to perform winter maintenance operations with a lower environmental impact as identified in the new Transportation Management Plan consultations.

Ottawa, like many municipalities, spends a significant amount of resources dealing with legal claims. The majority of claims between 2016 and 2020 involved slip and fall accidents with a total of 113 (Figure 6: Number of Legal Claims). Similarly, the majority of the legal cost to the City is from these slip and fall accidents at over \$2.2 million dollars (Figure 7: Legal Claim Costs).

Figure 6: Number of Legal Claims

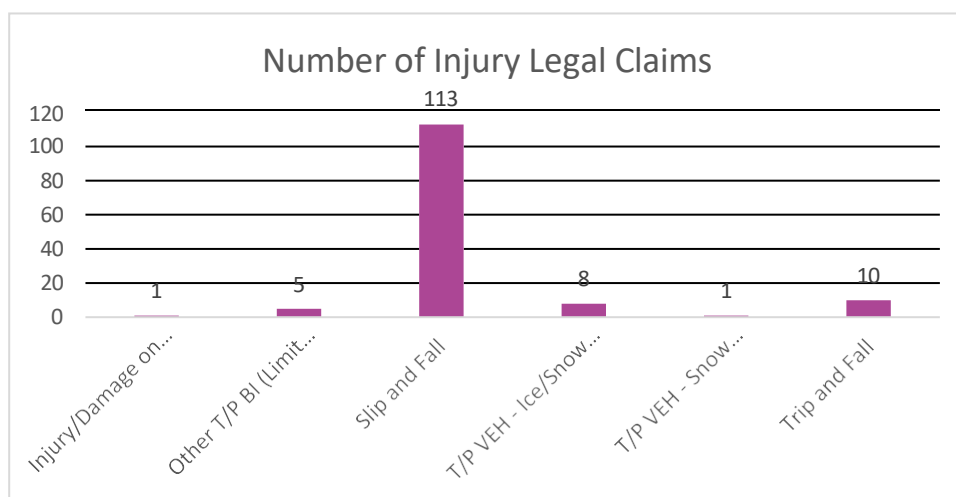
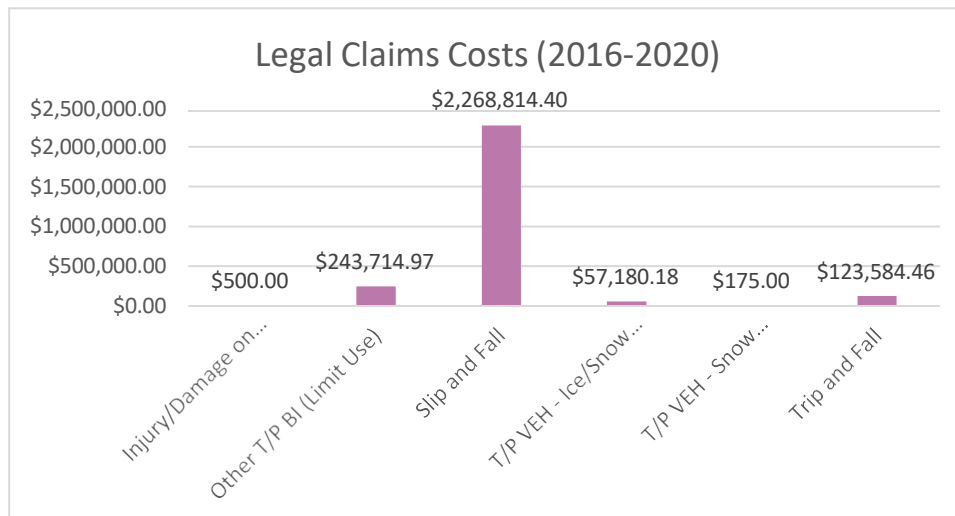


Figure 7: Legal Claim Costs



Key Themes - Maintenance Best Practices

A literature review identified numerous maintenance themes and best practices supportive of providing a high standard of comprehensive, year-round maintenance for AT and transit facilities, along with SSS, to maximize their utilization. They are summarized below:

- Demand for year-round Active Transportation (AT) alternatives in urban areas is growing.
- Clear sidewalks accessible to all are increasingly seen as a necessity to remain compliant with legislation around equity and accessibility for the disabled.
- Special-use spaces and off-road trails which form critical parts of the walking and cycling network are receiving greater attention in terms of year-round maintenance.
- Heightened attention regarding the value of SSS and the need to dovetail place keeping with place making.
- Municipalities are designing and building sidewalks, bike lanes, cycle tracks, and multi-use trails with maintainability in mind, including maintainability in winter.
- New ways of classifying and prioritizing facilities are emerging and roadway elements (e.g. sidewalks, bike lanes and adjacent multi-use trails) are being considered and classified independently from the vehicle lanes.
- Primary routes for transit and goods movement are being prioritized over those which cater mostly to passenger vehicles.
- Municipalities are being increasingly proactive and transparent in communicating their Winter Maintenance Quality Standards (WMQS), what is occurring during and after a storm in real-time and managing service requests / complaints through 311 operator training.



- Road authorities are making increased use of forecasting and meteorological data, Road Weather Information Systems (RWIS) and Maintenance Decision-making Support Systems (MDSS) to get the right resources to the right place at the right time.
- Optimization is the order of the day when it comes to beat planning, materials application, resource planning and equipment right-sizing. Increasingly technology and effective practices are being embraced to improve efficiency and cost-effectiveness.
- Many municipalities are moving away from reactive standards based on accumulation or the identification of occurrences of hazardous conditions before acting and are embracing a more proactive and pre-emptive posture taking the initiative in areas such as anti-icing so as to make restoring facilities to their desired condition faster, more efficient, and more economical over the longer term.
- Proactive measures such as anti-icing and pre-wetting of materials which can reduce salt usage are being embraced.
- Sand and other types of grit have fallen out of favour, with only municipalities who experience sustained low temperatures and operate under consistent snow-packed levels of service continuing to make widespread use of these materials.
- With adequate training, forewarning of anticipated conditions, clear standards to be achieved and flexible operating guidelines, road authorities are pushing decision-making down to a more local level, to allow for adaptability and timely response.
- Maintaining the surface quality of AT facilities is becoming increasingly important, both from a usability perspective and as a liability risk management measure.
- Sidewalks, cycling facilities, multi-use paths, trails, and areas where automotive traffic is restricted often tend to be over-salted and studies show that good salt management practices can often halve salt use on these facilities.
- Key Performance Indicators (KPI's) which account for mobility, accessibility and safety are becoming more common.
- Climate change is making the achievement and maintenance of snowpack less achievable due to freeze-thaw action and freezing rain, resulting in ice accumulation. Many road authorities are responding with a broader application of bare pavement standards.
- Relying on adjacent property owners to clear sidewalks rather than the municipality clearing them is an area of ongoing debate. One solution is a dedicated property levy for winter sidewalk maintenance.
- Clearing bus stops and crossings (both mid-block and at intersections) and managing ponding (due to blocked catch basins) in these areas is becoming an increasing priority to adequately serve pedestrians and transit users.

Key Themes - Designing for Maintainability

An extensive review of literature available on-line was undertaken to identify and capture key themes around designing roads, AT and SSS for maintainability. They are summarized below:



- Incorporate design strategies for AT and SSS to block wind, particularly prevailing winds, and downdrafts to benefit users and make winter maintenance requirements less onerous by reducing drifting.
- Maximize exposure to sunshine (solar melting) through orientation and design for AT and SSS facilities.
- Street and pedestrian lighting for roads, AT and SSS makes spaces attractive and safe for use after dark and assists maintenance staff when performing their tasks at night.
- Designs incorporating universal access are now the norm, in line with user expectations. Maintenance quality standards for AT and SSS which compromise this design objective lessen the benefits provided by pedestrian and cyclist facilities during the winter months.
- Choose construction materials and amenities for AT and SSS with commonality across facilities, market, availability, and proven durability.
- Follow guidance associated with Crime Prevention Through Environmental Design (CPTED) for AT and SSS facilities.
- Use materials and products for SSS to construct the space which are durable, vandalism-resistant and for which replacements are readily available.
- Consider the overhead and lateral clearance requirements of cyclists and maintenance equipment for roads, AT and SSS.
- Provide multiple points of access and egress, and connecting pathways, while considering the desired lines of users for AT and SSS.
- Consider vehicle access requirements for AT and SSS for police, fire, ambulance, and maintenance vehicles for summer maintenance, winter maintenance and year-round activities such as landscape maintenance and trash removal.
- Bridge and pavement designs, even when intended for pedestrians and / or cyclists only, should consider the accessibility needs of emergency equipment and maintenance vehicles for AT.
- Involve maintenance staff in the design standards and design review process for roads, AT and SSS. Layouts should facilitate efficient mechanical sweeping in summer, and snow plowing / snow removal in winter.
- Designs for roads, AT and SSS should include provisions for snow storage and managing contaminated melt water on-site.
- Drainage designs for roads AT and SSS should avoid ponding within walking / cycling areas; stormwater inlets should be cyclist-friendly; salt-contaminated melt water should be managed in an environmentally responsible manner.
- Consider pandemic social distancing requirements by avoiding pinch-points which force pedestrians close together for AT and SSS.
- For cyclists, consider ride quality requirements and the timing of winter maintenance as cyclists are much more inconvenienced by a lack of maintenance than motorized users.



- Recognize the need to either scale walking and cycling facilities to the applicable maintenance equipment or to purchase equipment scaled to the design(s) of the AT and SSS facilities.

4.0 City of Ottawa Internal Interviews

Interviews were held with City staff to acquire an understanding of the current maintenance operations and opportunities for Class 4 roads without sidewalks in proximity to public attractions, Class 5 roads, Active Transportation facilities and Specialty Spaces and Streets.

The twenty-two (22) interviews were held with thirty (30) people in May and June of 2020. A broad range of passionate and committed staff provided representation from the following areas:

- Director Roads and Parking.
- Director Parks and Forestry.
- Public Works & Environmental Services (PWES):
 - General Managers.
 - Program Manager Operations and Research.
 - Manager Transitway and Parking.
 - Area Managers (Suburban West, Urban Core, Suburban East, and Rural).
 - Zone supervisors (Suburban East and Urban Core).
- Planning, Infrastructure and Economic Development (PIED):
 - Urban Design team.
 - Manager Right of Way, Heritage and Urban Design.
 - Quality Standards
 - Economic Development team.
 - Landscape Architecture.
- Asset Management team:
 - Project Manager (Design and Construction).

The information obtained from these internal interviews is summarized in six (6) key areas of winter maintenance quality standards, Active Transportation facilities, specialty spaces and streets, public expectations, climate change and design considerations.

Winter Maintenance Quality Standards

City staff feel Maintenance Quality Standards (MQS) are important to support operational decision making and manage public expectations.

The City has recently been working with front line maintenance staff to proactively deliver the winter maintenance operations. Typically, municipalities wait for MQS thresholds to be reached before winter maintenance operations are initiated. With Ottawa's weather conditions, sometimes the threshold is



not yet reached to deploy equipment before another storm hits. This second storm can quickly exceed the threshold making it difficult or impossible to meet the standards. The proactive approach enables maintenance operations to assess the existing conditions in conjunction with weather forecasts and efficiently schedule work. This approach facilitates an improved level of service and mobility at a reduced cost.

Staff felt there is a need to understand the maintenance unit costs more fully. It is understood that increased winter maintenance operations typically increase costs, however, a reduction in public liability claims for slip and fall accidents, reduced OC Para Transpo costs, reduced clean up costs would help to offset the impact.

There was also an appreciation that the City needs to have different standards for the different areas of the city including tourist areas. There was also a desire to have standards reflect the local geography to break down barriers between core, urban, suburban, and rural residents.

Operationally, there was significant interest in bare pavement standards. Getting to bare pavement on all assets including roads, sidewalks, pathways, and bike lanes increases safety and mobility and helps to minimize the build up of snow and ice requiring removal later in the season. A proactive approach monitoring storm forecasts, and where appropriate, initiating operations before threshold triggers are met helps achieve the MQS's more efficiently reducing resources, materials, and costs while providing a better level of service. Utilizing salt earlier in the storm helps maintain bare pavement longer and return to bare pavement more quickly following a storm. It also reduces resources, materials, and costs while providing an increased level of service.

Storms with snowfall levels less than MQS thresholds for operations tend to result in packed snow and ice conditions. The snowpack continues to absorb additional snow and ice during subsequent storms and freeze thaw cycles. This results in continued compaction with slippery and uneven surfaces. A centre bare standard rather than a snow packed standard significantly increases the surface condition throughout the winter while reducing the need for ice breaking for road rutting, sidewalks, pathways, and bike lanes. Ice breaking equipment is somewhat effective as a last resort, however, keeping ahead of the ice and snow build up is safer and more efficient.

In moving to a higher level of service for bare and centre bare roads, there is expected to be a need for better salt application standards, and training.

On road winter cycling lanes are challenging to maintain through the winter. Inconsistencies in design from one section to another prohibit opportunities for efficient operations and utilization of more efficient specialized equipment. In addition, street plowing pushes the snow to the side of the road where the bike lanes typically reside. Sidewalk clearing also plows the snow towards the bike lane. The uncoordinated operations of street and sidewalk plowing frequently leave the bike lane with snow piled in it.

Parking, both legal and illegal, also creates an operational challenge for winter maintenance operations. Snowplows and spreaders are large pieces of equipment which must carefully maneuver around parked vehicles to clear the snow and ice as well as possible without damaging the cars and snowplows. The result leaves a significant amount of snow on the road around the car. Enhanced



parking strategies and management was suggested to increase the efficiency of winter maintenance operations, reduce damage, and yield a better road surface condition.

The City of Ottawa typically has one operator for each piece of winter maintenance equipment which works well. Challenges are experienced when equipment breaks down or staff are sick. Operators are generally assigned to a type of equipment and a route and changing either the equipment or the route results in less efficient operations and increased damage to equipment and infrastructure. A review of equipment, operators and contractors may yield opportunities to further improve operations and reduce costs.

While there was a good understanding of the MQS, there were pockets of staff who would benefit from a clearer understanding of standards and the prioritization of operations.

Active Transportation Facilities

Several staff felt a need for a proper definition of Active Transportation (AT) to include sidewalks, bike lanes, paths, and connectors. Staff felt the MQS are not clearly defined and identified AT facilities as either a priority operation or not a priority operation. Suggestions were made to prioritize AT based on the infrastructure demand and usage rather than the road classification.

The cycling network is expected to be maintained to a bare pavement standard. Bare pavement and centre bare pavement sidewalk conditions were encouraged for residential streets to improve accessibility and level of service. The increased level of service is expected to be close to cost neutral with savings from reduced slip and fall accident liabilities along with snow and ice removal operations.

There is also the expectation that AT will continue to increase in the future and the MQSs will need to account for increased levels of service and increased infrastructure.

Specialty Spaces and Streets

There is an expectation that City of Ottawa Specialty Spaces and Streets (SSS) are distinguished from other municipal spaces and will be maintained at a higher standard than the road network. These SSS need a specific and enhanced MQS to cover not only the winter surface condition, but also address summer conditions, furniture, maintenance etc. SSS specific classifications should be considered such as Tourist, Core, BIA, Suburban, Rural etc.

There is a need for tourist areas to have enhanced MQS for special events with more snow removal for winter events. Consultation with BIA's is important as there is a strong correlation between the BIA's and Service Requests to keep the spaces active and vibrant. Investments in SSS are expected to yield many economic benefits for the City.

Some of the challenges working in the SSS areas include limited space to maneuver large equipment, and restricted hours of operations to work at night when less people are around but before deliveries start early in the morning.

SSS design considerations should include maintenance operations to ensure there is enough room for equipment to operate safely and efficiently and reduce equipment and infrastructure damage. Smaller specialty units with back up cameras would also increase safety while reducing damage.



Public Expectations

Public expectations are high in the Nation's Capital. Confusion results when some standards are exceeded, and the public sees the exceedance as the desired standard. Developing clearly defined MQS will improve public understanding which will subsequently reduce the number of Service Requests and staff resources necessary to review and respond.

Accessibility is the highest priority amongst the public, particularly for aging and disabled citizens. It is felt that safe travel mode choices need to be available supporting equity and equality. Sidewalks are the priority focus as all modes need to use sidewalks for at least some part of the journey.

Maintenance quality standards should be reviewed through the lens of older and disabled people. In addition, slip and fall accidents on sidewalks are a significant impact on the City's budget.

It is important to ensure tourists' perception of the City is positive to promote additional tourism and support economic vitality. Downtown BIA's fund enhanced maintenance operations in their areas generating significant tourism and economic benefit for the City. Consultation with BIA's will be important to shape the MQS's supporting uniqueness while maintaining consistent and fiscally responsible standards.

Climate Change

Climate change is expected to continue adding more pressure to maintenance operations. There is concern the increased frequency and severity of weather events will increase winter maintenance operations costs which will be difficult to account for. However, roads are holding the bare pavement condition longer into the fall already which will help reduce winter materials and costs.

5.0 Municipal Best Management Practices

Interviews were undertaken with progressive municipalities and road authorities from across Ontario, Canada, United States and Europe seeking opportunities for new innovative maintenance solutions and benchmarking. Municipalities were chosen to provide benchmarks with organizations having similar location, population, climate, Active Transportation networks, Specialty Spaces and Streets as well as progressive state of the art initiatives beneficial to the City of Ottawa. Questions were designed to understand the infrastructure, weather, maintenance standards, challenges, innovations, and lessons learned that could be transferable to the City of Ottawa.

The information compiled below is directly from staff interviews and may not be the official position of the organizations interviewed.

A summary table of the interviews is available in Appendix B

National Capital Commission, Ottawa, Ontario, Canada

Infrastructure and Climate

The National Capital Commission (NCC) outsources all their maintenance operations in nine (9) contracts. NCC's snow and ice contract standards for roads and sidewalks are very high. All facilities have a bare pavement standard and must be cleared by 7 am with a maximum allowable accumulation



of 3 cm at anytime during a storm. Drifting snow is removed twice daily before 7 am and 4 pm. All snowbanks and windrows are removed immediately. Salt and grit are used except at building entrances where special de-icing products are used. All grit is swept away daily.

Maintenance Standards and Costs

NCC has four (4) Levels of Service A, B, C and N (Naturalized). All snow and ice control are in Level of Service B. One level of service simplifies operations and public expectations. However, there are a couple of locations where additional servicing is required around the Parliamentary Precinct and West Block areas where expectations are even higher. NCC is very involved with their contractors planning operations ensuring excellent standards are delivered through visual inspections.

Students (150) are hired throughout the summer to monitor the network assessing infrastructure and furniture condition and identifying maintenance operations and repairs needed.

All contractors manage their own workplans and equipment enabling the use of specialized equipment they believe delivers the best performance for investment.

All funding is provided by the Federal Government.

Innovations

NCC recently installed a snow melting system on a pedestrian bridge significantly reducing the need for plowing and hand shovelling. The snow melting system is also expected to prolong the life of the bridge structure and reduce costs overall.

NCC is starting to clear snow and ice from pathways in the spring that are not maintained during the winter. These areas tend to be connecting links in shaded locations where the snow lingers well beyond when other pathways are open to users. There is some concern about the potential pavement damage associated with this operation which is being monitored. If this operation is to continue, standards and funding are required.

Design Standards

NCC has design standards reflecting maintenance operational needs. The NCC representative finds the time invested at the design stage greatly improves maintenance operations once the project is constructed.

Lessons Learned

NCC operations staff have an increasing presence at the design stage of new projects. With this approach, they can identify potential maintenance problems early and evaluate new innovative design solutions when costs to modify plans are still low. The recent installation of the snow melting system on the Nepean bridge is one example of the value of participation at the design stage. Funding for maintenance operations is included in the budget at the design phase for new projects.

In recent years NCC has increased its clearing of multi-use paths identified on an individual basis. NCC would like to establish maintenance quality standards for clearing snow and ice from multi-use paths. There is a need to balance public expectations with maintenance capabilities and cost.



NCC would like to establish an ice and snow control Level of Service A classification to better service the Parliamentary Precinct and West Block areas.

All the NCC's contracts are still in paper form with hundreds of maps outlining the areas and operations. There is an understanding of the need to change to an electronic GIS based system to expedite contract start up and knowledge transfer associated with contracting operations. NCC does not yet use Automated Vehicle Location (AVL). Implementing AVL would enable NCC's contract management officers to be more hands off and concentrate on contract oversight. Smaller contracts with a higher level of technology and innovation is expected to make the contract management more effective.

NCC Call Centre staff are well trained and have a handbook to identify the specific contractor to notify of public complaints.

Interagency collaboration and partnerships can create exciting new ideas, significantly enhance network continuity and ease of public use.

City of Brampton, Ontario, Canada

Infrastructure and Climate

The City of Brampton Ontario has 2,500 km of Class 4 and Class 5 roads, 980 km of sidewalks, 425 km pathways in parks and some multi-use paths. Most of the Active Transportation network is off road on multi-use trails. Brampton is looking at separated on road bike lanes. They have a few Specialty Spaces which get a higher level of service due to BIA interest.

Brampton's weather is warmer than Ottawa and the last five (5) years has been inconsistent for weather events. Freeze-thaw cycles are more frequent and ice events are a major concern. Brampton is impacted by lake-effect snow streamers coming from Lake Huron and Georgian Bay that create extremely localized conditions on either side of the city. Drifting snow from open spaces causes problems particularly for sidewalks. There has been an increase in salt consumption associated with the changing weather and maintenance requirements.

Maintenance Standards and Costs

Brampton runs their maintenance operations on a 24hr/5day shift. This works well and provides rapid response to arterials, as well as addressing localized events. In-house and contractor staffing balance work well with in-house providing the rapid response needed for arterials and sidewalks (20%), with the remaining 80% being contracted out. Parks have a 50/50 split between in-house and contracted operations. Contractors bid a fixed rate for equipment on standby and when operational. Funding is from the municipality solely.

All roads are required to be safe and passable. The City of Brampton recently increased its maintenance standards for plowing initiating operations at 5cm accumulation from the previous 7.5 cm. Center bare and snow packed are acceptable for Class 4 and Class 5 roads, however, people want bare roads. Minimal maintenance is done on snow packed roads, occasionally they will be cleared. On road bike lanes have the same Level of Service as the road.



Sidewalks and pathways have a 5 cm trigger and must be plowed and salted within 24 hours of the end of each storm. In the downtown core, sidewalk operations must be complete before stores open. Sidewalk plows are parked in a downtown City garage for quick deployment. There is one dedicated crew for the downtown area. Snow removal is required 3-4 times per year due to limited storage. Windrows are the responsibility of residents. However, they generate a lot of complaints. Subsidies are available for seniors and disabled residents needing help clearing their sidewalks, windrows, and driveways.

There are very few complaints regarding access for the disabled.

The City monitors events, equipment, materials, weather details and time to complete work.

Innovations

Brampton uses salt brine for pre-wetting salt and Direct Liquid Application (DLA). They are finding DLA effective during the beginning and end of the season.

Brampton has GPS equipment on their maintenance vehicles, which are linked to their 311 website, so the public can see when a road was last cleared. The routes change colour depending on how long it has been since it's been serviced.

Parked cars are a problem prohibiting effective plowing. Brampton has three (3) hour parking limits with no overnight parking and with permits only by exception. Permits are invalid when snow clearing operations are underway. The City e-mails permit holders and residents when plowing is scheduled, however, a by-law officer is still required to ticket cars impeding operations. Brampton partners with their strategic communications team to deliver media blitzes focused on educating the public to move their cars before the storms.

Brampton is looking into smaller vehicles to get into smaller spaces such as laneways and separated bike lanes.

Brampton is starting to review their winter maintenance data to evaluate Key Performance Indicators.

Design Standards

The City does have some design standards, however, they are not always followed. There is an increase in rear laneways that are difficult to maintain. Traditional plows do not fit so they are looking at blowing the snow or using pick up trucks to plow it.

Lessons Learned

City staff generally receive a lot of winter maintenance questions from new councils during their first winter. The City runs workshops to explain winter maintenance and encourage 'ride alongs' to further understand the operations and challenges.

311 Operators are also trained in winter maintenance standards and do not take service requests until 24 hours following the end of a storm.



City of Toronto, Ontario, Canada

Infrastructure and Climate

The City of Toronto has 3,165km of local roads, 7,945km of sidewalk, 233km of bike lanes, 42km of cycle tracks and 10km of contraflow bike lanes. Toronto continues to add additional cycling facilities. Toronto has many Specialty Spaces and Streets including Nathan Philip Square, Mel Lastman Square, Little Italy, China Town, St. Lawrence Market, Kensington Market, King Street and Queens Quay, just to mention a few.

Toronto has a milder climate than Ottawa, however, it is very unpredictable, and they do experience a significant number of freeze thaw cycles with significant freezing rain particularly later in the season. Typically, winter maintenance is required between November and April.

Maintenance Standards and Costs

Toronto uses eighteen (18) area contractors to deliver all winter maintenance operations. All the funding comes from the City budget and is not supplemented from other sources. See Table 3: City of Toronto Cost of Contracted Services vs In-House Services below for Toronto’s comparison of contracted costs to in-house costs.

The AT (sidewalks and pathways) network is currently plowed and salted when 2cm of snow accumulates. High volume locations are maintained first followed by the lower volume locations. The 2cm threshold is a recent change due to public pressure from the previous standard of 8cm. On road cycling infrastructure is treated the same as the road. The downtown area and specialty areas do receive a higher level of service and some BIA’s provide financial assistance. Laneways are salted and not plowed.

Toronto’s maintenance standards are working fairly-well, with 60% of the public satisfied in a recent poll. However, there is a lack of understanding of some of the standards such as windrow clearing which receives the most requests for service while slippery sidewalks receive the most complaints.

Table 3: City of Toronto Cost of Contracted Services vs In-House Services

Contracted Salting (estimated costs for 1 storm over 3 days)		In-house Salting (estimated costs for 1 storm over 3 days)	
Costs for total CKM salted	\$2,370	Costs for total CKM salted	\$2,239
Operating cost (Includes labour and equipment)	\$22,921	Labour (20 HEO's)	\$22,352
Equipment	12 salt trucks	Equipment (20 salt trucks)	\$4,215



Material - salt	\$45,571.68	Material - salt	\$36,168
Standby - fixed costs	\$18,294	Combined hours - 3 days (8 hours) x 20 staff	\$482
Labour	12 drivers		
Total	\$86,786.68	Total	\$62,735.00

Innovations

Toronto has numerous progressive innovations and pilot projects underway:

- Toronto is piloting a sidewalk clearing program using in-house staff to mechanically clear sidewalks at requested locations such as seniors’ homes rather than manual shovelling. The sidewalk machines clear a path approximately 1.1m wide and have a 360° camera on some of the machines.
- Toronto uses anti-icing technology and is currently testing beet juice as a de-icing product to replace salt.
- Toronto uses Automated Vehicle Location equipment feeding the data to a public Track My Plow system on their 311 website.
- Toronto has trained their 311 team on winter maintenance standards and only logs complaints once a storm has ended and the location has exceeded its service time.

Toronto is currently developing Key Performance Indicators (KPI’s) to add to their level of service table. KPI’s are expected to include lane kms, claims and salt runs per weather event etc. The KPI’s are expected to be finished later this year.

Lessons Learned

The City of Toronto windrow program has a very high public profile; however, it is very expensive.

The City is undertaking a formal review of the winter cycling network.

City of Edmonton, Alberta, Canada

Infrastructure and Climate

Edmonton has approximately 5,700km of residential roads, 3,000km of Class 4 roads and 5,500km of sidewalks. There are Active Transportation networks serviced by others which include multi-use paths and winter cycling. There are about 40km of protected cycling network in the downtown area.

Winters in Edmonton are long and cold. Temperatures typically range from +5 to -35°C. The daylight hours are much shorter with fifty-two (52) days of snow and accumulations of 123cm annually. The snow is generally dry and fluffy making it easier to remove.



Maintenance Standards and Costs

Edmonton uses a combination of internal and contracted staff to deliver maintenance operations. Plowing starts at 2cm accumulation, but standards only mandate plowing at end of event. Priority 1 routes are serviced within 36 hours and Priority 2 within 48 hours. Residential roads have a snow packed standard and are bladed to 5cm. They are regularly bladed between storms with underbody plows and graders to help mitigate windrows. Edmonton does not remove windrows until they reach 30cm which receives a lot of public complaints. Maintenance operations are synchronized with priority 1 and 2 routes completed first before moving to lower priority and residential routes.

Active Transportation networks within parks are not maintained during the winter unless they connect to transit. Pickup trucks, bobcats, tractors, and brooms from summer grass mowers are used to clear other AT facilities during the winter. Multi-use trails and cycling lanes are cleared to bare pavement within 24 hours with daily brushing and de-icing with calcium chloride. The accessibility community is involved with the City and services are provided to vulnerable users. Transit stops have a lower priority and are cleared after the sidewalks.

Most specialty spaces are maintained to the road priority level with two locations receiving operations 24/7 to ensure there is no snow buildup. These locations are regularly used for festivals. The specialty space organizers pay for winter maintenance services as needed and use either City or contractors to perform the work.

Most of the maintenance standards are achievable, however, better public communication and understanding of the standards would help reduce service request calls. Staffing levels and training are an issue to get new seasonal staff up to speed quickly.

Edmonton spends \$5,800 per lane/km per season on winter maintenance operations with all the funding coming from the tax base.

Innovations

Edmonton has a neighbourhood plowing schedule with parking bans so residents can move cars in advance of plowing. This approach does prohibit continuous plowing and the City would prefer to have a consistent parking ban. Parking compliance is low.

Edmonton has a track my plow program that is updated 3 times daily showing completed plow routes.

Design Standards

Maintenance tries to be involved in new designs. There are a lot of space restrictions in the city and maintenance needs often can not be accommodated.

Lessons Learned

Social behaviours are changing, and it would be helpful to understand what standards citizens would accept in residential areas. The parking program is challenging.



City of Minneapolis, Minnesota, USA

Infrastructure and Climate

The City of Minneapolis (not the wider region) is 57 square miles and has 1,000 miles (1,600 km) of streets with 700 miles (1,120 km) of residential and local roads and 400 miles (640 km) of alleys. There are 100 miles (160 km) of shared use trails, 30 miles (48 km) of protected bike lanes and 2,000 miles (3,200 km) of sidewalk.

Minneapolis has a harsh winter with 20-25 winter events annually ranging from drizzle to blizzards. Typically, four (4) events are significant snowfalls with over four (4) inches (10 cm) and all snow is usually wet and heavy. 100-150 days are at or below the freezing temperatures.

Maintenance Standards and Costs

The goal is to plow to bare pavement, if not, the road needs to be treated within 24 hours. Streets identified as snow emergency streets are cleared to bare pavement in driving lanes, and it is hoped that the parking lanes will also reach bare pavement. Salt is used on these roads. Non-emergency streets are plowed to snow packed with sand applications for traction in critical locations. Alleys are plowed with front end loaders every time there is a snow emergency (over 4" or 10 cm) to snowpack condition. When rutting is a problem, the alleys are plowed when its warm enough to be effective. Commercial sidewalks/areas cleared within 4 hours after end of event.

Downtown Minneapolis has the highest winter maintenance level of service on all streets. Minneapolis has special service districts on some commercial corridors in the downtown area where enhanced services are contracted out. The City recoups the cost through increased taxes from the applicable Business Improvement Associations.

Trails and protected bike lanes are also plowed and treated within 24 hours of end of storm. On street bike lanes are treated with the road. The public would like bike lanes to have a bare pavement standard, however, this is not practical and there are few complaints. Property owners are responsible for their own sidewalks, Minneapolis is only responsible for City-owned sidewalks. Contractors are used where owner does not comply, and owners are required to pay the costs. Pedestrian priority routes are cleared first and windrows at intersections are cleared. It usually takes ten (10) days to clear the 1,600 intersections.

Streets and bike lanes are treated separately with specialized equipment for the bike lanes. Bike lanes, both on-road and trails are well maintained. Challenges are experienced with ice buildup in parking lanes and residential street rutting. Freeze thaw cycles make these areas icy.

Some specialty teams manage the bridges and sidewalks and transitions to intersection corner clearing once they are finished. Other departments can provide supplemental staff for "all-hands" on severe storm situations.

The City of Minneapolis spends approximately \$12M USD (\$16M CDN) annually on snow clearing. Trails and protected bike lanes account for about \$500K USD (\$665K CDN). All funding is from property taxes with the occasional State Aid funding for large events.



Innovations

On street parking is limited and in high demand. During snow emergencies (more than 4" anticipated accumulation) parking restrictions are implemented for three (3) days to enable full width street plowing. Emergency routes get plowed the first night on both sides (Day 1). The next morning (Day 2), the even numbered side of the street gets plowed. The following morning (Day 3), the odd numbered side of the street gets plowed. Heavy parking enforcement is required with 1,700 vehicles towed and 8,000 ticketed annually. There is a strong education program and outreach on the 311 website, 1,700 e-mails, 100,000 phone calls, plus active social media, and a smartphone app.

Minneapolis is using Jeeps with 6' (1.8 m) blades and bobcats to anti-ice and sweep bike lanes. Smaller baby bobcats are used on smaller bridges. They have also tried specialty equipment including anti-icing in the fringe seasons (works well), sweeping, vacuuming, and blowing for the bike lanes.

Minneapolis is looking at accessibility issues, mobility hubs, micro mobility and climate change challenges and opportunities.

311 staff are trained in winter maintenance and do not create service requests until 24 hours after a storm in general and four (4) hours for commercial sidewalks.

Design Standards

Minneapolis has a Complete Streets policy giving pedestrian and cycling facilities priority over cars. Funding is available to support bike lanes for Complete Streets installations. Funding is automatically allocated for maintenance when new protected bike lanes are built. However, bump outs at intersections and median crossings do not get the same level of maintenance funding.

Maintenance needs do not always get incorporated into new designs. Maintenance operations struggle with changing facility widths trying to get even small equipment into some protected bike lanes.

Lessons Learned

Minneapolis rents graders and loaders with operators as needed to supplement their fleet in a cost-effective manner.

Residential roads and alleys could be cleared better, however, snow is usually packed to the pavement by cars making it difficult to remove.

Minneapolis is moving towards Complete Streets with a 20-year fund to promote Active Transportation over personal cars. Council supports protected bike lanes and they are getting the funding to maintain them. Minneapolis also receives an annual adjustment in their budget based on the size of the infrastructure.

Minneapolis has an increasing number of scooters and e-bikes and is looking to create mobility hubs, regulations and identify vendors. Electric Vehicle Stations are challenging to keep clear. Often the power lines are left lying in the street.

It is important to keep maintenance involved at the design stage to avoid long-term problems and costly operations.



New York City, New York, USA

Infrastructure and Climate

New York City (NYC) has 6,000 miles (9,600 km) of streets, 12,000 miles (19,200 km) of sidewalks and 1,200 miles (1,920 km) of bike lanes. NYC has eighty-three (83) plazas and sixty-two (62) public spaces open to the public.

NYC's climate is much warmer than Ottawa's and they have recently experienced very mild winters with minimal snow. Temperatures will fall below freezing but generally return above freezing temperatures. However, this does result in a lot of ice which receives more complaints than snow.

Maintenance Standards and Costs

NYC has an interesting model for winter maintenance whereby they use their sanitation department equipment to clear the roads. Residents and businesses are responsible for their sidewalks. Sidewalks should be cleared within two (2) hours from the end of snowfall. Outside business hours in commercial areas, sidewalks need to be cleared before stores open the next day. All surfaces are maintained to bare pavement as temperatures generally help to melt the snow and ice.

Most of the plazas are managed through Public Private Partnership (P3) agreements with local organizations such as Business Improvement Areas (BIAs), the Horticultural Society and a few are City funded. Agreements include maintenance operations and some concession agreements.

Street furniture assets are maintained through contractors. Concerns are reported through the City's 311 service and are repaired within seven (7) days. There are some parkettes within the curb lane bike corral and street seat programs that operate ten (10) months of the year. The primary focus of summer cleaning is power washing; high traffic plazas will be washed nightly. Homeless encampments, litter, hypodermic needles, etc. need to be managed, although this is usually during the summer months.

Funding is provided by the City and public pressure ensures this priority expense is not cut. Plazas typically cost \$80-100K USD (\$107-\$133K CDN) per plaza per year to manage furniture, power washing, trash collection, flora, graffiti etc. An average plaza is about 3,500 ft² (325 m²). Some consultant fees are also included. Large venues like Times Square are significantly more expensive.

Innovations

NYC has a very abrasive salt mix so the more sensitive infrastructure such as bridges and plazas receive a different mix. They have tested beet juice and salt brine hybrid mixtures.

Sanitation equipment is quite large, and work is needed to review smaller specialty equipment to clear bike lanes.

NYC contracts out its bus shelter maintenance. The contractor generates revenues with advertising in the bus shelter.

Design Standards

NYC design standards focus more on people movement, rather than equipment needs. As a result, a lot of hand shoveling is required. Maintenance has more input on materials planned and focus on



consistency, durability, and improved lifespan. They try not to use anything too 'flashy' that could lead to higher maintenance costs for P3 partners. They also try to avoid pavers due to the maintenance requirements.

NYC is looking to redefine the plazas with a view of preserving open spaces following the COVID 19 needs. Some of the open spaces have been used for additional restaurant seating.

Lessons Learned

The P3 model works well. Oversight is by photographic evidence and there have been less than ten (10) lawsuits in over ten (10) years of using this model. Looking ahead, NYC would like to take more of an ownership role in the plazas to reduce the burden on the partners and manage a few items that go beyond the expectations of the partnership such as garbage dumping and encampments. NYC would also like to pursue more temporary motorist-free public spaces.

City of Oslo, Norway

Infrastructure and Climate

Oslo has 1,240km of roads of which 350km are highways and arterials, 550km are residential with the remainder rural and very low volume roads. Oslo also has 500km of sidewalks and 1,300km of cycling off road cycling paths. Most roads have bike lanes as well. There are pedestrian only streets in the downtown area and some plazas / squares.

The altitude in Oslo ranges from sea level to 500m over a very short distance creating changes in weather patterns and precipitation type. Winter starts by October 15th and runs until April 15th. Most of the snowfall is in January and February. Oslo has been experiencing more extreme weather events lately with harsh winters and temperatures hovering around the freezing mark. Rain and freezing rain events are common.

Maintenance Standards and Costs

Oslo contracts out all the maintenance operations for winter and summer. Contracts are for four (4) years with two (2)-year optional extension. Contracts are a fixed price for standby and contractors are paid for specific operations as needed. Funding is from the municipal budget, however, there is a studded tire permit program fund that can be accessed if additional money is needed.

Residential, low volume roads, sidewalks and other pedestrian areas are plowed when snow reaches 3cm. Contractors have one (1) hour to start operations and four (4) hours to complete. If snow continues to fall, the contractor will continually plow until complete. The contractor has forty-eight (48) hours after the storm to finish their clean up work. Tractors of various sizes are predominantly used to clear roads and AT facilities.

The highest maintenance standard is for high volume sidewalks and bike routes which are maintained to bare pavement using brushing / sweeping equipment deployed as soon as snow falls. A lot of salt is used on these facilities to maintain bare pavement. These facilities must be totally clean within 4 hours after snowfall ends. This is a very high standard and comes with a high cost. Oslo is questioning the value and if the investment generates enough cyclists.



The public does not like the use of salt due to the environmental impact and Oslo is exploring alternatives. Pre-wet salt is used before a storm event and dry salt during the storm.

Many pedestrian only areas have heated sidewalks. In the City, property owners clear their own sidewalks, however, some business owners will combine resources to install, operate and maintain heated sidewalks on a city block basis. While this approach is expensive, the result is a very high-quality surface. Power generation in Oslo is green, yielding a very environmentally friendly solution.

Snow packed surfaces are allowed on residential roads and sidewalks. However, with plowing starting at 3cm there is minimal snow buildup and rutting is usually avoided. When rutting does occur, hydraulic plows scrape the snowpack during mild weather.

Snowbanks are removed, as needed, for an extra price by the contractor when the public complains about snow encroaching on to sidewalks and in to parking spots.

These standards are very high compared to other Norwegian cities. However, the public continues to press for higher standards. Oslo would like to undertake more cost planning in the future to fully understand the implications of increases in maintenance standards and operations.

Innovations

Oslo maintains a high Active Transportation and transit usage in the winter with 15% walking, 50-60% using transit, and a high percentage cycling. Parking is limited and there are a lot of toll roads within the city centre which encourage Active Transportation and transit ridership.

Oslo uses brush sweepers on a lot of their facilities. Oslo finds the sweepers good for small snow events but in larger events, plows may be needed for the first pass followed by sweepers to fully clear the surface. Plastic brushers work well, the steel brushes tend to pack the snow down. The same brushes are used for the spring cleanup.

Oslo is investigating liquid salt alternatives for sidewalks and crushed salt on low traffic areas to help spread salt. Heated salt could be sprayed on cycle lanes and pedestrian areas. In 2011, Oslo tested heated sand due to a salt shortage, however, this was a complicated process requiring specialized equipment and a special type of sand. Traffic packed the sand into the snowpack reducing the effectiveness. This was a costly process and Oslo's warmer temperatures did not warrant heated sand.

Oslo has an online self-reporting tool for public complaints / service requests. Disabled individuals are supported at a higher standard and a complaint triggers a higher priority response.

Design Standards

Oslo has some design standards to help winter maintenance operations, however, it is not always easy to squeeze the standard into existing areas. Sidewalks in new areas need to be 2.5m wide, 3m would be better for maintenance. Snow storage is a concern, managing that will help improve maintenance operations, pedestrian safety etc.

Streetlights, signs, and traffic lights are clustered in one standardized area to reduce impact on maintenance operations. The maintenance department is actively involved in the planning and design process.



Lessons Learned

Oslo has undertaken numerous innovative pilot projects to better perform their maintenance operations. Their experience suggests costs are difficult to estimate and should be calculated from the technical details and then doubled for values that are more representative of the actual costs.

Heated salt water could be a good long-term tool, especially for low traffic areas. Magnesium chloride is a bit stickier and reduces winter dust. Having one substance is easier for contractors to manage. Using gravel and crushed granite is preferred over sand.

Transitioning to new methods takes time and some people will always complain.

Oslo's high standard in bike lanes is very costly and may not be best value for money. The benefit of the increased level of service, with the increased cost, may not actually generate enough cyclists to offset environmental impact. Oslo would like to do more work with cost planning to effectively utilize funds.

Oslo has found social media to be a good medium to convey information to the public. Messaging needs to come from a maintenance perspective to be meaningful in the moment rather than a polished communications script.

City of Stockholm, Sweden

Infrastructure and Climate

Stockholm is primarily an urban city with few low volume roads. There are 150 miles (240 km) of roads and 211 miles (340 km) of pedestrian / cycling facilities. All maintenance is done by contractors with timelines to finish clearing snow and ice once the deployment threshold is met. The maximum time to complete work is ten (10) to fourteen (14) hours for roads. It is up to the contractors to provide the quantity and size of equipment required to achieve delivery timelines. Contracts are typically three (3) years with two 2-year extension options. There is a strong collaboration between ministries and departments which works well.

Stockholm's weather is highly variable with respect to the quantity of snow each winter. Freezing rain is not very common (1-2 events per season), however, there are a lot of freeze thaw cycles. Typical winter temperatures are -5°C to -7°C.

Maintenance Standards and Costs

Stockholm has a lower tolerance for snow and a faster response time for all non-motorized mode facilities. Stockholm's vision is that "Everybody should be able to get to work". All bike lanes will be ready for the morning and evening commute. The transit system works well with a high priority and the full length of bus stop is cleared.

Active Transportation networks, specialty spaces and specialty streets have a higher maintenance standard with lower deployment thresholds and faster servicing. Focus is on transit stations and bus stops first to clear pathways allowing access. Stockholm had a successful trial focusing on clearing the outer suburban multi-use paths leading to the inner city (2-hour bike ride). They used sweepers followed by an application of brine. Contractors are required to provide equipment for up to 10cm heavy snow to be brushed. Contracts still allow for plowing but must be followed by sweeper. This is a



good method but is expensive. Sweeper and brine need to be out early before some events to allow it time to work.

Snow from the road is plowed to one side of the road using the sidewalk as storage. During these times pedestrians are required to walk on the other side of the road.

Bike paths have a high standard. However hardcore cyclists still complain that not enough is done. Others complain that their area is not done, or that they do not see maintenance taking place. Pedestrians and road users complain that bike paths are maintained better than their facility.

Stockholm's maintenance program costs approximately \$23M CAD annually for their contractors. All the funding is from the municipal tax base with some National grants available for specialty programs. Maintenance operations and funding are included in the design phase.

Innovations

Stockholm has an inner-city parking program where each street has one day a week when you cannot park. This program runs throughout the year and the city does all their maintenance during that time including snow plowing and removals. Residents are responsible for getting out of windrows until their 'street day'. The outer-city program is similar but only run in the winter.

A combination sweeper and brining unit was tested and is now in regular operation. Costs were initially higher with the new equipment. However, they are starting to level out. The results are great and there is potential for operating costs to be reduced over time.

Slip and fall accidents are being mapped to 'hot spots' for review and action.

The city runs a half day course for mobility focussing on viewing the city through a limited-mobility lens, which has been successful.

Design Standards

Stockholm has very detailed infrastructure and building design standards regarding what infrastructure should be used and where to place it. These standards have been very helpful in enabling effective winter maintenance operations.

Lessons Learned

Stockholm would like additional standards for prolonged snowfall with multiple fleets following each other to ensure standards are met.

While salt is still used, Stockholm would like stricter standards for their contractors outlining how much to use and when. A cost-efficient alternative to salt would be great. The city has a 2030 target to be free of fossil fuels.

Stockholm would like to improve their maintenance standards during the summer months as a higher level of cleanliness prolongs asset life and makes winter maintenance easier.



6.0 High Level Design Practice Considerations for MQS Efficiencies

Typical industry design standards include providing adequate width for all users including passing, providing lighting for users' safety and maintenance operations, providing a decluttered streetscape minimizing collisions with obstacles such as signs and trees, blocking wind where possible, maximizing exposure to sunshine to minimize maintenance operations, providing adequate space for snow storage and using pavement designs which are smooth and resistant of cracks and potholes. Ottawa has numerous good design standards and guidelines established for roads, buildings, transit, Complete Streets, and parks. However, there are some opportunities to expand these to include considerations for maintenance operations, further strengthening standards, effectiveness, and long-term economic viability of the infrastructure.

There is a clear understanding amongst all jurisdictions that maintenance staff should be actively involved in design projects for roads, AT and SSS. Understanding the maintenance implications of certain design features enables a fulsome evaluation. This ensures infrastructure design decisions can be maintained efficiently and kept in good repair to support Canada's National Capital as a strong vibrant place people want to live and visit.

As all of Ottawa's roads, AT and SSS continue to grow, appropriate funding for ongoing maintenance operations should be allocated as part of the project to maximize the lifecycle of the infrastructure and optimize the costs.

Roads

On-road cycling facilities in Ottawa are difficult to maintain in the winter as the infrastructure design changes frequently along the route. Maintenance operations need to change as the infrastructure changes resulting in inefficient operations with increased costs and lower levels of service. Developing design standard(s) and incorporating a corridor approach with design selection criteria including maintenance operations would help remedy this situation.

Winter maintenance operations efficiencies are significantly reduced in new subdivisions where the final lift of asphalt has not been placed before the winter leaving manholes raised above the road surface. The raised manholes require a reduced operational speed along the road and often result in damage to the manholes and snowplows. Efforts to promote road paving before winter maintenance operations commence and / or have the contractor pay for equipment damage, could be considered.

There are Right of Way (ROW) design opportunities which could significantly increase maintenance operations efficiency, reduce workloads, and reduce costs. It would be beneficial if the ROW design reflected winter maintenance vehicle dimensions to ensure they can efficiently and effectively maneuver the road. Narrow roads can restrict maintenance vehicles, reduce speeds and risk increased damage to equipment and public property. Rear laneways are particularly challenging. The laneways are very narrow, and parking and snow accumulation further reduce the functional width of the laneways for maintenance vehicles. Where possible, wide ROW designs should facilitate adequate snow storage to significantly reduce or eliminate the need for costly snow removal.



Ottawa is expected to experience a 15% increase in the number of freeze-thaw cycles by 2030 because of climate change. Pavement design and pothole patching materials that are more tolerant of freeze-thaw cycles should be evaluated for better mobility and reduce maintenance costs.

Active Transportation

Active Transportation facilities are challenging for maintenance operations. Different and or specialized equipment is often required to maintain different facility designs. Consideration should be given to the continuity of the facility and maintenance operations during the design phase. For example, on road cycling facilities can be plowed with a regular snowplow for a few kilometres until a separated lane is encountered where a smaller specialized piece of equipment needs to be brought in. This creates inconsistent and expensive maintenance operation resulting in an inconsistent riding experience for the cyclist.

On-road cycling facilities are maintained by snowplows. The snow is typically pushed to the righthand side of the road depositing it in the bike lanes. In addition, the sidewalk snow is typically pushed toward the road and deposited into the bike lanes. This results in snow being dumped into the bike lane as road and sidewalk operations are underway creating a very inconsistent level of service for the bike lane. Opportunities to provide adequate snow storage for all modes is recommended.

AT users are more vulnerable to discontinuities in the pavement structure. Cracks, potholes, and heaves are uncomfortable and can cause serious injury to AT users. Pavement patches or cuts, particularly longitudinal, would be best placed outside of the path. Proper drainage and materials with enhanced crack resistance could be considered to extend the pavement life and reduce the risk of injury. Adequate lighting and sight lines will enhance safety, particularly in the darker winter season. Consistent standard construction, signing and identification of allowed users would be beneficial.

Narrow passages and obstructing design features can cause difficulties when clearing the snow. These areas typically result in larger amounts of salt being applied and hand shoveling to prevent icy conditions.

Specialty Spaces and Streets

Specialty Spaces and Streets (SSS) in Ottawa have grown over the years developing into exciting areas attracting tourists and commerce. SSS are expected to have enhanced MQSs above and beyond the basic road maintenance standards. As such, criteria should be established to identify what qualifies as SSS and appropriate funding provided to not only design these amazing spaces but support ongoing maintenance.

The identification of SSS design standards would significantly benefit maintenance operations both for summer and winter including:

- Identify smaller specialized maintenance equipment to be used in SSS increasing the efficiency of operations such as smaller plows minimizing or eliminating the need for hand shovelling.
- Standardize adequate clearance around buildings, furnishings, and features to facilitate efficient operations, minimize reversing maneuvers and minimize damage.
- Provide adequate space for snow storage to prevent ponding and freezing of melt water.



- Provide adequate drainage directly into drains that does not run over surfaces which may refreeze and become slipping hazards:
 - From buildings.
 - Sidewalk grading.
- Accessible washrooms should provide adequate room to maneuver for the person, support person or animal and mobility devices. Accessible signage is also important.
- Provide lighting levels and adequate sight lines to ensure safety of all users with care for vulnerable users.
- Source materials to provide a consistent but unique look and feel across the City ensuring products are available for maintenance and repairs. This will reduce the need to repair infrastructure with different products giving a patchy disjointed appearance.
- Electric Vehicle needs should also be considered in future SSS designs to ensure they function effectively, and power cables are not damaged.

7.0 Summary

The City of Ottawa established its current Maintenance Quality Standards (MQS) for roads and sidewalks in 2003, including its standards for winter control, to provide safe and passable facilities. Its Winter MQS (WMQS) for facilities used by pedestrians and cyclists, along with those of its Class 4 and 5 roads, need to be reviewed.

The City currently has neither winter nor year-round Maintenance Quality Standards for its Specialty Spaces and Streets (SSS). All maintenance currently undertaken is through informal collaboration between the Public Works and Environmental Services Department (PWESD) and the Planning, Infrastructure and Economic Development (PIED) teams. Year-round MQS's (including WMQSs) are required for the City's unique SSS facilities.

Relating Ottawa's Mobility Goals, Objectives, and Guiding Principles to MQS / WMQS and SSS Development

To best understand how the City's stated mobility goals, objectives, and guiding principles relate to its MQS, we reviewed Federal and Provincial legislation, City policies, standards, guidelines and practices, Committee and Council reports, Service Requests, legal claims, media reports, along with the City's current and in-development Official Plan, Transportation Master Plan, Pedestrian Plan, Cycling Plan, Older Adult Plan, Accessibility for Ontarians with Disabilities Act Plans and related plans and Climate Change Plans.

From this wealth of information, six cross-cutting themes emerged, as follows:

- Mobility.
- Accessibility, Equity, and Inclusion.
- Healthy Livable Communities.
- Efficient and Effective Asset Management.



- Climate Change.
- Sustainability.

The new **Official Plan** (OP) provides a vision of the City's future growth and a policy framework to guide its physical development to the year 2046. By then, Ottawa is expected to grow by 402,000 people, reaching a total of population of 1.4 million. The OP revolves around an acknowledgement that there are no automobile-centered solutions to maintaining livability while growing to 1.4 million people and beyond. Therefore, the OP's overarching goal is for people to rely on sustainable transportation modes for most trips by that time.

The **Transportation Master Plan** (TMP) indicates that, for the City to achieve its long-term goals, population and employment growth need to be supported by public transit for longer trips and Active Transportation for shorter trips. Transit needs to be convenient, frequent, and fast, with growth areas served by rapid transit stations connecting the City's wider transit network with reliable local bus services. Walking and cycling require year-round access to dedicated, physically separated pedestrian and cycling facilities that are well-connected to transit stations and other community destinations such as schools, employment, shopping, and recreation.

Ottawa's **Pedestrian Plan** vision is to transform the City into a world-class pedestrian city where an equally vibrant and functional pedestrian realm encourages people to walk all year-round. The realization of this vision will support several important dimensions of a more livable Ottawa, including:

An equitable city: Walking is the only form of transportation that is universally affordable, and allows children, the elderly, and people of all abilities to travel independently.

A healthy city: Walking is a proven method of promoting personal health and well-being.

A sustainable city: Pedestrian-oriented land use patterns reduce automobile dependency, land consumption and emissions.

A safe city: An environment in which people feel safe and comfortable walking increases community safety for all.

An integrated city: Walking is a part of most trips. Through integrating an attractive pedestrian environment with cycling and transit networks, walking and other modes become a viable alternative to automobile travel.

Sixteen (16) million cycling trips are made annually in Ottawa. All the critical dimensions outlined in the Pedestrian Plan are also key to the **Cycling Plan**. To achieve these benefits, cycling facilities must complement local land uses and match the needs of all areas of the City. The cycling target is to reach 8% of mode share inside the Greenbelt and 5% city-wide. The current (2016) mode-share for cycling Citywide is 2.5%.

Safe alternatives are a key component of choosing sustainable options of walking, cycling and transit over the personal car. **Ottawa Public Health** identified that, for the three winters from 2016/17 to 2018/19, emergency department slip and fall visits range from 2,300 to 3,500 each winter (occurring on both public and private properties), with hospitalizations ranging from approximately 200 to 300.



Specific winter cycling-related visits are approximately 40 each winter across the City, as compared to about 250 during the summer months.

Universal accessibility, mobility, equality, and respect encompasses human rights, individual rights and freedoms, and continuing the effort to remove accessibility barriers. Ottawa's **Human Services Plan** characterizes Ottawa as a caring and inclusive city where access and mobility opportunities need to be inclusive and equitable. Communities should be easy to get around, safe and free of barriers for all users. Particular attention should be made to support mobility and access to services for all vulnerable users regardless of gender and inclusive of disabilities and older adults.

The **Accessibility for Ontarians with Disabilities Act** defines a "barrier" as anything that prevents a person with a disability from fully participating in all aspects of society because of his or her disability, including a physical barrier, an architectural barrier, an information or communications barrier, an attitudinal barrier, a technological barrier, a policy or a practice. Accessibility programs tend to focus on pavement infrastructure to mitigate challenges with uneven surfaces such as cracks and potholes which may cause barriers. Winter maintenance is not addressed.

The City's **Accessibility Working Group and Accessibility Advisory Committee** has a keen interest ensuring accessibility during the winter months, noting that winter transportation barriers result in challenges acquiring and keeping meaningful, steady employment. The City's **Older Adult Plan** identifies specific needs of Ottawa's older residents. Improved conditions of sidewalks in areas highly frequented by older adults and better access to bus stops and public transit stations are needed to improve accessibility for older adults and persons with disabilities.

The City has an **Equity and Inclusion Lens** tool to enable it to be systematic, consistent, and coherent in its efforts to promote equity and inclusion in all areas of municipal activity. This will enable the City to operate in a manner that embraces the spirit of equity and inclusion in the development and implementation of policies, programs, and services (Equity and Diversity Policy), intended to achieve service excellence. Transportation equity and inclusion helps to connect more people to jobs, recreation, services, school, shopping, and other activities that narrow access and equity disparities.

The City's **Climate Change Master Plan** is an overarching framework to reduce greenhouse gas (GHG) emissions and respond to the current and future effects of climate change. The Plan aims to transition Ottawa into a clean, renewable, and resilient city to reach the Greenhouse Gas (GHG) emission reduction target of 100% reduction by 2050. Transit and AT are key pillars supporting this framework.

Ottawa supports a **Complete Streets** approach to road planning and design where sidewalks, cycling facilities, multi-use paths, intersections and transit stops are integrated and enable seamless access for all users. Their life cycle cost, including winter maintenance operational needs to assure year-round availability, should be evaluated during the design process to ensure safe, efficient, aesthetically pleasing and fiscally responsible operations are feasible throughout the life of the asset.

Specialty Spaces and Streets (SSS) are very important to the image of Ottawa, to residents and to tourists. They should be built and maintained to a world-class caliber. Design standards should review and identify products and materials available to support Ottawa's world class image while enabling effective maintenance and preservation to the same high standard.



Construction is challenged to balance the cost and quality of the work against adverse public impact. Ottawa is seeking to reduce construction disruptions across the transportation network. Citizens want better provisions for pedestrians and cyclists through **Construction Zones**.

Maintenance Quality Standards. The City has Maintenance Quality Standards (MQS) for roads, sidewalks, cycling facilities, pathways, and bus pads. While the MQS's were implemented in 2003, Ottawa currently experiences winter maintenance services which exceed the Minimum Maintenance Standards as outlined in the Municipal Act. The City spends approximately \$63 million dollars on winter maintenance annually and uses an average of 185,000 tonnes of salt each year. There are ongoing efforts to reduce the amount of salt used while ensuring fiscal responsibility, mobility, and safety for all users.

The City's stated maintenance objectives are as follows:

- To enhance the appearance and the health of the community through well-maintained public spaces and rights-of-way where the risk of mobility-related trauma is minimized.
- To protect the natural environment.
- To provide adequately safe, dependable, consistent, and affordable service levels.
- To preserve infrastructure assets by avoiding physical damage and chemical degradation.
- To identify key performance indicators to control costs, demonstrate accountability and highlight accomplishments in a transparent manner.
- To ensure that best practices are being utilized and that Ottawa's levels of service are comparable to peer municipalities.
- To improve communications with elected officials and the public, and to manage their expectations.

Ottawa citizens have concerns with the condition of the infrastructure in the winter and the impact on their safety and mobility, including:

- Sidewalks and transit stops are not cleared in a timely manner making them slippery and uneven.
- Water pools around uneven pavement, potholes and frozen catch basins which refreezes and becomes slippery.
- The Canal and other Active Transportation facilities have water ponding which refreezes and becomes slippery.
- Narrow streets became narrower with snowbanks making it challenging for passing vehicles, emergency services and winter maintenance activities.
- It is difficult for seniors to clear plow windrows across their driveway.
- Snowbank height restricts vehicle visibility.
- Deep ruts in the road surface, and snowpack damage cars.



Over 15 per cent of the City's population is over 65 years of age, and that number is projected to reach an estimated 20 per cent by the year 2031. When sidewalks are unsafe, Ottawa provides people with disabilities Para Transpo services. However, many people with disabilities still feel trapped in their homes not wanting to risk going out.

Ottawa, like many municipalities, spends a significant amount of resources dealing with legal claims. Most claims between 2016 and 2020 involved slip and fall accidents (all types) with a total of 113. Similarly, most of the legal cost to the City is from these slip and fall accidents at over \$2.2 million dollars.

Winter Maintenance Best Practices

A literature review identified numerous winter maintenance best practices supportive of providing a high standard of comprehensive, year-round maintenance for Class 4 and 5 roads, AT and transit facilities, along with SSS, to maximize their utilization.

Designing for Maintainability

A literature review identified numerous best practices for designing with maintainability in mind. Highlights included the importance of involving maintenance staff in design standards development and design reviews and scaling either the design or the maintenance equipment to match one-another.

Internal Interviews

A broad range of passionate and committed Ottawa staff provided representation across numerous functional areas. Commentary highlights included:

- Would like to see enhanced MQS's with opportunities for staff to be more proactive.
- Maintenance costs and collateral benefits (business case) need to be understood more fully.
- Standards should reflect the local geography to break down barriers between core, urban, suburban, and rural residents.
- Significant interest in bare pavement standards.
- Need a more proactive approach to being more efficient, cost-effective, and to provide a better level of service.
- A minimum centre bare pavement standard rather than a snow packed standard should be considered for lower-class paved facilities, as keeping ahead of the ice and snow build up is safer and more efficient.
- Need for better salt application standards, and training.
- Inconsistencies in design compromise efficient operations and the utilization of more efficient specialized equipment.
- Uncoordinated operations compromise the achievement of MQS in a timely manner.



- Parking, both legal and illegal, creates an operational challenge and enhanced parking strategies and management are needed.
- Operators and equipment should be “decoupled” to increase response flexibility.
- While there was a good understanding of the MQS, there were pockets of staff who would benefit from a clearer understanding of facilities definitions, MQS specifics, and the prioritization of operations.
- Need for a clearer definition of Active Transportation (AT) facilities and prioritization based upon demand and usage, rather than the associated road classification.
- Expectation (from public and elected officials) is that SSS will be maintained at a higher standard than the road network. These SSS need a specific and enhanced MQS and winter MQS.
- Tourist areas should have enhanced MQS for special events.
- Confusion results when some standards are exceeded at times or in some locations but not others.
- Accessibility is the highest priority amongst the public, and sidewalks are the priority focus as all trips involve some walking component.
- Must ensure tourist perceptions of the City are positive. BIA-funded enhanced maintenance operations generate significant tourism and economic benefit; BIAs should be consulted on MQS / WMQS.
- Climate change is expected to continue adding more pressure to maintenance operations.

Peer Agency Interviews

Interviews were undertaken with progressive municipalities and road authorities from across Ontario, Canada, United States and Europe seeking opportunities for new innovative maintenance solutions and benchmarking. Much of the commentary reinforced themes identified through the background literature reviews and internal interviews with City staff, along with providing additional MQS benchmarks, means and methods, costs, and benefits.

Phase 2 Option Development Considerations for WMQS and SSS

Overall, Phase 1 presents a compelling qualitative case for maintenance enhancements to support the City’s stated goals and objectives. Phase 2 will attempt to quantify the costs, benefits, and collateral impacts of these potential enhancements, under a series of business cases and sensitivity analyses, to uncover where the optimal level of expenditure versus return may exist.

To that end, three meaningful scenarios for each of the Class 4 roads, Class 5 roads, AT and SSS are proposed for development, representing a moderate, progressive, and aspirational level of MQS / WMQS enhancement, as follows:

- The **moderate** case will examine incremental enhancements, largely involving more proactive means and methods, intended to keep maintenance activities “ahead of the curve” in terms of



preventing undesirable conditions from compounding over time. Examples may include enhanced forecasting, intuitive maintenance decision support, aggressive parking management during winter events, proactive ice accretion prevention on AT and SSS facilities, measures to address windrows accumulating on narrower roadways, AT and SSS compromising accessibility, interventions against other cumulative events which require extraordinary efforts to undue, and specific specialty needs for SSS.

- The **progressive** case will encompass all aspects of the moderate case but will carry them a step further by disaggregating and prioritizing AT, transit, SSS, emergency service and goods movement needs over those associated with facilities whose primary function is to facilitate the unimpeded movement of individual autos. Examples may include higher relative standards (e.g. bare pavement in winter, sweeping / landscaping in summer) for the year-round accessibility and presentability of sidewalks and pedestrian crossings, paths, cycling facilities, transit facilities, SSS, goods movement routes, and special publicly and privately-owned spaces accessible to the public.
- The **aspirational** case will encompass all aspects of the progressive case, and will fully reflect the stated goals and ambitions of the City's OP, TMP, and Climate Change Plan, amongst others, to present MQS / WMQS means, methods, and levels of service which fully support a City of Ottawa in 2050 which travels primarily by sustainable means year-round. It will draw on current and future NCC standards and ambitions, provide superlative levels of equity and inclusion for all, and will support a vastly-reduced societal carbon footprint, so as to make a world-class contribution towards reducing or eliminating the detrimental impacts of climate change. Examples may include the virtual elimination of salt usage in favour of environmentally sustainable options, maintenance equipment which does not rely on fossil fuels, bare-pavement standards in all areas which may benefit from an operational and / or safety perspective.

Additional Consultation Findings

The background work in this Phase 1 stage of the Maintenance Quality Standards review involved numerous discussions with staff from the City of Ottawa as well as other municipalities in Ontario, Canada, USA, and Europe. During these discussions, a few ideas were presented which the City may want to investigate further. While these ideas are beyond the scope of this project, they are identified here for the City to optimize the usage of the information collected.

Several organizations had strong communications plans to educate the public on maintenance standards and levels of service and the public responsibilities and keep the public informed regarding operations planned and underway throughout the winter. They found the investment in these programs valuable for improved public relations and reduced complaints. Specific activities include:

- Track my plow is typically incorporated into city 311 programs enabling the public to see what streets have been cleared.
- Most municipalities have a strong media and public education program outlining what the public can expect and when.



- 311 Call Centre staff were trained in winter maintenance standards and were able to reduce the number of service requests and complaints. In most cases, complaints were not taken until the storm had ended and, in some cases, complaints were not taken until the timeline had exceeded the maintenance standard. This significantly reduced complaints and reduced the need for maintenance staff to review and respond to these issues.

All municipalities are concerned with the environmental impact of winter maintenance operations and strive to provide a balance between public safety and environmental protection. Many municipalities continuously review winter maintenance materials, means and methods. There are numerous organizations and committees such as the Transportation Association of Canada, Environment and Climate Change Canada, Federal Highway Administration etc., which Ottawa may want to consider participating in to take advantage of work already underway or completed in this field including materials, equipment, salt management etc.

All municipalities had challenges plowing around parked cars. Several of the municipalities interviewed had innovative approaches which could be considered.

Appendix A: Background Material

Maintenance Operations

Maintenance Quality Standards 2003
Maintenance Quality Standards Review (2003)
Salt Management Plan 2018
Winter Operations Review 2016 KPMG
NCC – Western Lands MQS

City of Ottawa Plans

Ottawa Official Plan (2003, 2020)
Ottawa Transportation Master Plan (2003, 2013, 2020 Update)
Infrastructure Master Plan (2013)
Ottawa Cycling Plan (2013, 2020)
Ottawa Pedestrian Plan (2013, 2020)
Older Adult Plan (2020-2022)
Climate Change Master Plan (2019)
Greenspace Master Plan (2006)
Human Services Plan (2003)
City of Ottawa Municipal Accessibility Plan (2016- 2020)
Accessibility Report (2019)
Public Engagement Feedback Report, Accessibility Consultations (2020 – 2024)

City of Ottawa Guidelines

Transportation Impact Assessment Guidelines - Multi-modal LOS Guidelines
Transit-Oriented Development Guidelines
Urban Design Guidelines for Development along Arterial Mainstreets
Urban Design Guidelines for Development along Traditional Mainstreets
Urban Design Guidelines for High-rise Buildings
Urban Design Guidelines for Large-Format Retail
Urban Design Guidelines for Greenfield Neighbourhoods
Village Collector and Rural Collector Guidelines
Regional Road Corridor Design Guidelines



Arterial Road Cross-Sections
Design Guidelines for Rural Villages
Downtown moves: Transforming Ottawa's Streets
Traffic Calming Design Guidelines
Park Development Manual - Second Edition (2017)
Complete Streets Implementation Framework
Building Better and Smarter Suburbs

Legislation

Canadian Charter of Rights and Freedoms
Canadian Bill of Rights
Canadian Human Rights Act
Canada's Constitution Act
Ontario Human Rights Code
Ontarians with Disabilities Act
Accessibility for Ontarians with Disabilities Act
City of Ottawa's Bylaws
Municipal Act

Reports

Getting Around in the Winter 2020
Climate Projections for the National Capital Region March 2020
Snow Mole Report 2020
Winter Maintenance Quality Standards Review – Public Health Considerations

Media

Media Articles 2016 – 2020

Data

City Vehicle Winter Collision Data 2014- 2018
Service Requests 2017 – 2019
Legal Claims Data 2016 – 2020

Council

Council and Committee Reports



TRC and Council Minutes 2016- 2019

On-line Literature Review

Maintenance Best Practices

COV ID- 19 Street Rebalancing Guide. How to temporarily redesign streets to ensure physical and mental health, safety, and well-being. Presented by the Federation of Canadian Municipalities, June 2020

Cycling Through Winter. By Cara Fisher, an Associate of the Winter Cities Institute

City of Minneapolis Pedestrian and Bicycle Winter Maintenance Study. Toole Design Group. 2018

Ontario Good Roads Association Managing Winter Operations Workshop. 2018

Winter Parking Lot and Sidewalk Maintenance Manual - Third Revision. June 2015. Published by: Minnesota Pollution Control Agency www.pca.state.mn.us/programs/roadsalt.html

How Communities are Paying to Maintain Trails, Bike Lanes, and Sidewalks. Advocacy Advance 2014

Maintenance of pedestrian infrastructures in winter. Pietons Quebec. www.pietons.quebec

Bicycle Facilities Maintenance. 2017. Public Works, City of Madison, Wisconsin

Salt Lake City, Utah Prioritizes Plowing Snow from Bicycle Lanes using Downsized Street Maintenance Equipment. Fostering Multi-modal Connectivity Newsletter. U.S. Federal Highway Administration. April 2020, Volume 9, Number 1

Optimal Snow and Ice Control of Parking Lots and Sidewalks. A Summary Final Report. iTSS Lab, Department of Civil & Environmental Engineering, University of Waterloo, January 2015

Winter Maintenance Program Review – City of Toronto. Report to Infrastructure and Environment Committee, October 2019

Best Practices in Designing for Maintenance

Winter Design Guidelines - Transforming Edmonton into a Great Winter City. City of Edmonton. 2019

Active and Public Transportation Facility Planning Best Practices. State of North Dakota, 2019

Trail Design Guidelines, City of Toronto, Transportation Services – Parks, Forestry and Recreation, 2015

A Guide for Maintaining Pedestrian Facilities for Enhanced Safety. U.S. Federal Highway Administration Accessed July 9, 2020. https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa13037/chap5.cfm

National Strategic Winter Maintenance Plan 2018-2020. Snow and Ice Pooled Fund Cooperative Program – SICOP. AASHTO’s Winter Maintenance Technical Service Program. www.transportation.org
<https://sicop.transportation.org>



Incorporating the Costs and Benefits of Adaptation Measures in Preparation for Extreme Weather Events and Climate Change—Guidebook. [NCHRP Web-Only Document 271: Guidelines to Incorporate the Costs and Benefits of Adaptation Measures in Preparation for Extreme Weather Events and Climate Change](#)

Cycling Master Plan. City of London, ON. 2016



Appendix B: Municipal Interview Summary Table



Municipality	Infrastructure	Climate (compared to Ottawa)	MQS / Costs				Innovations	Design Standards	Lessons Learned
			Standard	Timing	Cost (CDN)	Other			
NCC	Pedestrian 158,200m ²	Same	BP, max 3cm	Before 7am	\$1.5M/yr	Snowbanks & windrows removed immediately	Bridge snow melting	Time invested at design stage improves maintenance operations over life cycle	Increased participation in design phase
	Vehicle 49,500m ²					Contracted out	Early spring snow removal from snow packed surfaces		Want MQS for MUP rather than ad hoc
									Want AVL for contract oversight
									Call Centre staff training on MQS reduces workload
Brampton, ON	2,500km Class 4&5 roads	Warmer	Safe & passable. CB & Snow packed for Class 4&5			24hr/5d operations	Pre-wet, DLA	Some standards exist. Not always followed	
	980km sidewalk	Increased freeze thaw	Sidewalk & MUP 5cm trigger (reduced from 7.5)	Within 24 hours		20% inhouse - rapid response	Track my plow	Increase in rear lanes	311 Operators trained in MQS. No SR's before 24 hours after the storm
	425km MUP	Lake effect snow	On-road cycling same as road			80% contract	No overnight parking - permits void when snow fighting		Educational workshops for new Councillors
							Looking for smaller vehicles for bike lanes & laneways		
							Reviewing KPI's		
Toronto, ON	3,165km local roads	Milder	AT plowed at 2cm (reduced from 8)			18 contract areas	Anti-icing		Windrow program has a high public profile, is very expensive, receives significant complaints
	7,945km sidewalk	Significant freeze thaw	On-road cycling same as road				Testing beet juice to replace salt		Reviewing winter cycling network
	233km bike lanes	Significant freezing rain	Laneways salted not plowed				Track My Plow		
	42km cycle track		BIA's higher LOS		Some BIA's fund higher LOS		311 only enter SR if MQS exceeded		
	10km contraflow bike lanes						Developing KPI's		
	Many high profile SSS								



Municipality	Infrastructure	Climate (compared to Ottawa)	MQS / Costs				Innovations	Design Standards	Lessons Learned
			Standard	Timing	Cost (CDN)	Other			
Edmonton, AB	5,700km residential roads	Cold (temp range +5 to-35C)	Snow packed residential roads, blade at 5cm		\$5,800/lnkm/y	In-house and contracted work	Track My Plow	Maintenance try to participate at design stage. Cannot always accommodate maintenance needs	Parking program is challenging
	3,000km Class 4	Daylight hours short	Windrows removed at 30cm				Parking bans for neighbourhood plowing schedule		Would be helpful to understand public expectation
	5,500km sidewalks	123cm snow annually	AT cleared to BP	24 hours					
	40km protected cycling	Dry snow	AT sweeping and DLA	Daily					
	MUP serviced by others		SSS cleared to road MQS						
	2 high priority SSS		Priority SSS no snow accumulation	24/7 operations	Festival organizers pay for priority SSS				
Minneapolis, MN	1,120km local & residential	Harsh	Plowed to snow packed		\$16M/y roads	Property owners responsible for sidewalks	3-day parking restriction plan for significant events	Complete Streets program prioritizing AT over cars	Rent graders and loaders as needed to supplement fleet
	640km alleys	20-25 events	Alleys only plowed in significant snowfall to snow packed, rutting plowed when warm		\$665K MUP & bike lanes		Using Jeeps & bobcats to anti-ice bike lanes. Baby bobcats used on small bridges.	Bike lane funding allocated at design stage	EV stations hard to maintain, people leave power cables lying across street
	160km MUP	~4 significant snowfalls/yr	Bike lanes & MUP plow & treat	24 hours			311 Staff training in MQS and do not take SR until 24 hours after storm and 4 hours for commercial sidewalks	Maintenance needs do not always get incorporated into design	Important to be at design table to prevent long term maintenance challenges
	48km protected bike lanes	100-150 days below freezing	Commercial sidewalks BP	4 hours after event			Creating mobility hubs for scooters & e-bikes		
	3,200km sidewalks	Snow is wet and heavy	Sidewalks & intersections prioritized	Usually 10 days to clear		Enhanced service downtown funded through BIA tax			
New York City, NY	9,600km streets	Warmer	BP -Residents clear their sidewalks	2hrs after snow	Plazas \$107K-\$133K/plaza/y	warmer temperature enables BP standard	Sanitation equipment plows streets as needed	Focus on people movement not maintenance. Significant hand shoveling	P3's work well. NYC would like to participate more to reduce P3 burden. Some items beyond expectation i.e. encampments, dumping
	19,200km sidewalks	Minimal snow	BP- Commercial sidewalks	Before stores open following day			SSS receive a less abrasive salt mix. Testing brines	Furniture materials for consistency, durability and lifespan, nothing flashy to keep costs manageable for P3's	Pursue temporary motorist free public spaces



Municipality	Infrastructure	Climate (compared to Ottawa)	MQS / Costs				Innovations	Design Standards	Lessons Learned
			Standard	Timing	Cost (CDN)	Other			
New York City, NY	1,200km bike lanes	Significant ice	SSS furniture repair	7 days		Plazas maintained by P3	Contractors maintain bus shelters and generate revenues from advertising to offset costs	Try to avoid pavers due to maintenance needs	
	83 Plazas (average 325m ²)		SSS Power wash	Nightly				Some open spaces may be used for restaurants following COVID	
	62 Public spaces								
Oslo, Norway	550km residential	Altitude range sea level to 500m	Snow packed residential roads and sidewalks, plow at 3cm (rarely SP)	1 hour to start and 4 hours to complete		All maintenance by contractors	Studded tire permit program can provide additional funding if needed	Have standards, but hard to squeeze in	Pilot projects are difficult to estimate and costs are usually higher.
	340 very low volume	Temperature around freezing	BP - High volume sidewalks and bike routes	Brush / sweep when snow starts, totally clean 4 hours after storm	Significant cost and salt		Pre-wet salt before storm, dry salt in storm	Furniture clustered for ease of maintenance	Heated salt water expected to be good in low volume areas
	500km sidewalks	Rain & freezing rain common					Many pedestrian only areas with heated sidewalks		Easier to have one winter liquid
	1,300km off-road cycling						Winter stats: 15% walk, 50-60% transit, high cycling %		Need Benefit / Cost analysis to effectively use funds
	Most roads have bike lanes						City tolls encourage AT & transit		Social media good for getting information to public
	Some SSS in downtown core						Use sweepers for AT		
							Investigating salt alternatives, fine salt & heated salt (heated sand did not work)		
							On-line SR system. Disabled have a higher standards and complaints trigger high priority response		
Stockholm, Sweden	240km roads	Highly variable	road	10-14 hours				Very detailed design standards	
	340km AT facilities	1-2 freezing rain events	AT & SSS	AT higher standard than road	\$23M CDN		Use sweepers & brine. Need to start early for time to work	Helpful for maintenance operations	Bike paths have high standards, but cyclists still complain
		Many freeze thaw cycles		Ready for morning commute			Inner city parking restrictions 1d/w		Pedestrians & drivers complain that bike paths are better maintained



Municipality	Infrastructure	Climate (compared to Ottawa)	MQS / Costs				Innovations	Design Standards	Lessons Learned
			Standard	Timing	Cost (CDN)	Other			
Stockholm, Sweden		Temperature - 5C to -7C					Mapping slip * fall accidents		Would like to add a standard for long duration storms
							Mobility courses for staff to see through disabled lenses		2030 target to be free of fossil fuels
									Seeking cost effective salt alternative
									Would like to improve summer MQS to prolong asset life and make WMQS easier to deliver

