Winter 'n' Wheels Study:

Understanding experiences of key stakeholder groups regarding sidewalks accessibility in winter for wheeled mobility device users.

by

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Abstract

Background: Involvement in community activities during the cold winter months can be challenging, particularly for people who use wheeled mobility devices (WMD, such as manual wheelchairs, power wheelchairs, or scooters). WMD users report sidewalk conditions to be problematic in winter due to the accumulation of snow and ice.

Purpose: This qualitative study explored the specific issues faced by key stakeholders (wheeled mobility device users and City of Winnipeg employees) with respect to sidewalks accessibility (using sidewalks & providing accessible sidewalks) in winter and identified solutions to improve winter accessibility of sidewalks.

Method: An interpretive description approach with inductive analysis was used to answer the central enquiry. Eleven representatives from two stakeholder groups provided information through a combination of go-along interviews, key informant interviews, photographs, and meteorological data.

Findings: Through analysis, four themes were identified: 'the context of winter season', 'winter and wheels interact', 'winter versus the city', and the 'framework for winter access and success'. Findings ascertained that the winter season brings unique challenges to the functioning of each stakeholder: winter barriers either originated from natural factors (such as snow, ice and cold temperatures) or through human actions or responses (delayed snow clearing on residential sidewalks) to the winter changes. Ultimately, the solutions identified proposed the collective use of awareness creation, action points, and accountability actualized through the processes of information sharing and collaborative efforts of stakeholders to enable winter accessibility of sidewalks.

Conclusion: Findings ascertained that the outdoor winter access is difficult for WMD users and the task of keeping sidewalks accessible in winter is challenging. However, winter sidewalk barriers can be overcome through an informed collaborative approach.

Implications: Study findings add to the overall body of knowledge on winter accessibility for WMD users. The barriers and facilitators identified by representative stakeholders can assist in applying focused interventions for enabling winter accessibility of sidewalks. The solutions framework provides practical implications for improving WMD users' outdoor mobility and thus, community participation in wintertime.

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Figure 1: Graphical representation of the ICF by the World Health Organization

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World Health Organization. (2001). *International classification of functioning, disability and health.* Geneva: World Health Organization.

Note:

The Winter 'n' Wheels Study was approved by the Health Research Ethics board (HREB), Bannatyne campus, University of Manitoba. The content of this research document is in accordance to the study protocol approved by the HREB for review purposes. The Appendices references in the text (as they are introduced) are not in the alphabetical order. The non-alphabetical appearance of the appendices in text is to ensure that the appendices labels in this document are the same as those in the protocol document submitted to the HREB.

HREB ETHICS #: H2013:455

1.0 Introduction

1.1 Statement of the problem

Over the past few decades, community participation has gained a central locus in the realm of human functioning. Participation, as defined in the International Classification of Functioning, Disability and Health refers to the "*involvement in a life situation*" (World Health Organization (WHO), 2001). In particular, successful community participation refers to the self-satisfactory involvement of an individual in a social life outside of the home. Many researchers have associated participation with life-satisfaction, quality of life, health and overall well-being of individuals with disabilities (Carpenter, Forwell, Jongbloed, & Backman, 2007; Chan & Chan, 2007; Tonack et al., 2007). However, involvement in community activities during the cold winter months can be a challenging task. This is in particular true for people who use wheeled mobility devices (WMD, such as manual wheelchairs, power wheelchairs, or scooters).

Winter in northern environment represents the most challenging season for people with mobility impairments (Lemaire, O'Neill, Desrosiers, & Robertson, 2010). WMD users face a dual challenge of dealing with cold environment and simultaneously managing their wheeled mobility device. WMD users report community participation becoming increasingly difficult during winter months, which consequently restricts them to their homes (Bennett, Blanchette, Friesen, & Solomon-Ani, 2013). In a recent survey, WMD users in Manitoba reported a decline of nearly 50% in the frequency of everyday outings during winter months as compared to summer (Ripat, Brown, Ethans, & Whaley, 2013).

In Winnipeg, the winter season typically extends from the months of November to March (Province of Manitoba, n.d). A long winter period makes the presence of winter conditions (such

as snow and ice covered surfaces) a common and frequently faced part of life for Winnipeggers. WMD users identify the physical environment conditions during winter as primary barriers preventing them from participating in their daily activities, social roles and communities (Bennett et al., 2013; Boschen, Tonack, & Gargaro, 2003; Lysack, Komanecky, Kabel, Cross, & Neufeld, 2007; Noreau, Fougeyrollas, & Boschen, 2002; Whiteneck, Meade, Dijkers, Tate, Bushnik, & Forchheimer, 2004b). In particular, WMD users identify sidewalk conditions in winter as problematic (Ripat et al., 2013).

A sidewalk that may be accessible during other parts of the year becomes inaccessible in winter due to the accumulation of snow and ice. The combined existence of sub-zero temperatures, wind chill, shorter daylight hours, snow and icy conditions makes it difficult for a WMD user to access sidewalks and participate in their community as compared to the rest of the year. Such adverse winter conditions can pose a significant threat to the safety and mobility of wheeled mobility users. However, policy development and designing of built structures (like sidewalks) often occurs without considering the year-round accessibility for wheeled mobility device users. Considering the nature and impact of cold weather conditions on individuals using mobility devices, need for research that focuses in-depth on issues around winter accessibility for WMD users was identified. Furthermore, winter accessibility research for WMD users is scarce, and limited work is available that systematically addresses the winter accessibility of sidewalks, especially from the perspectives of key stakeholders groups.

1.2 Significance of the study

Occupational therapy researchers emphasize the interaction between person, environment and occupation in determining occupational performance (Baum and Christiansen, 2004; Law et

al., 1996). An occupational therapy approach to enabling participation acknowledges the interaction between person and environment. The process of enabling participation requires a multifaceted approach addressing personal factors such as skills training for WMD users as well as focusing on environmental factors such as physical environment accessibility. It is essential for occupational therapists working with clients towards the goal of independent participation to enable individual's access to community.

The occurrence of lengthy winters is a reality for Winnipeggers. WMD users in the city of Winnipeg are at a particular risk of experiencing winter barriers that limit their community participation and ultimately, contributing to social isolation during winter months. Considering WMD users need to participate in community throughout the year, it is essential to enable their outdoor mobility in winter by making sidewalks accessible. For this reason, it is most logical for regional researchers to conduct research that explores issues around sidewalks accessibility in winter for WMD users.

However, there is a dearth of evidence explicating specific issues faced by WMD users while accessing sidewalks in winter. Furthermore, to improve the winter accessibility of sidewalks for WMD users there is a need for solutions that are evidence-based and realistic. Such solutions can be made possible by incorporating the multiple perspectives related to sidewalks accessibility. This study incorporates multiple perspectives by learning about the experiences of key stakeholder groups: (1) wheeled mobility device users' and (2) service providers who are responsible for maintaining sidewalks during winter months.

In the context of professional practice, this study will assist occupational therapists in their concern with enabling occupations by identifying and advocating for the positive changes

that can improve services, programs and society for WMD users. With respect to a larger goal of enabling winter community participation of WMD users, this study assists in creating the awareness among key stakeholder groups regarding the issues encountered by WMD users while accessing sidewalks in winter. Additionally, the outcomes of this study provides useful information base for policy makers and city agencies to guide the development of future policies and practices. For researchers interested in winter accessibility, findings from this study contribute to a better understanding of the topic and will assist in future knowledge creation. For wheeled mobility device users, health care professionals and disability advocates the findings of this study provides additional support for creating awareness regarding winter accessibility.

1.3 Purpose Statement

The purpose of this qualitative study was to understand the experiences of key stakeholder groups (wheeled mobility device users and City of Winnipeg -Public Works Department employees) regarding sidewalks accessibility in winter for WMD users.

1.4 Research Objectives

The objectives of this study were:

1. To identify the specific barriers and facilitators related to sidewalks accessibility in winter for wheeled mobility device users.

2. To identify the obstacles and facilitators faced by city officials in providing accessible sidewalks during winter.

3. To gain sidewalk maintenance officials perspectives on winter accessibility of sidewalks for WMD users.

4. To inform the development of a winter accessibility of sidewalks audit tool.

The overall aim of this study was to gain an in-depth understanding of the specific issues faced by key stakeholders with respect to sidewalks accessibility (providing accessible sidewalks & use of sidewalks) in winter and subsequently, to use those findings to identify solutions or recommendations that can improve winter accessibility of sidewalks for city residents.

1.5 Research Question

What are the experiences of key stakeholder groups (wheeled mobility device users and City of Winnipeg- Public Works Department employees) related to winter accessibility of sidewalks for wheeled mobility device users?

2.0 Literature Review

The intent of this literature review is to understand the use of wheeled mobility in winter: how wheeled mobility devices help users to participate in their community, and what components of the physical environment during winter present specific challenges to community participation of WMD users. Overall, this literature review will explore what is currently known about winter accessibility and the need for further in-depth investigation into issues related to winter accessibility of outdoor physical environment for WMD users.

2.1 Method of review

To review the current literature on winter accessibility of sidewalks for WMD users, a literature search was performed using following electronic databases- PubMed, CINAHL, Scopus, Google Scholar, OTDBase, OTseeker, EMBASE, Geobase and CIRRIE. In addition, the reference list of key articles and specific journals related to topic were hand searched to identify any potentially useful literature. The literature search was expanded for each concept using synonyms and commonly used words. The articles published in the English language only were screened for the inclusion in a review.

Table 1. Key concepts and related search terminologies included in the literature review.

Keyword	Alternate words
Sidewalk	Pedestrian pathways, pavement, footpath, footway
Accessibility	Access, visitability, walk-ability, wheel-ability

Winter	Snow, ice, cold, climate, weather, frost, chill, sleet
Wheeled mobility device users	Wheelchair/s, scooters, mobility scooters, people with disabilities, disabled people, older adults

2.2 Summary of the literature

2.2.1 Prevalence of mobility impairments. More than 4.4 million Canadians reported having an activity limitation in 2006, yielding a disability rate of 14.3% (Statistics Canada, 2007). In Manitoba, the disability rate stands above the national figure with 15.7% of residents reporting to live with a disability (Statistics Canada, 2007). In particular, disabilities related to mobility are one of the most common, with approximately 3 million Canadians reporting to have some mobility limitation (Statistics Canada, 2007). No specific statistics could be located on the number of individuals with mobility impairments in Manitoba.

Mobility impairments may occur in many forms, from a variety of causes and to varied extents, and should be regarded as a functional limitation of an individual (Warren, 1990 as cited in Cook & Hussey, 1995, p. 526). As a general definition, mobility impairment refers to an inability or difficulty in walking independently. Mobility impairments may occur as a condition related to specific diagnosis like paraplegia due to spinal cord injury or may even surface as a residual of aging process (Brandt, Iwarsson, & Stahle, 2004; Cook & Polgar, 2012). According to Statistics Canada (2007), one in three Canadians aged 65 and over experience some degree of mobility limitation. Impairment in body functions like mobility impairment can lead to limitation in activity and participation (WHO, 2001). To overcome activity limitation, individuals with mobility impairment are often required to use mobility aids that assist in maintaining mobility

and active participation in society (Brandt et al., 2004; Buning, Angelo, & Schmeler, 2001; Cook & Polgar, 2012; Wennberg, Ståhl, & Hydén, 2009). One example of such mobility aids is wheeled mobility systems.

2.2.2 Wheeled mobility systems. Wheeled mobility devices serve as an extension of a user's body and enable the individual with mobility impairments to be involved in his/her life situations independently (Batavia, Batavia, & Friedman, 2001; Chaves et al., 2004; Rousseau-Harrison et al., 2009; Wressle & Samuelsson, 2004). In the Participation and Activity Limitation Survey (2006), nearly 1.2 million Canadians identified the need for specialized aids or equipment (including wheeled mobility devices) because of mobility limitations (Statistics Canada, 2008). Furthermore, with the aging population, increased enactment of accessibility legislations and better life-saving medical procedures, the total number of individuals using mobility devices in North America is expected to grow (Cook & Polgar, 2012). Considering the present statistics and expected future increase in the number of individuals with mobility impairment, there is a requirement for focused research around the needs of people with mobility disabilities.

Wheeled mobility systems are comprised of three broad categories: (1) Dependent mobility systems, (2) Independent manual mobility systems and (3) Independent powered mobility systems (Cook & Polgar, 2012). The first category includes wheeled mobility systems such as strollers and transport wheelchairs that are pushed by other people instead of the user himself. These dependent mobility devices may allow movement from one place to another but do not fit in the realm of mobility devices promoting independent mobility. The second and third categories include wheeled mobility devices like manual wheelchairs, power wheelchairs and

scooters. These wheeled mobility devices promote independent mobility as they are operated by users themselves.

Wheeled mobility devices (WMD). This study and literature review focuses on the independent wheeled mobility systems (both manual & power) and refer to them collectively as wheeled mobility devices (WMD). The key characteristics of each type of independent wheeled mobility device are explained below.

Manual wheelchairs. The term manual wheelchair refers to a wheel-based mobility system propelled by a manual force (Cook & Polgar, 2012) The two key propulsion components of this mobility system includes (1) wheels- tires & casters and (2) an interface that is used to move the chair using manual force (Cook & Polgar, 2012). Primarily, the manual wheelchair promotes independent mobility of a user wherein the user propels the wheelchair using his or her body parts (upper extremity, lower extremity or the combination of both) and propelling interface. A manual wheelchair is usually considered for individuals who have difficulty in walking but have sufficient bodily strength to propel using manual force.

Power wheelchairs. The term power wheelchair (or powered wheelchair) refers to a wheel-based mobility system operated using electric power. Power wheelchairs have various types of propelling structure but the basic components of this wheeled mobility system includes: a power drive to the wheels, power source (e.g. batteries), electronic controller & accessories and an interface for users to control the movement of a wheelchair (Cook & Polgar, 2012). Power wheelchairs are generally heavier and more sophisticated in control than manual wheelchairs (Cook & Polgar, 2012; Giesbrecht, Ripat, Cooper, & Quanbury, 2011).

When an individual with mobility impairment lacks the considerable stamina, strength or upper-extremity mobility due to any reason (for example repetitive stress injury to upper-extremity), operating a manual wheelchair becomes difficult. In such cases, where the individual's ability to use a manual wheelchair is compromised, a power wheelchair provides a useful replacement and enhances participation (Brandt et al., 2004; Buning et al., 2001; Cook & Polgar, 2012; Giesbrecht et al., 2011). However, the substantial weight and large size of powered mobility devices is associated with increased spatial requirements for operation (Brandt et al., 2004; Giesbrecht et al., 2011). This factor creates limitations for the use of powered mobility devices inside home, but the ability to cover large distances with less effort makes power wheelchairs suitable mobility device for outdoor purposes.

Scooters (also known as Mobility scooters). Mobility scooters are another example of power mobility systems. Scooters represent a unique alternative in the powered wheelchair category due to their structure and use (Cook & Hussey, 1995).The propelling structure of a mobility scooter includes the drive train, battery (power source), tiller and the tires. The tiller control assists with steering and acceleration of a scooter (Cook & Polgar, 2012). Scooters are usually available in three or four-wheeled versions with front or rear-wheel drive. Front-wheel drive scooters perform better on level terrains and are more maneuverable, while the rear-wheel drive scooters are good on inclines and rough terrains, making them preferred for outdoor mobility (Cook & Polgar, 2012).

Like other powered mobility devices, scooters are considered useful for people who have limited ability to use a manual wheelchair and require the mobility device for energy conservation (Cook & Polgar, 2012). In addition, many WMD users use a scooter for going farther distances from home that are difficult to reach using a manual or power wheelchair.

However, scooters are not suitable for individuals with limited trunk control (Cook & Polgar, 2012).

Customization of wheeled mobility devices. Wheeled mobility systems are adapted or modified to meet the specific functional requirements, physical abilities and preferences of the user (Cook & Polgar, 2012; Giesbrecht et al., 2011). Adaptations or modifications may include basic changes such as changes in height, tilt, recline, axle positions, or more high-tech changes involving robotic, artificial intelligence, and advanced controls (Cook & Polgar, 2012; Cooper et al., 2006; Cooper, 2009; Frank, Ward, Orwell, McCullagh, & Belcher, 2000). One example of the extensive modification and customization available in wheeled mobility systems is the development of sports wheelchairs (Burton, Fuss, & Subic, 2010; Cooper, 1991), where the wheelchairs are designed to meet the specific needs of athletes participating in sports. However, corresponding wheelchair modifications to meet WMD users' needs stemming out of the seasonal changes in environment are relatively absent.

WMD users identify the negative effects of cold weather on their devices such as cold parts (e.g. push-rims and control interfaces), freezing cushions, quick discharge of batteries and increased wearing of devices (Bennett et al., 2013; Ripat et al., 2013). In this regard, some researchers recommend designing wheelchairs specific to winter use that can better match the winter environmental demands (Shirado, Shundo, Kaneda, & Strax, 1995). However, very few winter-related wheelchair modifications are available that promise to ease the winter use of wheelchairs. One such commercially available winter modification is Wheelblades™, but the efficacy of such devices is largely unknown. While designing specialized winter wheeled mobility devices is one promising solution, research related to winter device efficiency, affordability, and safety must also be inducted.

Benefits of wheeled mobility devices (WMD). Many studies have identified positive outcomes associated with the use of wheeled mobility devices, such as enhanced activity and participation (Brandt et al., 2004; Evans, Neophytou, De Souza, & Frank, 2007; Rousseau-Harrison et al., 2009; Wressle & Samuelsson, 2004), self-esteem (Buning et al., 2001), mobility, and independence (Buning et al., 2001; Frank et al., 2000; Wressle & Samuelsson, 2004). Wheelchairs are the most important and widely used outdoor mobility devices among individuals with spinal cord injury and older adults with mobility impairments (Chaves et al., 2004). However, some studies also report wheelchairs as either a limiting factor in participation (Chaves et al., 2004), or not performing as per user expectations (Jedeloo, de Witte, Linssen, & Schrijvers, 2000).

WMD users have expressed problems with the design, size, maneuverability, portability, and weight of wheeled mobility devices as factors contributing to their dissatisfaction with the device (Kittel, Marco & Stewart, 2002; Chaves et al., 2004). The dissatisfaction with wheeled mobility devices can be considered to occur due to individual or external factors. While certain individual factors, like fit between wheelchair and user body, are amenable to remediation, others such as demographics (e.g. age, gender) are not. Furthermore, even in situations where a good wheelchair-users fit exists, participation of WMD users may still be limited by external factors (Harris, Sprigle, Sonenblum, & Maurer, 2010). One such external factor that can create a negative impact on participation is physical environment barriers.

2.2.3 Physical Environment. The physical environment is comprised of built (man-made) elements (e.g. sidewalks) and natural elements (e.g. weather) (Juvani, Isola, & Kyngas, 2005). Barriers in the physical environment may interact negatively with individual conditions (like existence of mobility impairment) and play a contributing role in limiting community

participation (Brandt et al., 2004; Chaves et al., 2004; Imrie, 2004; Lysack et al., 2007; Noreau et al., 2002; Reid, Angus, McKeever, & Miller, 2003; Rosenberg, Huang, Simonovich, & Belza, 2013; Whiteneck, Meade, Dijkers, Tate, Bushnik, & Forchheimer, 2004b; WHO, 2001). Features of the physical environment such as stairs or rough pavement present barriers to WMD users that may render a particular physical environment inaccessible. Often these barriers stem from poor design of the physical environment that neglects considering the needs of people with disabilities (including WMD users) (Imrie, 2012). However, the natural elements of the physical environment such as snow and ice may also present significant barrier to the outdoor access of WMD users.

Natural elements of physical environment. The natural environment has been reported as an important environmental barrier faced by people with mobility impairments (Gallagher, O'Donovan, Doyle, & Desmond, 2011; Lysack et al., 2007; Whiteneck, Meade, Dijkers, Tate, Bushnik, & Forchheimer, 2004b). One component of the natural environment that in particular influences health and participation is climate. Climatic conditions, such as those experienced in winter, pose a particular challenge to the wheeled mobility device use (Bennett et al., 2013; Boschen et al., 2003; Brandt et al., 2004; Lemaire et al., 2010; Noreau et al., 2002; Reid et al., 2003; Ripat et al., 2013; Shirado et al., 1995). Canadian winters are one of the most severe winter climates in the world characterized by the presence of snow, icy conditions, shorter daylight hours, and persistent sub-zero temperatures (Environment Canada, 2013). In Manitoba, the winter season typically extends from the months of November to March, with average daytime temperatures ranging from -15 (in December) to -20 degree Celsius (Province of Manitoba, n.d.). In Winnipeg, the yearly average snowfall is 110.6 cm with average snow-depth of 6 cm (Environment Canada, 2000).

While the above stated averages do not specify the extreme winter temperatures or snowfall, they do indicate the winter conditions in which residents of Winnipeg perform their outdoor activities. Cold winter environments are known to affect the physiological, psychological and social functions of human (Juvani et al., 2005). People with spinal cord injuries who rely on wheeled mobility devices for their outdoor mobility are known to have thermoregulation difficulties (Batavia et al., 2001). Shirado et al., (1995) reported pain, muscle spasticity and numbness of lower extremity as common problems experienced by people with spinal cord injury during outdoor winter activities. Extreme winter temperatures, combining wind chill and precipitation, can pose a significant challenge to the safety and mobility of WMD users. In addition, the increased risk of cold injuries such as frostbite and respiratory problems like difficulty breathing are persistent in cold environments. Considering the potential negative effects of prolonged exposure to cold on human body, the crucial time and energy spent by WMD users in overcoming inaccessible outdoor environment during winter can be hazardous and even life threatening.

However, a review of the current literature reveals a paucity of studies focusing on the accessibility needs of WMD users in winter conditions. The existing winter research (with a few exceptions) has primarily explored winter in relation to walking conditions, physical activity and health, with pedestrians and older adults' experiences in focus. Although the knowledge from existing winter studies can be helpful in developing a preliminary understanding of the topic, studies specifically focused on experiences of WMD users during winter months are lacking.

Current research identifies seasonal variation of temperatures, snow and ice, light variation and distances as main threats to the well-being of older adults living in the northern physical environment (Juvani et al., 2005) and these threats may be equally applicable to WMD

users. A survey-based study by Li, Hsu, & Fernie (2013) on aging and winter use of pedestrian facilities reported the presence of snow and/or ice as deterrents that prevented older adults from going outside. The same researchers found that the cold weather in itself had a little impact in deterring the outdoor participation during winter as compared to the presence of snow and ice. In a participatory action research conducted in Winnipeg, community participants identified physical limitations, difficulty using assistive devices, and poor outdoor conditions such as cold weather, icy sidewalks as barriers to walking during winter (Ripat, Redmond, & Grabowecky, 2010). Presence of snow, icy surfaces, pavements with limited traction and inadequately cleared snow are challenges that prevent ambulant individuals from moving outdoors and WMD users may be even more vulnerable to such winter conditions (Hjorthol, 2012; Li et al., 2013; Ripat et al., 2010; Wennberg et al., 2009).

The concerns expressed by cold climate denizens are genuine but these concerns are magnified for WMD users who have to negotiate their way in harsh winter conditions while simultaneously managing their mobility devices. Several studies by Canadian researchers exploring the interaction between physical environment and participation of individuals with mobility impairments noted that winter climatic conditions influence the mobility and participation of WMD users (Bennett et al., 2013; Boschen et al., 2003; Lemaire et al., 2010; Noreau et al., 2002; Reid et al., 2003; Ripat et al., 2013).

In the study by Noreau et al., (2002) exploring perceived influence of environment on social participation of four hundred and eighty-two individuals with spinal cord injury (SCI), participants recognized the inhibitory effect of climatic conditions on participation during both summer and winter seasons. However, the majority of respondents (88%) seemed concerned with winter conditions such as snowy streets and sidewalks that made their wheelchair mobility

energy consuming or ultimately impossible. In the same study, nearly 12% of participants reported winter climatic conditions having either no influence or a positive influence on participation. Authors attributed the reason for the small proportion of participants favoring winter conditions to the impact of personal characteristics such as mild severity of injury or accessible housing that limited the adverse effects of winter conditions (Noreau et al., 2002). In another study examining community reintegration and quality of life among adults with SCI, participants identified winter conditions as a top environmental barrier interfering with the accomplishment of daily activities and social roles (Boschen et al., 2003). However, neither of the studies elaborated upon specific components of the winter environment that limit the participation of individuals with SCI.

One Japanese study attempted to explore the winter activities of individuals with SCI while focusing on outdoor mobility (Shirado et al., 1995). In the survey-based study, one hundred and eight individuals with SCI who used a manual or power wheelchair reported facing problems like wheels and casters slipping on ice or easily being buried in snow (Shirado et al., 1995). Although, 90% of the respondents in the study identified going outdoors in winters as necessary for various purposes like shopping or doctor's appointment, respondents reported difficulty or inability in doing so due to winter barriers (Shirado et al., 1995). The findings from the study verified that wheelchair users have various reasons to go outside in winter. However, winter conditions along with the lack of appropriate mobility methods inhibit the outdoor mobility of individuals with SCI. While the authors of the study suggested that a wheelchair specifically designed for winter conditions would be beneficial to outdoor mobility of individuals with SCI, they did not discuss any environmental intervention that could potentially benefit a larger section of population and WMD users.

Because of winter barriers and inaccessible surface conditions, individuals with mobility limitations and WMD users report leaving home less often in winter months as compared to summer months (Hjorthol, 2012; Lemaire et al., 2010; Li et al., 2013; Ripat et al., 2013). In particular, individuals with mobility impairments identify snow-covered streets and poor sidewalk conditions as major barriers to outdoor mobility in winter (Boschen et al., 2003; Cooper et al., 2012; Noreau et al., 2002; Reid et al., 2003; Ripat et al., 2013; Rosenberg et al., 2013). As an alternative, many WMD users rely on private transportation, accessible transport services (e.g. Handi-transit) or even opt for a risky option of sharing roads with motor vehicles in order to participate outdoors (Ripat et al., 2013).

Studies in Winnipeg. Two regional studies that have closely analyzed winter accessibility for WMD users are: (1) The Winter Wheel-Ability Survey (Ripat et al., 2013) and (2) Building an Inclusive Winter: What Comes Next? (Bennett et al., 2013) While neither study is yet published, the data was obtained from the authors upon request, as the study results could provide useful insight into winter experiences of WMD users in Manitoba.

The Winter Wheel-Ability survey was conducted online over the period of two years, with hundred respondents. The primary goal of the survey was to gain a comprehensive understanding of the winter-related issues faced by WMD users in Manitoba (Ripat et al., 2013). In the survey, WMD users reported a decline of nearly 50% in the frequency of everyday outings in winter as compared to summer months. In winter, many WMD users identified going out only for emergencies. This data points to a decline in the community participation of WMD users during winter months. Furthermore, nearly 99% of WMD users and family members identified sidewalk conditions in winter as problematic and an issue that prevented their outdoor access in winter. The sidewalk conditions identified by Manitoban WMD users as problematic were

similar to those reported in other studies and included snow accumulation, slippery surfaces, icy conditions and puddles (Boschen et al., 2003; Li et al., 2013; Noreau et al., 2002; Reid et al., 2003).

In the survey, WMD users identified the responsibility for winter accessibility being shared among different stakeholders including WMD users, government officials, wheelchair service providers, transportation services providers and health care professionals (Ripat et al., 2013). The survey aimed to explore the winter experiences of WMD users in Manitoba and thus, no information was obtained regarding the perspectives of other stakeholders on winter accessibility. The Winter Wheel-Ability study draws attention towards the major environmental concerns that limit the winter participation of WMD users and supports the need for future research into the identified concerns.

In a second Winnipeg based study involving interviews with two WMD users, participants identified winter weather conditions, snow clearing practices, public transportation, equipment difficulties, and financial resources distribution as winter barriers to community participation (Bennett et al., 2013). Participants emphasized the negative impact of decreased community participation during winter including decreased independence, social isolation and emotional responses like frustration. The authors of the study suggested three solution-based themes to improve year-round community participation of WMD users: (1) accountability of various stakeholders: identification of responsible individuals or groups to address barriers and improving services (2) advocacy: to recommend & support the winter accessibility and (3) awareness: increasing understanding of the issues faced by WMD users.

There have been no previous studies documenting winter accessibility for WMD users in Winnipeg. The findings from both studies provide useful insight into winter accessibility for WMD users at a regional level. Several significant findings in both studies warrant future research. Firstly, both studies support the development of a collaborative approach involving various stakeholders to address winter accessibility for WMD users. Secondly, participants in both studies identify sidewalks conditions in winter as challenging that limits their ability to go outside in community. Thirdly, at a regional level, findings from studies identify snow-clearing practices as contributor to challenging winter conditions. However, neither study details the specific features of sidewalks in winter or snow-removal practices that contribute to the development of challenging outdoor winter conditions. Therefore, previous studies conducted at a regional level provide the foundational base that can guide the in-depth investigation into specific issues around winter accessibility for WMD users.

Built element of physical environment: sidewalks. Built or man-made elements in the physical environment include structures like buildings, bus shelters, streets and sidewalks. A sidewalk is a path alongside the road that has an improved surface, flattened or paved to facilitate the movement of people. A sidewalk usually comprises of change in surface level from road to separate the vehicular section from pedestrian movement zones and a curb ramp. A curb ramp forms an important transitional interface that connects the top surface of sidewalk to the adjacent street using an intermediate gradient.

However, several studies highlight that sidewalks that may be accessible in dry conditions may turn inaccessible in winter due to accumulation snow and ice (Bennett et al., 2013; Cooper et al., 2012; Garvin, Nykiforuk, & Johnson, 2012; Li et al., 2013; Novek & Menec, 2013; Ripat et al., 2013; Rosenberg et al., 2013; Wennberg et al., 2009). The common sidewalk

impediments to mobility in winter include snowy and icy surfaces, accumulations of snow, slush and puddle formation (Bennett et al., 2013; Cooper et al., 2012; Garvin et al., 2012; Li et al., 2013; Noreau et al., 2002; Novek & Menec, 2013; Ripat et al., 2013).

The design of a curb ramp is also often reported as problematic when considering the outdoor accessibility for WMD users in winter (Cooper et al., 2012; Li et al., 2012). Li et al., (2012) in their study of winter use of pedestrian facilities suggested that curb ramp designs are often ineffective and inaccessible in winter due to accumulation of snow, ice, and water puddles. The varying surface characteristics of the sidewalk in inclement weather conditions make traversing a sidewalk difficult or altogether impossible for a wheelchair user (Cooper et al., 2012). Despite understanding that weather conditions might affect the usability of sidewalks, curbs or slopes by WMD users, the issue has not yet been studied systematically (Cooper et al., 2012). There is a need for research analyzing design components of sidewalks and curbs with the aim of improving all weather use by WMD users.

2.2.4 Policy on snow clearing. In particular, the responsibility of sidewalk maintenance in the City of Winnipeg (including snow clearing) lies with the Public Works Department. In Winnipeg, snow removal practices are guided by city policy on snow clearing and ice control (City of Winnipeg, 2011). The goal of the city policy is to provide safe and accessible street conditions while simultaneously reducing the hazards of icy conditions. For the purpose of efficient snow clearing, the street system in Winnipeg is divided into three priority-based categories: priority I (P-I), priority II (P-II) and priority III (P-III). In addition, certain routes are identified as designated priority (e.g. Downtown Square) receiving accelerated snow removal services. The city relies on snow removal services, and the application of sand and salt, to manage snowy and icy sidewalks in winter.

Sidewalks are normally plowed on the same priority as the adjacent street. The priority I streets include all regional streets and streets around Health Science Centre. The priority II streets include non-regional bus-routes and collector streets, while the priority III includes all residential streets and little used industrial streets. Sidewalks in the P-I and P-II categories are normally maintained to compacted snow surface and are cleared following 5 cm snowfall accumulation or equivalent snow drifting. Downtown, P-I and P-II sidewalks are generally plowed to bare pavement surface. P-III sidewalks are plowed when an 8 cm of snowfall accumulation or drifting indicates necessity for snow clearing operations. Within P III sidewalks, designated access routes are established from senior citizens complexes to the most logical priority I or II street. In addition, the City offers snow-clearing services to people with disabilities who meet the specific eligibility criteria. According to the policy governing the service, private crosswalks between a sidewalk and curb should be cleared to 0.7 metres by city forces or contractors.

The economic cost of providing snow-clearing services is high, with a substantial amount of the city budget allocated to snow clearing. In 2012-2013, the planned snow clearing and ice-control budget of City of Winnipeg was $31 million and additional $10 million were spent due to a heavier than expected snow season (personal communication, William Grabowecky, Research and Process Improvement Coordinator at Public Works Department, Winnipeg). The City of Winnipeg officials purport that they are providing high quality services, surpassing the services provided by other Canadian jurisdictions (personal communication, William Grabowecky). The city service organizations are often limited by snow clearing policy, resource allocation and spending capacity. Furthermore, the mechanical limitations of snow-clearing equipment and the dynamic nature of winter present an added challenge to city forces in providing snow-free

sidewalks (personal communication, William Grabowecky). Finally, community dwellers (including WMD users) continue to identify poor snow clearing as a contributing factor to poor sidewalk conditions in winter, and recommend changes be made to snow-clearing practices (Bennett et al., 2013; Ripat et al., 2010).

Thus, current preliminary understanding on sidewalks accessibility in winter highlights the significant gap between consumer (WMD user) expectations, and service delivery by city forces. Furthermore, at a broader level, very little attention has been given to sidewalks and curbs design that can prevent or reduce occurrence of adverse winter-related barriers to access. Cooper et al., (2012) argued that although not all geographical locations experience severe winter conditions, designers and developers in particular regions (like Winnipeg) must take winter conditions into consideration. There is a need to conduct a study that explores the multiple perspectives on winter accessibility of sidewalks and enumerates solutions that are balanced and realistic.

2.2.5 Measurement tools for physical environment. To understand the complex interaction between the person and environment, the need often arises to identify the existence and measure the extent of, an environmental feature that presents as a barrier or facilitator. At present, several measurement tools are available that aim to capture physical environment accessibility either by using objective measurements or perceived influence. Table 2 provides an overview of some commonly used environmental measures that have well established psychometric properties. Each tool described in the table was screened to identify how they capture winter or sidewalk accessibility component.

Table 2. Description of commonly used environmental audit tools.

Name	Description
***Measure of the Quality of the Environment* (MQE)** *Authors:* Fougeyrollas, P., Noreau, L., St-Michel, G., & Boschen, K. (2002). Total number of items: 109	Assess the level of perceived influence of the environment. In particular, measures the possible level of influence- major, average, minor for both obstacle and facilitator. ▪ Uses 7-point scale: Major, Moderate, and Minor obstacle as [-3,-2,-1]; No influence [0]; "Major, Moderate, and Minor facilitator as [+3, +2, +1].
***Craig Hospital Inventory of Environmental Factors (*CHIEF**) *Authors:* Whiteneck, G., Harrison-Felix, C. L., Mellick, D. C., Brooks, C., Charlifue, S. B., & Gerhart, K. A. (2004a). *Total number of items*: 25 items, four domains	This tool measures the frequency and magnitude of environmental barriers as reported by individuals. Uses five subscales: (1) attitudes and support, (2) services and assistance, (3) physical and structural, (4) policy, and (5) work and school environmental barriers. ▪ Total score [0–8]: Frequency [0–4] x Magnitude [0–2] Asks how often in the past 12 months, natural environment (terrain, climate, temperature) made it difficult to do what individual intended to do and whether the problem was big or little.

Shorter version :12 items	
***Facilitators and Barriers Survey* (FABS/M)** *Authors:* Gray, D. B., Hollingsworth, H. H., Stark, S., & Morgan, K. A. (2008) *Total number of items:* 61 questions, 133 items and six domains	A self-reported survey of environmental facilitators and barriers to participation, designed specifically for people with mobility impairments. The scores are reported as the frequency of encounter with environmental factor and the magnitude of influence on participation. ▪ Frequency of encounter: Never to Daily ▪ Facilitator scale: None, helps some, helps a lot ▪ Barrier scale: None, limit some, limits a lot Asks a general question as whether winter weather (snow and ice) influences participation in the community and if so, to what extent.
***Community Health Environment Checklist* (CHEC)** *Authors:* Stark, S., Hollingsworth, H. H., Morgan, K. A., & Gray, D. B. (2007) *Total number of items*: 65 with	Measures the receptivity of physical environment for individuals with mobility impairments. ▪ A dichotomous scale [yes/no] is used to determine the presence of an environmental feature. ▪ Followed by what is a score for each feature on weighted levels of accessibility.

22 environmental features and 15 key destinations	
***Home and Community Environment* (HACE)** *Authors* Keysor, J., Jette, A., & Haley, S. (2005). *Total number of items:* 36 items, 6 domains	Assesses the presence of environmental features in six domains: 1) home mobility, (2) community mobility, (3) basic mobility devices, (4) communication devices, (5) transportation factors, and (6) attitudes. Five subscales—home mobility barriers , community mobility barriers , mobility devices , communication technologies , and transportation facilitators .

Though not all tools described in the table were specifically developed for use with WMD users, they are often used to determine environmental accessibility for WMD users. The Facilitators and Barriers Survey (FABS/M) and Community Health Environment Checklist (CHEC) are two tools described in the table that were developed considering environment and people with mobility impairment in focus (Gray, Hollingsworth, Stark and Morgan , 2008; Stark, Hollingsworth, Morgan, and Gray, 2007).

Although, all of the described measurement tools provide valuable information regarding environmental accessibility, none of them specifically addresses sidewalk accessibility in winter or winter accessibility. Evidence indicates that sidewalks in winter conditions may not be as accessible as they may be in dry conditions (Bennett et al., 2013; Cooper et al., 2012; Garvin et al., 2012; Li et al., 2013; Novek & Menec, 2013; Ripat et al., 2013; Rosenberg et al., 2013; Wennberg et al., 2009). Winter elements like fresh snow, ice, water pooling, puddles, snow

banks, and windrows can significantly change the surface and spatial characteristics of a sidewalk. These dynamic winter elements are difficult to capture quantitatively. Furthermore, considering the subjectivity of human experiences, particular winter element may pose a significant barrier to one person, but for another it may act neutral.

Considering these complex factors related to sidewalk accessibility in winter, there is a need for an audit tool that can capture (or if possible measure) the presence of winter elements that can potentially act as barrier to the mobility of WMD users. An audit tool for winter accessibility of sidewalks should address the dynamic component of winter and report data on winter components such as snow depth, presence of ice, slippery surfaces, and sidewalk width. Data in this form can enable users to self-identify whether a particular sidewalk in winter permits their mobility or not. At the same time, the data can assist snow clearers to make decisions regarding whether or not the sidewalk they cleared is able to provide accessible conditions for WMD users. This way the audit tool could be beneficial to multiple users and assist in decision-making regarding the accessibility of sidewalks in winter. However, to inform the development of such an audit tool, there is a need for an in-depth understanding of winter accessibility issues and associated experiences of key stakeholders.

2.2.6 Summary of the literature review

Satisfactory participation in the community emerges from a positive interaction between an individual and his or her environmental context. People with mobility impairments often utilize the assistance of wheeled mobility devices to participate successfully in their communities. While it is true that outdoor mobility in winter is challenging to all residents, the winter season specifically presents the most difficult climatic conditions for WMD users'

mobility. The WMD users in Winnipeg report primary concerns around sidewalk conditions in winter. Some difficulties faced by WMD users while accessing sidewalks in winter include snowy and icy surfaces, accumulations of snow, water puddles, windrows and cold temperatures. Using a wheeled mobility device on an inaccessible sidewalk in harsh winter conditions is energy consuming and could be potentially risky. The blend of cold temperature and challenging sidewalk conditions greatly restricts the ability of a WMD user to participate in community life during winter months.

While the current evidence suggests that challenging sidewalk conditions in winter contribute as a major barrier to WMD users' outdoor participation, very little is known about the specific issues faced by WMD users. Furthermore, past research has overlooked winter accessibility for WMD users' and no study has attempted to explore the winter accessibility of sidewalks for WMD users from various stakeholders' perspectives. WMD users' themselves recognize the shared responsibility for winter access that is balanced between different stakeholder groups including themselves, government, health professionals and other wheeled mobility service providers (Ripat et al., 2013). It has been argued that overcoming 'street barriers', like sidewalks access, will result in true utilization of other accessible services, especially those involved in travel chains (Lavery, Davey, Woodside, & Ewart, 1996).

As a methodological concern, most of the current winter accessibility studies have relied on questionnaires, indoor interviews, and focus groups as primary data collection methods. While these methods provide valuable information on a topic of interest, they are unable to capture an important component of winter accessibility i.e. dynamicity. Dynamicity refers to the real-time experiences of WMD users that are shaped by constantly changing micro-landscapes (e.g. snow and ice formation on sidewalks) during winter. The changes in micro-landscapes are

shaped by the factors like fresh snow, melting of snow, ice formation, presence of puddles, snow accumulations and other meteorological factors.

Retrospective recall of experiences to answer questionnaires or interviews is dependent on the vulnerabilities of retention of experience and memory recall. People with time may forgive, forget, ignore or simply adjust to the adversities they might have faced in actual life situations, thus the potential opportunity to capture valuable information may be lost. Some researchers have suggested future winter studies to take the benefits of real-time measurement tools such as GPS devices, local meteorological data, and outdoor in-field data collection to increase the richness of collected data (Li et al., 2013). Such real-time measurements can help better understand the dynamic relationship between winter environment and accessibility.

In summation, winter barriers faced by WMD users are corrigible but they need solutions that are evidence-based and guided by the cumulative experiences of key stakeholders. In-depth exploration from different perspectives is required to understand the specific issues around sidewalks accessibility in winter involving (1) wheeled mobility device users, and (2) sidewalk maintenance authorities. Enquiry using collaborative approach can help identify, recommend, and evaluate the strategies that can provide realistic and meaningful solutions to improve outdoor winter accessibility for WMD users.

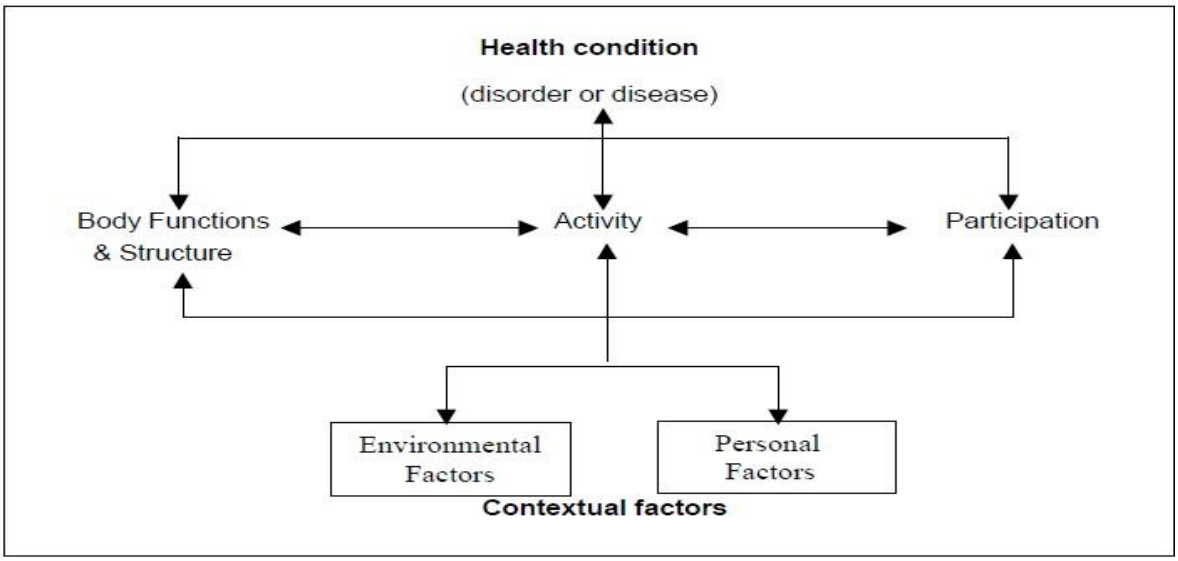
2.3 Guiding Conceptual framework

The overall winter and wheels study was guided by the theoretical underpinnings of the International Classification of Functioning, Disability and Health (ICF) (WHO, 2001). The value of using the ICF as a conceptual framework lies in its bio-psychosocial approach to human functioning. The ICF incorporates the bio-psychosocial model of disability that combines both

the medical and social models of disability. The ICF looks beyond the notion of disability simply existing at a malfunctioning body level and locates it at an intersection of biological body and societal structures (Hammel et al., 2008; Imrie, 2004; WHO, 2001). The ICF describes disability development as occurring consequently to impairment (loss or malfunctioning of a body part), activity limitation (difficulties faced by an individual in performing desired activities), and participation restriction (problems encountered while involvement in life situations) (WHO, 2001). Figure 1 graphically illustrates the ICF model.

Figure 1. Graphical representation of the ICF by the World Health Organization

From "Towards a Common Language for Functioning, Disability and Health: ICF," by the World Health Organization, 2002, p. 9. Copyright 2002 by the World Health Organization. Reprinted with permission.



As per a conceptual understanding of the ICF, individual functioning and disability is shaped by the dynamic interaction between an individual's health condition and contextual factors (Imrie, 2004; Schneidert, Hurst, Miller, & Üstün, 2003; WHO, 2001). The contextual factors pertain to both personal and environmental elements. Personal factors refer to individual

characteristics like demographics, education level, personality, and coping styles that influences how an individual perceives disability. The environmental context is comprised of the physical, social and attitudinal environment that surrounds people and in which people conduct their life activities.

Using the ICF framework, different aspects of the environment (immediate -in relation to the individual and distant -broader at society level) can be analyzed as contributors to participation restriction. Thereby, in this research using the ICF environmental framework assisted in learning about the specific issues related to sidewalks accessibility in winter, from both an immediate environment level (e.g. WMD user & sidewalks) and distant environment level (policy, services, program level). The ICF framework provided a comprehensive classification of environmental factors, enabling us to gain information on environmental barriers and facilitators from different stakeholder groups.

This study was guided by the understanding of person-environment fit in promoting occupational performance (Law et al., 1996). All occupations, including community participation, are performed in an environment. Successful participation in daily occupations is dependent on the dynamic interaction between person and his or her contextual factors. As suggested by Schneidert et al., (2003), in inclusive society where the physical environment is accessible, societal attitudes and social supports are positive, policies, services and systems attend to people with disabilities, the experience of disability never arises. In such inclusive situations, people with impairments will be functioning as participating members of community, without the outcome of disability.

3.0 Methodology

3.1 Research design and plan

A qualitative, interpretive description approach was utilized in this study (Thorne, 2008). The interpretive description approach allows qualitative studies that typically originate from the applied health sciences disciplines (like occupational therapy) to be designed and enacted with meaningful results that can inform practice. According to Thorne (2008), interpretive description constitutes a method that involves generating a question from the ground, involving: (1) actual practice goals and (2) understanding of what we presently know and do not know. Correspondingly, the winter 'n' wheels study explored the specific barriers and facilitators faced by each stakeholder group related to winter accessibility of sidewalks and identified realistic solutions and recommendations that can improve the winter accessibility of sidewalks.

Applying an interpretive description approach allowed the researcher to design a study using a logical, systematic and credible plan while simultaneously creating a context for dynamic engagement in the study. Dynamic engagement referred to the use of multiple data collection methods, and an iterative process of data analysis to describe and interpret findings. In particular, interpretive description allowed the researcher to move beyond the mere description of surface words or data and dwell in-depth into the process of inductive analysis involving interpretation of meanings. This way the analysis process lead to the findings that explained central phenomenon while yielding application implications (Thorne, Kirkham, & O'Flynn-Magee, 2008).

The use of interpretive description approach to better understand the winter accessibility of sidewalks was justified for several reasons. First, due to the paucity of information on winter

components affecting sidewalks accessibility, there was the need for an improved understanding from various stakeholders' perspectives. Secondly as a qualitative research methodology, interpretive description approach allowed in-depth knowledge generation in the study involving human experiences that is sometimes difficult to attain using quantitative procedures (for example understanding decision-making processes). Thirdly, an interpretive description approach recognized the presence of multiple and varied realties on the same phenomenon, thus guided the involvement of two different stakeholder groups and their perspectives in the study. Fourthly, the interpretive components of interpretive description approach allowed moving beyond the priori knowledge and generate new knowledge using multiple realities and perspectives that evolved from the data (Thorne, Kirkham, & O'Flynn-Magee, 2008).

3.2 Study participants

The study participants were recruited from two stakeholder groups:

1. Wheeled mobility device (WMD)users
2. Public Works Department employees, City of Winnipeg (CoW)

In this study, WMD users represented the service user (sidewalks user) stakeholder group while the Public Works Department employees represented the service provider (sidewalk maintenance) stakeholder group.

3.2.1 Sampling. The sampling strategy was purposive to attain the data from informed, experienced and relevant individuals. In purposeful sampling, the researcher selects participants based on their relevance and ability to inform the research problem and central phenomenon (Cresswell, 2007). The initial aim was to recruit twelve participants in the study. However,

eleven stakeholder representatives agreed to participate in the study (four from the WMD user group and seven from the CoW group). The conditions used for sampling in each stakeholder group are discussed below.

Stakeholder group-I: wheeled mobility device users (WMD user group). Four participants were recruited in the stakeholder group-I (WMD user group). Of all participants, two participants were manual wheelchair users and two participants were power wheelchair users. All participants were asked to self-identify the primary wheeled mobility device they use for outdoor purposes. The selection of two manual WMD users and two powered WMD users served the purpose of capturing the variation in needs and experiences of WMD users that are associated with the use of a particular type of mobility device.

The inclusion criteria for WMD user group participant included:

1. Independent use of a wheeled mobility device for a period of 12 months or more.

This inclusion criterion ensured that the participant had the necessary experience and functional skills for wheelchair use in the community. Furthermore, a minimum 12 months experience of using a wheeled mobility device assisted the WMD user in better relating the experiences of winter sidewalk conditions to the year-around conditions.

2. Use of a wheeled mobility device (wheelchair/ scooter) to participate outdoors in winter.

This study attempted to explore the experiences of WMD users while accessing sidewalks in winter, therefore necessitated the involvement of WMD users who regularly participated outdoors in winter using their wheeled mobility device.

3. Self-identified stable medical status and no history of major illness during past 6 months.

The data collection primarily occurred in the outdoor winter environment that included sub-zero temperature, snowy, and icy surfaces. Such winter conditions can be threatening to WMD users who have unstable medical status or had a recent medical history. In addition, the recent health condition could affect the wheelchair maneuvering abilities of a WMD user, thus compromise the quality of data collected. On the other hand, chronic health conditions like obesity may also have affected the WMD user's ability to maneuver. However, it was assumed that the WMD user who is independently participating outdoors would have sufficiently adapted to his or her condition and would have acquired skills that neutralized the impact of chronic conditions. Unstable medical status referred to any health condition that could affect the WMD user's participation in daily activities of living or contraindicated any moderate or heavy physical activity.

4. Must be a resident of Winnipeg and 18 years or above of age.

This study was conducted in Winnipeg and the study design included collaboration with the Public Works Department, City of Winnipeg. For practical reasons associated with the study design and process, it was necessary for the participant to be a resident of Winnipeg.

Stakeholder group II- City of Winnipeg (CoW). The Public Works Department (PWD), City of Winnipeg, represented the second stakeholder group in this study. Participants in this group were individuals who were involved in the sidewalk maintenance operations during winter. For collecting the data rich in information, participants in the stakeholder group II were recruited according to their job roles and responsibilities. Participants in the stakeholder group II were sub-divided into two groups: CoW-sub-group1- ground level operations staff (snow-removers) and CoW-sub-group2- management level operations staff (officials associated with

managing the citywide sidewalk maintenance and snow-removal operations). The principal investigator discussed the project scope with concerned PWD officials prior to the study initiation and attained their permission for collaboration (Appendix E & Appendix F). In total, seven participants were recruited in the City of Winnipeg group with four participants in the CoW-sub-group1 (ground level operations staff) and three participants in the CoW-sub-group2 (management level operations staff).

The inclusion criteria for stakeholder group II (CoW Group) participants included:

1. CoW-sub-group1: City of Winnipeg employees who were actively involved in the snow-removal operations at ground level during winter months.

Preferably, individuals with the job roles of inspector, supervisor, or shift manager were recruited for participation under CoW-subgroup-1 in the study. This decision was based on the understanding that these individuals were the frontline working staffs who also had the cumulative knowledge of experiences of other ground level operations staff. Alternatively, if the interested individual was not from any of the above-described job roles but was directly involved in the ground-level snow removal operations, he/she was recruited in the study. For each WMD user group participant, one CoW-subgroup-1 participant was recruited in the study.

2. CoW-sub-group2: City of Winnipeg employees who were involved in managing the sidewalk maintenance and snow-removal operations during winter months.

3.3 Data Collection

The interpretive description approach involves multiple data collection strategies such as interviews, participant observation, and literature search to collect data that enables a

comprehensive and contextualized interpretation of the central phenomenon (Thorne et al., 2008). This study utilized the following data collection instruments to gain a comprehensive understanding of the research problem.

3.3.1 Entry-point questionnaires. Participants in both groups were asked to complete a brief entry-point questionnaire. The entry-point questionnaire was different for each group and included questions regarding the basic demographics such as age, gender, and type of wheeled mobility device used or position at the City of Winnipeg. The purpose of the brief entry-point questionnaires was to gain a demographic description of the study participants. The entry-point questionnaires for both groups are included in Appendix H. In addition, a participant cover sheet was maintained that had the details regarding participant name, contact address, emergency contact and assigned participant number in the study (Appendix I).

3.3.2 Participant interviews. The primary data collection in this study was accomplished using two types of interview designs: indoor key informant interviews and outdoor go-along interviews.

Indoor key informant interviews. The indoor interviews were conducted with the CoW-sub-group-2 participants (managerial level operations staff). Participants in the CoW-sub-group-2 were the key informants who had an extensive experience and knowledge about the sidewalk maintenance during winter months. The key informant interviews are well recognized as qualitative data collection tools that provide the opportunity to gain in-depth information from informants who are considered an expert on a topic of interest (Creswell, 2012; Miller, 1999).The CoW-sub-group-2 participants were interviewed once, for a maximum duration of one hour. The indoor interviews were semi-structured type enabling informants to elaborate upon

their experiences but at the same time helping the interview process remain close to the central phenomenon. These interviews were facilitated by the use of an interview guide that included questions regarding snow-clearing policy, municipal stance on sidewalk maintenance, and other operational considerations (Appendix J).

The indoor interviews were conducted face-to-face at the mutually agreed location such as the key informant's work site. The interviews were organized to fit the schedule of participants and minimize any disruption in their daily work roles. Each interview was audio-recorded. The audio recording of interviews facilitated the smooth flow of interview session and assisted in accurate data analysis.

Outdoor 'go-along' interviews. The outdoor go-along interviews were conducted with the WMD user group and CoW-sub-groups-1 participants. The 'go-along' interview is a hybrid approach to qualitative data collection that incorporates interviewing and participant observation (Evans & Jones, 2011; Kusenbach, 2003). In the 'go-along' interviews, the interviewer walks along with the informants as they go on outings in their familiar environments, while simultaneously asking them questions on a topic of interest (Carpiano, 2009; Evans & Jones, 2011; Jones, Bunce, Evans, Gibbs, & Hein, 2008; Kusenbach, 2003). In this way, the interviewer is guided through the lived experiences of the informant, in the context of informant's particular environment (Carpiano, 2009).

The 'go-along' interview approach has also been referred to as a 'ride-along', 'walk and talk', 'walking interviews' or 'walk-along', indicating the primary mode by which the interviewer accompanies the informant (Carpiano, 2009; Evans & Jones, 2011; Jones et al., 2008; Kusenbach, 2003; Van Cauwenberg et al., 2012). Several researchers have emphasized that in

studies focusing on the environment, the go-along interviews generate richer data as compared to the traditional indoor/in-room interviews as the surrounding environment continuously prompts the informants about key features (Carpiano, 2009; Evans & Jones, 2011; Jones et al., 2008; Kusenbach, 2003; Van Cauwenberg et al., 2012). In this way, informants are less likely to depend upon the retrospective recall of experiences and attempt to give their 'best 'or a 'right' estimation of their actual experience (Evans & Jones, 2011).

Van Cauwenberg et al., (2012) used walk-along interviews in their study to analyze the environmental factors that influenced the older adults walking for transportation. They specifically used walk-along interviews to gain the context sensitive and detailed information on environmental components. In their study, they conducted walk-along interviews to community destinations that were within 15 min. distance from participants home and used the paths that were frequently used by the participants. Kusenbach (2003) evaluated go-along interviews as the qualitative research tool for street phenomenology and based on the ethnographic fieldwork, appraised the benefits of go-along interviews in domains of environmental perceptions, spatial practices, biographies, social architectures and realms. She concluded that the go-along interviews brought greater sense to studies by exposing the subtle as well as complex meanings of the environment in experience. Evans & Jones (2011) in their study evaluating the walking interviews also found that the data from walked interviews gave access to a richer understanding of the environment as compared to the data from conventional interview techniques.

Considering the strength of go-along interviews in capturing immediate experiences and the dynamic component of the human-environment interaction, this interview style was ideal for use in this study as we attempted to explore the different stakeholders experiences related to sidewalks accessibility in winter. Each go-along interview was scheduled for a maximum of 30

minutes. However, some interview sessions extended up to 60 minutes in recording as guided by the participants. The extended 60 minutes duration included time lapsed in taking breaks, setting the stage for interviews and concluding discussions. The participant and interviewer travelled on the stretch of a selected sidewalk, while simultaneously talking about experiences of using the sidewalk.

The minimum 30 minutes duration for go-along interview was found to be sufficient to collect an appropriate quantity and quality of data, as during the go-along interview the participant was essentially sharing his or her presently lived experience and did not have to recall past experiences. The surrounding environment provided cues and prompts that facilitated the interview session. Through this method, the participant and the interviewer were able to discuss the central phenomenon in detail from beginning. The practical consideration of exposure to cold also prohibited lengthy outdoor interview sessions. In situations where it was deemed necessary to take a break from the outdoor cold environment, the interviewer and the participant took shelter in an enclosed space such as participant's home, car or nearby business stores. However, with the participant's consent, the interview process continued during the break time.

The go-along interviews were facilitated by the use of interview guides developed specifically for each stakeholder group. The interview guide for WMD users consisted of questions adapted to snow and icy conditions, WMD use, and sidewalk accessibility. The interview guide used with CoW-sub-group-1 consisted of questions around winter sidewalk maintenance, snow removal, roles and responsibilities and accessibility conditions. The go-along interviews mainly involved participants themselves discussing their sidewalk experience. The questions from the interview guides assisted in additional probing into participant experiences and served well to facilitate the continuous engagement in an interview session. The interview

guides for WMD users group and CoW-sub-group-1 are provided in the Appendix K and Appendix L.

In addition, the principal investigator also took photographs of the environmental features that surfaced as relevant to the study inquiry. During go-along interviews, participants were encouraged to suggest environmental features they considered important or relevant and should be photographed by the interviewer. Post completion of the go-along interviews, the principal investigator also walked on the selected stretch of sidewalks again to make sure all key features observed in the interview session were photographed. The principal investigator also recorded or photographed any critical incident that occurred during the go-along interview session. In this study, a critical incident was defined as a situation where an accessibility problem was encountered or there was an occurrence of any other problematic event that hindered the mobility of a participant, such as a situation or event that necessitated the detour from decided sidewalk route like a blocked sidewalk. The interviewer recorded all critical incidents after the completion of go-along interview and these records were used to assist with in-depth interpretation of information from go-along interviews.

Whenever deemed important during interview session, the principal investigator maintained field-notes that were used to assist in further data collection and analysis. All interview sessions were audio-recorded.

3.3.3 Meteorological Data. Meteorological data was obtained from the Environment Canada website. The hourly meteorological data was collected for the specific days on which the go-along interview sessions with each stakeholder group took place. The meteorological data included information on following climatic parameters: actual temperature, humidity, wind speed

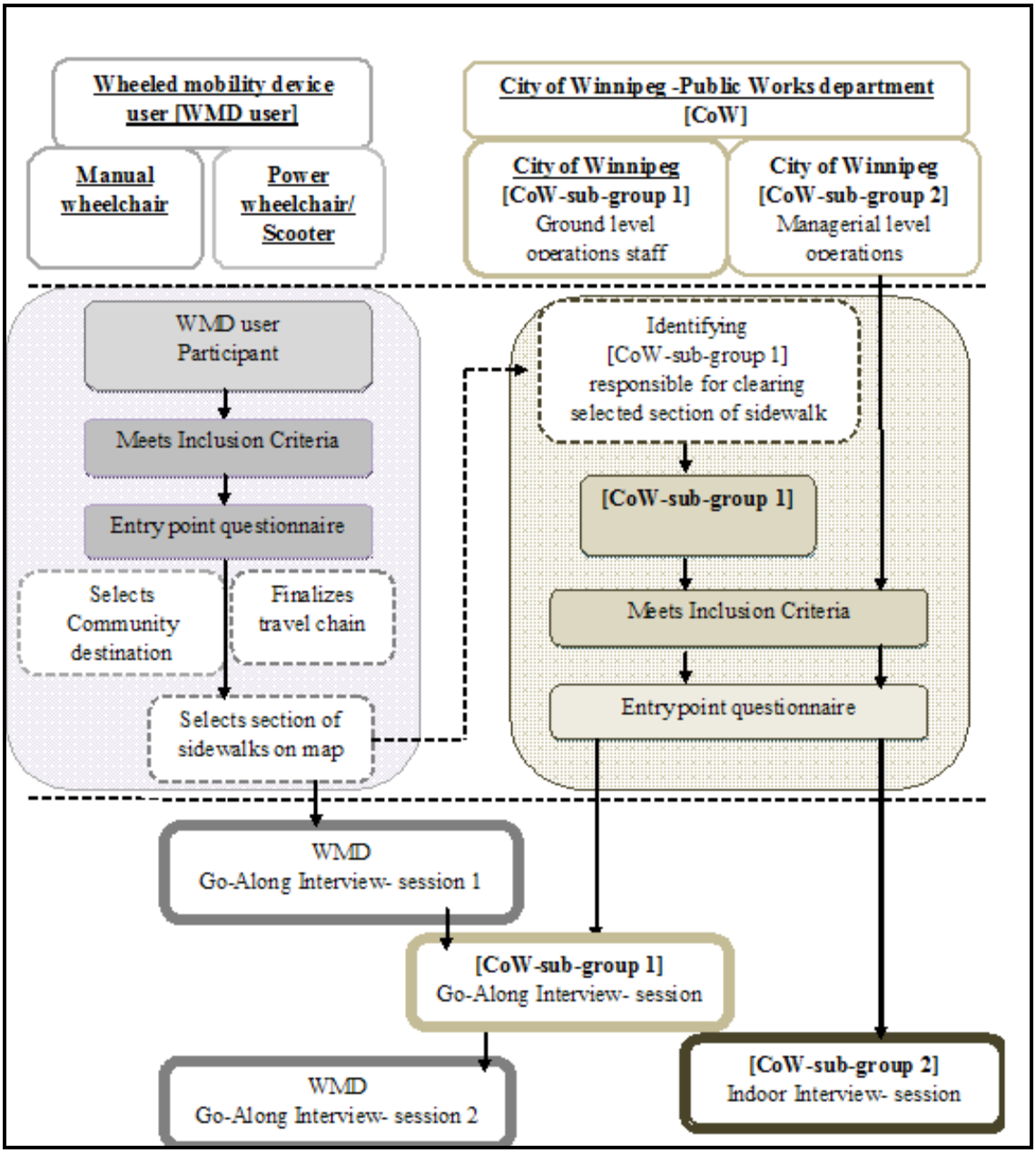
and wind-chill. The data collected on climatic parameters was used in interpretive analysis of interview data collected from each go-along session. The primary assistance of weather data came in during the understanding of information gathered in interviews from the perspective of immediate climatic conditions and occurrence of snow event in recent days.

3.3.4 Participant recruitment and Data collection protocol. The data collection in the study took place in the form of four cases and for each case; the data collection started with the WMD user group participant. Each case involved the data from one WMD user group participant and one CoW-subgroup-1 participant. In addition, the data from key informant interviews with three CoW-subgroup-2 participants was used for collective analysis with the other two groups. The case based approach is known to be useful in bringing the accounts of two stakeholder groups together on a central phenomenon, such as accessibility of sidewalks in winter, while yielding diverse and detailed data (Price, 2008). Figure 2 provides the diagrammatic representation of the data collection in the winter 'n' wheels study.

WMD user group- Participant recruitment. The WMD user group participants were recruited on a voluntary basis. The recruitment period extended from the months of February to April 2014. Participant recruitment occurred through the advertisements, distribution of handouts, and recruitment posters at public locations that were expected to be used by WMD users (Appendix A). In addition, the organizations that provided services to WMD users were contacted for a potential assistance in the participant recruitment (Appendix B). The initial contact to the organizations was made through an invitation letter sent by mail or e-mail (Appendix C). When the organization agreed to assist in study advertisement, they were provided with the study advertisement material to display at their sites. The organizations representative provided the interested individuals with the contact information of principal

investigator. Alternatively, study advertisements also had the principal investigator's contact information so that participants can directly make the contact.

Figure 2. Depicting the flow chart of the data collection in the study



Interested individuals who contacted the principal investigator were given the study details and asked screening questions based on the inclusion criteria through e-mail or telephone

to determine their study eligibility (Appendix D). Eligible individuals (participants) were then asked to attend the first study appointment at the mutually agreed location. At the first meeting, the principal investigator provided participants with the study details and obtained written consent for enrollment in the study (Appendix O). Following this, the principal investigator also completed the entry point questionnaire with the participant and obtained information for the participant cover sheet (Appendix H and Appendix I). In the entry point questionnaire, participants were asked to select one community destination that they frequently visited during winter months using their wheeled mobility device. After this, participants were asked to select the travel route /specific stretch of sidewalks that they normally use to visit their selected community destination. The travel route was later marked on a city map for use in the go-along interviews.

The data collection with the WMD user group participants involved two go-along interview sessions that took place on a selected travel route/ stretch of sidewalks on two different occasions, one before and one after the City of Winnipeg cleared the selected stretch of sidewalk. Only on one occasion, the second go-along interview session was not conducted as the city forces had terminated the snow clearing operations. The first go-along interview session with each WMD user took place on the same day they enrolled in the study. The second go-along interview session was scheduled as early as possible after the city plow operations on the selected stretch of sidewalks were finished. The collaborating city officials provided the information regarding when the selected stretch of sidewalks was scheduled to be cleared. The before and after data collection points helped better illustrate the WMD user experiences with respect to sidewalks conditions when sidewalks are not cleared of snow and when they are cleared.

The WMD user participant guided the maximum length of an interview session. If the selected community destination was nearby and the total time to reach the destination was below 30 minutes, the go-along session was completed to the point at which the participant reached the selected community destination. In situations, where the travel chain included the use of any connecting transport such as bus service or taxi, the travel route to the point of access to transport service was selected for a go-along interview session. This decision was based on an assumption that the transport service will drop the WMD user to his or her final destination. Furthermore, the practical limitations restricted the breadth of a physical area that could be covered in the interview session.

CoW group-participant recruitment. Participants in the CoW group were recruited with the help of collaborating city officials at the Public Works Department (PWD), City of Winnipeg (Appendix E). The collaborating PWD officials suggested individuals who met the primary inclusion criteria for stakeholder group-2 participants. The collaborating PWD officials provided the potential participant with the information on study and requested permission to be contacted by the principal investigator (Appendix G). If the potential participant agreed and provided permission, the principal investigator then contacted them through either telephone or an e-mail. At that time, the principal investigator provided them with the study details and asked screening questions based on the inclusion criteria to determine their eligibility in the study (Appendix D). Eligible individuals (participants) were then sent the consent form through e-mail for participation in the study (Appendix O).

The CoW-subgroup-1 participants (ground level operations staff) were recruited once the WMD user group participants finalized the specific stretch of sidewalks they use in their travel chain. The CoW-Subgroup-1 participants were recruited based on the area WMD users selected

in their travel route. The CoW-subgroup-1 participants were requested for an appointment for go-along interview on the day they were scheduled to clean the stretch of sidewalks selected in the study. Alternatively, if the city officials had already cleaned the selected stretch of sidewalk before the go-along interview session, the principal investigator walked on the selected stretch of a sidewalk with the participants and discussed the snow-removal operations. Also in such cases, principal investigator observed the city officials (participants) doing snow removal operations in the nearest location on the same day. The appointments for go-along interview session with the CoW-subgroup-1 were booked through either e-mail or telephone. The CoW-subgroup-1 participants were engaged in the go-along interviews immediately before and after the snow-removal operations. The principal investigator observed the snow-clearing operations and noted any key observations (e.g. techniques used, potential obstacles created by leaving piles of snow).

The primary goal of go-along interviews with CoW-sub-group-1 participants was to develop familiarity with snow-removal operations and gain the participant's perspective on sidewalks accessibility for WMD users. The intent of go-along interviews with CoW-sub-group-1 was not to evaluate their performances or rate their work efficiency rather the motive of interviews was to understand the ground level difficulties that hinder snow-removal and thus, prevent ability to provide snow-free sidewalks to WMD users.

After determining eligibility, the CoW-subgroup-2 participants were requested appointment for the face-to-face interview. The CoW-sub-group-2 participants were interviewed once, for a maximum duration of one hour. The indoor interviews were conducted at the mutually agreed location such as the participant's work site.

Before the beginning of interview sessions with both CoW-sub-groups, the principal investigator completed the entry point questionnaire and participant cover sheet with the participants (Appendix H and Appendix I). At this point, the principal investigator also collected the signed written consent from participants and addressed any questions (Appendix O).

During the process of study, the collaborating city officials only helped identify the suitable individuals and distribute the information regarding study. Thereafter, the principal investigator followed the communication with potential participants and the decision to participate in the study was made independently by the participants. The city officials only acted as a source of referral. Participants in the stakeholder group II did not lose any wages or work hours for the time they were engaged in the study. Appropriate permission and letter of support was sought in the beginning of study from the Manager, Street Maintenance Unit, who is in a position to authorize the involvement of street maintenance staff in the study (Appendix F). Furthermore, the data collection sessions were scheduled to minimize any interference with the work of stakeholder group II participants.

3.4 Data Analysis

A general inductive approach for qualitative data analysis as described by Thomas (2006) guided the data analysis in this study. The inductive approach provided a systematic procedure for analyzing qualitative data that helped produce reliable and valid findings. Using the inductive analysis approach, the investigators condensed the raw data into a summarized format and established clear links between the research objectives and summarized data. The inductive analysis assisted in developing a framework of the fundamental experiences related to central phenomenon. The inductive analysis approach synchronized well with the interpretive

description approach as it assisted in understanding the central phenomenon and illuminated its characteristics, patterns, and structures yielding practical implications (Thorne et al., 2008).

The data from the go-along interview session 1 and 2 with each WMD user participant and the corresponding CoW-subgroup-1 participant formed a single case. This way there were four separate cases containing data from both go-along interviews with each WMD user participant and corresponding CoW-subgroup-1 participant.

The data analysis started with the transcription and analysis of each individual interview. Once all the interviews were analyzed individually, they were pulled together to form four cases as described above. However, initial analysis of the four cases did not reveal any significant findings or variations from one case to another. The principal investigator re-examined the data, observed it collectively for each study group, and discerned that the data was more logically analyzed within each stakeholder group. As explained by Thorne et al., (2004) in discussing the analytic challenges in interpretive description approach, a rigorous analytic process often involves attentive navigation within and beyond the first selected analytic framework with which the researcher enters into the inquiry. Such a shift in the analytic process is necessary for full engagement in the process of inductive reasoning, and to advance towards abstracted interpretations that illustrate the central phenomenon with new meanings (Thorne et al., 2004). Thus, in keeping with this pragmatic stance of interpretive description approach, the data collected in the study warranted the movement beyond the case-based analysis, and towards within and across the groups. Thereafter, the analysis process first addressed an in-depth exploration within each group, before proceeding to compare data across the groups.

Figure 3. Diagrammatic description of how data from all instruments was brought together for analysis.

Across Groups Analysis

Wheeled mobility device users group			
WMD user *Participant 1* Go-along interview session 1	*WMD user* *Participant 2* Go-along interview session 1	*WMD user* *Participant 3* Go-along interview session 1	*WMD user* *Participant 4* Go-along interview session 1
Additional data	*Additional data*	*Additional data*	*Additional data*
WMD user *Participant 1* Go-along interview session 2	*WMD user* *Participant 2* Go-along interview session 2	*WMD user* *Participant 3* Go-along interview session 2	*WMD user* *Participant 4* Go-along interview session 2
Additional data	*Additional data*	*Additional data*	*Additional data*

With-in Group Analysis

CoW-Subgroup-1 (Frontline working staff)			
CoW-subgroup-1 *Participant 1* Go-along interview session	*CoW-subgroup-1* *Participant 2* Go-along interview session	*CoW-subgroup-1* *Participant 3* Go-along interview session	*CoW-subgroup-1* *Participant 4* Go-along interview session
Additional data	*Additional data*	*Additional data*	*Additional data*

With-in group Analysis

CoW-subgroup-2 (Management level working staff)		
CoW-subgroup-2 Participant 3 Indoor interview session	CoW-subgroup-2 Participant 3 Indoor interview session	CoW-subgroup-2 Participant 3 Indoor interview session

****Additional data***: Photographs Critical incident reports	Field notes Meteorological Data

Following steps as suggested by Thomas (2006) for inductive data analysis were used in the study:

1. *Data cleaning- Preparation and arrangement of raw data files*. All the interviews were transcribed verbatim into a word processing document. Photographs taken during the interviews were transferred to a separate word processing document. The photographs were arranged in the serial order to assist with the story line of corresponding interviews. The meteorological data for the particular interview day and the day before was also copied to a research file folder.

All the files were printed and the backup for each file was stored on a password-protected computer. Separate folder was prepared for information collected from each participant and included transcribed interview sheets, entry point questionnaire, field notes, photographs sheet, meteorological data and any critical incident report.

2. *Close reading of data.* The prepared text files containing raw data were read in detail several times, to gain familiarity with the text content and gain initial understanding of the surface themes that emerged from the text. At this point, principal investigator started to underline or highlight key surface ideas that directly emerged alone from the interview.

3. *Category formation*. In this stage, the raw data was re-read and the principal investigator started to identify, name, and define categories. A coding system was developed, and used to condense data into categories, representing the most prominent and recurring ideas. The coding process included word-by-word reading of the interview transcripts, labeling or marking of the words or sentence segments, and assigning codes. The labels or codes represented

the important pieces of information. The principal investigator also maintained the memo-notes on coding process.

At this stage, two levels of categories were developed. The first level of categories were general (surface level), describing information that was self-evident from the surface of raw data. The second level of categories were interpretive (more specific), explaining meanings of the information that became evident in the first category. The second category (interpretive) was derived from the multiple readings of raw data, use of photographs, critical incident reports, field notes, and meteorological data to associate meanings with the emerging categories.

This process started from the analysis of each interview and then moved in-depth involving analysis across the groups as units. In a movement from case based analysis to more group based analysis, the information from second go-along interview sessions with WMD group participants was still analyzed separately and a specific category was added to capture the key ideas from the second go-along interviews. This way, the data that specifically emerged due to the post-clearing data collection point was maintained for inclusion in data analysis.

In using an interpretive description approach, the range of information gleaned from the raw data is considered more useful than precision in the earliest stages of coding (forming surface level or descriptive categories). Following which, the clusters of data can be re-examined for a range of alternatives (discerning similarities and dissimilarities) with a move to a more interpretive level (defining specific categories) (Thorne et al., 2008). At this level, data interpretation was less dependent on coding and sorting of information, and instead the emphasis shifted to the processes of intellectual inquiry (Thorne et al., 2008). The intellectual inquiry involved the investigator to engage in a dialect between prior theory and evolving information

from the data. All the pieces of information that emerged from the data until this point were compared for any relationship among itself and with the available literature.

The theoretical reference for data analysis came from the past studies, and from an understanding that the disability develops because of a poor fit between the person-environment (WHO, 2001). The data analysis initially utilized the existing classification of environmental factors provided in the ICF to analyze raw data and then advanced to develop interpretive categories that described winter accessibility of sidewalks. The information from the data was initially sorted and related as per the five environmental domains of ICF: (1) products and technology (e.g. need for winter WMD, WMD getting stuck in the snow, alternate snow removal methods); (2) natural environment and human-made changes to the environment (e.g. sidewalks designs); (3) support and relationships (e.g. support from citizens and family); (4) attitudes (e.g. citizens response towards the WMD users on sidewalks or streets), and (5) policies, services, systems (e.g. citizen engagement in the snow removal, upgrading of snow removal policy). After understanding the developing information in categories using the ICF lens, the analysis process began to connect the overarching and intersecting information among various categories to develop interpretive themes that more fully described the winter accessibility of sidewalks.

The use of ICF framework during initial analysis prevented the study from becoming an atheoretical description i.e. prevented the data analysis and description from moving beyond the central phenomenon of sidewalks accessibility in winter for WMD users and the role environmental factors play in it. However, at the same time, an interpretive analysis avoided any theoretical impositions i.e. sole dependency on prior theory and instead used inductive analysis of the data gathered to change prior knowledge or evolve new theory.

4. *Assessing and interpreting overlapping codes.* In keeping with a qualitative inductive analysis, several segments of the text were coded into more than one category and several parts of the text remained untouched or unlabeled. At this point, re-reading of the developed categories and segments of information under them was done to ensure the meaningful and correct assignment of the information to categories and thereby, developing themes. The text that was not coded anywhere was re-read to check if it was relevant to any pre-existing category or was there any scope of new categories or theme to emerge from the leftover text.

5. *Refinement and revision of categories/themes.* This process involved refinement of information within each theme. Each theme was searched for sub-topics that included identification of contra-indicatory points of view, new information and interpretation of meaning of existing information. This stage involved development of new categories or themes either by division of original categories or merging of previous category to form a new category. Overall, all the categories were interpreted to develop a framework that can illustrate the winter accessibility of sidewalks for WMD users.

Throughout the process of data analysis, key findings, decisions and pieces of information were discussed with the study supervisor (Dr. Jacquie Ripat) to ensure correct and logical progression of the data analysis. In addition, the emerging final themes from categories were discussed with the study supervisors (Dr. Jacquie Ripat, Dr. Emily Etcheverry and Dr. Gina Sylvestre) to ensure that the process followed and associated outcomes made logical sense from the collected data.

3.5 Audit tool for winter accessibility of sidewalks

Presently, no audit tool is available that assess the winter accessibility of sidewalks for WMD users. The fourth objective of this study was to gather data that could inform the development of a winter accessibility of sidewalks audit tool. The information from the data in study was used to develop some suggestions that could assist in determining the nature of a tool for an accessibility of sidewalks in winter for various stakeholders. The information relevant to the development of an audit tool or its purpose is discussed in the solutions section of the findings under the heading of information sharing.

3.6 Ethical considerations

Ethics approval for the study was obtained from the Health Research Ethics board (HREB) at the University of Manitoba (HREB ETHICS #: H2013:455). Each participant was provided with the detailed description of study design and process before enrollment in the study. The key ethical considerations associated with this study are discussed below.

Voluntary Participation in the study and withdrawal

The participants' decision to take part in the study was voluntary. Participant had the right to refuse participation or withdraw from the study at any stage. The participant's decision to withdraw from the study or not to participate at initial request did not affect their access to any services or relationship with any agency/official or concerned individuals.

Potential risks and discomforts.

This study involved data collection in the outdoor winter environment. The typical winter weather in Winnipeg includes below-zero temperatures, cold winds, snowy, and icy surfaces. Such winter conditions could be hard for anyone and in particular, pose challenge to the safety and mobility of WMD users. Though the study topic and objectives necessitated the data collection during winter months, special attention was paid to the safety and health of each participant. Data collection with WMD users was scheduled during the daytime when temperatures were expected to be warmer as compared to evening and night times. The data collection for WMD users did not occurred on the days for which the weather advisory was issued or temperature forecast was - 25 degree Celsius or colder (including wind-chill). Every participant was advised to dress accordingly to the weather forecast and in situations with escalated stress to participant; the data collection process was paused or discontinued. However, the participants may would have felt tired or discomfort due to physical efforts they invested in moving their wheeled mobility device outdoors. To prevent additional fatigue or stress, the WMD users were asked to use the travel routes that they normally used to participate in their community. The CoW participants were also advised to dress according to the weather and to maintain their personal safety in the winter environment. In situations where it was deemed necessary to take a break from the outdoor cold environment, the interviewer and the participant took shelter in an enclosed space such as participant's home, car or nearby business stores. The participants were also advised in their consent form to take suggestions from their family members or health care professional, if they want to, regarding their participation in the study.

Confidentiality

Upon enrollment in the study, each participant was assigned a specific enrollment number. All documents, including interview transcripts, were kept confidential by using participant's assigned

study number in research offices (EPIC research lab, RR367, 800 Sherbrook Street, School of Medical Rehabilitation, University of Manitoba). Only the authorized study team members had access to the information. All documents were kept in locked filing cabinets and/or password-protected computer files. Participant cover sheet and consent forms that bore personal identification details of the participant were stored separately from the other data files of the participant. Entry point questionnaires were also stored separately in a locked filing cabinet at a research office. Any further identifiable information was anonymized and will not leave the research offices or shared in the release of study findings. Audio recordings and photographs taken during the study are kept on a secure, password-protected computer. The audio recordings were deleted subsequent to transcription. Photographs taken during the interview sessions did not included participants faces or any other identifying features.

Data collected from this study will be maintained for two years following completion of this study, at which time all data will be erased or destroyed. All printed files will be destroyed through confidential shredding by the principal investigator/ study supervisor. Electronic copies of data files will be stored in a password-protected computer and will be deleted from the hard disk two years after study completion.

Participants' involvement in the study.

Participation of WMD user group participants involved maximum three 30-minutes appointments with the principal investigator Deepak Joshi. The first appointment involved obtaining written consent, completing entry point questionnaire and participant coversheet while the second and third appointment involved outdoor go-along interview sessions on selected stretch of sidewalks. The two go-along interview sessions took place on different days during the

daytime except for one incidence where second go-along interview session immediately followed the first as the city forces cleaned the area during the completion of first interview session. In this case, additional on-site verbal consent was taken from the participant to carry out second go-along session and upon approval, the session was conducted.

Participation of CoW-subgroup-1 participants involved one 30-minute long go-along interview session and the participation of CoW-subgroup-2 participants' involved one 1-hour long interview session with the principal investigator, Deepak Joshi. Before the beginning of interview session, the principal investigator completed the entry point questionnaire and participant cover sheet with the participants. This information gathering took no more than 5 minutes to complete.

Cost to the participants

There was no cost to the participants for their involvement in the study. Participants in the WMD users group were provided with an honorarium of $20 per go-along interview session for their participation in the study. Participants in the CoW groups were not given any monetary amount, as they were participating in the study during their paid work hours. All participants were given a thank you note after the completion of last data collection (Appendix P).

Time-lines for project:

Project period - January 10, 2014- October 2014 (Please refer to Appendix M for detailed study timelines).

4.0 Results

4.1 Socio- Demographic description

Participants. In total, eleven individuals participated in the study. Four individuals in the WMD group, four in CoW-Subgroup-1 and three in the CoW-Subgroup-2. The key socio-demographic description of the participants is provided in the Table 3,Table **4**,Table **5** below.

Study period. The data collection in the study took place from February to April 2014. The minimum temperature on days with WMD user group data collection was -23.5 degree-Celsius (with wind chill) and the maximum temperature was -2.5 degree-Celsius (with wind chill). The minimum temperature on days with CoW sub-group-1 data collection was -24.1 degree-Celsius (with wind chill) and the maximum temperature was +1.5 degree-Celsius (with wind chill).

Table 3. Demographics of Study Participants (WMD user group)

Wheeled Mobility Device group *(Total participants-4)*					
AGE (in years)	SEX M-Male F-Female	Available family Support	Length of time living in Winnipeg (in years)	Dew point temperature on the day of Go-along session (Degree Celsius)	
				Minimum GoA-01/02	Maximum GoA-01/02
31	F	Lives alone	07	-23.5/-20.3	-16.4/-8.6
60	M	Lives alone	14	-22.6/-21.7	-8.2/-2.5
36	F	With Someone	01	-9.0	-3.5
30	M	With Someone	10	-22.2	-9.7

Table 4.Demographics of Study Participants (WMD user group)-Contd.

Wheeled Mobility Device group *(Total participants-4)*			
Primary WMD Type	Length of time using primary WMD (In years)	Length of time using any WMD (In years)	Prior WMD Used (Type)
Power Wheelchair	02	08	Manual wheelchair
Power Wheelchair	05	18	None
Manual Wheelchair	03	13	None
Manual Wheelchair	2.5	14	None

Table 5 Demographics of Study Participants (CoW group)

City of Winnipeg Group *(Total participants-7)*				
Age (in years)	Sex M-Male F-Female	CoW-Sub-group	Length of time with snow removal operations at City of Winnipeg (in years)	Dew point temperature on the day of Go-along session Minimum/ Maximum Degree Celsius
54	M	Subgroup-1	15	-22/-14.5
33	M	Subgroup-1	07	-22.0/-14.5
51	M	Subgroup-1	15	-24.1/-16.2
58	M	Subgroup-1	39	-2.1/1.5
35	M	Subgroup-2	02	Not Applicable
57	M	Subgroup-2	26	Not Applicable
49	M	Subgroup-2	04	Not Applicable

Study sites. The study was conducted in the physical parameters of the City of Winnipeg. The community destinations that were selected by the WMD group participants as the common winter destination included: workplace, downtown shopping area, Canada Post community mailboxes, restaurants, coffee shops, and leisure based neighborhood walks. In addition, the participants frequently highlighted the bus stops that enabled their connectivity of travel routes or chain. Overall, the study sites covered a wide range of city parameters, including south, east and north zones and newly added suburbs at the city boundaries.

Table 6. Community destinations identified by WMD users

Community destinations identified by WMD users
Workplace
Grocery stores
Community Mailbox
Restaurant/Coffee shops
Downtown Business area
Bus stops (in travel chain)
Shopping malls
Neighborhood leisure walks

4.2 Themes

Four themes emerged from the data answering the four key objectives and central enquiry of the study. These themes were classified as first- 'The Context of Winter Season', second- 'Winter and Wheels Interact', third- 'Winter versus The City' and fourth- 'Framework for Winter Access and Success'.

The first theme 'the context of winter season' illustrates the detailed context of winter season in Winnipeg. This theme discusses Winnipeg as a 'winter city' and reflects on the commonality of winter experiences among different stakeholders.

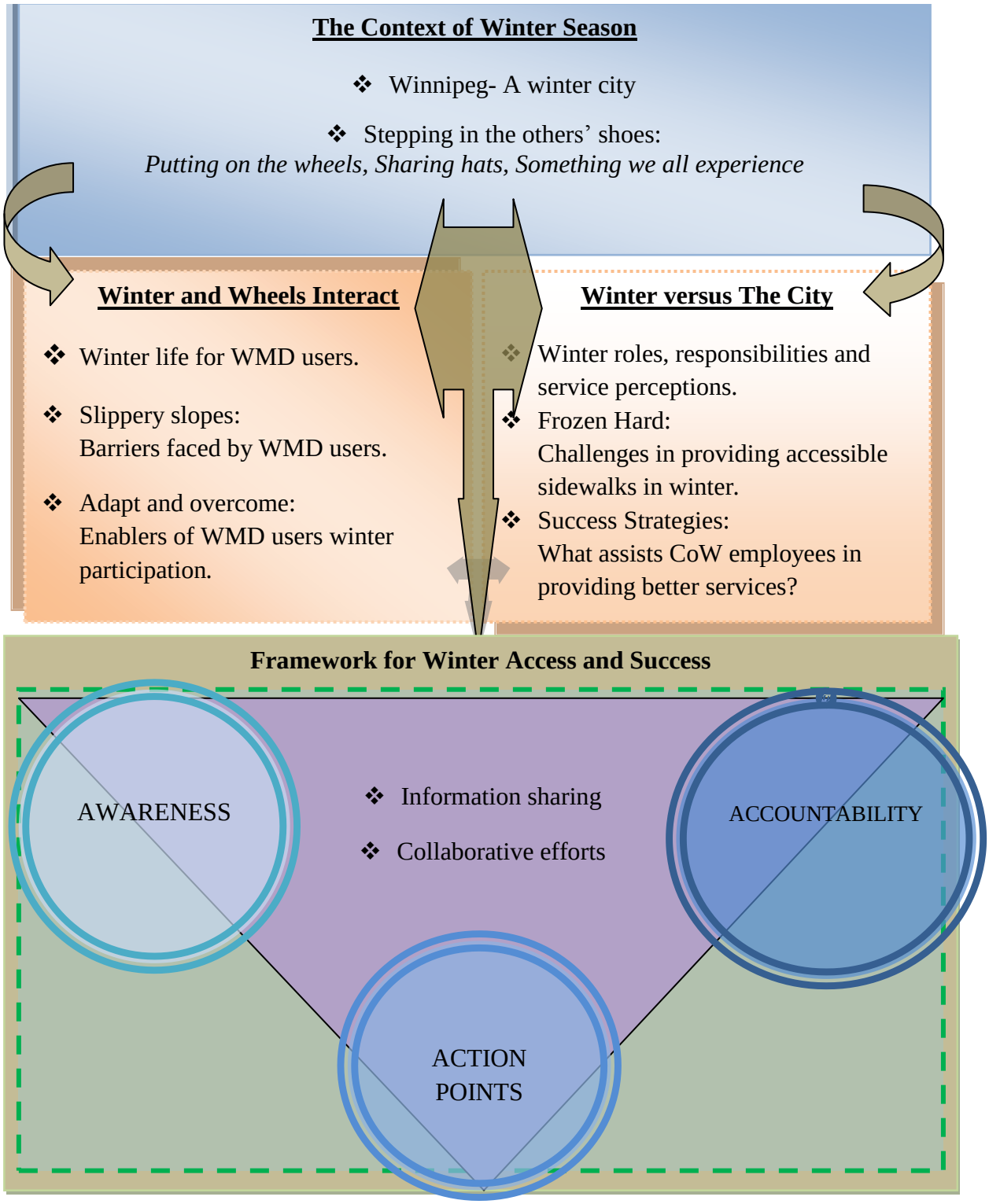
The second theme 'winter and wheels interact' corresponds to the life of WMD users in winter, the challenges they encounter, and the facilitators that work for WMD users. This theme addresses the first stated objective of the study 'to identify barriers and facilitators faced by WMD users while accessing sidewalks in wintertime'.

The third theme 'winter versus the city' corresponds to the difficulties that city forces experience with the winter elements. This theme highlights the challenges that city forces encounter during the snow removal operations and factors that assist them in providing better services. This theme addresses the second objective of the study 'to identify the obstacles and facilitators faced by city officials in providing accessible sidewalks during wintertime'.

The fourth theme 'framework for winter access and success' explicates an interpretive answer to the overall enquiry of the study that intended to identify solutions or recommendations that can improve the winter accessibility of sidewalks. This theme discerns solutions and the instruments that can assist with the enablement of winter sidewalks access. A visual representation of the framework is provided in the discussion to elaborate individual components and their interaction.

Figure 4 provides a graphical overview of the study themes.

Figure 4. Graphical representation of study themes



4.2.1 Theme 1 – The Context of Winter Season

4.2.1.1 Winnipeg - A winter city. There was the consensus among the participants that the long and harsh winter season is a reality in Canada and in Winnipeg specifically. One WMD user commented on this as- "Yeah, we are in Canada. The cold weather also has some effect on people going out too, right? Like when it was -40, even if they have cleaned it [sidewalk], I wouldn't even go outside (laughs)". Participants emphasized that the Winnipeg is a winter city and the winter conditions are unique in nature for Winnipeg.

> And I think in North America, I don't know if there's many cities that deal with the conditions that we do deal with here. It's because of the cold and because of the length of the winter that we have here. Other jurisdictions may deal with more snow but they don't have the lasting effects that we have here of temperature that plays on that. Yeah, there's lots of cities that get more snow than us, but they also get a lot more melting than us. -CoW employee

WMD user group participants also pointed to the length of the winter season in Winnipeg, lasting for half a calendar year. One WMD user commented as -"Most of the time I avoid it [using sidewalks], pretty much anywhere from the November to April. Yeah, pretty much any time between November to April". Participants also identified the change in surface conditions of sidewalks that sets in with the onset of winter. Participants' form both groups noted that the concrete surfaces are progressively covered with snow and ice over the winter. One WMD user identified the change in surface conditions of sidewalks with respect to her ability to be mobile -"I can still get around fairly well during the beginning of winter... um...up until the certain point when they get a certain amount of snow".

Participants from both stakeholder groups highlighted that the winter climate is a major influence on their decision-making and they need to prepare themselves in accordance to the nature of winter period. With this, participants also identified that the winter conditions change

over the season and at large, three sub-parts of the winter exist: onset, peak, and the offset. During the onset period, the surface snow is fresh and lighter with relative absence of hard icy surfaces. During the peak of winter, snow deposits become heavier, dense, and the presence of hard packed ice is more common. At the time of winter offset, the temperatures are warmer causing snow and ice depositions to melt, and thus lead to slushy, loose packed surfaces. Participants identified how each of these conditions created challenges specific to the respective sub part of winter. For example:

> And because it [outdoor environment] was a little warmer... the snow had melted a bit and it was quite slushy and that always makes it [wheeling] more difficult. When the snow is slushy, I get stuck much easier. -WMD user

The dynamic component of the winter environment that constantly changes and affects the outdoor conditions was also realized in the study.

> Yeah and again, we go from, you know, conditions can be fairly good throughout the city, where we get a lot of snow and a lot of wind and then we go from good to bad real quick [on sidewalks]. - CoW employee

Participants also noted that some winters are more severe than others are, and in particular, the extreme winter season with above-average snowfall or below average temperatures heightens their challenges. In extreme winters, the environmental conditions continue to be challenging without any respite and thereby, multiplies the effects of winter elements. Study participants regarded the particular winter season in which the study was conducted as an extreme winter.

Overall, representatives from both stakeholder groups identified Winnipeg winters as long, dynamic, with extreme outdoor conditions and constantly changing surface conditions. These conditions act as a barrier to the mobility of WMD users and as an obstacle to the snow

removal operations done by city forces. The ways these natural factors uniquely interact with each stakeholder group are illustrated in the second and third themes.

4.2.1.2 Stepping in the others' shoes. Many participants in the study appreciated the problems that were faced by the others in wintertime. Participants in the CoW group at several occasions 'put on the wheels' and identified the situations that hinder the mobility of WMD users. For example, one CoW group participant stated- "look at the way the sidewalks are made. The older sidewalks, how is the wheelchair supposed to come off the edges [curb slope with icy surface]?" WMD users were also able to 'put on the hat' of the CoW employees and appreciated the obstacles that city workers overcome to provide snow-clearing services.

> I understand that given their current resources they are not going to be able to do all the time and it's probably unrealistic to say that they are gonna clear every sidewalk in the city to the same extent, [but] they might in certain high traffic areas. - WMD user

There was the general appreciation of the job city workers did, given the winter challenges:

> I think it's pretty good as they plow and clear pretty decently. I know the side streets and stuff like that take a little bit of longer as they have to do the main street and main sidewalk and stuff, but it does, they are pretty good in the city here. -WMD user

Another key concept that emerged in relevance to the context of winter season was the commonality of winter experiences. WMD users voiced that the winter barriers do not uniquely affect them, but rather the barriers affect the entire population.

> Well this is clear enough for me to get on here but it probably won't be clear enough for someone who uses a manual wheelchair or walker or even an elderly person who walks using a cane, this would still probably be difficult.

Overall, WMD users related their experiences as commonly shared experiences among Winnipeggers and emphasized them to be universal or "something we all experience".

4.2.2 Theme 2 – Winter and Wheels Interact

The core of this theme addressed three main categories:

- Winter life for WMD users. (Page-78)
- Slippery slopes- Barriers faced by WMD users. (Page-81)
- Adapt and Overcome- Enablers of WMD users winter participation (Page-88)

4.2.2.1 Winter life for WMD users. WMD users highlighted that life roles and responsibilities continue during the winter season but they are greatly influenced by the winter elements. One participant added that - "Obviously... I pretty much just go to work and come home... Work I, I work Monday to Friday, 8:30-4:30 pm". WMD users identified the need to go outdoors for grocery shopping, social life, and two participants discussed how going out can also be associated with their leisure and social life, and important for mental wellness. One participant quoted- "Or even that you're just, you're um, you know, as far as just, I guess, wellbeing of getting out and being able to go around just to get outside per se."

Nevertheless, WMD users identified that in winter season they do not socialize as much as they do in summer time. One participant said- "Well during the summer months I am probably out socializing every day, if not, every second day whereas in winter that is probably get reduced to only about once or twice a week." WMD users associated the reason for reduced socialization and outdoor participation with increased mobility challenges present in the winter environment.

> I do not use the city of Winnipeg [sidewalks] at all in the winter months, anytime where there is a chance of snow being present; I just avoid it [sidewalks] completely because they are 100% impassable with the manual wheelchair.

However, some participants from WMD users group also reported that they are more susceptible to cold environment and getting sick in wintertime as compared to other able-bodied individuals. Therefore, WMD users reported avoiding going outdoors in wintertime for the same reason- "I think weather is also a factor. People who are in wheelchairs are often more susceptible to getting sick so that might be another reason why they would be avoiding using the sidewalks".

WMD user group participants connected the mobility challenges presented by winter environment to elevated risks and concerns for safety. Specifically, participants identified the risk of falling out of the wheelchair, tipping, injuring self, and being stuck on the sidewalks as concerns. One WMD user shared her recent experience in the study- "I am constantly afraid of getting stuck... umm and I have gotten stuck many times. I took the bus home from work on Tuesday this week and I got stuck three times". While describing the elevated risk and hazards on winter sidewalks, WMD users shared how their WMD interacts with the icy sidewalk surface- "Ya (yes) my casters... well all my wheels go in and I basically, just spin but I don't go anywhere".

Study participants reported varied responses to the elevated risks and safety hazards. Some avoided a particular route or a sidewalk while others avoided going out altogether. However, many participants said that they opted for sharing streets with the vehicles as they were cleared to a greater degree, while simultaneously indentifying this practice as a safety hazard where they would "risk getting hit".

> Yeah... and for us to go onto the street, this is the pretty busy street and often to go sit there and wheel down in the middle of the road. Because there's corner and you are gonna get hit. You know you are risking yourself of getting hit so...

WMD users noted that while they used streets in the absence of safer alternatives, they did not like to do so. Overall, participants noted that winter barriers causing reduced outdoor mobility and participation not only limited their socialization, but also influenced negatively on their independence.

> I would say overall in the winter... umm my mobility is greatly impacted, I don't go out and I am not as independent as I would be during other times of the year... Obviously, I pretty much just go to work and come home... I don't do this much socializing or other activities like that and if I have to do other stuff like grocery shopping. I have to rely solely on Handi-transit or a family member...

WMD users mentioned the need for support and assistance from others for safe outdoor mobility "I wait for somebody to come by" and identified that doing so, "takes away from my independence". However, participants also emphasized the utmost importance of their independence and valued it over the elevated risks and hazards. One participant noted:

> I am younger person and I am also very stubborn in independence so I won't hesitate to walk on the road if I have... Whereas, yes, I consider my safety but I would not allow it hinder my independence. My independence is way more important, which is probably isn't the big thing but its reality of who I am as a person.

WMD group participants emphasized it is important for them to stay mobile and active outdoors, and for that they can opt for difficult choices too.

> and it was... like -23 out, strong wind, snowing out, blowing like crazy... and I am dressed like this [shorts, t-shirt and jacket] and I refuse to use the Handi-transit, I refuse to use regular transit, I just go on cruise [in his power wheelchair].

4.2.2.2 Slippery Slopes- Barriers faced by WMD users. WMD users recognized sidewalks access to be difficult in the wintertime for several reasons. The reasons identified by WMD users categorized into two groups- natural environment and human-fabricated factors.

Natural environment factors. WMD users identified the presence of snow, ice, wet surfaces, colder temperatures, and wind as natural factors limiting outdoor participation in wintertime. Participants stated that "the physical presence of snow" itself can be a big deterrent to outdoor mobility. One participant quoted- "umm... Because snow and ice affects my ability to physically move in places... They stop my wheelchair from moving". In addition to snow and ice, participants also noted the surrounding cold environment as a limiting factor. During the go-along interviews, participants were observed putting increasingly laborious effort in order to overcome outdoor barriers.

> But I would say that the temperature and wind chill is also another significant factor. So...on a day like today...I would probably... even if the sidewalks are perfectly clear I would probably take Handi-transit...just because it is a significantly chilly day.

WMD users highlighted how the micro-geographical conditions amplified the influence of natural factors. Participant described one such micro-geographical condition to be wind and the force it gains around the corners and opens spaces-"This corner is really windy as well... I think we are right by the river". Often in the go-along sessions, it was hard for the participants to maneuver their device in the presence of wind. Another participant noted that the heat energy from the sun hitting part of a sidewalk could lead to the patches of slushy snow, non-uniform surface conditions, and create access difficulties.

Human fabricated factors. WMD users also identified barriers that originated due to human actions or responses.

Basic sidewalk structure. Study participants identified how the poor accessibility of the basic sidewalk structure was a barrier even in the absence of snow-"The quality of the sidewalks in this area is really bad, they are uneven and broken and they are definitely not completely accessible". Participants in the study also noted the absence of a sidewalk as a deterrent and barrier to the safe outdoor mobility. Photograph 1 shows one such residential street that lacks the sidewalk.

Photograph 1. Photograph of residential street without sidewalk.

Poor surface conditions due to the poor snow removal. However, on most occasions, participants noted the poor accessibility of sidewalks in winter to stem from snow-removal practices- "but, really if you notice, the sidewalks in that are not cleared very well what so ever". WMD users shared that sometimes a sidewalk that appears to be cleared and usable was not accessible.

> I have tried to use this stretch of the sidewalk in the past when I thought it was a little clearer, when there was just a little bit of snow on it, and I have gotten stuck a few times.

Reflecting on priority-based snow removal, many participants asserted that the quantity and quality of services that residential sidewalks (priority -3) receive were insufficient. One participant stated that she has never seen any snow clearing equipment at her end of the sidewalk; the only time she has seen any snow removal machinery in her area is at the point where priority 2 and 3 intersections meet. She showed the principal investigator this point:

> I have only never seen snow clearing equipment come in this end of the Road. But, I normally avoid this sidewalks altogether up until this point because it's not very clear and I... then I think this is where the city starts to clear the sidewalks.

WMD users perceived city forces to focus only on high priory areas while neglecting priority-3 systems. With this, some participants suggested abolishing priority-3 category under the current priority based snow removals system- "Personally I think, priority-3 roads should be... like there should... priority-3 shouldn't exist". However, WMD users also noted that the accessibility on priority-1 and priority-2 networks is not guaranteed. One participant gave the example of city's highest priority area- "Even downtown, where I work the sidewalks are very hit and miss... some areas get cleared very well and other aren't".

To underline one perplexing snow removal practice, participant reported that the street or sidewalk plows often push the snow back onto the cleared surface of sidewalks:

> You know because the sidewalk plows will, or streets will, go and push the windrow on the sidewalk and [then the] sidewalk plow will [have to] go and push the windrow back onto the street and it's a vicious circle.

Other problem areas identified by WMD users with respect to snow removal services included incomplete snow clearing on first attempt, delayed services, compromised quality, and

lack of coordination among street and sidewalk plows. WMD user also identified the limited information availability on snow clearing schedule as a barrier to going outdoors in wintertime. The inadequate snow removal practices led to the overall discontent among WMD users regarding the city services. As one participant responded to the question on quality of sidewalks after snow removal -"It's very seldom that they're, that they are actually cleared off to be considered cleared".

In describing surface conditions, participants identified several common characteristics that contributed to limited accessibility. Photograph 2 shows some of the common surface features of sidewalks (before snow clearing) during wintertime identified by the participants.

Snow accumulations- WMD users highlighted that snow removal operations do not clear sidewalks to the bare pavement and often leave behind snow sufficient to create access difficulties -"Snow for one and two, it is not clear. It is not cleared and it's soft. So, I wouldn't even attempt it". WMD users explained that the residual snow is not often close to the bare pavement and with time, people walk on it, the sun melts the top surface and creates the amalgam of conditions that are hard to maneuver. During the go-along interviews, we observed that in the peak of winter, constant snowfall pushes the fresh snow onto the old snowy surface, and in the springtime, varied level of melting lead to the slush formation. Participants highlighted that due to these factors, sidewalk surfaces become irregular, uneven, and bumpy.

Windrows and snow ridges- WMD users identified the heaps of snow created either by wind or snow removal machines as barriers.

> The mounds of snow that are left by the snow clearing equipment are impossible to get over, even with a power chair, they are either too big or its warmer and those mounds are too slushy and I would get stuck.

Photograph 2. Showing blocked sidewalk due to snow accumulations. The rough, uneven, narrow sidewalk surface can be seen in the same photograph.

Narrow sidewalks- WMD group participants also identified concerns with the usable width of sidewalks. For narrow sidewalks, participants identified two key causes: snow falling back onto the sidewalk from the pileup of snow on the sides, and sinking of the centre of sidewalk by the weight of walking pedestrians. The CoW group participants referred this phenomenon as "tunnel effect".

Soft slushy snow- Many participants identified the hard packed, compacted surfaces to be beneficial in the peak of winter. However, with some melting, the leftover compacted snow gave rise to loose-packed slushy surfaces that were hard to navigate. One participant noted so "but with the slushy surface it makes more difficult, it's more strain on the body".

Incomplete, inconsistent access. Another human-fabricated barrier identified by the participants was incomplete or inconsistent access in a particular travel chain. In incomplete

inconsistent access, participants identified inaccessibility of curb slopes, intersections and blocked travel chains.

Blocked access to curb slopes and intersections- When referring to the elements of travel route to the community destination, WMD users identified the accessibility of curb slopes and intersections as a big concern. At many occasions, WMD users reported failure to use the sidewalk as the ends (curb slopes) were not accessible. One participant commented on this as- "What if you are, you can get along the sidewalk which is fine and then you get hung up on the curb because there is snow there or the curbed ramp is [inaccessible]...no better than..., having snow there, anywhere".

Participants identified the primary cause of blocked curbs as the surface run-offs from the top of sidewalk. They pointed to the melting of snow on sidewalks that washes to the sloped ends and then freezes overnight leading to icy surfaces.

> You know, they usually... Its sloped, curb cuts... if you go the... uhh... traffic clips, slush builds up there and then it freezes over night and then you have got ice there, It could be 4-6 inches, 10-15 cm high.. How will I navigate the cut?

During go-along sessions, it was observed that frozen snow and ice at the curb ends often chips and scatter with the pedestrians walking onto them creating rutty and bumpy surfaces that are insurmountable for WMD users. In addition, the traffic turning around the frozen curbs also chips and scatters the loose snow making the approach to curb slopes rough and inaccessible. Photograph 3shows the blocked curbs with the presence of rutty and uneven surfaces.

Correspondingly, participants identified the inconsistent accessibility at connecting points of intersections as a barrier in their travel route- "and probably, the biggest barriers aren't the sidewalks themselves but are the intersections at the end of each sidewalk". WMD users were

never sure about the accessibility of target end of the intersection as that might belong to a different priority system thus having different surface conditions.

Photograph 3. Showing blocked curb slopes with rutty and bumpy surfaces.

Blocked travel chains- In addition to access inconsistencies at curb slopes and intersections, WMD users identified limited access to connecting points such as bus stops as barrier to reaching community destination. One participant identified that the snow was not removed from the entrance of a bus shelter, thus she could not go in on a cold winter day while waiting for the bus to arrive.

Blending of natural environment and human-fabricated factors. Participants identified that natural environment and human-fabricated barriers can act alone or in conjunction with one another, blocking their use of sidewalks in winter. As quoted by one participant "and with the cold-weather, it makes it (use of inaccessible sidewalk) more difficult".

4.2.2.3 Adapt and Overcome- Enablers of WMD users winter participation. WMD user group participants identified certain facilitators that enabled them in accessing the sidewalks during wintertime. These facilitators related to the type of WMD they use, physical environment (i.e., structure of sidewalks and surface conditions), support from family members and the general public, support from policy, services, and systems, and personal factors.

WMD and its interaction with winter. Participants identified that certain WMD's gave them advantage in accessing sidewalks during wintertime. Most participants identified power wheelchairs as more useful in winters than manual wheelchairs.

> They are heavier, the tires are wider and everything like that makes it easier to get over snow if I have too... yeah whereas in a manual wheelchair it really just takes a little bit of snow and you can't use them...manual wheelchairs... whatsoever.

One participant shared how her manual wheelchair had tire modifications but that the modifications did not eliminate the winter access issue: - "you know I have mountain bikes tires but that still not gonna get these little tires...the front tires from the snow". Participants noted using the manual wheelchair as more difficult, risky and effortful than power wheelchair.

> yeah you can get through perfectly you can do your whole pathway[on a sidewalk with melting snow] but you are still looking at the slush and difficulty....of injuring yourself not just failing out of your chair but trying to wheel through stuff [slushy snow] can injure your shoulder because I am in a manual wheelchair, right.

However, WMD users also reported limitations of power wheelchairs in winter such as frozen batteries that discharge quickly, slow speeds, spinning in one place, skidding, and sinking-in to the snow.

Physical environment- WMD users identified the physical presence of a sidewalk as a facilitator for going outdoors- "If there was a sidewalk I would probably go for a walk". WMD

users reported the availability of sidewalks that were clear of snow or had smooth compacted surface near to the bare pavement and wider space as facilitators. One participant shared her ground experience with facilitators as- "Yes, and even if you see here... There is a fair amount of snow but my chair can still get through this because it's hard [packed]...I wouldn't get stuck in this at all".

Another component of the physical environment identified as supportive by the WMD users was the presence of covered skywalks. Covered skywalks presented enclosed, clear (smooth pavement) and warm spaces to use in the wintertime - "Yes. They [skywalks] are great options because they are indoors and warmer. It takes longer to get where I am going but that's the trade off. Right?"

In addition, participants also preferred to use streets, parking lots, or driveways, as they were clearer than sidewalks. The presence of enclosed warm space such as business stores and bus shelters was identified as another facilitator where WMD users can take break to warm up and relax. WMD users also identified the relief due to natural factors (such as warmer temperatures, melting of snow to bare surface and sunny days) as facilitator to the use of sidewalks in winter -"Yeah, I would, once it is all melted out, I will go out even without the sidewalk, but that would be easier to maneuver without the snow".

Support from family members and public. Often WMD user group participants identified the support from relatives such as family members or friends as an enabler to outdoor mobility. In addition, participants also identified support from the public as an asset. The support received was generally voluntary in nature and came in different forms. Sometimes participants described the supportive role of the public as a 'helping hand' when stuck in adverse situations -

"Thankfully, there were a lot of people out because it was a nice day... and usually people are very helpful in helping me get unstuck".

On other occasions, participants described the importance of the role taken by city residents who voluntarily removed snow from the sidewalk in front of their houses, apartments or business stores - "Because this sidewalk is cleaned very nicely by the people in the apartment there, by the maintenance people in the apartment, this is the way it should be". Participants commented that while they would like to see more residents adopt such practices, they had concerns around the uniformity of sidewalks surfaces cleaned by different residents.

> Yeah I mean, a lot of the buildings in this area, umm... the building managers have snow-clearing equipment... and they do their best in clearing the sidewalks in front of their own building but there is no connection in between in the building.

Support from policy, services, and systems. WMD users identified the high level of accessibility in the areas that come under the priority-1 networks of policy.

> Priority 1 roads and sidewalks are really great. I can use them probably 95% of the time...uhmm...because they are cleared quickly and to the pavement... Yes... So that...that goes right there as an advantage of priority 1 compared to the priority 3....

WMD users reported availability of Handi-transit as a valuable support in enabling their community participation. Participants also pointed towards the benefits of connector routes and travel routes that allowed them to reach their destinations safely. One participant noted that he sees survival in winter season as an opportunity to "adapt and overcome" and in doing so, he uses Hand-transit as a support - "Well, I will tell you... like I say I adapt and overcome, I always use Handi-tansit or Dart".

WMD users preferred to work in the areas with high service levels, with better travel connectivity, and to use the sidewalks that received more services and were clearer. Participants opted for alternate routes that provided better connectivity and enabled their travel route. Participants explained that the alternate routes were better trade-offs even if longer in distance as they ensured safe arrival at community destination.

> Nope, nope, if it is longer I don't mind it. But, if it is clear to the bare pavement level, that's is much more better. That means I can make it. It might not...it probably would not be longer time wise but longer distance.

Cognizance. Another facilitator realized by WMD users was citizens being aware or knowledgeable of the needs of WMD users and respectful of those needs - "Greater public awareness will be facilitator as well, so as we mentioned umm... when I was on the road the cars slowed down and were aware of me." WMD user group participants constantly emphasized the need for more education and awareness among city staff and citizens regarding the needs of WMD users. WMD users linked greater awareness as a stimulus for ensuring adequate winter accessibility of sidewalks.

> I guess, educating people about the really small things that seem insignificant if you aren't using the wheelchair but really are...umm... you know realizing that...just that one little small... you know... really small ridge of snow or small bump in the curb or that doesn't seems like a huge deal, is really..really is. And once those problems are identified, or once you realize the issues there, then you can start to notice them and as you are creating policies or as you going about doing the clearing you will be able to take out by them and then make... make the differences that probably aren't that difficult if you are looking for them but some people might not just realize.

Participants ascertained more awareness than present as a key factor in ensuring improvements.

> I am gonna say that this will definitely make an improvement and like I know... I.. I.. I..think the ...the ...education should start from grade school, start teaching the

> kids... this is all about accessibility and everything else, so that they go off with it and it will be just be the part of the normal. That they all will automatically think it and they will automatically do it.

Personal factors. WMD users also stated the importance of personal factors that motivated them to cope with winter barriers and go out. The personal factors such as availability of finances, private transport, and personal motivation to be independent also came up in the discussions as facilitators. One participant added that his vehicle enabled his outdoor involvement in winters but that he only went to places with accessible parking spots.

> Interviewer: So majorly, you use your private vehicle and park it near to the stores where you can have clear access?
>
> Participant: yeah or where I can park very closely.

4.2.3 Theme 3 - Winter versus The City.

The central aspect of this theme addressed:

- Winter roles, responsibilities and service perceptions. (Page-92)
- Frozen Hard- Challenges in providing accessible sidewalks in winter. (Page-98)
- Success Strategies -What assists CoW employees in providing better services? (Page-105)

4.2.3.1 Winter roles, responsibilities and service perceptions. Participants in both the CoW groups contended that the winter season is difficult, bringing unique challenges in providing the accessible sidewalks.

Roles and responsibilities. CoW employees identified the residents of Winnipeg as their primary clients, and providing an accessible sidewalk network (beyond just removing snow) as their primary role -"Well there’s a couple of things. One is that the city has a mandate to provide

accessibility year round". With respect to snow removal services, Cow group participants stated that their main objective was to deliver the services as per the policy guidelines- "That's the policies I'm talking about - is that we're here to deliver on the council approved policy".

The management level CoW participants described their roles and responsibility with relation to the effective implementation of city policy. One participant commented on the totality of winter sidewalk maintenance operations and moved beyond just adhering to the snow-removal policy.

> I'm here to ensure the responsible delivery of the streets maintenance program in a safe and efficient environment. What we're trying to do here in that responsible delivery is ensure that either council policies are met or the funding made available is prioritized and spent with efficiencies and effectiveness in mind.

Front-line level participants described their primary roles and responsibility as "to keep sidewalks clean to the best of my ability" and "to make sure that all the sidewalks get plowed, down to [the defined service level]".

The CoW group participants highlighted that the task of providing snow clearing throughout the winter is demanding and substantial- "I see that as a challenge... because you... you are fighting things you have no control over, you can't control the temperature, you can't control the amount of snow". CoW group participants added that the vital part of their job was to provide "best value for your… taxpaying dollar" and manage resources while ensuring that the city policy is implemented rightly.

Perceptions. Overall, the CoW group participants described their services as important and valuable while taking pride in the services they offer during wintertime. CoW participants

stated that the services City of Winnipeg provides in winter is "more than all the cities in North America" and that only one other Canadian city provides the same level of service.

> Yeah, we're one, well Ottawa, Ontario and Winnipeg are I believe the only two jurisdictions of a city's in those top seven of Canada, that provide entire snow clearing services for the entire city. There's no other city in North America outside of those two that perform that service. So that tells you that's not the norm.

In service level comparisons, participants referred to the city forces providing residential sidewalks snow removal. However, CoW group participants also identified that their services are not perfect and there is scope of improvements in the services they provide.

> Oh ! I believe we do. We always go up and down and we have accessibility program and we umm...we are not a hundred percent perfect by no means or I think any city as such is or a person and everything takes time - we have so many days to do everything.

Snow removal methods and approach. Another key finding that emerged through the analysis of city official's roles, responsibilities and perceptions is the city's function of snow removal. CoW employees ascertained that they provide services as per predefined guidelines in the city policy regarding which area receives what level of services, at what times, and to what extent. The city participants in their interviews appreciated the objectivity this policy provides.

> Well our current policy is based on priority, so there's three levels of priority. So that's good because we've defined our response to a snow event in terms of three priorities. So that's good. And we've also recognized schools within the policy as a recognized level of attention that we have to have in the policy. It also identifies what triggers our work. So in terms of snow depth and those kind of things, so that's good.

Participants described how the snow removal operations start with the snowfall and accumulation of a certain amount of snow on the streets. The first operations begin with clearing the priority-1 networks, then moving onto the prioity-2 and then priority -3. In case of any snow

event prior to fully completing the rotation, the snow levels are re-assessed on p-1, p-2 networks and if they meet the baselines for initiating snow-removal operations, services are shifted back to the p-1or p-2 networks. Participants reported that the result of this is that when this situation occurs, and snow removal operations are unfinished on p-3 networks, city resources are diverted back to the higher priorities as per policy. As described by one participant:

> So we put all the equipment to work. A lot of snow events though will, you'll get started, you'll get priority one street or sidewalks plowed and that may lead into the next event. So before you've progressed, based on the policy onto priority twos and/or threes, you may get another event.

In freshly initiated snow removal operations, the participants described how the first equipment used is the Bobcat machines (blades in the front). These types of machines were identified as useful in scraping, peeling and pushing snow accumulation to the side from a sidewalk. With some progress in snow levels on ground, the snow blades start depositing snow on the sides or banks of the sidewalk. This equipment was viewed to be limited in terms of the proximity to which the front blades can be lowered to the sidewalk surface and the load that the front buckets can lift. Therefore, they were not identified as the equipment of choice for bare pavement cleaning or as the snow loads increases. As commented on by one participant:

> At the beginning of the winter, typically we would use a sidewalk plow... Which is exactly the same equipment except the snow board attachment, it has front blades just… plow blades... and it works well and… and just removes the snow from the sidewalk itself but as the winter progresses and the snow accumulates or continues to accumulates, the sidewalks plow are ineffective... There is just too much snow to move…

Therefore, with winter progressing and accumulated snowfall, participants explained that the equipment of choice shifts to snow blowers. These machines blow snow from sidewalk to the sides, usually onto pre-existing piles of snow. The speed of these equipment is slow, thus the average time taken for snow removal is increased.

> Yeah the sidewalk and snows on sides puts the snow back in...Yeah it just falls back in...Then we have to go... We have to remove the blades and go in to a blowing operation and then what we do... which is quite a bit slower... That adds to our kind... Because snow blowing takes longer than snow pushing...

At some point during the peak of winter, the snow piles on sides become too high for further safe deposition of snow. At this stage, the snow removal operations haul the snow to regional snow storage sites. Snow hauling requires a snow blower, usually bigger than the typically used and loading trucks. Participants shared that snow hauling is not always done and is typically dependent on the circumstances prevailing in the part of winter season as the cost and resource utilization of snow hauling is very high. One participant commented:

> There is no more room. The winds, the equipment can no longer push it up off the road. It continues to fall back in because it's piled up so high on sides... In those circumstances, we will haul it... But hauling snow is very limited because it's very, very, costly…very expensive. You need to have lot of truck lined up...it takes five-ten minutes to fill up a truck.

In the early winter with fresh snowfall and springtime, the snow removal process also involves sanding and salting. The primary reason reported for applying salt and sand on top of the snow is to increase frictional resistance and prevent slipping.

Self-assessment and reflection. Participants in the CoW group not only 'put on the wheels' to identify what difficulties are faced but WMD users but they also performed self-assessments to identify the probable issues that originate from the snow removal practices and operations. The participants in the CoW groups identified several key issues:

Quantity is priority not quality. Participants emphasized that considering the magnitude of snow removal operations their focus is often onto the quantity (number of kilometres covered in a given period) while the quality (level of snow removed or surface characteristics) is often disregarded. One participant stated:

> Yeah, I guess right now when service level is measured it's like okay, did you finish your priority one or two streets within thirty-six hours? Not what was the quality level of that plow? You know, nobody talks to management or us as supervisors and says well don't worry, you know, that it took you forty-eight hours or sixty hours to finish that and that group of streets, 'cause the quality of work you did was perfect, right?

Disparities in snow removal process lead to barriers. CoW group participants also identified the disparities in snow removal operations that lead to the accessibility barriers on sidewalks. One participant commented on the discrepancy between street and sidewalk plowing.

> I think more consideration on the street plowing versus sidewalk plowing. Where the sidewalk gets plowed then we have a street plow, street plows plow onto the sidewalk.

The snow pushed back onto the sidewalk from street is usually in large mounds and include heavy pieces of ice that can block the access path- "well because there's limited storage, a lot of the snow that was plowed off the street ends up on the sidewalk, which isn't just natural snowfall, now you've got ice and ice chunks, ice buildup".

Participants also identified the uneven or rutted surfaces and windrows created by the snow removal machines. In addition, participants also identified the clogging of the sidewalks due to snow falling back onto sidewalk from the snow piles on sides.

> So you end up, instead of your nice five foot surface that's flat, the machine goes through, it falls back in behind it, maybe the wheels of the machine have packed it down and made some ruts. So then, you end up with a very narrow area of two or three feet kind of in the middle.

Neglect of accessibility needs for WMD users. CoW group participants identified that the accessibility for WMD users were often neglected. One participant attributed the neglect to the time constraints of completing the job as early as possible, and in doing so neglecting the quality of clearing to accessible level for WMD users.

> Um, yeah but you're going to have to understand, we're under time restraints when we do our residential plow. We're under time, we have to get so many streets done in a certain amount of time. That's also in the policy, it's gotta be done in a certain amount of time so it's a rush factor. So it's, to get it down, to get it clean, to get traffic flowing, sometimes the, when that's all being taken into account, sometimes wheelchairs and scooter things aren't being taken into consideration. It's a time restraint, hurry get it done and...

Another participant connected the lack of concern for the accessibility to the lack of awareness and clearly defined service agreements. He emphasized that the policy and training caters to the pedestrians needs primarily.

> Yeah, we make it clear for pedestrians to get through and we don't address restricted mobility people and wheelchairs. It really isn't part of any of the... But again, you know, the difficulty with that is what is acceptable, I guess. What should the city, what should be the city's service level when it comes to that? Is it going to be…It's a tough thing to define because again, myself and the staff, we, we're not in that situation so. All of us can walk usually, but certainly none of us are in wheelchairs in our work so we really don't know...

Service lag on priority-3 networks. CoW group participants realized that the priority-3 networks often lag behind in the services they receive- "Yeah...they (P-3 sidewalks) don't see clearing equipment for weeks as a result of the P1, P2, P3 priority" and this led to poor surface conditions on residential streets.

> For the most part... we are pretty close to bare pavement on that sidewalk. This is P2, it would have received that level of service more frequently. This is a P3 and I can tell, I bet you are on top of 6 to 8 inches of flat on top of snow here.

Overall, the issues identified by the CoW group participants originating from the snow removal operations were in accordance with the issues identified by WMD users in the study such as services levels lagging on residential (priority-3 networks) and street plows dumping snow onto cleared sidewalks leading to blocked access for WMD users.

4.2.3.2 Frozen Hard- Challenges in providing accessible sidewalks in winter. The CoW participants highlighted that the task of providing accessible sidewalks in winters is

challenging and they face both natural environment and service resource related barriers. In addition, participants identified other barriers that necessitate attention. To fully describe each of these factors they are presented individually. However, in the dynamic winter environment they blend to create challenges to effective snow removal.

Natural environment factors. Participants identified that the winter components and their interaction with natural elements leads to unique conditions in Winnipeg and adds to the difficulties they face in wintertime. The uniqueness of winter season in Winnipeg included basic soil conditions that are prone to variation in moisture content, frequent snowfalls, high winds, consistently low temperatures and extreme winter seasons.

Many participants highlighted that the particular winter occurring during the study was extreme and prolonged. One participant noted the effect of this:

> This winter, one of the factors was is that we really never saw any thawing at all. Mother Nature never helped us much at all in terms of snow storage, so the snow that kind of fell in December was basically with us until spring melt.

Other natural environment component discussed included the dynamic nature of winter season that change quickly.

> Yeah and again, we go from, you know, conditions can be fairly good throughout the city, where we get a lot of snow and a lot of wind and then we go from good to bad real quick.

Participants highlighted several natural elements that create challenges in the winter months such as colder temperatures, winds, snowstorms, and frequent snowfall. One participant commented on the role of colder temperature in making conditions tough.

> Yes, colder, certainly colder. What can happen with colder temperatures is as the snow falls, because the city continues to operate, people drive and walk

> throughout the city and move around, with cold temperature snow becomes packed, changes to ice and then it becomes that much more difficult an element to remove from the streets and sidewalks.

Participants identified that the amount and frequency of snowfall over the course of winter season can have substantial bearing on the timely delivery of snow removal services. One participant added- "Just the sheer amount of snowfall that we have, accumulation through the winter as it builds through the winter can cause us a lot of difficulty again".

Another participant commented specifically on the role of wind. He noted that the wind alone could play a huge role in blocking sidewalks and turning accessible sidewalks into inaccessible one.

> Well wind conditions with a very little bit of snowfall can result in many plugged situations, like sidewalk or streets. So it may not be an event that, that has a lot of snowfall but because of wind and drifting we find ourselves with situations throughout, whether it's street or sidewalk that are plugged again. And that would result in us having to, uh, you know, respond to that. And you can go from acceptable conditions on a street or sidewalk to unacceptable plugged conditions quickly with wind.

In addition, participants also commented on the micro-climatic factors and geographical conditions such as sharp turning winds, sunshine and shade from local buildings creating unique combination of conditions that are difficult to manage.

> Because this will cause... this form or this surface to ice up creating a hassle on sidewalk for pedestrians… But we really have no control over where this occurs because it is a function of…you know, it is sheltered from wind... There is sunshine directly on it... With these - this phenomenon ...the icing that forms in the…in the…ahh...early spring happens all over again.

Service resource related barriers. The service resource related barriers identified by the participants included four areas: finance, work force, equipment, and snow storage.

Finance. The ability to do snow-removal that is efficient, regular and timely was constantly associated with limited financial resource availability. One participant stressed how the greatest concern in bringing improvements to the current system was the lack of additional money.

> Everything is possible... and in terms of functional. It it... it aaa.. .there are some... I.. I would have some functional concerns... trucks are very high, sidewalk equipment are very low. There are some operational issues that... that have to be addressed... but the biggest one is cost.

To this, another participant added that even in the current practice focus is on tailoring services to be cost-effective and justified for the best use of taxpayers' money.

Workforce. While concerns around the availability of workforce were not overly prevalent, one participant added that some degree of challenge is always persistent when it comes to availability of sufficient work force.

> Well within the city's own internal staff, we've been fairly stagnant over the years. The way the city has handled the increase in population is through private sector involvement, so that's kind of the way that's been handled. When it comes to sidewalk plowing, but we're still limited in terms [of manpower].

Equipment. The major service resource related barriers centred on equipment issues and snow storage sites. Participants in both the groups, but especially the front-line staff group, highlighted the struggle faced related to fleet management and adequate functional equipment availability. One participant commented:

> What I think the difficulty we have is, uh, I think probably our biggest challenge within, if we're just going to focus on sidewalks in the winter, again, is that fleet of sidewalk equipment that the city manages, not only from internally but externally. Winter, it's a type of activity that's very hard on the equipment. And at this point in time, after this winter it's demonstrated that we really aren't managing the fleet quite right or properly. Because it's shown that in this past winter the percentage of, you know, available equipment versus broken down equipment was quite high. A lot of breakdowns and, not only in the internal, the city's forces, but also in the private sector.

Participants mentioned that the snow removal activity is hard on equipment as the machines are worked on constant basis with limited breaks. Participants also identified the overall aging of city equipment as a pre-disposing factor to breakdowns. CoW group participants also expressed concerns that the maintenance and repair operations were insufficient in keeping the equipment running.

> We have equipment, we have equipment that has been with us for over two years that has broken down every time we use it for the same thing, for two years. Yeah, it’s a quick fix, it’s always Band-Aid, it’s a Band-Aid fix, hurry up get the piece equipment out so we can use it again. Use it again, break down again. In again, maintain it, another Band-Aid, get it out, get it fixed again.

Participants perceived that the limited availability of functional equipment compromised timely service delivery- "We start plowing now as soon as it snows. The only thing that holds us back is equipment break down because you can't get enough of these [equipment]".

Participants identified the limitations of equipment compromised the quality of services. Specific equipment limitations were inability of the equipment to clear contoured surfaces such as curbs (due to solid flat blades), inability of snow blades to reach the bare concrete surface (as this would lead to hydraulics damage by sidewalks kicks), and limited load capacity of sidewalk plows (smaller machines).

> That air space [from blade to sidewalk surface] is what is leaving the snow behind. But that air space, is required because, you are not goanna hit any imperfection in the concrete. So, its balance, why it is, where it is today.

Snow storage. Another major area of concern for CoW group participants was the difficulty with snow storage. Participants associated the limited snow storage to narrow sidewalk structures and highlighted that the task of keeping sidewalks clear of snow would be easier if adequate snow storage on or near the sidewalks were available.

> Because a lot of our difficulty on the sidewalk system isn't necessarily the snow that's on the walk, it's a lot of time it's the amount of storage space we have. So if you have a lot of space to plow the snow away, keeping the sidewalk clear isn't bad. That's why usually at the start of the winter the conditions are better than they are as you progress. 'Cause soon as you get a lot of buildup of snow on the sides, the sidewalk plow goes through, a lot of times it, you know, the plow plows it over and it falls in behind.

Limited snow storage necessitates snow-hauling operations that further elevate the costs of snow removal. Participants ascertained that the quality of snow removal increases when the issues around snow storage are absent.

> The storage is such a big factor in terms of expenditure. Yeah, and in terms of the quality of your plowing, if you have room for the snow to plow then you will get a good result. It's when you don't have room where…

Other issues. In addition to the above-identified challenges, participants also mentioned safety concerns and hazards of winter environment, urban planning, and basic sidewalk design to be associated with snow clearing capacity.

Hazard and safety concerns. Participants stated that there is a constant risk of damaging public or private property (such as fences, bushes, lampposts, etc.) and to prevent that they have to compromise quantity, quality or speed of snow clearing. One such example was as follows:

> Ooh!! Much harder... much harder, because its packed, it doesn't plow easily. The machines have tendency of, they will spin out or go sideways, umm... damage starts to occur, because you try to get close to the walls and then the machines slides and you hit a wall or you damage, hit a tree, umm... light poles...

Concerning safety, CoW group participants highlighted the safety concerns for operators and pedestrians at the time of snow removal operations. They highlighted they have to be careful of factors that involves potential safety concerns and thus, compromise with the quality of service. One participant commented on the safety of equipment operators and machine:

> you gonna appreciate if you drove five, ten miles an hour and you hit something like that, they damages your vehicle and your back. Yeah! Very... very… hard on the equipment and back of the operator... Every little bump... you feel that bump.

Basic sidewalk designs and surfaces. The heaving of sidewalks, uneven surfaces, unusual sloping, cracks on surfaces, older sidewalk with narrow width, and lifts at the joints are some obstacles identified by the participants in sidewalk structure and design. Participants elaborated how the design or surface characteristics of the sidewalks interact with their equipment, and lead to increased breakdown. One participant commented in this as:

> Well... there is umm... the issue because we plow to bare pavement, every little crack and umm... informity causes lot of issues, breakdowns, severe temperatures they become brittle, line breaks so, umm... the repairs are very costly and the life cycle of equipment. Equipment is expensive to buy and equipment doesn't last long.

Urban planning. CoW group participants reported concerns with the urban designing or planning of the city where the winter elements are often ignored. Participants reported that the horizontal expansion of the city puts more stress on the current resources and make them vulnerable to new challenges.

> Right, it’s flat expansion, kind of level expansion instead of vertical. And it’s those kind of things and I’m not, yeah again, I haven’t seen a lot of change internally. And again, because I work for the city, you know, I’m not sure we’ve really looked in terms of the city’s investment in terms of the equipment and employee numbers has really reflected that. And we’ve relied on the private sector to do with a lot of that and they’ve been busy too so they’re, you know… Yeah, so we’ve kind of exposed ourselves to maybe some issues there, incapable of taking care of all the growth

In addition, they identified the increasing number of street structures (such as benches, trash bins, and utility boxes) that impedes with the snow clearing operations. One example of such street infrastructure is depicted in the Photograph 4.

Photograph 4. Street infrastructure (near to the centre of sidewalk) dangerously close to the line of city snow clearing path.

4.2.3.3 Success Strategies - What assists CoW employees in providing better services? Participants in the CoW identified the City of Winnipeg-snow-clearing and ice control policy as their biggest asset. They highlighted the support and direction they gleaned from the policy. Participants identified policy as the tool that provides them with objective guidelines on what to do, when to do and to what extent. They also identified policy to be helpful in defining service agreement with the private contractors and citizens. Participants identified how the priority-based system in the snow removal policy is an asset that makes their job easier.

> Well with snow and ice control, it's actually pretty straightforward actually. It's not a complicated environment because what we have is... we have a priority network in this city and we have established guidelines to deal with that priority network. So when you have that, right away you a, you know, a pretty good setup.

Another participant expressed his confidence in how services were provided at priority one and two street systems, while highlighting the attention needed on priority three systems.

> Wheeled mobility devices I would say our priority one street network, I would say that the majority, ninety percent of them, you know, the users can use them the better part of the season, like, you know? Which might be, like if you're going days, might be ninety percent of the time, eighty percent of the time maybe. and it just gets lower from, you know, into priority two walks it might be, you know, seventy percent maybe. That one's pretty close but as soon as you go into a priority three sidewalk, depending on what the weather delivers, you know, it can go down to, you know, that sidewalk this year maybe was only fifty percent useable or twenty-five percent useable for a mobile [person using a WMD].

CoW group participants commented on the strengths of current policy in extreme winters.

> That's what we're looking at. We had the worst winter in a hundred and eighteen years, we have a council policy. Number one, did we prevent the emergency access ability for any human being, any piece of equipment, right? Any service, emergency response service? So first and foremost did your council policy stand up? Did it stand up to those three things? And the answer would be, as we know right now, we'd say yes it did. So you're talking about a policy that just went through the worst winter in a hundred and eighteen years and met the three most important criteria that human beings have in a city, an established city.

However, for improvements in the policy, participants commented on the need for bracing up policy for success in the extreme winter seasons. One participant added- "Then when you deal with extreme conditions, longevity of events, [and] continuation of transfers of events, that's where things start to fall apart because your model is based on the average events".

Another grey area in the policy identified by participants was the lack of defined number of required resources and matching of the financial resources availability to described service levels.

> The, I guess what hasn't really been identified in the policy is the, I guess it would be the financial capability of doing that [snow clearing]. Like a lot of times we have the policy but are we, is the city financially capable of doing that [promised level of snow clearing]

In addition to the policy-based facilitators, CoW group participants identified milder winters (those with less snow and warmer temperatures) as a facilitator. The CoW participants

welcomed the heat supplied by the sun as it made their jobs easier- "The results though, with milder temperatures, they just kind of naturally result in a better, a better result because you got less snow pack and it, you know, you’re not subject to [hard packed ice]". Another participant added that the average winter season also assists in timely delivery of services - "Right. So it take a couple of shifts before everything is off hauled away... but in a in a normal winter we can keep the sidewalks in a good shape you know within a day or so".

Another participant added that the appropriate availability of resources acts as a facilitator in providing accessible sidewalks networks.

> When we’re able and we do have, when time permits, when equipment permits, when man power permits, yes I do have a blower that will go on ahead and I do have a plow in behind them. Mostly I’ll do that on regional streets and on our P2s. When we start getting it ahead of the game, getting ahead of an event, I will have a blower that goes on up ahead with a plow in behind it to clean it right down.

Many other potential facilitators were discussed by the participants that they do not have currently, but will like to have as a resource in the future. These facilitators are presented with the solutions themes of the findings.

4.2.4 Theme 4 – Framework for Winter Access and Success.

This final theme outlines the solutions recognized in the study. The existing and wanted facilitators discussed by the participants were interpreted with the barriers they discussed to identify key solutions. The solutions are divided into three main categories:

1. Need for awareness
2. Action points
3. Accountability

This theme also addresses how two main instruments of change can be used to directly enable winter accessibility of sidewalks as well as other solutions.

1. Information sharing: Increasing connections and bridging gaps

2. Collaborative efforts: Bringing stakeholders together

Following the independent presentation of solutions, the framework for bringing solutions together will be elaborated on in the discussion section.

Solution#1: Need for Awareness. Participants in all the groups identified the need for greater awareness than present for winter accessibility. While the context of required awareness varied from group to group, participants in all groups agreed to the need for more awareness regarding the accessibility needs of WMD users. WMD users stressed the importance of awareness among the city residents to create more understanding and courteous behavior towards the needs of WMD users.

> I think there could be greater public awareness as to how just important can be to other people, wheelchair users and what not, to use the sidewalks. And in general, public to being to more courteous and respectful to the people who have to use the road because they don't have any other choice.

WMD user group participants believed that that once society is better educated on the concept of accessibility, it will become part of normalcy and not something extra. In this way, accessibility of sidewalks would be automatically included in the design and services rather than an after-thought. CoW group participants also identified their own need for more education and training regarding the needs of WMD users so that they can provide better services. CoW group participants identified that in the current practice, the emphasis is on pedestrian accessibility without a specific focus on WMD users or access for people with disabilities.

CoW group participants also identified the essential need for awareness among city residents regarding the snow removal policy and guidelines to promote realistic expectations and the efficient communication -"So there's an education and awareness campaign that's being lost somewhere with the local citizens, 'cause they believe that they should have, their street should be bare all day long".

CoW group participants stated that it is essential for citizens to be aware of the magnitude of operations, the difficulties they face, and to understand that it is not always realistic to provide 100% bare surfaces. CoW group participants believed that such awareness would assist in building trust and ultimately, promoting a collaborative effort to address winter challenges.

Solution#2: Action points. This solution highlighted the actions needed to improve the winter accessibility of sidewalks.

1) Products and technology. The action points in this theme included the need for winter adapted wheeled mobility devices, alternative technology for removing snow and more efficient snow removal equipment, and fleet management.

- *Winter wheeled mobility devices.* WMD users identified the benefits of particular mobility devices and suggested the need for winter adapted wheeled mobility devices. Participants indicated heavier power wheelchairs, wider tires, non-slip parts, and bigger casters make it easier to go through the snow and thus, enable their winter outdoor mobility. As one powered WMD user identified the advantages of her power wheelchair-, "They are heavier, the tires are wider and everything like that makes it easier to get over snow if I have to".

- *Alternate measures for snow-removal.* Participants also discussed the need for and potential scope of new methods of snow removal. Participants identified the role of heat in aiding and expediting the snow clearance. CoW group participants often discussed how heat was useful (by breaking hard snow or melting) on warmer days.

> And if you get a, you know, three or four days of plus two, three temperatures, which normally we do get but we didn't get this past winter, it makes it significant, you get two or three days of that, Mother Nature helps us a lot. It provides, it lowers the snow levels, things start to recede and all of a sudden we have, without any effort of the city, we have room again.

One WMD user group participant also noted the pilot project undertaken by CoW where they applied some chemical or alternate ice control substance on sidewalks to improve snow melting. However, participant noted that the project was discontinued due to public concerns- "People complained like the businesses complained that... umm... people were dragging it in on their shoes, plus it was hard on the animals or something".

- *Fleet upgradation.* Participants in the study recommended that city officials explore the availability of new types of equipment with the industry that are more efficient and resistant to winter conditions. Participants suggested city officials to take advantage of machines that have brush likes scrapers attached to them. This kind of equipment can be useful in early days of winter, where it can brush or scrape the fresh, loose packed surface snow, and in springtime, such equipment might be useful in removing the loose snow chunks that were left after partial melting from sun.

> It's funny the mall by my house, they have actually got the snow clearing device, it's attached to the front of their BobCat. It's like a big rotating brush that actually brushes all of the snow away from the curb so it's not...there is one side where it goes by there is no snow left...it's...it's completely bare pavement.

Another improvement in equipment management and use suggested by participants included the use of assembly of equipment to achieve better snow clearing rather than pushing one machine to the extreme use. One participant cited such example- "you know... you have got the...say...got these... like a plow or snow blower here and just blow behind it... with the little rotating brush to sweep it ahead ... so that it would get to the right level [bare pavement]".

2) Built Environment. Natural elements of the winter environment such as snow or cold temperatures were viewed as inevitable. However, participants identified certain changes in the physical environment components to improve the winter accessibility of sidewalks.

- *Sidewalks design and surface improvements.* WMD users identified the need to get rid of the narrow, uneven, and rough surfaces while the CoW group participants identified heaved or uneven, cracked, and lipped sidewalks as obstacles to be addressed. Participants emphasized the need for accessibility of basic sidewalk structure and suggested giving equal attention to the sidewalk maintenance as to the streets. In addition, specific attention was demanded for curb slopes and intersections during wintertime to make them snow free and accessible at bare pavement.

- *Urban planning specific to being a winter city.* Study participants suggested urban planners consider vertical expansion of the city as a priority. By vertical expansion, city forces would be in a position to provide better services to more people owing to the increased population density in a particular area. In addition, the CoW group participants emphasized the need for planning the street infrastructure to assist with snow removal operations in wintertime. One participant added:

> We have constantly have to push. This is in so much of [operators] level... But at my level when I see the drawing come through or any new sub-division...Any move with sidewalks...any...any...I always, always, always push back...by asking them to consider the snow storage issues for the winter.

- *Building connector and active transportation routes.* The active transportation routes provide dedicated paths to the individuals who use active modes of transportation such as bicycles. These routes are cleared to the bare surfaces and are smooth. WMD users welcomed the idea of having active transportation routes that they can use - "Yeah I mean it would be great ...umm...to increase the active transportation routes. That would make the traveling easier".

CoW group participants also identified connector routes as good alternative they are exploring to improve the outdoor mobility of WMD users- "We are already looking at making that adjustment recommendation to reprioritize sidewalk networks as they tie into [the] connectivity routes, right? Whether, it’s active transportation pathways and/or business improvements or accessibility to seniors, that kind of stuff". CoW employees emphasized the re-prioritization of sidewalks based on their proximity to the connecting routes. Another action point identified was to build more skywalks in high volume areas as the participants in the WMD user group highlighted skywalks as a useful resource to use.

3) Changes in policies, services, and systems. Action points in this domain suggest the need for improvement in service provisions and service delivery.

Changes in service provision. The key areas discussed by the participants included changes in the snow removal and ice control policy, citizen engagement in snow removal, and identifying the access priority areas.

- *Changes in snow removal and ice control policy*. The key changes in service policy included pushing up service levels on priority -3 networks and making service provisions in the policy more adaptive to dynamic winter seasons.

> Yeah I think ... definitely be causing impact on their priority system... you know because... my system is priority 3... When there is winter that is as this winter may be they should consider cleaning priority 3 roads more efficiently.

Participants also suggested that policy guidelines should be more responsive to the dynamicity of winter by adjusting services based on the amount and frequency of snowfall.

- *Citizen engagement in snow removal*. The other component that emerged with the recommended change in service provisions was the suggestion that residents be responsible for snow clearing in front of their homes. WMD users always welcomed and highlighted the sidewalks that were maintained by some city residents on a volunteer basis during wintertime, and how that facilitated access.

> The city is a good one... I... it's.... they are not goanna like take care of everything, the property owners could probably, I have known this driving around, there are, there are certain buildings around, around where I, you can just tell that the property owners has gone ahead and done little extra cleaning around there buildings and that makes them work good too, I guess.

CoW group participants also suggested that citizens' involvements in the snow removal from the front of their homes would be a facilitator.

> I know there’s, in my years a lot of cities, a lot of people that are involved with that, a lot of residents, if they know they gotta do the front of their home as part of their day to day activities, actually respond quicker than the civic forces can. So I know a lot of cities do it that way too.

However, the participants in both the groups highlighted concerns related to ensuring the consistency of surface conditions on sidewalks cleaned by residents.

- *Defining access priority areas.* Participants also described the need for designated priority areas that include places that are frequently used by people with disabilities. Participants suggested that such areas should be high on the priority list and ensure complete access. Many participants from both the groups identified the needs and provided supportive examples.

> I was around the health sciences centre few times this summer, this winter... and um... the snow clearing on the sidewalks around there were awful and you know, if think there was one, specially it was funny because I was crossing from the rehabilitation hospital to the Society of the Manitobans with disabilities building and the snow clearing around there and just the state of the sidewalks itself were ferocious and I thought boy if there was any place where they should be providing good accessibility, it should really be there... and it wasn't...

One WMD user suggested the city conduct surveys to identify such areas and provide enhanced services in those areas. Participants in the CoW group also supported the concept of access-designated areas and shared examples of how schools and senior complexes on residential streets receive enhanced services. However, CoW group participants cautioned about the potential for such areas to increase in magnitude and lead to additional issues- "as long as the volume of that or the magnitude of that [access priority areas] isn’t just another level of priority that the, you know, our system can’t handle".

- *More efficient snow removal equipment and fleet management.* Participants in the study identified the constant shortage of functioning equipment due to frequent breakdowns and long repair times. This is one area where immediate solutions were viewed as possible through proactive fleet management aiming to prevent equipment breakdown and keeping them functional for longer periods.

> And I think that’s basically our fleet management people have to recognize that and we have to take some... It’s not something that we haven’t experienced

> before. That sector of our snow clearing activity, it's always been a challenge to keep the equipment going because it's a, it's a type of equipment that maybe, you know, life cycling has to be shortened up, has to be replaced sooner, it has to be given maybe a bigger priority in the shop to be fixed.

Changes in service delivery. Participants in the study also identified the need for changes in the methods, approach and delivery of snow clearing services. The suggestions provided include:

1. *Proactive snow removal.* Participants noted the need for early and more frequent snow removal. The task of snow removal was reported to be easier at the start of an event and as the time passes, the snow removal becomes difficult due to amalgam of conditions that develop with winter season.

2. *Maintaining smooth, compacted snow surfaces*. WMD user group participants identified that, while bare surfaces are ideal, they can access sidewalks if the sidewalk surfaces are maintained to the compacted, smooth level and closer to the concrete.

> Yeah, I mean clear to the concrete will be ideal but clear to the compacted snow would be well enough as well so as long as it's clear to well enough and wide enough..... Then it would make it a lot easier for me to use the sidewalk on a more regular basis.

The two types of sidewalk surfaces (ideal bare pavement surface and smooth, compacted surface) identified to be acceptable for the mobility of WMD users are depicted in the Photograph 5.

3. *Targeting bare pavement surfaces in springtime*. Participants added that in springtime, the efforts should be made to reach more closely to the concrete surfaces so that the heat from sun can work on snow layers and melt it.

4. *Ensuring accessible curbs and intersections*. Participants also suggested clearing curb slopes and intersections to the bare pavement to facilitate the movement of WMD users.

> Well the intersections need to be cleared right down to the concrete... I think ... So [that] the curb cut is fully exposed and it makes it easier for a wheelchair to get up onto a sidewalk.

Photograph 5. Ideal bare pavement surface and acceptable smooth, compacted sidewalk surface post snow removal operations

5. *Avoiding build up of snow piles.* Participants stressed upon the need for frequent removal of snow piles and efforts to maintain the surface conditions consistent.- " If they [city workers] are gonna clear it to certain level, and then they need to do away with the large amount of snow, make sure it is consistently clear to the certain level". The CoW group participants also noted the importance of snow hauling but voiced their concerns with the associated expenditure and limitation of space for snow storage.

6. *Identifying more storage sites*. CoW group participants realized the need for identifying more snow storage sites around the sidewalks.-"Yeah, and in terms of the quality of your plowing,

if you have room for the snow to plow then you will get a good result. It's when you don't have room where...".

7. *Promoting efficient practices.* WMD group participants suggested CoW forces to do their best job at the first attempt- "Why not do it properly like right the first time. Take the snow away, and that is it". CoW group participants also emphasized the need to be more efficient in services by improving internal coordination and communication. One such example was to improve synchronization between street and sidewalk plowing operations.

Solution#3: Accountability. Participants in both the groups identified the need for greater accountability. The accountability proposed by the participants was not limited to having somebody answerable but also included defining the specific responsibility for individuals. Further to the action point already discussed, one WMD user group participant suggested it would be welcoming to see the residents taking responsibility of sidewalk snow removal in the front of their buildings- "when...city buildings are gonna step up like that, umm... You know...I don't expect everyone to do it but it would be nice if they did". Another WMD group participant noted that the city workers should understand their responsibility and act in accordance to that, so that they can identify potential barriers.

> The installer, the people that were supervising these, people that signed of the completed job [Installing curb slope and tactile markers on pavement]... somebody should have been able to pick up that we have created a new problem for someone else but it is just the way it is [new installation failing to be accessible for WMD users]

Participants suggested that the city workers who are responsible for snow removal should be made accountable for the work they did:"Not only responsible, they must have some accountability here". Participants added that based on that accountability, the responsible

individual would be asked to correct the job. Participants suggested that by adding the accountability the occurrence of mistakes could be prevented- "and for accountability, where it hurts people is in the pocket book and they learn... after one episode".

Participants in the CoW group also identified the need for greater accountability among city staff as well as with the private contractors. One participant identified that the "the level of service varies with different contractors" and thus there is a need for accountability to ensure the uniformity between the services offered by city workers and private contractors.

Instruments of change. The identified instruments of change are also considered solutions for improving winter accessibility of sidewalks but were seen to be valuable as enablers of the above-proposed solutions. The two instruments identified in the study were:

1. ***Information sharing: Increasing connections and bridging gaps.*** Many participants identified how communication that involves information sharing at various levels was crucial. CoW group participants identified the need for improved communication between them and residents where the information regarding services they offered can come back as feedback and suggestions.

> So, I may not understand hundred percent, but we [City of Winnipeg] have programs and we have some of the information needs come back to us. Explain why we think we did a good job and why people doesn't feels so?

CoW group participants explained that the communication could be exercised at various levels including among the ground level crews as well vertically in the city's organizational structure. As one participant noted:

> Um, I guess more communication. Communication is key. Sometimes because of the time restraints, we’re on a hurry up factor on getting things done and there’s, in that aspect, there’s not too much communication going around. The

> communication is per crew, per crew, getting what needs to be done at that moment to get it done.

Another participant described the level to which communication of information is needed.

> So it's better if the… if there's better communication, the formal level is a good thing. The foreman can communicate with the other foreman- "hey! we just cleared the sidewalks, you guys are going in there with your... street clearing equipment... make sure you don't plug up all the sidewalks again"... Something as simple as that.

CoW group participants also identified the need for information sharing with citizens regarding city policies and services: "I mean letting people know what policies are, and then it, then it. You know, both sides have to work". Such information sharing can create awareness, build trust on city forces among residents, as well as promote team effort in improving winter snow removal.

This need for information sharing contributes to the fourth objective of the study aimed at informing the development of an audit tool. Study participants identified greater value of an audit tool as an information-sharing tool where the information on sidewalks accessibility and snow removal can be freely exchanged between the city residents and city workers. Furthermore, participants preferred to have the new information-sharing tool as a component of existing communication channels rather than a new entity. One participant brought attention to the functional concerns that may arise with the introduction of new tool as communication channel:

> You know if you ask is that possible, I say yes. You have to have people that are assigned to that task and in today's time, lot of people are over taxed for what they can offer in a day, and to start doing one more thing, to someone else would be nothing or max already one more thing. So, at some level somebody has to say, yeah, we wanna do and there is some value to it. And we now have to say who is goanna do that and make sure that it is done and the other thing is, there is no sense of putting a huge program like that into place if nobody is gonna use it.

With further exploration participants reflected on the components of winter information sharing tool.

> It has to be user friendly; it has to be with umm... people have to be able to have, like not everyone, all of us can do but how about the less fortunate, the income levels a lot lower, may be they can't afford computer or afford having an internet. So maybe it has to be something or someway of umm... making it feasible for entering the information.

Participants valued the use of current 311-communication systems available through the telephone and with an app for smart phones. However, suggested improved information gathering and delivery regarding winter snow-removal operations. CoW group participants highlighted difficulties with prioritization of complaints they get from the 311 system.

> Okay. Yeah, we have 311. People have the ability to call 311 and place concerns about sidewalk conditions. Say we’re focusing on that, that there’s a sidewalk out there that isn’t properly, it’s not in an acceptable conditions. Part of the problem with, that we see with 311 from my perspective is it’s, it’s trying to properly convey to the people, like the frontline service people like myself and my staff, that it’s such a volume, so the difficulty is where, you know, trying to prioritize that. We can’t do everything all at once so you try to prioritize where do you go first, second, third to, you know, to get the problems resolved?

The WMD user group participants also had unsuccessful experiences with the current 311 systems and expressed the need for improvement- "because like as I said, I phoned that ... girl... I call it a joke line because I phoned like three times to get that sidewalk... sidewalk... clean".

Participants suggested improvements that can help 311 systems function better such as service standards guided information collection and delivery, real-time tracking of information, information filtration, and a prioritization component. Participants also highlighted that the new information-sharing component should provide the scope for quicker attention to the issues, availability of functional timeframes and ready to use information regarding what areas were cleared by the city and when or when they are expected to be cleared. Such a nature of

information could enable the use of travel routes- "if I know that they are plowing or whatever like that... then yeah... there's possibility of going out...like right now...say they plowed this sidewalk".

2. ***Collaborative efforts: Bringing all stakeholders together.*** The second instrument of change identified in the study was use of a collaborative approach where all stakeholders work together for winter solutions. Participants emphasized that all stakeholders need to discuss and define what is acceptable in terms of realistic and balanced solutions.

> But again, you know, the difficulty with that is what is acceptable, I guess. What should the city, what should be the city's service level when it comes to that? Is it going to be… It's a tough thing to define because again, myself and the staff, we, we're not in that situation.

Table 7 lists all the stakeholders identified by participants in the study. Study participants often referred to the potential role various stakeholders can play in addressing the winter accessibility of sidewalks. For example, CoW employees, while discussing the feasibility of new solutions, often referred to the council members/ politicians as key players in getting everyone on-board and bringing new changes. The potential role of each stakeholder will be presented in the discussion section of this document. Participants illustrated that for the success of winter accessibility, all stakeholders need to work together and understand the winter issues from each other's perspective.

Table 7. Identified stakeholders for enabling winter accessibility of sidewalks

Identified stakeholders	
Public Works Department, City of Winnipeg	City Council, City of Winnipeg

Health authorities and professionals	Urban planners and designers
Access advisory committee	Universal design coordinators
Members of public who use WMD	Citizens

4.3 Summary of results

With the help of context sensitive data collection procedures, information was gathered on the issues faced by key stakeholders when either using or clearing the sidewalks during wintertime and ultimately, feasible solutions were identified that can improve the winter accessibility of sidewalks. Study participants identified the Winnipeg as a winter city with long and harsh winter season. Each stakeholder group emphasized that their life roles and responsibilities continue during wintertime but are greatly influenced by the winter elements. Furthermore, participants shared the commonality of winter experiences and identified that the winter barriers do not uniquely affect them, but rather the barriers affect the entire population.

Study participants identified the natural environment factors such a snow, ice, wind, cold temperatures, and local geographical conditions to hinder their functioning during wintertime. However, stakeholders particularly identified the winter barriers to originate from human actions or responses to winter elements. WMD users attributed the existence of sidewalks accessibility difficulties in winter to an inadequate snow clearing services provided by the city of Winnipeg. CoW employees while appreciating the quantity of services they provide to city residents identified that they are often limited in providing accessible sidewalks for WMD users. The primary reasons discerned by CoW employees affecting their ability to clear sidewalks to

accessible level for WMD users were related to the service resource limitations. In particular, restricted financial, human, and equipment resources, along with limited snow storage, were viewed as compromising factors limiting the overall quality of snow clearing services.

Each stakeholder group also identified certain facilitators that assisted their functioning during wintertime. WMD users identified the support from their WMD, physical environment, family, cognizant citizens, and policies, services, and systems, along with the personal factors as facilitators that enabled their outdoor mobility during winter. CoW employees identified the adequate availability of resources, respite from natural environment and clear service guidelines outlined by the city policy on snow clearing and ice control as the facilitators that enabled them to do better snow clearing.

Ultimately, the interpretive analysis of identified issues and facilitators lead to the development of key solutions; need for more awareness, accountability, and action points. In addition, two more solutions were identified as instruments of change (Information sharing: increasing connections and bridging gaps and Collaborative efforts: bringing stakeholders together) that can directly enable the winter accessibility of sidewalks but are crucial in successful implementation of other identified solutions. The solutions identified for ensuring the accessible sidewalks in winter were combination of immediate actions and future suggestions that were brought together to form a framework for winter access and success.

5.0 Discussion

5.1 Findings.

Components of the natural environment have been known to create barriers for people with mobility impairments (Gallagher, O'Donovan, Doyle, & Desmond, 2011; Lysack et al., 2007; Whiteneck, Meade, Dijkers, Tate, Bushnik, & Forchheimer, 2004b). WMD users have identified winter environmental conditions as challenging to WMD use (Bennett et al., 2013; Boschen et al., 2003; Brandt et al., 2004; Lemaire et al., 2010; Noreau et al., 2002; Reid et al., 2003; Ripat et al., 2013; Shirado et al., 1995) and in particular, difficulties with sidewalks that turn inaccessible in winter due to accumulations of snow and ice have been identified (Bennett et al., 2013; Cooper et al., 2012; Garvin, Nykiforuk, & Johnson, 2012; Li et al., 2013; Novek & Menec, 2013; Ripat et al., 2013; Rosenberg et al., 2013; Wennberg et al., 2009). However, limited attention has been given to this particular subject by involving various stakeholders in developing a detailed understanding of the issue and in identifying solutions.

In an attempt to fill this gap, this study aimed to understand the specific issues faced by key stakeholders with respect to sidewalks accessibility in winter and subsequently, identify solutions or recommendations that could improve winter accessibility of sidewalks for WMD users. Using an interpretive description approach and context-sensitive data collection procedures (i.e., go-along interviews, key informant interviews, photographs, meteorological data and field notes), this study addressed several key objectives.

Previously, researchers expressed concerns with environmental studies over-reliance on static or fixed-in-space data collection procedures, and have suggested the use of more real-time data collection methods when focusing on the outdoor environment (Carpiano, 2009; Evans &

Jones, 2011; Li et al., 2013). Addressing this concern, the current study analyzed the winter accessibility of sidewalks by using in space, context-sensitive data collection techniques. The combined use of go-along interviews and photography of key environmental features enabled the researcher to understand the winter phenomenon in-situ. The use of these methods was strength of this study, as it facilitated the learning of how dynamic, real-time experiences of participants were constantly shaped by changing winter landscapes.

The eleven representatives from two stakeholder groups (WMD users group, CoW-subgroup-1 and CoW-subgroup-2) provided variety in terms of viewpoints, experiences, study sites, type of WMD used, and CoW job roles and responsibilities. Taken together, viewing the central phenomenon from the perspective of sidewalk maintainers as well as the sidewalk users helped in defining issues and solutions from different perspectives. The individual experiences of the manual or powered wheeled mobility devices users helped discern the winter issues that arise from the type of mobility device used and the ones that arise from the surrounding environment. Supplementing that perspective, experiences of frontline and management-level city staff allowed in-depth exploration of the specific issues prevalent on the ground or at the management level. The use of purposive sampling allowed the researcher to incorporate diverse experiences, while not losing the uniqueness of individual stakeholder experiences, and ultimately created the opportunity to identify commonly acceptable solutions.

In the Winter 'n' Wheels study, stakeholders articulated a number of key components that defined life through the winter season in Winnipeg. They reflected on the extreme weather conditions that prevail in Canada and designated Winnipeg as a winter city with a tough, long, and harsh winter season. Canadian winters are known to be severe, stretching over half a calendar year from the months of November to March (Environment Canada, 2013).

Stakeholders recognized the dynamic nature of a winter environment that rapidly changes with wind, snow event, or sunshine, altering the outdoor surface conditions and surrounding temperatures. The dynamicity of the winter environment was reflected in the stakeholders' constant engagement in an evaluation of outdoor conditions, influencing their decision-making and functioning.

Overall, the yearly average snowfall of 110.6 cm with an average snow-depth of 6 cm (Environment Canada, 2000) represents the level to which the winter conditions progress in Winnipeg. However, the particular winter component identified in this study that influenced stakeholders' decision-making was the occurrence of the three winter sub-seasons: onset, peak, and the offset. The manner in which the each sub-season influenced the individual stakeholder can be interpreted through considering how the accompanied change in surface conditions (amount of snow on ground) and imminent environment (such as temperature) influenced their unique experience of sidewalk accessibility.

During the onset period, surface snow is fresh, lighter, and relatively absent of hard icy surfaces: this sub-season created sidewalk surfaces that may be easier to navigate and clear. At the peak of winter, snow deposits become heavier, dense, and the presence of hard packed ice becomes common. At this stage, snow removal activity can become increasingly difficult as the frequent snowfall and sub-zero temperatures adds fresh snow onto the previously frozen ice rocks. While in peak winter, the presence of smooth hard-packed surfaces can allow WMD users to be mobile on sidewalks, at the same time, poorly maintained rough hard-packed surfaces may impede the mobility of WMD users. Finally, at the time of winter offset, ambient temperatures are warmer, leading to melting of snow and ice, and the formation of slushy and loose packed surfaces. The spring melt-off assists with snow removal operations by melting and loosening the

hard packed surfaces, however for WMD users, spring melt-off creates the new challenge of navigating through soft and slushy snow.

Furthermore, the occurrence of extreme winters (with above-average snowfall or below average temperatures) heightens the winter challenges. Study participants regarded the particular winter of 2014 in which this study was conducted as an extreme winter. In extreme winters, the frequent and high volume of snowfall leads to a rapid buildup of snow on the ground that takes considerable resources and time to remove. In addition, the long lasting sub-zero temperatures convert soft snow into heavy, hard packed ice that is difficult to remove.

While defining life in the context of winter season, it was observed that life roles and responsibilities continue during wintertime, though greatly influenced by winter elements. For CoW employees, winter life meant engaging in the considerable task of providing snow clearing throughout the city. Accounting for the uniqueness of Winnipeg as a winter city, CoW employees highlighted that the services provided by City of Winnipeg in winter are more than all other cities in North America as they are one of only two cities that provide residential sidewalks snow plowing. The other such city identified by the participants was Ottawa, Ontario; attributing this level of service to the fact that as the capital city, it perhaps enjoys the advantages of having more resources and political attention. For Winnipeg, while service delivery on residential sidewalks could be the point of a pride, it also reflected the expanded service delivery area and need for more service resources (such as equipment, money, and workforce) to provide quality services.

With self-assessment and reflection, CoW group participants identified improvements that could be made to the services they provided, and desired to know more about the perceived

shortcomings in services they provide from the end-users' perspective. This interest in learning more about the scope for improvements may be attributed to the CoW employees' identification as holding their primary responsibility towards city residents. Foremost, CoW employees identified providing accessible sidewalks to the city residents as their primary role during the wintertime. Management level participants described their role with relation to the effective implementation of city snow-removal policy, while the frontline working staff associated their roles with carrying out plow operations and keeping sidewalks clean to the best of their ability. The slight variation in the perceived responsibility between two CoW sub groups can be associated with their work profiles. For example, a frontline machine operator has to focus on clearing a sidewalk as per the pre-defined quality guidelines in a snow removal policy, while the management level staff has to focus on ensuring the availability of sufficient resources to implement the policy guidelines.

WMD users also realized that life continues during the wintertime and they need to go outdoors for various purposes such as work, grocery shopping, social life, leisure activities, or even for an overall well-being, but were limited in doing so due to winter elements. A similar need to go outdoors was also identified by Shirado et al., (1995) in their study of 108 individuals with SCI, where 90% of the respondents identified going outdoors in winter essential for purposes such as shopping or attending medical appointments. In the Winter 'n' Wheels study, WMD users identified that their outdoor mobility and participation was greatly restricted in winter months and they were not able to socialize as much as they are able to in summer. This finding supports the findings of a recent Manitoba based survey with approximately 100 WMD users or caregivers where there was an approximately 50% reduction in WMD users' frequency of going outdoors in winter months as compared to summer (Ripat et al., 2013). Limited

frequency of going outdoors in winter months may be explained by the existence of winter elements such as the long length of the winter season in Manitoba and its negative effect on community participation of WMD users for almost half of the calendar year (Bennett et al., 2013).

The dramatic reduction in outdoor community participation of WMD users in winter is a cause for concern. As described by WHO (2001), participation is 'involvement in life situations' and in the context of community participation, it can be related to the ability to access community events, activities, and spaces with social engagement. Limited participation in life domains (including outdoor participation and socialization) has been associated with poor life satisfaction, social isolation, and overall well-being (Carpenter, Forwell, Jongbloed, & Backman, 2007; Chan & Chan, 2007; Hjorthol, 2012; Tonack et al., 2007).

However, winter was identified to affect the wellbeing of WMD users not only by limiting their outdoor community participation but also by affecting their health. In accordance with the findings of other studies (Batavia et al., 2001; Juvani et al., 2005; Shirado et al., 1995), WMD users in the Winter 'n' Wheels study noted winter elements to directly affect their overall well-being while simultaneously identifying their susceptibility to cold weather and predisposition to becoming ill. In particular, people with spinal cord injuries (who rely on WMD's for their outdoor mobility) have difficulties with thermoregulation (Batavia et al., 2001), report increased occurrence of pain, muscle spasticity, numbness of lower extremities (Shirado et al., 1995), and experience frostbite of body parts (Lindsay& Yantzi, 2014) during winter months. Albeit, the thermal (cold) injuries to the body parts (such as hands or feet) can be prevented by wearing protective gears (e.g. gloves, caps, warmer clothing); such accessories may also limit the performance ability of a WMD user. Lindsay& Yantzi, (2014) in their study exploring the winter

experiences of youth with physical disabilities noted that most WMD users found wheelchair navigation to be difficult while wearing gloves. In addition to susceptibility to cold weather, WMD users in the Winter 'n' Wheels study commonly voiced concerns for their health and safety due to slipping on icy surfaces, being stuck on a sidewalk, experiencing tipping of their WMD, falling out of their wheelchair, or the chance of being hit by vehicles passing on the streets. With the presence of winter hazards, the wintertime is indeed a time of elevated risks and safety concerns for WMD users.

In the Winter 'n' Wheels study, the WMD users' response to elevated risks and safety hazards varied; while some avoided the route or a sidewalk and instead used alternative routes, others avoided going out altogether. Similar to these findings, Lindsay& Yantzi (2014) reported that youth using mobility devices to participate outdoor in winter were in constant fear of injuring themselves and bore the added psychological burden of winter social isolation. However in contrast to this finding, many WMD users in current study prioritized the need for being active, mobile, and going outdoors over the winter hazards and even opted for riskier options such as sharing streets with vehicles (as they were clearer than sidewalks) while disregarding the risk of being hit by a passing vehicle. Nonetheless, the consequences of such risk taking behaviors can be severe and multifarious.

Overall, WMD users perceived the occurrence of elevated risks, challenged mobility, and reduced outdoor participation as negatively affecting their independence. The need to rely on others to become unstuck from a barrier or to assist in overcoming winter barriers may act as a facilitator in difficult situations, but the expressed need by WMD users of having to have someone accompany them always while going outdoors indicated a sense of dependence, and limited their overall independent living.

In agreement with the argument by Lindsay& Yantzi (2014), the specific winter influences on people with disability (as identified above) may be simpler to present individually for the sake of identifying them, but in reality the cumulative winter challenges make conditions much harsher. Overall, the threefold winter weather consequences on older adults discussed by Hjorthol (2012) can be related to the consequences of winter hazards on WMD users identified in the Winter 'n' Wheels study. In both studies, restriction in activities of daily living, compromised overall well-being (reduced activity, leading to deterioration in physical and psychological health), and limitations in community participation (social isolation through limited going outdoors associated with negative psychological conditions) were reported. The commonality of winter weather consequences between those experienced by older adults validates the WMD users concerns for their wellbeing and warrants the exploration of solutions to address these consequences.

While WMD users faced additional risks and hazards in winter, CoW employees also identified winter risk and hazards associated with snow removal operations. CoW employees face the risk of damaging public or private property (such as fences, bushes, lampposts etc.) and to prevent that damage from happening, had to compromise quantity, quality or speed of snow clearing. In addition, CoW employees expressed concern for the safety of equipment operators and pedestrians. For example, operators risked hitting an uneven sidewalk surfaces with their snow-clearing equipment's blade and injuring themselves or breaking the equipment. Machine operators also worried about colliding with inattentive pedestrians on sidewalks.

Moving beyond the influence of winter season to the factors causing concerns, each stakeholder group identified winter barriers to originate either from natural environment factors or by human factors. For WMD users, the *slippery slopes of winter* (barriers to sidewalk use)

originated from the interaction between natural environment factors and human actions or responses to the surface snow on sidewalks. For CoW employees, the *frozen hard barriers* (barriers to winter sidewalk clearing) originated from the natural environment factors and service resource related issues that hindered overcoming winter elements.

Both stakeholder groups identified the common natural environment threats of winter season: snow, strong winds, constant sub-zero temperatures, limited sunshine, long length, unpredictability, extreme variability over seasons, and ability of temperatures to reach extremes. Similar natural environment factors inherent in the winter has been repeatedly reported to affect the mobility of WMD users (Bennett et al., 2013; Boschen et al., 2003; Brandt et al., 2004; Morales , Gamache, & Edwards, 2014; Lemaire et al., 2010; Noreau et al., 2002; Reid et al., 2003; Ripat et al., 2013; Shirado et al., 1995; Torkia et al., 2014). In the Winter 'n' Wheels study, we found the physical presence of snow or isolated occurrence of cold temperatures, to act as a major deterrent to the outdoor mobility of WMD users by making the task of wheeling a WMD harder and more effortful. Moreover, several studies in the past have supported how the presence of winter elements can turn accessible sidewalks into inaccessible (Bennett et al., 2013; Cooper et al., 2012; Garvin, Nykiforuk, & Johnson, 2012; Li et al., 2013; Novek & Menec, 2013; Ripat et al., 2013; Rosenberg et al., 2013; Wennberg et al., 2009).

Similar to WMD users, CoW employees identified the frozen hard challenges in winter environment but emphasized how the dynamic nature of winter environment and micro-climatic factors such as strong winds at corners, sunshine, and shade from local buildings created a unique combination of conditions on partial stretches of sidewalks. They expressed how the dynamic component of a winter season can quickly turn the freshly cleared sidewalk into an inaccessible sidewalk, for example how the onset of high-speed winds pushes the snow from

storage piles on sidewalk banks back into the centre and clogs the freshly plowed sidewalk. These particular conditions lead to rapidly altering sidewalk surfaces and hinder the CoW snow-clearing operations, as well as the mobility of WMD users.

In addition, winter elements were believed to interact with the natural geographical conditions in Winnipeg and create unique difficulties for snow removal. The unique geographical element in Winnipeg includes soil conditions that are highly prone to variation in moisture content. With fluctuations in the moisture content of the underlying soil, the concrete surfaces of sidewalks become uneven, bumpy and irregular. This "frost action" leads to an approximately 9% increase in volume when water freezes to ice at zero degrees centigrade (Lavery et al., 1996). With frost action, the water-saturated pavement (along with the underlying soil) freezes and expands, leading to high-pressure breaks in the sidewalk surface. Lavery et al., (1996) suggested that one solution to the problem could be to leave spaces between the concrete blocks on sidewalks. In addition, recommendations from participants in the current study included filling the expansion spaces in between the pavement blocks with materials like tar (already used on streets) to limit the sidewalk breakdown that occurs through water saturation and the associated freeze-thaw frost action.

While the natural environment factors were identified to independently affect each stakeholder, human factors (human-fabricated and service resource) contributed most to the creation of winter barriers for each group. WMD users identified that for them most winter barriers originated from the human actions or responses to the altering sidewalk surfaces. The snow clearing services provided by city forces and in particular, delayed services on residential sidewalks were identified as primary reason leading to the winter accessibility challenges. On residential sidewalk networks, the low frequency of snow removal allow more snow to rest for

longer periods and to accumulate to form large mounds of snow and ice. These mounds of snow create uneven, narrow travel surfaces that are difficult to navigate using WMD's. Besides difficulties for WMD users, the mounds of snow create challenges for CoW employees as, once frozen; they become too heavy and hard for snow clearing equipment to remove.

The concern with the extent and quality of snow removal services often linked to the priority based service provisions in the current snow removal policy, neglected accessibility concerns for WMD users, and reported service resource limitations by CoW employees. Specifically on residential sidewalks, the assignment of priority level 3 meant frequently neglected or delayed services. CoW employees also agreed that one reason for limited accessibility conditions on residential sidewalks is the delay in snow removal on priority-3 networks as a fresh snow event causes city snow removal resources to return to the p-1 or p-2 networks. With this, the CoW employees focus on quantity coverage (covering the maximum area in a given time) to reach a larger section of a population, resulting in an undermining of the quality of sidewalk surfaces cleared, and compromising sidewalk accessibility for WMD users.

Another sidewalk accessibility challenge that arose independent of winter elements due to human actions is poor accessibility of basic sidewalk structures and absence of sidewalks. Such accessibility barriers independent of winter elements are easily amenable by ensuring construction and maintenance of accessible sidewalks. However, if not properly maintained, concrete surface barriers such as narrow, uneven, broken, or unusually sloped surfaces interact with the winter elements to cause additional issues; for example, uneven or lipped sidewalk might be buried under the snow and out of the sight of a WMD user or a snow clearing machine operator. At times, such buried obstacles (like a lip from a broken sidewalk) might act as a

hidden danger and lead to a risky situation such as obstructing the motion of WMD user or snow removal machine, or causing a tipping accident.

Considering the sidewalks accessibility, the Winter 'n' Wheels study identified the greatest concern as the usability or curbs slopes. Issues relating to basic accessibility, design, angulations, cross slopes, and winter use of curb slopes have been reported in many past research reports (Cooper et al., 2012; Li et al., 2012; Lindsay& Yantzi; 2014; Morales et al., 2014). Even current snow clearing practices were found to block the access of curb slopes, where the sidewalk or street plows often dump snow at the end of sidewalks, making curb slopes inaccessible. While the incline of a curb slope facilitates the WMD users access to sidewalks in summer months, in the wintertime the incline favors snow and water accumulation at the base rendering the curb slope unusable and snow removal process problematic (Morales et al. 2014). In addition, snow accumulations at the base of curb slopes often chip with turning vehicles or passing pedestrians creating challenges of rutted and bumpy surfaces at the inclined ends. Similar to the findings in the current study, the conventional design of a curb ramp has previously been reported as problematic when considering winter outdoor accessibility (Cooper et al., 2012; Li et al., 2012).

Problems with curb slopes were further intensified when the travel routes were found to become challenging due to limited access of curb slopes at the ends of intersections. WMD users were never sure of the accessibility at the other end of the intersection. Differing priority assignment of sidewalks that connect at the intersections also led to inconsistent access at intersections, i.e. one end of the intersection may have superior surface conditions due to being assigned a high priority, while the other end may have very different surface conditions due to assignment of a lower priority and service level. The inconsistent-irregular access created

obstructed travel routes and chain, as for any travel chain to be considered completely accessible, accessibility of all its constituent components is essential (Lavery et al., 1996). WMD users noted that inaccessible curbs and intersections blocked their travel route, and inaccessible bus stops blocked their travel chain, thus limiting their ability to participate independently in their community.

In addition to natural environmental factors, CoW employees also identified how service resources (finance, work force, equipment, and snow storage) intended to equip the CoW staff in managing winter sidewalks were a limiting factor. The financial ability to provide enhanced snow removal was always raised as a concern as management level staff often mentioned the necessity of ensuring the financial efficacy or cost effectiveness of snow removal services. Moreover, adequate availability of finances was identified as the top most concern in adopting new solutions in this study. The city budget for snow-clearing runs in the millions of dollars each year and this expenditure can be associated with the services that the city provides within a vast residential sidewalks network. One potential way of addressing the financial service-resource limitation could be promoting the citizens' engagement in residential sidewalks clearing with support from city forces. By enlisting the assistance of citizens, available money can be used to improve the quality of services provided rather than solely focusing on quantity. On certain occasions, the limited availability of a work force to carry out enhanced snow removal services was perceived as a barrier. However, CoW participants mainly regarded the workforce shortage as situational and not of greatest concern when considering winter sidewalk management.

Thoughtful urban designing or planning is essential in ensuring the growth of any city. Current horizontal expansion of the city is stressing current resources and creating new challenges. Flat expansion adds new areas to the city, spreading the population distribution, and

resulting in low density. In such cases, the physical boundaries that require service become vast, and if the resources are not added proportionately, the quality of services are compromised to address quantity needs. In addition, while the increasing addition of street structures (such as benches, trash bins, and utility boxes) in the public right of way may serve a variety of community functions, in the winter they serve to delay snow clearing by slowing down machines in order to avoid collision.

Limited space allocation for snow storage at a regional level while designing the urban landscape creates winter snow management issues. Specifically, the tunnel effect where excessive snow on the banks of sidewalks falls back onto the cleared sidewalk surface and clogs them was identified as arising from limited consideration to winter snow storage on sidewalks. Limited snow storage also creates a demand for snow hauling operations that further elevates the costs of snow removal. Finite financial and human resources, along with horizontally expanding city, was viewed as compromising the overall quality of snow clearing services.

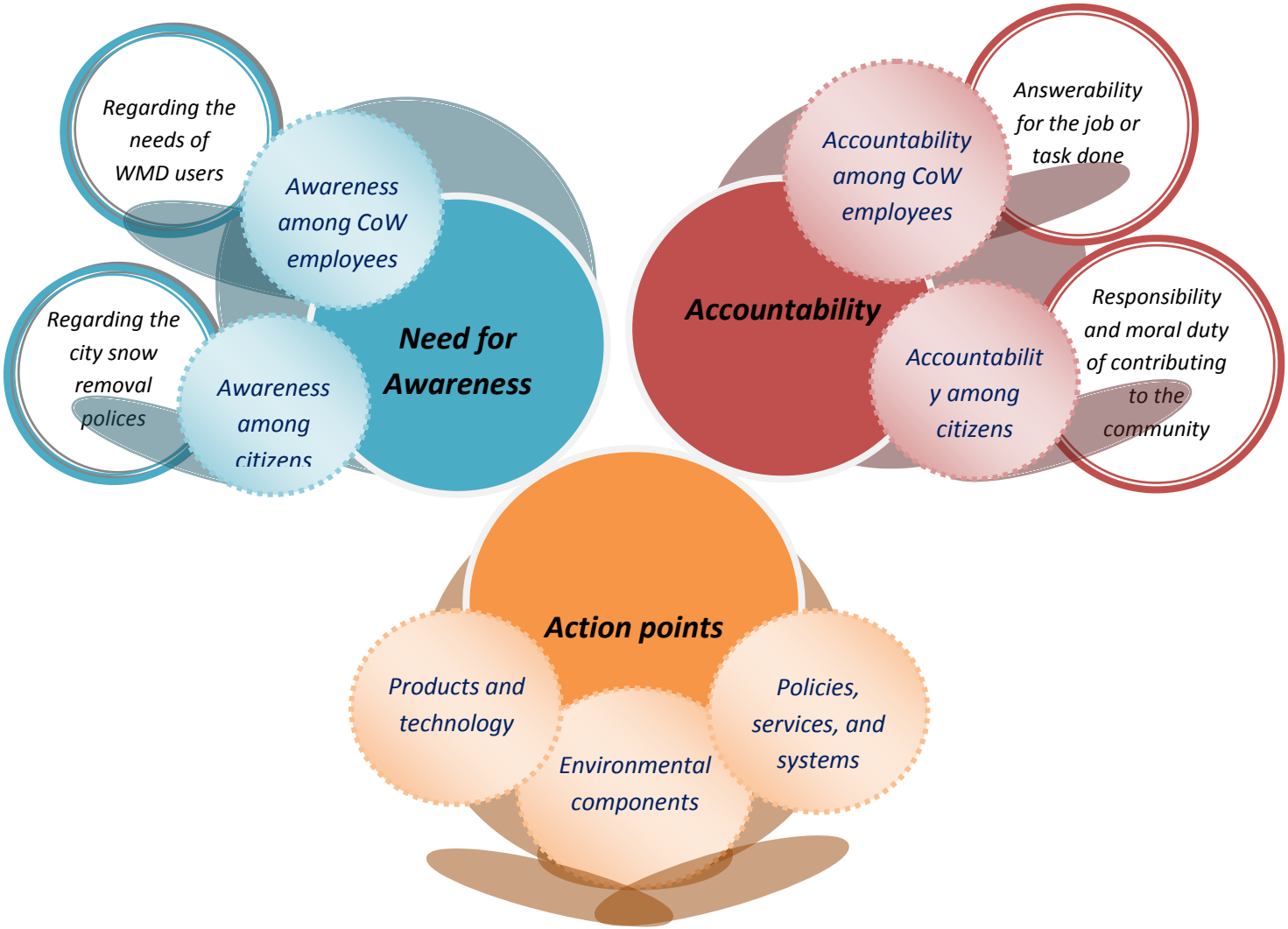
One service resource limitation affecting the CoW snow removal operations pertained to snow clearing equipment. The ratio of equipment needed to complete snow removal in an area to the functional equipment available to do so was always high. Mechanical breakdowns frequently slowed the snow removal operations. Snow removal activity was identified as being hard on the equipment, and with machines running on a constant basis with limited downtime, the rate of a equipment breakdown increased. Furthermore, the mechanical means of snow removal was limited to few types of equipment (front-end plows and blowers) that have inherent limitations. For example, conventional plows with front-end blades are inefficient in clearing contoured curb slopes to bare pavement or to a smooth uniform surface. Challenges with fleet management and appropriate equipment availability often prevented city employees from delivering quality

services. Proactive fleet management and exploration of newer technology may be useful ways to address the equipment related issues.

Framework for Winter Access and Success. The occurrence of winter elements is unavoidable but the opportunity exists to prevent the elements from becoming barriers. The solutions proposed in the study (need for awareness, accountability, action points, increased information sharing, and collaborative efforts) are a combination of immediate actions and future suggestions. Moving through the analysis of identified barriers and suggested facilitators to identify enabling winter solutions, it was realized that though individual solutions can improve winter access, they will be more effective in overcoming winter barriers when practiced collectivity, or as a part of bigger framework. Therefore, the solutions identified for ensuring accessible sidewalks in the winter were brought together to form a framework for winter access and success.

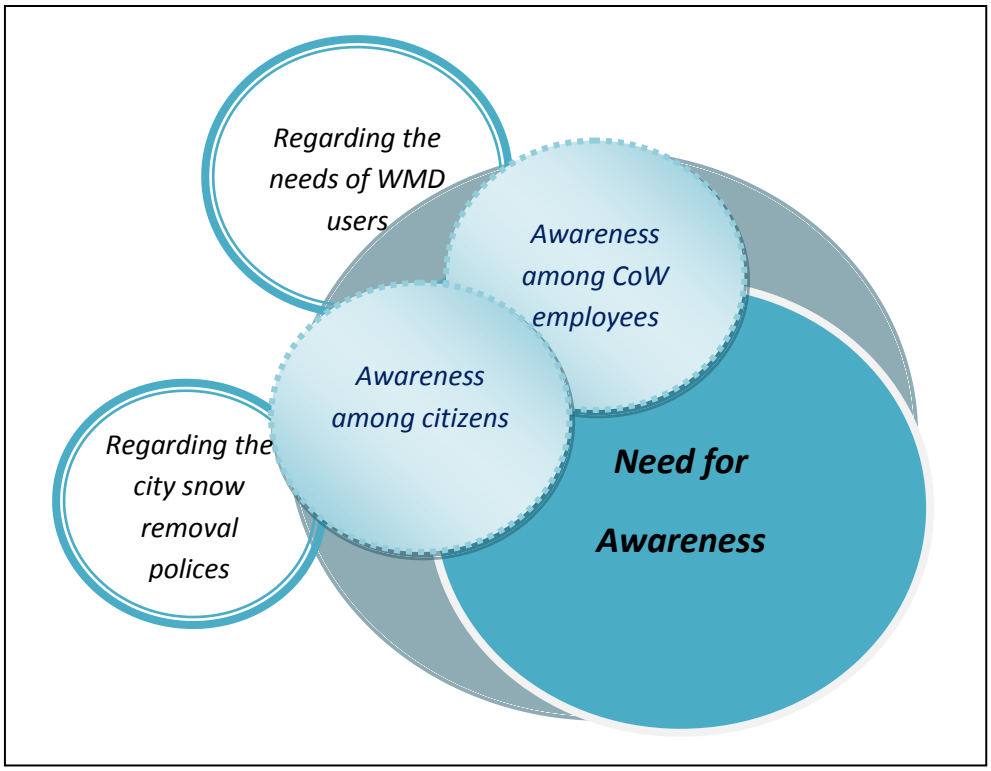
As a framework, the solutions group together to form a supporting structure where the practice of one solution can assist in the enablement of another solution. Furthermore, the framework of solutions will assist individual stakeholders in identifying how their individual actions can contribute to a comprehensive picture of different solutions to enable successful winter use of sidewalks. In short, this framework of solutions will assist stakeholders in understanding the comprehensiveness of solutions as well as provide a foundational structure to enact desired solutions. A pictorial representation of components of Framework of Winter Access and Success is presented in Figure 5.

Figure 5 Solution components of Framework of Winter access and Success



Solution#1: Need for Awareness. The need for increased awareness was identified. Specifically, this solution addresses increased knowledge about the needs of WMD users, as well as public awareness of city policies relating to snow removal. Figure 6 shows a diagrammatic representation of the need for awareness component in the Framework for Winter Access and Success.While the type of required awareness varied from group to group, participants in all groups agreed there is a need for more awareness regarding the accessibility needs of WMD users. CoW employees acknowledged that their limited consideration of the needs of WMD users was due to their lack of awareness or training regarding accessibility. As per current snow removal services and guidelines, the focus of attention is on pedestrian accessibility, without specific mention of WMD users or access for people with disabilities.

Figure 6. Pictorial representation of need for Awareness component of Framework for Winter Access and Success



Educating citizens (including city staff) about the common winter barriers faced by WMD users and their influence on the WMD users' mobility will assist in developing attitudes that are more cognizant, and ultimately courteous, towards WMD users' needs. The benefit of such awareness would be an increased understanding of the concept of accessibility among citizens and city staff and a promotion of access inclusion practices. WMD users believed that if society were to be better educated on the concept of accessibility, it could become the part of everyday consideration and not something extra. Thus, accessibility of sidewalks would be automatically included in the design and service provision, rather than being an after-thought.

Similarly, Bennett et al., (2013) in their Winnipeg based study also reported increased awareness as a strategy for improving community participation of WMD users in wintertime. The provision of accessibility education and training may be a useful strategy in promoting the proactive management of sidewalks accessibility in wintertime for people with disabilities.

Greater public awareness regarding the importance of accessibility can be developed by collaboration among various stakeholders and WMD users, educating schoolchildren, and training professionals such as engineers and designers to specifically identify and promote accessibility features. The CoW street operations employees can increase their awareness of winter accessibility features of sidewalks by engaging in accessibility specific training programs where they are informed about the needs of WMD users and learn to consider the key barriers to sidewalks accessibility.

In addition to increasing awareness of the needs of WMD users, improved public awareness regarding the CoW snow removal policies may be beneficial. CoW representatives suggested that Winnipeg residents need to be made aware of the magnitude of operations, the

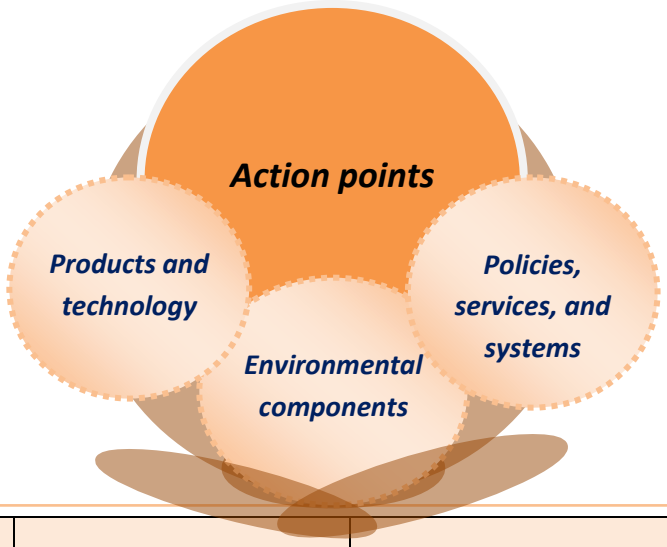
difficulties they face, and to understand that it is not always realistic to provide 100% bare surfaces for technical, resource and weather-related reasons. The CoW employees believed that if citizens were equipped with knowledge of city polices and operations, it would improve their ability to have realistic expectations of snow clearing operations. One feasible way of creating public awareness regarding the CoW snow removal polices would be to expand the current advertisement of citizen-government partnership programs around snow clearing.

Solution#2: Action points. The current study identified specific strategies that could be implemented to improve the winter accessibility of sidewalks. The action points (developed by interpretive analysis of all of the data gathered) were proposed as suggestions and recommendations for various stakeholders to improve the WMD users' winter navigation of sidewalks.

1) Products and technology based action points.

Winter wheeled mobility devices. Overall, power wheelchairs were reported to be more successful in navigating wintertime conditions due to heavy weight, wide tires, large casters, and force from batteries. For those who used manual wheelchairs, the presence of non-slip parts and large casters made WMD use in the winter easier. Although, participants rated power wheelchairs over manual wheelchairs as preferred WMD in winter, power wheelchairs use has been also identified to be challenging in the rainy or snowy sidewalk conditions (Torkia et al., 2014). Exploring the influence of wheelchair technology on participation, wheelchairs are supported as an important mobility device for people with mobility impairments, but also the devices that people with mobility impairments most often associate with barriers (Chaves et al. 2004).

Figure 7. Pictorial representation of Action points component of Framework for Winter Access and Success



Products and technology	Environmental components	Policies, services, and systems	
		Changes in service provisions.	Changes in service delivery
Winter wheeled mobility devices. Alternate measures for snow-removal. Fleet upgradation.	Sidewalks design and surface improvements. Urban planning specific to being a winter city. Building connector and active transportation routes	Changes in snow removal and ice control policy. Citizen engagement in snow removal Access priority designated areas More services for WMD users Fleet management	Proactive snow removal Maintaining smooth, compacted snow surfaces. Targeting bare pavement surfaces in springtime. Avoiding build up of snow piles Identifying more storage sites Ensuring accessible curbs and intersections Promoting efficient practices

Aside from environmental barriers, it is clear that dissatisfaction with one's WMD may also be due to a poor fit between the individual and device, or a lack of appropriate skills training with the device. Our finding that experienced WMD users who are well acquainted with their devices and posses wheelchair skills to successfully navigate sidewalks during non-winter months also face accessibility difficulties during winters with the use of a same device, signals a need for future research into WMD technology that can successfully navigate winter terrains. Another potential area of investigation is to explore whether WMD users can be provided with winter-specific skills training (e.g. skills to ascend icy ramps), in a manner similar to that reported by Lemaire et al., (2010). In the study by Lindsay & Yantzi (2014), the lack of training to use one's WMD on snow and ice was reported as a barrier to community participations; such training provided by healthcare professionals such as occupational therapists might better prepare the WMD users to navigate the adversities of wheeling in a winter environment.

Alternate methods of snow-removal. As with most other northern cities, snow removal in Winnipeg is usually accomplished by mechanical means (snowplows and blowers), assisted by the application of chemical salts or sand. However, mechanical and chemical methods are not always efficient and have been associated with drawbacks. For example, Morales et al., (2014) described disadvantages associated with the mechanical means of snow removal such as damage to the street furniture and high maintenance cost of equipments due to frequent breakdowns.

In the Winter 'n' Wheels study, the need for alternate means of snow removal, especially ones focused on thermal melting of snow and use of newer types of equipment were supported. Beside mechanical methods, another potential way of reducing winter barriers on sidewalks is using de-icing and anti-icing methods (Birch & Kobach, 2008). De-icing refers to the responsive or reactive application of ice-control products to already snow-covered sidewalk surfaces. The

common de-icing materials are salt (NaCl) and sand (Birch & Kobach, 2008). Anti-icing methods refer to proactive methods of snow and ice controls where ice-control products are applied to the sidewalks surfaces before the snow event. Commonly used anti-icing materials that release heat when melting ice are calcium chloride and magnesium chloride (Birch & Kobach, 2008).

However, the de-icing and anti-icing materials have been critiqued as being inefficient or negatively affecting the environment (Demers & Sage, 1990; Mayer et al., 2001; Remakrishna & Viraraghavan, 2005; Ripat, Redmond, & Grabowecky, 2010; Shi et al., 2009). Despite the drawbacks, anti-icing strategies have been purported superior to de-icing as in they reflect pro-active management and are believed to be more efficient in ice control than de-icing methods (Hossain, Fu, & Olesen, 2014). While these benefits may be true, environmental concerns and efficacy of anti-icing materials at extreme temperatures is still a concern in their adoption (Shi et al., 2009). The determination of efficacy of de-icing and anti-icing methods is an altogether different area of research that is beyond the scope of this thesis, but that is recommended for consideration by other winter accessibility researchers. Nevertheless, based on our current knowledge from the field visits in go-along sessions, we argue in favor of exploring the use of anti-icing methods (reflecting proactive snow management), especially during the onset of winter when it can slow down the build up of snow on sidewalks.

Recently, Morales et al., (2014) examined possible and feasible design solutions for improving the accessibility of sidewalks during winter conditions in Quebec. These researchers also suggested the need for alternate measures of snow melting, and specifically suggested using hydronic and electrical asphalt-heating systems to melt snow on sidewalks. In hydronic systems, heated liquid with antifreeze properties is pumped through a network of circulatory pipes present

underneath the concrete surface of sidewalks to melt or loosen the hard snow. In electrical systems, a pipe network is buried under the concrete surface of the sidewalk but instead of using a heated liquid, the heat is generated from the flow of electric current through the cables present in the piping system. The electric systems are believed to be more effective as the resistance of electric cables can control the amount of heat generated (Morales et al., 2014).

The adoption of hydronic or electrical systems may be associated with some practical concerns such as the need for freeze protection of underground pipes, energy efficient design of circulatory network, and cost efficiency. It would be advisable to garner the knowledge of related experts (such as street design engineers) and conduct pilot research in a limited area before applying such systems to the citywide sidewalks network. Morales et al. (2014) argued that despite the limited geographical application of hydronic and electrical heating systems to frequent snow receiving cities, such systems could be used effectively in snow melting. Other literature supports that these systems have been successfully adopted in other countries such as Argentina, Finland, the United States, Japan, and Iceland (Iwamoto et al., 1998; Rees, Spitler, & Xiao, 2002).

Fleet upgradation. The study findings point to an opportunity to explore the availability of new types of equipments that are more efficient and resistant to winter conditions. One newer type of equipment suggested by study participants was the use of machines that have brush-like scrapers attached to them. This kind of equipment can be useful in the onset of winter, where it can brush or scrape the fresh, loose packed snow from the surface. In the offset of winter, such equipment might be useful in removing the loose snow chunks that were left after a partial melting from the sun.

City officials might also explore the combined use of different types of equipment (assembly of equipment) to achieve better snow clearing rather than pushing one machine to extreme use. One study participant provided an example of how a snow blower or plow might be combined with brushing equipment to reach closer to the bare surface. Collaborating with researchers in the Faculty of Engineering at the University of Manitoba to examine new design of snow-clearing equipment might be one way of pursuing this avenue. In sum, the findings under this domain indicated that stakeholders recommend exploring alternate methods of snow removal by looking into the potential scope of using hydronic or electrical systems of snow melting and exploring the use or development of new types of equipment.

2) Environmental components.

While the natural components of winter environment are unalterable, changes in the built environment can help improve the ground conditions on sidewalks. Improvements in sidewalk design and installation of surfaces that are more resistant to the winter elements and accessible to WMD users are essential. The concrete surfaces of sidewalks should be made smooth, wider and appropriately sloped. In particular, attention is needed to the design of curb slopes and their maintenance in winter. Curb slopes that allow WMD users access to sidewalks should be maintained to bare pavement level during wintertime, or they are rendered unusable.

Morales et al., (2014) suggested a winter design for curbs based on a series of consultation exercises with various stakeholders such as city officials, urban planners, designers, people with disabilities, and occupational therapists. The exploration of the following curb design suggested by Morales et al., (2014) for implementation in the city of Winnipeg could be a useful solution:

> The implementation of a 30 cm-deep reservoir or through the width of the curb cuts' incline is proposed. This reservoir would be covered with a metallic grating for the snow to fall through. The proposed configuration for the metallic grating is a trellised section with 1.5 cm by 1.5 cm holes and 20 cm solid strip in the center of the grating, allowing women wearing high heels to circulate safely. At the bottom, there would be an electric source of heat for snow melting purposes. The resulting water from the snow melting process would be disposed of in the storm sewers. (p. 45)

In the future, city planners and designers should continue to explore vertical expansion of the city. By moving to vertical expansion, city forces will be able to provide enhanced services to more people living in a particular area. Urban planners should plan Winnipeg's growth as a winter city. Bergum & Beaubien (2009) described specific consideration for a winter city design focused on the city of St. Albert, Alberta and advised winter city planners consider sunlight exposure, safety, wind, and darkness in the built environment. The authors purported that smart growth of a winter city would consider the year-round use of public spaces, facilitate alternate modes of transportation (walking, cycling), maximize sun exposure, and minimize wind on streets to facilitate snow removal. Although the winter conditions in St. Albert are not as severe as in Winnipeg, the components of planning a winter city as discussed by Bergum & Beaubien (2009) are worth exploring with the perspective of adopting them in the City of Winnipeg.

In addition to the above considerations, the arrangement and installation of street infrastructure should take into account winter snow-removal operations. For example, street infrastructure organization could include the installation of benches that are movable (so that

they can be moved away from the path of snow removal machines) and slim (so that they take less space on sidewalks).

Another prominent concept identified in the Winter 'n' Wheels study was the importance of enabled travel chains and routes for WMD users. The concept of enabled travel chains has been discussed in the past (Lavery et al., 1996) with a focus on other population groups such as older adults. Lavery and colleagues (1996) argued that travel can be carried out if all components of a travel chain (the person, vehicle, and built environment) are accessible and synchronized. Carlsson (2004) argued that travel chains and inherent traveling is an occupation in and of itself as the reason for most travel is to participate in an occupation at the destination. Thereby, with inherent intrinsic value, travel from one community point to another (specific destination) becomes an occupation, and the corresponding travel chain (including linkages from origin to destination) becomes part of an occupation.

One example of a travel chain might be the travel from home to a local grocery store for routine grocery shopping. Such a travel chain might involve a person with his or her bodily abilities, with or without an assistance of a assistive device, moving out of the home, onto a sidewalk, to the nearest bus stop, waiting at a bus shelter, boarding the bus, arriving at a target bus stop, getting of the bus, and using sidewalks to get to the end destination of a grocery store. This example of a travel chain depicts the different components involved in a travel chain: the person, an environment (with sidewalk and transportation medium), and the end destination of a grocery store to engage in the occupation of grocery shopping. In this travel chain, a snow covered inaccessible sidewalk or unclear bus shelter might present a travel barrier and prevent the occupation from successfully happening.

In accordance, participants in the current study identified the difficulties they encounter in their travel chain. However, they also identified the potential of connecting routes and active transportation pathways as a means to enable their outdoor mobility. Travel chains that connect key community destinations through a network of accessible travel routes (including accessible sidewalks, active mobility routes, active transportation pathways) and components (such as accessible bus shelters, busses, taxi stands, parking lots) can be useful in enabling the active mobility of all citizens, including WMD users. The accessible routes and components identified above, if synchronized well in a larger network of connecting routes, can assist in the community participation of WMD users.

Enabling travel chain and routes can be practiced through overlapped interventions in developing accessible environments such as by identifying key connecting routes with linkages and prioritizing them for enhanced snow removal. One component of an enabled travel chain already in consideration by city officials is the development of active transportation pathways that provides dedicated path to individuals who use active modes of transportation such as bicycles. The suggestion to promote the shared use of such active transportation paths to enable the winter mobility of WMD users is valuable, as these routes are cleared to the bare surfaces in winter. Furthermore, to promote the success of connector routes, re-prioritization of sidewalks based on their proximity to community destinations, other connecting routes, and travel points such as bus stops will be needed. In high volume pedestrian areas, the connector routes might include skywalk networks linking key community buildings, while in low volume pedestrian areas such as residential streets the connecting sidewalk networks can form linkages between residential and main streets or local community points.

3) Changes in policies, services, and systems.

The action points pertaining to policies, services, and systems involve long-term changes such as upgrading snow removal and ice control policy, promoting citizen engagement in snow removal, and adding access priority designated areas. The main areas of suggested policy upgrade in current snow removal policy involve making service provisions more adaptive to dynamic winter seasons and improving services levels on priority -3 networks. These changes are long term and would require due consideration and consultation before implementation. However, to begin with, developing a snow removal service model that is guided by weather forecast might prove to be useful. In such a model, snow removal operation would begin proactively with the prediction of a snow event, and include application of anti-icing materials on pavement or speeded snow removal on at-risk (prone to quick clogging) sidewalks with the warning of a snow event.

Furthermore, the snow-clearing policy can be adjusted to provide services as per the three sub-seasons of winter identified in the study. During the onset of winter season, sidewalk surfaces are relatively clear with the presence of soft and loose packed snow and snow removal operations at this stage can more often target sidewalk clearing to the bare pavement thereby preventing the buildup of snow as winter progresses to the peak of the season. In the peak of winter, with frequent snowfall, the snow deposits become heavier, dense, and presence of hard packed ice becomes common. At this stage of a winter season, the snow removal activity can be organized to clear sidewalk surfaces close to bare pavement, but with the focus on creating smooth, compacted snow surfaces. During the winter offset, temperatures that are warmer and lead to snow melting have the potential of assisting snow removal operations by melting and loosening the hard packed surfaces. Therefore, at this point in a winter, snow removal policy might focus on clearing sidewalks closer to a bare pavement (only leaving behind a thin layer of

snow) so that with natural melting, the sidewalk surfaces become clear to the bare pavement. The changes in snow removal policy can make the snow removal activity more closely aligned to the winter sub-seasons that exist in the city and ultimately help provide more efficient and quality services.

In addition, current city policy provides some service to people with disabilities who are not able to independently remove snow from the front of their building. However, the specific criteria to qualify for the service itself may serve as a barrier. With this consideration, exploring how to improve access to such services for people with disabilities to promote outdoor participation in winter is warranted.

The provision of improving services levels on priority-3 networks can be guided through more resource allocation on residential sidewalks; this can occur either by city policy or by engaging citizens in the residential sidewalk snow removal. The concept of citizens' engagement in residential sidewalks clearing in not new, and is already in practice in other Canadian cities such as Toronto, Calgary, and Edmonton (personal communication, Jim Berezowsky, Manager, Streets Maintenance, Public Works Department, City of Winnipeg). While concerns may be raised about the level of consistency of sidewalk surface conditions cleaned by residents, these concerns might be managed through the supportive and supervisory function of city staff. The CoW employees can team up with citizens to determine snow removal standards on residents maintained sidewalks and support citizens by cleaning residential sidewalks at predefined intervals. Citizen engagement in snow removal on residential sidewalks is a sensitive topic, as it needs consideration over the nature of engagement, whether to be driven by law or through voluntary community efforts.

Another key area proposed in the domain of changes in policies, services, and systems was the identification of access priority designated areas. WMD user participants themselves supported the idea of access priority designated areas, which would include areas frequently used by people with disabilities. Examples of such areas could be schools, independent living centres, seniors' residences, personal care homes, hospitals, offices of disability organizations, local shopping centres, and community meeting points. Considering the value of such community destinations or points, it is worth considering re-assigning them to a higher priority service level to promote access. One recent example of access-designated areas includes the priority listing of schools and senior complexes on residential streets to receive enhanced services. However, the implementation of such solution will need cautious approach, as there is a considerable potential for such areas to increase in numbers, leading to an additional burden on already stressed city snow-removal resources.

In addition, better fleet management was viewed as one area where immediate and proactive solutions were possible that can also help in overcoming the constant stress on snow removal services. The following are suggested as ways to keep more equipment operational on a consistent basis:

- City officials could determine the length of time each piece of equipment could be safely used per day without causing breakdown from overloading.
- Maintain adequate stocks of frequently damaged parts to increase the rate of repairs.
- Engage in routine inspection of equipment to identify any early damage to the machine or need for parts replacement.

- Use bigger machines on sidewalks to lift heavy ice rocks and pieces that are difficult to move using current smaller machines.

In summary, suggestions for changes in the methods, approach and delivery of snow-clearing services in the current system were identified. To start with, it would be helpful to take a more proactive approach involving early and more frequent snow removal that aims to prevent the buildup of snow piles on sidewalks. Ideally, snow clearing should target to reach to the bare pavement, but minimally should maintain surfaces to a smooth and compacted level. Additionally, city frontline workers should attempt to clear sidewalks to the best of their ability in first attempt, while the management level staff should focus on ensuring synchronization between street and sidewalk plowing operations, thereby preventing some winter issues that originate from snow removal operations.

In order to manage sidewalk snow piles, exploration of buffer snow storage sites in the communities, such as on, least used lands in community parks or community centres, might help in overcoming the snow storage issues during wintertime. Identifying local snow storage sites will also assist in controlling the additional expenses associated with transporting the hauled snow to distant storage sites.

At last, considering the functional importance of curb slopes in enabling the use of sidewalks, snow removal to the bare pavement at curb slopes should be the target. Making extra efforts to ensure uniform surface conditions on all ends of the intersections so that the traveler from one end can complete the crossing by safely getting onto the sidewalk at the other end is recommended. These suggestions will help streamline the current snow removal operations and have some immediate positive effect in improving the winter accessibility of sidewalks.

Solution#3: Accountability. The accountability solution proposed in the study related to two aspects, (1) responsibility for doing something voluntarily, and (ii) answerability for a specific job or a task. Concerning voluntary responsibility, WMD users suggested it would be valuable to see city residents take responsibility for sidewalk snow removal in front of their homes and buildings. They viewed this accountability not as a legal obligation for snow removal, but rather as a moral duty to contributing to the community.

Figure 8. Pictorial representation of Accountability component of Framework for Winter Access and Success.

WMD users as citizens supported that CoW employees or contractors responsible for snow removal in an area should be made answerable for the work they do. Participants added that based on the accountability, the responsible individual shall be asked to correct the job on their own time. In agreement, CoW employees also supported having greater accountability

among city staff, as well as with private contractors, and perceived that greater accountability would lead to improved uniformity of services provided by the city. Such accountability may also help in overcoming the barriers that arise out of the service disparities among city workers and private contractors or street plows and sidewalk plows. Study participants suggested that by adding additional measures of accountability, the occurrence of mistakes will be minimized and more proactive identification-fixation of barriers can occur.

To define the accountability of each stakeholder, first individual stakeholders need to be educated of their legal and moral responsibilities towards sidewalk accessibility. CoW employees already have a degree of answerability inherent in their job roles and responsibilities. However, specific education regarding accessibility provisions under city by-laws will assist city workers and contractors in being judicious and observant of their responsibility towards WMD users. City residents also need to be apprised of their potential role in improving winter accessibility of sidewalks. For example, city residents should commit to sharing legitimate complaints based on city policies and identify their potential role in taking responsibility for residential sidewalks snow clearing. The awareness for elucidating the accountability of each stakeholder can be achieved by organizing public awareness campaigns, specific accessibility workshops for city workers, and community engagement programs by government authorities and disability support organizations.

Instruments of change. The two identified instruments of change, (i) Information sharing: Increasing connections and bridging gaps and (ii) Collaborative efforts: Bringing all stakeholders together, can themselves act as independent solutions as illustrated in the Results section. However, the instruments may also be useful in steering changes through other

solutions. Figure 5 depicts the individual components while Figure 9 depicts the individual components coming together in a Framework for Winter Access and Success.

The stakeholder groups represented in the current study frequently emphasized that winter elements influence everyone in one or another way, and that the most useful solutions will be the ones that enable everyone's use of sidewalks. Participants identified that a clear accessible sidewalks not only benefits the WMD users, but also equally benefits a wide range of individuals such as parents with strollers, seniors with walkers, packers and movers, as well as regular pedestrians. Considering this wide range of individual sidewalk users, solutions need to be developed in collaboration, by bringing all stakeholders or their representatives (such as council members) together. Table 8 summarizes a list of stakeholders with their potential role in enablement of identified solutions and winter outdoor mobility.

For example in the solution of need for more awareness timely dissemination of information from CoW employees to city residents, or from WMD users to CoW employees, will be needed and can be facilitated through channels of information sharing. Similarly, the discussed action points where upgrading city policy on snow clearing is recommended, changes can only be developed and implemented with the collective efforts and agreement of all stakeholders.

In another example, the action point of involving citizens in snow removal on residential streets will require the determination of citizens' responsibility (accountability) to do so, and for that, citizens will need education (awareness) regarding their potential contribution in snow removal along with an understanding of the ultimate benefit of engaging in this practice. Ultimately, efficient citizen engagement in snow removal will require support by city resources.

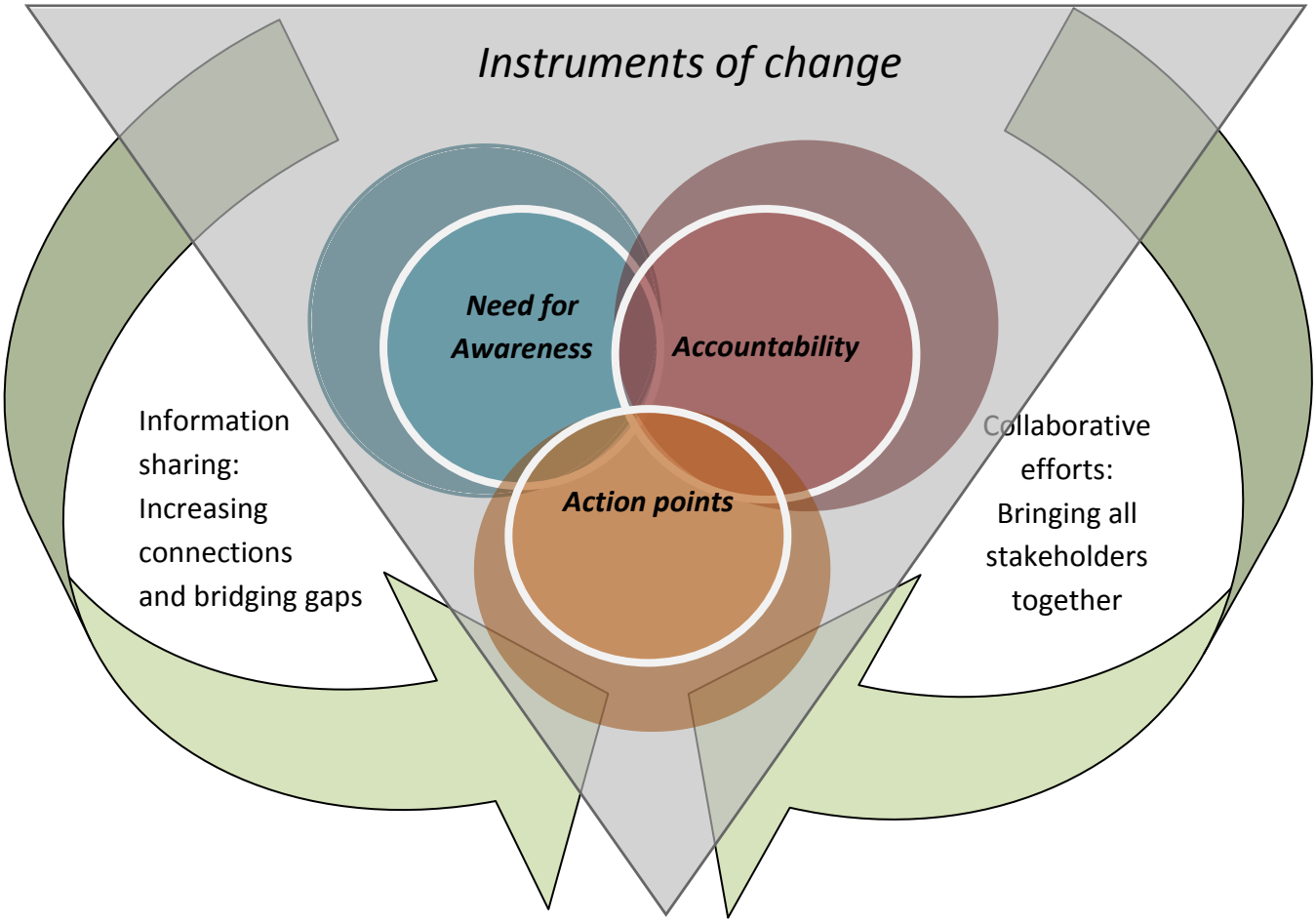
Such connection between different solutions and stakeholders may be bridged through information sharing among different stakeholders working collectively.

Table 8. *List of identified stakeholders with their potential role in enablement of identified solutions and winter outdoor mobility.*

Identified stakeholders	Potential role in enabling winter accessibility of sidewalks
Public Works Department, City of Winnipeg	Efficient snow removal operations, information sharing within the organization and with citizens, guiding the implementation of proposed solutions and supervisory role in ensuring the accessibility of sidewalks.
City Council, City of Winnipeg	Making policy changes considering the needs of WMD users, making changes in policies to re-prioritize snow removal and introduce more connector and active transportation routes, arranging finances, and defining accountability.
Health authorities and professionals	Information sharing on winter accessibility, educating individuals and creating awareness on winter accessibility and community participation, collaborating with city departments for effective public awareness campaign, providing consultations for policy changes based on accessibility needs of WMD users, WMD modifications and winter skills training

	for WMD users.
Urban planners and designers	Considering Winnipeg as a winter city and designing city elements for winter environment and use by everyone.
Universal design coordinator, City of Winnipeg	Consulting on design and implementation of proposed solutions, design process and new constructions, guiding, and information/resource sharing.
Access advisory committee, City of Winnipeg	Creating awareness and advocating for the needs of people with disabilities, consulting and advising councilors and government departments on the access needs of people with disabilities, guiding the implementation of accessibility standards, and providing information and resources for winter accessibility solutions.
Members of public who use WMD	Consulting in the development of new policies, information resource on accessibility needs and current barriers.
Citizens	Consulting in the development of new policies, information resource on local geographical conditions and, responsibility for adapting proposed winter solutions, advocating for the needs of fellow citizens who use WMD's and engaging in the community-driven collaborative snow-clearing efforts.

Figure 9. Framework for Winter Access and Success- pictorial representation.



Overall, participants representing different stakeholder groups emphasized the universality of winter experiences as "something we all experience", indicating that winter elements affect everyone and have varied influence on the functioning of every citizen. WMD users reported that other people with disabilities or impairments also face access difficulties in wintertime. The commonality of winter conditions or experiences compliments the findings reported by other winter studies with different study population such as older adults (Juvani et al., 2005; Li, Hsu, & Fernie., 2013), pedestrians, and people with SCI (Batavia et al., 2001;

Boschen et al., 2003; Noreau et al., 2002; Reid et al., 2003; Shirado et al., 1995). The existence of experiencing commonalities in winter barriers underpins the idea that winter accessibility solutions can be beneficial to the population at large, rather than to one particular stakeholder group.

Thus, to achieve winter access and success, solutions need to be balanced (matching the needs of each group), realistic (possible in dynamic winter environments), proactive (ahead of, and predictive of, winter challenges), universal (enabling for everyone) and tested (to be safe and practical). While all the identified solutions may independently improve winter access, when enacted collectively, they will be complementary and additive. It is important to note that the solutions presented as a part of the framework are suggested, as such, they have not yet been tested for individual success. However, it is hoped by the principal investigator that by consideration of collective implementation and stakeholder collaboration, the solutions will be useful in improving winter accessibility of sidewalks for WMD users. As reflected in the comment from one CoW group participant referring to what he believed would assist in improving winter accessibility of sidewalks:

"Everything will help us and everything we can offer will help them also"

5.2 Trustworthiness

Attention to rigour in qualitative studies is essential for their findings to be considered worthy. The most comprehensive concept in considering the rigour for qualitative studies is trustworthiness (Letts et al., 2007).This study attempted to establish its trustworthiness by following the guidelines for critical review discussed by Letts et al., (2007). The four essential components of trustworthiness and how they were addressed in the current study are outlined below:

- *Credibility*: Credibility is related to presenting the true picture of the phenomenon under study. In this study, the credibility was ensured by the use of following procedures:

    1. The data in this study was collected through the months of February to April. Months were selected to represent part of a typical winter in Winnipeg. During this period, the daily average temperatures range between -18 degree to +4 degree centigrade with snow-depth ranging from 20 cm to 0 cm (Environment Canada, 2000), providing the breadth of winter elements needed to capture sufficient quality data. This data collection period, encompassing the major wintertime, ensured that the collected data captured the essential variations that incur due to winter conditions such as those identified in three winter sub-seasons.

    2. Participants in the study were recruited from two stakeholder groups and within each group, variation was sought on the type of wheeled mobility device used or job roles and responsibilities.

3. Multiple data collection methods were used, to try to ensure a complete picture of the phenomenon of winter sidewalk accessibility was garnered. Data collection utilized the technique of conducting go-along interviews, a method that incorporated real-time interviews and participant observation components. In addition, photographs of environmental features and meteorological data also assisted in interpretive analysis and data triangulation.

4. The study integrated the benefits of data triangulation, by collecting the data from three relatively distinct sources (WMD users group, CoW-sub-group 1, CoW-sub-group 2) and incorporated the unique advantage of first understanding the central phenomenon from the perspectives of different stakeholders followed by a process of bringing them together.

- *Transferability*: This component relates to whether the findings from study can be transferred to other situations. The above-mentioned features of the study (especially those related to participants and study setting) assist in transference of the study findings to other similar situations or areas. Even though the total participants in the go-along interview sessions were limited (eight participants), the amount and depth of the data collected ensured the quality of study findings that can be applied to other areas with similar winter conditions. Furthermore, the incorporation of a service-provider group (Public Works Department, City of Winnipeg) assisted in ensuring widened application of the study findings. However, as discussed in the study findings, it would be essential to test the proposed solutions before directly implementing them to ensure they are context and purpose sensitive.

- *Dependability*: This component relates to the consistency between study data and the findings. Using an interpretive description approach allowed the investigator to establish a credible study plan and be involved throughout the process of inductive analysis. The data analysis in the study followed an iterative process that involved multiple readings and analysis sessions to draw the findings from raw data. In addition, the use of direct participant quotes in presenting the results also adds to the study dependability, allowing the reader to examine the consistency between raw data coding and development of categories or themes from it.

The documentation was maintained in a systematic manner to create an audit trail. The concepts for the study were generated from a thorough review of the literature and followed the ICF framework (described in the literature review and theoretical framework section of this thesis). Each interview session was discussed with the research supervisor and field notes were taken to record personal observations during the sessions. Interview sessions were guided by the use of interview guides (Appendix J, Appendix K and Appendix L) and the data gathered was transcribed into a word processing document. At each step of the data analysis, starting with the individual interview and proceeding to analysis within the group and finally across the groups, developing codes, categories and themes were shared with the study supervisor for review. In developing the final themes, preliminary codes along with the quotes were transferred to a new word processing document that contained the identification labels of the original source of the quotes and was shared with the study supervisor. Throughout, the analysis process print outs were made and re-read by the principal investigator. The raw data collected in the study will be maintained in records for 2 year after

the study completion. Furthermore, the critical decisions during the study were continuously discussed with the study supervisor (Dr. Jacquie Ripat).

- *Confirmability*: This component relates to the strategies that were employed to limit the bias in the research. Interpretive description approach, unlike other qualitative approaches, does not essentially require the investigator to bracket his or her perceptions. Rather this approach presumed that some theoretical knowledge, observation or scientific basis always exists behind health sciences studies.

Accordingly, interpretive data analysis in the study occurred through the interactive engagement between raw data and prior theory, but was not solely guided by existing theories. In addition, multiple modes of data collection and consultation exercises with study supervisor (Dr. Jacquie Ripat) assisted in limiting any potential bias. During the completion of each interview session, the principal investigator confirmed the raw findings or discussions that were part of the interview or otherwise highlighted with the participant and obtained their views and confirmation.

5.3 Limitations of the study

Several limitations of this study need to be identified. The total number of study participants was small; 11 participants with a maximum of four participants from each subgroup were recruited. In the WMD user group, participants equally represented manual (n=2) and power (n=2) wheelchair users; however, absence of any mobility scooter user participant limited the understanding of specific difficulties associated with the scooter use in winter.

As with all human studies, individuals self-selected involvement as a participant in the study. Therefore, the study did not incorporate the views of individuals who do not go out at all in winter due to poor sidewalk conditions or for other reasons; such individuals may identify winter barriers differently. In the City of Winnipeg group, participants represented the desired study population characteristics as per the inclusion criteria. However, interviews were not held with other city employees associated with snow removal operations, such as with mechanics that take care of snow clearing equipment, urban designers, or engineers who design and construct the city sidewalks. Thus, their perspectives were not captured in the data, and could not be included in the proposed solutions. In addition, most of the study participants (9 out of 11) were male. However, the representation of male and female population was equal in the WMD user group where it is expected to matter most, as certain discrepancies in the WMD use experiences could be associated with the gender of a user. For example, women using wheelchairs frequently face issue related to freedom, availability of economic resources, and limited community access (Reid et al., 2003) that could have influenced the noted WMD use experiences in winter, if either gender was under or over represented in the sample size.

The specific data collection period employed in this study did not include the onset of winter period, when fresh winter conditions set in. There may be unique environmental aspects worth exploring during this period. In addition, the winter season that spanned the data collection period in the current study was identified as one of the most severe in decades; therefore, some of the challenges identified may not be representative of typical snow clearing practices, such as the reported lag in providing residential sidewalk snow clearing. However, the extreme winter may have served to magnify the issues, enabling the researcher to identify the winter phenomenon and their influence to a greater extent and with more clarity. The solutions that

were based on the study conducted through an extreme winter potentially hold the benefit of being more successful in an average winter season, when resources are less stretched.

This study was conducted within the perimeter of Winnipeg where the services are solely provided by the City of Winnipeg. The main idea was to gain a focused and contextualized understanding of the winter phenomenon by keeping key stakeholders in the centre of an activity. Specifically, this study was conducted in an urban city, which enjoys the advantage of more resources while simultaneously bearing the burden of serving expanded service area compared to a smaller town or rural community. Therefore, some variation in identified barriers or the magnitude of impact is expected when compared to another major city or rural community.

Strength of this study was the opportunity to collect in-depth, real-time data that provided more context sensitive information then other published studies. Overall, this study was exploratory and descriptive, attempting to look into a topic that has been explored in breadth, but not in depth, in the past. Consequently, transferability of the results may be limited. A longer study period, with more participants and sites could have increased the depth of data collected and thereby influenced the results by providing more elaborate information.

5.4 Future Areas of Research

Based on this study, several key directions for winter accessibility researchers are suggested. First, the proposed solutions are grounded in the data collected but require further development and exploration to examine feasibility. Many solutions or recommendations provide individual stakeholders with some direction, but the mechanism for implementing solutions require specific exploration prior to operationalizing them. For example, while it was

recommended that occupational therapists and other rehabilitation professionals develop winter specific mobility devices and skills training program to enable the winter mobility of WMD users, the feasibility and implementation of such a suggestion could be an area of future investigation.

In addition, additional research based on identified limitations of this study will provide useful understanding of the presented themes. In particular, the principal investigator of the Winter 'n' Wheels study would recommend interested winter accessibility researchers to address the same study objectives in rural communities. Furthermore, other research could explore the development and utility of a checklist/guide/reference list on sidewalks snow removal systems to assist with information sharing and quick auditing of cleared sidewalks. Another area to explore would be to move away from the environmental contexts to more individual and mobility device based research. Researchers could explore the avenues for development of new mobility devices or modifications that are winter specific and more useful in enabling winter accessibility for WMD users.

Thus, while useful as directions for future research, each of the suggested solutions requires detailed elaboration and examination to develop them into purpose-and context specific interventions.

6.0 Conclusion

The overall purpose of this study was to understand the specific issues faced by key stakeholders with respect to sidewalk accessibility in winter, and subsequently, to identify solutions or recommendations that could improve the winter accessibility of sidewalks for WMD users. Eleven representatives from two key stakeholders groups, WMD users (sidewalk users) and Public Works Department employees, City of Winnipeg (responsible for providing snow-clearing services in the city during winter months), were engaged in this study. This study met its four key objectives in the following ways:

Objective 1. To identify the specific barriers and facilitators related to sidewalks accessibility in winter for wheeled mobility device users.

The Winter 'n' Wheels study showed that the winter environment brings about a unique set of challenges for WMD users, and that winter barriers for WMD user surfaced either from natural components of winter season, by human actions and responses, or by combination of both.

Objective 2. To identify the obstacles and facilitators faced by city officials in providing accessible sidewalks during winter.

The Winter 'n' Wheels study provided insight into the specific issues faced by CoW employees in maintaining accessible sidewalks during winter season. These challenges in sidewalk clearing either surfaced from natural components of winter season or due to the limitations imposed by service resources.

Objective 3. To gain sidewalk maintenance officials perspectives on winter accessibility of sidewalks for WMD users.

The Winter 'n' Wheels study provided insight into the perspective of each stakeholder group regarding the dynamic winter season and associated accessibility challenges. An understanding of the snow removal mechanisms adopted by city forces, and the associated perceptions held by city employees regarding the level of services provided, was gained. The commonality of winter experiences in terms of experiences emerged as a central finding.

Objective 4. To inform the development of a winter accessibility of sidewalks audit tool.

The information-sharing component of the framework for winter access and success addressed the fourth objective of the study and discussed the potential need, scope and nature of a winter accessibility tool.

In the context of professional practice, this study will be useful in assisting occupational therapists interested in enabling winter community participation of WMD users. This study also assists in creating awareness among key stakeholder groups regarding the issues encountered by WMD users while accessing the sidewalks in winter. As stakeholder groups' representatives participating in the study were frequently provided with the relevant background information on winter accessibility of sidewalks to discuss the winter phenomenon in detail. In the future, the principal investigator intends to share the study findings with the CoW stakeholders though appropriate knowledge translation mechanisms. Additionally, the outcomes of this study provide useful information for policy makers and city agencies to guide the development of future policies and practices. Finally, the outcomes of study add to the existing body of knowledge on

winter accessibility, provide foundation for further research, and highlights specific areas where further research is warranted.

The study outcomes supported WMD users need for winter community participation. The findings ascertained that during winter months accessible sidewalks could turn inaccessible, limiting outdoor mobility. As an integral part of a travel chain inaccessible sidewalks ultimately preclude community participation. Although the changes in sidewalks surface conditions were triggered by natural factors (such as snowfall), the human fabricated factors (snow clearing) in particular limited the winter use of sidewalks. Thus, as with any other human practices, the winter barriers to the WMD users' use of sidewalk are resolvable.

Finally, based on the interpretative analysis of barriers and facilities faced by both stakeholders groups, a framework for winter access and success of sidewalks accessibility was developed in the study that can successfully contribute to the enablement of winter use of sidewalks by WMD users and thus, winter community participation.

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Appendices

- Appendix A: Study Advertisement (Posters and Handouts)
- Appendix B: List of Organizations
- Appendix C: Invitation Letter for WMD organizations
- Appendix D: Screening Questionnaire/ Inclusion Criteria
- Appendix E: Collaborating Public Works Department Officials
- Appendix F: Letter of Support from Public Works Department, City of Winnipeg
- Appendix G: Invitation Letter for Public Works Department, City of Winnipeg
- Appendix H: Entry Point Questionnaires
- Appendix I: Participant Cover Sheet
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- Appendix L: Interview Guide-WMD User Group
- Appendix M: Study Timelines
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Appendix A

INVITATION TO PARTICIPATE
in the
Winter 'n' Wheels Study
Study Poster a

1. **Have you been using a wheelchair or scooter for more than 12 months?**
2. **Do you use a wheelchair or scooter for outdoor purposes in winter?**
3. **Are you 18 years of age or above and live in Winnipeg?**

If you answered 'YES' to these questions, you may be eligible to participate in the Winter 'n' Wheels Study.

The purpose of this study is to understand the experiences of wheelchair or scooter users regarding sidewalk accessibility in winter. The information you provide in the study will be used to better understand the winter accessibility of sidewalks in Winnipeg and develop realistic suggestions that can improve winter accessibility.

- There is no financial cost to you for participation.
- Participation includes one indoor and two outdoor interview sessions.
- If eligible for the study, you will receive an honorarium for your participation time.

This study is being conducted by a University of Manitoba graduate student. If interested, please contact Deepak Joshi at joshid@myumanitoba.ca or [redacted] for more information.

Appendix A [Contd.]
Study Poster b

If yes, we would like to hear from you in the

Winter 'n' Wheels Study

The purpose of this study is to understand the experiences of wheelchair or scooter users regarding sidewalk accessibility in winter. The information you provide in the study will be used to better understand the winter accessibility of sidewalks in Winnipeg and to develop realistic suggestions that can improve winter accessibility.

- There is no financial cost to you for participation.
- Participation includes one indoor and two outdoor interview sessions.
- If eligible for the study, you will receive an honorarium for your participation time.

This study is being conducted by a University of Manitoba graduate student. If interested, please contact Deepak Joshi at **joshid@myumanitoba.ca or** [redacted] for more information.

Appendix A[Contd.]
Handout

* The background photograph was purchased from iStockphoto LP

Appendix B

List of Organizations

Canadian Centre on Disability Studies
56 The Promenade
Winnipeg, MB R3B 3H9
(204) 287-8411
Fax: (204) 284-5343
TTY: (204) 475-6223
Email: ccds@disabilitystudies.ca

Canadian Paraplegic Association
211-825 Sherbrook Street
Winnipeg, MB R3A 1M5
Telephone: (204) 786-4753
Fax: 204-786-1140
Toll Free: 1-800-720-4933

Independent Living Resource Centre
311A-393 Portage Ave.
Winnipeg, Manitoba, R3B 3H6
Phone & TTY: (204) 947-0194
Toll-Free & TTY: 1-800-663-3043
Fax: (204) 943-6625
Email: thecentre@ilrc.mb.ca

Society for Manitobans with Disabilities
Head Office
825 Sherbrook Street,
Winnipeg, MB R3A 1M5
Email: info@smd.mb.ca
Tel: (204) 975-3010
Toll-Free: 1-866-282-8041
Fax: (204) 975-3073

TenTen Sinclair
1010 Sinclair Street
Winnipeg, Manitoba R2V 3H7
Telephone: (204) 339-9268
http://www.tenten.mb.ca

Student Accessibility Services- University of Manitoba
155 University Centre
Winnipeg, Manitoba R3T 2N2
Telephone: (204) 474-6213

UNIVERSITY OF MANITOBA

Faculty of Medicine
School of Medical Rehabilitation

R106-771 McDermot Ave.
Winnipeg. Manitoba
Canada R3E 0T6
Telephone (204) 789-3897
Fax (204) 789-3927
Department of Occupational Therapy
Department of Physical Therapy

Appendix C

Winter 'n' wheels study
Invitation letter-Wheeled mobility device users group

Dear Sir or Madam,

We are conducting research focusing on the experiences of wheelchair and scooter users (wheeled mobility users) related to sidewalks usability during winter months in Winnipeg. In particular, we are interested in learning from wheelchair and scooter users regarding the issues they face while accessing sidewalks in winter months. Our study is dedicated to explore the winter accessibility of sidewalks for wheeled mobility users from various stakeholders' perspectives and identify realistic solutions that can improve the winter accessibility of sidewalks.

We are looking for individuals who have been using a wheeled mobility device (manual wheelchair/ power wheelchair/ scooter) for more than 1 year and are residents of Winnipeg. We will appreciate, if you can spread the word regarding our study at your organization and help us to explore winter accessibility.
For quick reference, we are looking for individuals who meet the following criterion and are interested to participate in this study:

1. Independent user of a manual/ power wheelchair or scooter for a period of 12 months or more.
2. Uses wheeled mobility device (wheelchair/ scooter) to participate outdoors in winter.
3. Self-identified stable medical status and no history of major illness during past 6 months.
4. Adult 18 years of age or above and resident of Winnipeg

The study is open until April 30, 2014.

If you have any questions regarding the study, please feel free to contact the principal investigator, Deepak Joshi at [redacted] or e-mail at joshid@myumanitoba.ca
Thank you for your time and interest in our study.

Sincerely,
Deepak Joshi
Graduate Student,
School of Medical Rehabilitation
University of Manitoba

UNIVERSITY OF MANITOBA

Faculty of Medicine
School of Medical Rehabilitation

R106-771 McDermot Ave.
Winnipeg. Manitoba
Canada R3E 0T6
Telephone (204) 789-3897
Fax (204) 789-3927
Department of Occupational Therapy
Department of Physical Therapy
Department of Respiratory Therapy

Appendix D

Screening Questionnaire (Inclusion criteria)

- **Wheeled mobility device users**

1. Have you been using a wheeled mobility device independently for a period of 12 months or more? (Study inclusion answer- yes)
2. Do you use a wheeled mobility device (wheelchair/ scooter) to participate outdoors in winter? (Study inclusion answer- yes)
3. Do you have any history of major illness during past 6 months for which you needed medical attention? Do you have any illness, health problem or medical condition at present? (Study inclusion answer- no)
4. Are you 18 years of age or above and resident of Winnipeg? (Study inclusion answer- yes)

- **Public Works Department employees, City of Winnipeg- Sub-group1 (Ground level Operations staff)**

1. Are you a City of Winnipeg employee and actively involved in the snow-removal operations at ground level during winter months? (Study inclusion answer- yes)
2. What is your job position/role at city of Winnipeg? (Study inclusion answer- Shift manager/ inspector/ supervisor/ or any other frontline working staff)

- **Public Works Department employees, City of Winnipeg- Sub-group2 (Management level staff)**

1. Are you a City of Winnipeg employee and involved in managing the sidewalk maintenance and snow-removal operations during winter months? (Study inclusion answer- yes)

Appendix E

Collaborating Public Works Department officials

Contact information

- William R. Grabowecky
  Research & Process Improvement Coordinator
  Public Works Department, City of Winnipeg
  107-1155 Pacific Avenue
  Winnipeg, Manitoba
  Telephone[redacted]
  E-mail: bgrabowecky@winnipeg.ca

- Jim Berezowsky
  Manager, Streets Maintenance
  Public Works Department, City of Winnipeg
  107-1155 Pacific Avenue
  Winnipeg, Manitoba
  R3E 3P1

Appendix F

Letter of Support from Public Works Department, City of Winnipeg

Winnipeg

PUBLIC WORKS DEPARTMENT • SERVICE DES TRAVAUX PUBLICS

Streets Maintenance Division • Division de l'entretien des rues

Oct 28, 2013

Re: Winter accessibility of sidewalks for Wheeled mobility device users

To Whom It May Concern:

This letter is to acknowledge that permission is granted for Mr. Deepak Joshi, Masters Student in the University Of Manitoba School Of Medical Rehabilitation to have access to Streets Maintenance Division employees and facilities to collect data solely for the purpose of completing his thesis requirement on "Winter accessibility of sidewalks for Wheeled mobility device users'.

The intent of the data collection is to;

- Understand the experiences of key stakeholder groups (wheeled mobility device users and Public works department, City of Winnipeg) regarding sidewalks accessibility in winter for Wheeled mobility device users.
- From PWD, City of Winnipeg, we want to learn about the specific barriers and facilitators faced by city officials in providing accessible sidewalks in winter. The overall aim of the study is to identify realistic solutions or recommendations that can improve the winter accessibility of sidewalks for citizens, including wheeled mobility users.

Mr. Joshi shall abide with the following conditions:

- Follow all safe work practices while engaged in data collection with City of Winnipeg Public Works Department employees.
- Disclose the intent of his data collection to all participants.
- Provide periodic updates as to progress and findings to the Public Works Department

James Berezowsky
Manager, Streets Maintenance Division
Public Works Department
City of Winnipeg

Embrace the Spirit • Vivez l'esprit

104 – 1155 Pacific Avenue • 1155, avenue Pacific, bureau 104 • Winnipeg • Manitoba • R3E 3P1
Fax/télec. (204) 986-5566 • www.winnipeg.ca

UNIVERSITY OF MANITOBA

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Fax (204) 789-3927
Department of Occupational Therapy
Department of Physical Therapy
Department of Respiratory Therapy

Appendix G

Winter 'n' wheels study
Invitation letter- City of Winnipeg group

Date :___(DD)/__ (MM)/_____ (YYYY)

Dear Sir or Madam,

We are conducting research focusing on the winter accessibility of sidewalks for wheelchair and scooter users (wheeled mobility users). Our study is dedicated to explore the winter accessibility of sidewalks for wheeled mobility users from various stakeholders' perspectives and identify realistic solutions that can improve the winter accessibility of sidewalks. In particular, we would like to learn about the experiences of city of Winnipeg employees who are associated with sidewalk maintenance and snow-removal operations during winter.

We would appreciate if you can spread the word regarding our study at your organization and help us to explore the winter accessibility.

For quick reference, we are looking for individuals who meet the following criterion and are interested to participate in this study:

> City of Winnipeg employees who are actively involved in sidewalk maintenance operations during winter months (Both ground level operations staff and Management level operations staff).

The study is open until April 30, 2014.

If you have any questions regarding the study, please feel free to contact the principal investigator, Deepak Joshi at [redacted] or e-mail at joshid@myumanitoba.ca

Thank you for your time and interest in our study.

Sincerely,
Deepak Joshi
Graduate Student
School of Medical Rehabilitation
University of Manitoba

Appendix H

Winter 'n' Wheels Study
Entry point questionnaire- Participant Demographic form [CoW Group]

Participant Id#_____ Date-___ (DD)/__ (MM)/_____ (YYYY)

Study group: _____

Year of Birth: _____	Age (years): _____	Sex: (place tick mark) Male: _____ Female:_____
Highest Level of Education: _____		
Position at city of Winnipeg _____		
Length of time for which you have been involved with snow-clearing operations at city of Winnipeg: _____		
Attach map with established travel route		

Appendix H [Contd.]

Winter 'n' Wheels Study
Entry point Questionnaire- Participant Demographic form [WMD users group]

Participant Id#_____ Date-____ (DD)/___ (MM)/_____ (YYYY)

Study group: _____

Year of Birth:	Age (years):	Sex: (place tick mark)	Lives: (place tick mark)
_____	_____	☐ Male ☐ Female	☐ Alone ☐ With someone
Length of time for which you have been living in Winnipeg: _____			
Primary type of wheeled mobility device you use for outdoor purposes in winter: ☐ ***Manual Wheelchair*** ☐ ***Power Wheelchair*** ☐ ***Scooter***			
Other types of wheeled mobility device you use: _____			
Primary diagnosis/ reason for using a wheeled mobility device: _____			
Length of time using a ***wheeled mobility device*** (Any): (In months) _____			
Length of time using a ***primary wheeled mobility device***: (In months)			

_____

List ***one community destination*** that you visit during winter months using your primary wheeled mobility device and is important to you.

_____

_____

Do you use any transportation services like Handi-Transit or Taxi for visiting the above selected community destination?

- ☐ Yes. What service do you use?_____
- ☐ No

Attach Map and establish travel route

Appendix I

Winter 'n' Wheels Study
Participant Cover sheet

Participant Id#_____ Date-___ (DD)/__ (MM)/_____ (YYYY)

Study Group_____

Name:

_____

Contact information:

_____

_____

_____

Emergency contact

Name:_____Telephone:_____

_____

_____

Appendix J

Winter 'n' Wheels Study
Interview Guide-CoW Sub group 2 (Management level operations staff)

Introduction

The purpose of today's interview is to discuss about the winter accessibility of sidewalks. You are the expert and the purpose is to learn about the accessibility of sidewalks in winter from your experiences. In general, we would like to know about the snow-clearing policy & procedures: what you do and how you do it?, general maintenance of sidewalks, customer services and services you provide for people with disabilities/wheelchair users. We would like to know how you make decisions regarding the particular sidewalk being clear and ready for use by people, especially by those who use wheelchair or scooter for outdoor mobility.

Feel free to share your opinion, experiences and ideas, so that we can better understand the conditions that are critical in relation to winter accessibility of sidewalks. You can also comment upon any feature of the city operations that you think are important when considering the accessibility of sidewalks in winter for WMD users.

I might ask some additional questions to completely understand your experiences. However, I will encourage you to take the lead and discuss points, which you believe to be relevant. This interview session is recorded using an audio-recorder. All the information and experiences you share with us will be kept confidential and only be used for study purposes. Do you agree with what all I discussed with you? If you have any questions, feel free to ask me anytime. Can we start the session?

Questions that will assist in continuous engagement through the interview session

Starting questions

1. Please tell us about your (job) position at the city of Winnipeg; can you briefly describe us your job roles and responsibilities?
2. What specific role do you play concerning sidewalks maintenance operations in the City of Winnipeg?
3. How long have you been associated with the responsibility of sidewalk maintenance or snow-removal?
4. How do you see your job of providing clear and usable sidewalks to city residents?

Winter specific questions

5. What changes do you see in sidewalk conditions in winter as compared to the year-round conditions?
6. How do you see the accessibility of sidewalks in winter for general population and wheelchair/scooter users?
7. Is there certain environmental factor (in relation to winter and sidewalks access) that you recognize as a barrier for wheelchair/scooter users?
8. Is there certain environmental factor (in relation to winter and sidewalks access) that you recognize as a facilitator for wheelchair/scooter users?
9. Is there some provision of providing accessible sidewalks for people who use wheelchair/ scooters for outdoor purposes?

Snow removal and Ice control policy related questions

There is a policy in the City of Winnipeg that guides the snow removal and ice-control during winter months.

10. Can you provide us with information about the snow-removal policy and how does it guide the snow-removal operations during winter?
11. What do you think are the strengths of current snow-removal policy? (In general and keeping in mind the needs of wheelchair users)
12. What are the weak points in current snow-removal policy that you recognize as obstacle in providing accessible, snow and ice-free sidewalks to wheelchair/scooter users?
13. Are there some changes that you would recommend in snow-removal policy, what are they and why?
14. Are there any other policies or guidelines that guide the snow-removal operations during winter?
15. How do you see the standards of snow-removal in Winnipeg as compared to other Northern cities?

Questions related to snow clearing operations

16. Do you recognize some weak points in the current snow-clearing services provided by city of Winnipeg, keeping in mind the needs of people who use wheelchair/ scooters? If yes. What are they?
17. Do you receive any complaints or suggestions from residents of Winnipeg regarding sidewalk conditions in winter, especially from wheelchair users?
18. If yes, what is the nature of complaints or suggestions? Can you share some examples?
19. How do you manage those suggestions or complaints?
20. What changes in the current snow-clearing services do you think will be useful with respect to providing accessible and better sidewalks in winter to wheelchair/ scooter users?

21. According to you, who shall be responsible for making changes to improve winter accessibility of sidewalks?
22. How do you suggest that the proposed changes can be brought into action?

Ending phase of interview

Collective briefing of the entire session (Approx 10 min. before session termination) -

Interviewer will discuss the quick summary of interview session and have informant's feedback

23. Now, I will summarize the key points that we discussed in the interview and would like you to provide the feedback regarding how well I understood the information you provided.
24. Is there something else you would like to discuss regarding the winter accessibility of sidewalks for WMD users?

Thank you for participating in this interview. We appreciate your time and efforts, the information you provided to us in the session will be helpful in understanding the winter accessibility of sidewalks for wheelchair and scooter users.

Appendix K

Winter 'n' Wheels Study
Interview Guide-CoW Sub group 1 (Ground level operations staff)

Introduction phase

The purpose of today's outdoor interview is that you tell us which things hinder or facilitate your job of clearing sidewalks in winter. You are the expert and the purpose is to learn about the accessibility of sidewalks in winter from your experiences. Feel free to share your opinion, experiences and ideas, so that we can better understand the sidewalk conditions that are critical in relation to winter accessibility of sidewalks.

We would like to know about the snow-clearing procedures. What all you do and how you do? We would like to understand how you make decisions regarding particular sidewalk being clear and ready for use by people especially by people who use wheelchair or scooter for outdoor mobility. We would like to know how do the sidewalk conditions changes in winter as compared to the rest of year conditions and what impact it leaves on sidewalks maintenance operations. You can also comment on any feature of the physical environment or sidewalk that you think may affect the mobility of person using wheelchair or scooter.

I might ask some additional questions to completely understand your experiences. However, I will encourage you to take the lead and discuss points, which you believe to be relevant. This interview session will be recorded using audio-recorder, as taking notes will be difficult in the outdoor environment. All the information and experiences you share with us will be kept confidential and only be used for study purposes. If anytime during the interview, you feel tired or distressed please stop and notify me. Your safety is my priority.

Do you agree with what all I discussed with you? If you have any questions, feel free to ask me anytime. Shall we start?

Questions that will assist in continuous engagement through the interview session

- *Starting questions*

1. Please tell us about your (job) position at the city of Winnipeg; can you briefly describe us your job roles and responsibilities?
2. What specific role do you play concerning sidewalks maintenance operations in the City of Winnipeg?
3. How long have you been associated with the responsibility of sidewalk maintenance or snow-removal?
4. How do you see your job of providing clear and usable sidewalks to city residents?
5. What changes do you see in sidewalk conditions in winter as compared to year-round conditions?

- *Targeted questions*

6. What do you think about the sidewalk accessibility for people who use wheelchair or scooter for outdoor mobility?
7. Is there certain environmental factor (in relation to winter and sidewalks access) that you recognize as a ***barrier*** *for* wheelchair or scooter *users*?
8. Is there certain environmental factor (in relation to winter and sidewalks access) that you recognize as a ***facilitator*** *for* wheelchair or scooter *users?*

- ***Sidewalk features***

9. Is there a *sidewalk feature* or area *that can or cannot be fully cleaned during winter*? If *yes*, what is that?
10. How long does it take you to clean a section of sidewalk say like one block?
11. Is there any feature of sidewalk that makes your job of clearing sidewalks difficult or easier? Design issues?

Snow clearing operations/ policy

12. What is your perception regarding the current sidewalk clearing operations in winter?
13. Do you recognize some weak points in the current snow-clearing services provided by the city of Winnipeg, concerning people who use wheelchair/ scooters? If yes. What are they?
14. What features in the current sidewalk snow-clearing operations you think are obstacles in providing accessible sidewalks to people who use wheelchair/ scooter?
15. What features in the current sidewalk snow-clearing operations you think are good or facilitators in providing accessible sidewalks to people who use wheelchair/ scooter?
16. What changes in the current snow-clearing services do you think will be useful with respect to providing accessible and better sidewalks in winter to wheelchair/ scooter users?
17. According to you, who shall be responsible for making changes to improve winter accessibility of sidewalks?
18. How do you suggest that the proposed changes can be brought into action?

Ending phase of the interview (*Collective briefing of the entire session)*

Interviewer will discuss the quick summary of interview session and have informant's feedback

19. Now, I will summarize the key points that we discussed in the interview and would like you to provide the feedback regarding how well I understood the information you provided.

20. Is there something else you would like to discuss regarding the winter accessibility of sidewalks for WMD users?

Thank you for participating in this interview. We appreciate your time and efforts, the information you provided to us in the session will be helpful in understanding the winter accessibility of sidewalks for wheelchair and scooter users.

Appendix L

Winter 'n' Wheels Study
Interview Guide-Wheeled Mobility Device user group

Introduction phase

The purpose of today's outdoor interview is that you tell us which things in the environment hinder or facilitate your mobility or use of you manual/ power wheelchair/scooter. You are the expert and the purpose is to learn about the accessibility of sidewalks in winter from your experiences. Feel free to share your opinion, experiences and ideas, so that we can better understand the environmental features that act as barriers or facilitators when one tries to access sidewalk. We would like to know how does the sidewalk conditions changes in winter as compared to the rest of year conditions and what influences it leaves on your life.

In doing so, you can consider the things in the environment that eases or makes the use of sidewalks difficult, more or less comfortable or safer in winter .You can also comment on any feature of the physical environment or sidewalk that you think is neutral for you but may affect the mobility of any other person. I might ask some additional questions to completely understand your experiences. However, I will encourage you to take the lead and discuss points, which you believe to be relevant. During the interview session, I will be taking photographs of the important environmental features that affect the winter accessibility of sidewalks and would like you to guide me in taking photographs. I will make sure that you are not in these photographs.

This interview session will be recorded using tape-recorder, as taking notes will be difficult in the outdoor environment. All the information and experiences you share with us will

be kept confidential and only be used for study purposes. If anytime during the interview, you feel tired or distressed please stop and notify me. Your safety is my priority.

Do you agree with what all I discussed with you? If you have any questions, feel free to ask me anytime. Can we start the session?

Questions that will assist in continuous engagement through the interview session

- *Starting questions*

1. What places do you generally visit in your neighborhood using you wheelchair/scooter?
2. How often do you go out in winter months? Is it same as in summers?
3. Do you go outdoors alone using your wheelchair/Scooter?

- *Specific questions around sidewalks*

4. What are your experiences of using sidewalks for outdoor mobility in past?
5. What changes do you see in sidewalk conditions in winter as compared to the rest of year-round conditions?
6. How has been your experience of using wheelchair/ scooter for outdoor purposes until now this winter?

- *Targeted questions (Questions variating between past and present context)*

Barriers

7. Is there certain environmental factor (in relation to winter and sidewalks access) that act as a ***barrier for you***, when you use sidewalk for community access in winter?
8. Is there any environmental factor (in relation to winter and sidewalks access) that is ***neutral for you***, when you use sidewalk for community access in winter

9. Do you recognize certain environmental factor (in relation to winter and sidewalks access) that act as a ***barrier for others***, when they use sidewalk for community access in winter? If yes, who are they and how?
10. How ***often*** do you ***face a barrier*** that makes sidewalk access difficult for you?
11. ***What*** do ***you do*** when you ***face a barrier***?
12. In ***what ways*** does the ***barrier affect*** your outdoor mobility?

Facilitator

13. Is there certain environmental factor (in relation to winter and sidewalks access) that act as a ***facilitator for you***, when you use sidewalk for community access in winter?
14. Do you recognize certain environmental factor (in relation to winter and sidewalks access) that act as ***facilitator for others***, when they use sidewalk for community access in winter? If yes, who are they and how?
15. In ***what ways*** does the ***facilitator affect*** your outdoor mobility?
16. Is a potential ***facilitator beneficial*** to ***certain individuals/ population?*** If yes, then for who all is it good?
17. Are there ***additional facilitators*** desired? If yes, What all?

- ADDITIONAL POINTS

18. How long does it take you to access or cross a section of sidewalk like one block? Is the time spent same as in summer?
19. What have been you experiences related to sidewalks access over the year? Did some things changed? If yes? Please elaborate ?
20. Are you satisfied with present overall sidewalks access in winter? Yes/ No and why?

21. What changes do you suggest in current sidewalk conditions, so that they become more accessible?
22. Who should be making changes to improve sidewalks accessibility?
23. How do you suggest that changes can be brought into action?

Ending phase of interview *(Collective briefing of the entire session)*

Interviewer will discuss the quick summary of interview session and have informant's feedback

21. Now, I will summarize the key points that we discussed in the interview and would like you to provide the feedback regarding how well I understood the information you provided.
22. Is there something else you would like to discuss regarding the winter accessibility of sidewalks for WMD users?

Thank you for participating in this interview. We appreciate your time and efforts, the information you provided to us in the session will be helpful in understanding the winter accessibility of sidewalks for wheelchair and scooter users.

Write down about any critical incidents that occurred during the session

Appendix M

Winter 'n' Wheels Study
Time-lines for project

Project Activity	**Estimated Time-line**
Project period	January 10, 2014-October 2014
Initiate participant recruitment	January 10, 2014
Data collection	January 10, 2014 - May 1, 2014
Participant recruitment ceases	April 30, 2014
Data Analysis (concurrent with data collection)	January10, 2014- June 30, 2014
Data Synthesis	July1, 2014- August 31, 2014
Study report writing	July 1, 2014- September 30, 2014
Project completion	October 1,2014

Appendix N

Winter 'n' Wheels Study
Study Budget

Project Requirement	Estimate
WMD user group participant honorarium ▪ Paid for two go-along interview sessions per participant ▪ Maximum four participants	$20/ go-along session/ participant $20 x 2= $40 $40 x 4 =$160 **Total = $160**
Transportation costs Taxi for participants ▪ WMD group: Return fare from the site where go-along interview session finishes. Total sessions=8 ▪ CoW-sub-group-2: 4 participants with one data collection each.	$15/one way $15 x 8= $120 $30/ round trip $30 x 4= $120 **Total = $240**
Office supplies: ▪ Paper, costs for printing recruitment posters, hand-outs, invitation letters and costs of printing transcripts and study forms ▪ Stamps and envelopes for sending invitation letters	Provided at no cost by study supervisor $15 **Total=$15**
Equipments	

▪ Audio recorders for interviews ▪ Camera for photographs	Provided at no cost by study supervisor
<u>Transcription:</u> ▪ Transcription cost ▪ Total interview hours =10 hours (4 hours - WMD user group interviews + 2 hours- CoW-subgroup-1 interviews + 4 hours -CoW-subgroup-2 interviews) 1 hour interview ~6 hours transcription ▪ Total transcription time for 10 hours of interviews= 10 x 6 = 60 hours ▪ Total cost of transcription (60 x 25=_)	$25/hour **Total= $1500**
Total budget of the project	**$1915**

UNIVERSITY OF MANITOBA

Faculty of Medicine
School of Medical Rehabilitation

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Telephone (204) 789-3897
Fax (204) 789-3927
Department of Occupational Therapy
Department of Physical Therapy
Department of Respiratory Therapy

Appendix O

Research Participant Information and Consent Form

Title of Study: Winter 'n' Wheels Study: Understanding experiences of key stakeholder groups regarding sidewalks accessibility in winter for wheeled mobility device users.

Principal Investigator:
Deepak Joshi
Graduate Student
School of Medical Rehabilitation, University of Manitoba
R131-771 McDermot Avenue,
Winnipeg, Manitoba R3E 0T6
Telephone: [redacted]
E-mail id: joshid@myumanitoba.ca

Study Supervisor:
Dr. Jacquie Ripat
Associate Professor, Department of Occupational Therapy,
School of Medical Rehabilitation, University of Manitoba
R131-771 McDermot Avenue,
Winnipeg, Manitoba R3E 0T6
Telephone: 2047893303
E-mail id: jacquie.ripat@med.umanitoba.ca.

Sponsor: This study is funded by a research grant from the Manitoba Health Research Council (MHRC).

You are being asked to participate in a research study. Please take your time to review this consent form and discuss any questions you may have with the study staff. You may take your time to make your decision about participating in this study and you may discuss it with

your friends, family or your doctor before you make your decision. This consent form may contain words that you do not understand. Please ask the study staff to explain any words or information that you do not clearly understand.

This research study is a part of Deepak Joshi's master's thesis project. The results will be published in a thesis, which is a public document.

Purpose of Study

This research study is being conducted to understand the experiences of key stakeholder groups (wheeled mobility device users and Public Works Department employees, City of Winnipeg) regarding sidewalks accessibility in winter for wheeled mobility device (WMD) users. Wheeled mobility devices in this study represent devices such as manual wheelchairs, power wheelchairs and scooters. A total of 12 participants will participate in this study, which is being conducted in the city of Winnipeg. You have been invited to take part in this research study because you are either:

- Associated with sidewalks maintenance operations during winter months.

Or

- You have been using a wheeled mobility device for more than 12 months and use your wheeled mobility device for outdoor purposes in winter.

The overall aim of this study is to gain an in-depth understanding of the specific issues faced by key stakeholders with respect to sidewalks accessibility (providing & use) in winter and subsequently, use those findings to identify solutions or recommendations that can improve the winter accessibility of sidewalks for wheeled mobility device users.

Study procedures

This study involves data collection from two stakeholder groups: (1) wheeled mobility device (WMD) users and (2) Public Works Department employees, City of Winnipeg (CoW). From WMD user group we want to learn about the specific barriers and facilitators that influence the winter use of sidewalks in Winnipeg.

From CoW group we want to learn about the specific barriers and facilitators that influence the service providing of accessible sidewalks in winter for WMD users. If you take part in this study, you will be representing either the CoW group or WMD user group.

Wheeled mobility device (WMD) user group: If you take part in this study and use a wheeled mobility device for outdoor purposes in winter, you will be representing the WMD user group.

Your participation in the study will involve three 30-minutes appointments with the principal investigator Deepak Joshi. The first appointment will involve going over few background questions while the second and third appointment will involve outdoor go-along interview sessions. At the first appointment, we will collect some background information about you and your wheelchair/scooter (e.g., age, length of time using a wheelchair/scooter, type of wheeled mobility device you use). At this meeting, the principal investigator will ask you to select one community destination that you frequently visit during winter months using your wheeled mobility device. Following which, you will select the specific route (stretch of sidewalks) that you use to visit the community destination. The second and third appointments will involve go-along interviews that will take place on the route/ stretch of sidewalks you selected. In go-along interviews, we will have you using your wheelchair/ scooter on the selected route while simultaneously discussing about your experiences of using sidewalks in winter months with the principal investigator.

The two go-along interview sessions will take place on different days during the daytime. The maximum length of each go-along interview session will be 30 minutes or less as guided by you. In go-along interviews, we will request you to take the lead and discuss about sidewalks accessibility in winter for WMD users. However, the principal investigator will also ask some additional questions to further probe into your experiences and understand them better. At the time of interviews, principal investigator will also be taking photographs of environmental features that are considered relevant or important when focusing on the winter accessibility of sidewalks. All interview sessions will be audio-recorded.

Public Works Department, City of Winnipeg (CoW): If you take part in this study and are associated with sidewalks maintenance operations during winter months, you will be representing the CoW group. For in-depth data collection purposes, the CoW group is divided into two subgroups: (i) CoW-subgroup-1-Ground level operations staff and (ii) CoW-subgroup-2- Management level operations staff.

If you are participating under CoW-subgroup-1 (Ground level operations staff), your participation in the study will involve one 30-minute long go-along interview session with the principal investigator, Deepak Joshi. Before the interview session begins, principal investigator will collect some background information from you (e.g., age, your job position at city of Winnipeg, number of years since you are associated with sidewalks maintenance operations). This information gathering will take no more than 5 minutes to complete. During the go-along interview session, principal investigator will walk-along with you on a stretch of pre-selected sidewalks while you are actively involved in the snow removal operations. During this time, we would like you to take the lead and discuss about sidewalks accessibility in winter for WMD users. We would like to learn about the specific barriers and facilitators that influence your job of providing accessible sidewalks in winter. However, the principal investigator will also ask some additional questions to further probe into your experiences and understand them better. At the time of interview, principal investigator will also be taking photographs of environmental features that are considered relevant or important when focusing on the winter accessibility of sidewalks. The maximum length of go-along interview session will be 30 minutes or less as guided by you. The interview session will be audio-recorded.

If you are participating under CoW-subgroup-2 (Management level operations staff), your participation in the study will involve one l-hour long interview session with the principal investigator, Deepak Joshi. The interview session will be conducted face-to-face at the EPIC research lab (RR367-Rehabilitation hospital, 800 Sherbrook St.), School of Medical Rehabilitation, University of Manitoba, or at any other mutually agreeable location such as your work site. During the interview, we would like you to take the lead and discuss about the sidewalks accessibility in winter for WMD users. We would like to learn about specific barriers and facilitators that influence your job of providing accessible sidewalks in winter. However,

the principal investigator will also ask some additional questions to further probe into your experiences and understand them better. The interview session will be audio-recorded.

The researcher may decide to take you off this study if during the course of study, you become unwell and require medical attention or researcher feels your on-going engagement in the study could pose a significant risk to your safety and health. You are strongly advised to inform principal investigator Deepak Joshi about any health condition or problem that may arise during the period you are participating or enrolled in the study. You can stop participating at any time. However, if you decide to stop participating in the study, we encourage you to talk to the study staff first and discuss any concerns.
You can also opt for having the aggregated results of the study from the principal investigator. The results will be provided to you after the study completion.

Risks and Discomforts

For WMD user group participants: The study involves data collection in the outdoor winter environment. The typical winter weather in Winnipeg includes below-zero temperatures, cold winds, snowy and icy surfaces. Such winter conditions could be hard for anyone and in particular, pose challenge to your safety and mobility. Use of wheelchair/ scooter on slippery outdoor surfaces in winter creates a risk of tips and falls that could result in damage to your device or personal injury. In addition, the use of wheelchair/ scooter on snowy and icy surfaces could lead to fatigue, discomfort or injury in hand, elbow or shoulder. Along with the above risks, increased chances of cold injuries such as frostbite and respiratory problems like difficulty breathing are persistent in cold environments.

To reduce the risks and discomforts associated with being in outdoor winter environment, the data collection will take place only during the day times when temperatures are expected to be warmer as compared to evenings and night times. Furthermore, interviews will not take place on the days for which the bad weather advisory is issued by Environment Canada or the temperature forecasts are - 25 degree Celsius or colder (including Wind-chill). To prevent additional fatigue or stress, you will be asked to use the travel routes that you normally use to visit your community destination. Despite these measures, risks of cold environment can persist and you are advised to take all necessary precautions including dressing according to the weather forecast, reporting any

discomfort or stress immediately to study staff.

For CoW-subgroup-1 (Ground level operations staff) participants: This study involves data collection in the outdoor winter environment. The typical winter weather in Winnipeg includes below-zero temperatures, cold winds, snowy and icy surfaces. Such winter conditions could be hard for anyone and in particular, pose challenge to your safety and mobility. The sidewalks in winter are known to have snow accumulations and slippery surfaces that can create a risk of slip and fall. However, no additional risks are foreseen for your participation in the study as you will be involved in your regular work roles and will not be asked to do any additional or new tasks. Furthermore, to reduce the risks and discomforts associated with being in outdoor winter environment, you are advised to take all necessary precautions including dressing according to the weather forecast, reporting any discomfort or stress immediately to the study staff. You are advised to follow all safety instructions provided to you by your department or City of Winnipeg.

For CoW-subgroup-2 (Management level operations staff), no risks are foreseen for participants.

Benefits

There may or may not be direct benefit to you from participating in this study. We hope the information learned from this study will benefit in improving sidewalks accessibility in winter for wheeled mobility devices users, which could ultimately help in improving or making outdoor winter participation easy for wheeled mobility device users in the future.

Costs

All the procedures, which will be performed as part of this study, are provided at no cost to you.

Payment for participation

WMD user group participants will be given $20 per completed go-along interview session to a maximum of two interview sessions for participation in the study.

CoW group participants will receive no payment or reimbursement for any expenses related to taking part in this study. CoW group participants will participate in the study during their paid work hours.

Confidentiality

Information gathered in this research study may be published or presented in public forums; however, your name and other identifying information will not be used or revealed. Despite efforts to keep your personal information confidential, absolute confidentiality cannot be guaranteed. Your personal information may be disclosed if required by law. The University of Manitoba Health Research Ethics Board may review records related to the study for quality assurance purposes.

We will take all necessary measures to keep all information that we collect from you confidential. All study related documents will bear only your assigned study number. All documents will be kept in locked filing cabinets and/or password-protected computer files. All documents, including interview transcripts, will be kept confidential by using your assigned study number in research offices. Only the authorized study team members will have access to your information. Audio recordings and photographs taken during the study will be kept on a secure, password-protected computer and will not be used beyond this study without your consent. No information that will disclose your identity will be recorded in the digital files. The audio recordings will be deleted once the study team members transcribe them. Records that identify you by name or initials will not be allowed to leave the investigators' offices. The investigators will be the only people who will have access to this information. Photographs taken during the interview sessions will not include your face or any other identification feature. However, part of your wheeled mobility device or body may be captured in the photographs. Investigators will try their best to avoid photographs that include your face or other identification features but in cases where such photograph is taken, principal investigator will delete them.

Data collected from this study will be maintained for two years following completion of this study, at which time they will be erased or destroyed.

Voluntary Participation/Withdrawal from the Study

Your decision to take part in this study is voluntary. You may refuse to participate or you may withdraw from the study at any time. If the study staff feels that it is in your best interest to withdraw you from the study, they will remove you without your consent. We will tell you about any new information that may affect your health, welfare, or willingness to stay in this study. You are not waiving any of your legal rights by signing this consent form nor releasing the investigator(s) or the sponsor(s) from their legal and professional responsibilities.

You are free to ask any questions that you may have about your role and your rights as a research participant. If any questions come up during or after the study or if you have a research-related injury, you can contact the study staff: Deepak Joshi [redacted] or study supervisor Dr. Jacquie Ripat [redacted].

For questions about your rights as a research participant, you may contact the University of Manitoba, Bannatyne Campus Research Ethics Board Office at (204) 789-3389.

Do not sign this consent form unless you have had a chance to ask questions and have received satisfactory answers to all of your questions.

Statement of Consent

I have read this consent form. I have had the opportunity to discuss this research study with Deepak Joshi and or his/her study staff. I have had my questions answered by them in language I understand. The risks and benefits have been explained to me. I believe that I have not been unduly influenced by any study team member to participate in the research study by any statements or implied statements. Any relationship (such as employer, supervisor or family member) I may have with the study team has not affected my decision to participate. I understand that I will be given a copy of this consent form after signing it. I understand that my participation in this study is voluntary and that I may choose to withdraw at any time. I freely agree to participate in this research study.

I understand that information regarding my personal identity will be kept confidential, but that confidentiality is not guaranteed. I authorize the inspection of any of my records that relate to this study by The University of Manitoba Research Ethics Board for quality assurance purposes. By signing this consent form, I have not waived any of the legal rights that I have as a participant in a research study.

I agree to allow the investigators to take photographs during the interview sessions for analysis and presentation purposes. **Yes ___ No ___**

I would like to have a copy of aggregated results/findings of the study, post-study completion.

Yes ___ No ___

Participant signature: _____ Date: _____

(day/month/year)

Participant printed name: _____

I, the undersigned, have fully explained the relevant details of this research study to the participant named above and believe that the participant has understood and has knowingly given their consent

Printed Name: _____ Date: _____

(day/month/year)

Signature: _____

Role in the study: _____

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Appendix P

Thank you note to participants

Dear *(participant's name)*,

We would like to thank you very much for the valuable information and time you have provided in the Winter 'n' Wheels Study. The information you provided will be used to better understand the winter accessibility of sidewalks and subsequently, identify solutions or recommendations that can improve winter accessibility of sidewalks for wheeled mobility device users.

Once all the data are collected and analyzed for this project, I plan on sharing this information with public through seminars, conferences, presentations, and journal articles. If you are interested in receiving more information regarding the results of this study, or would like a summary of the results, please let me know, I will send you the information.

Thank you again for taking the time to be a part of this important research. We value your expertise and appreciate your continued commitment to and support of winter accessibility for wheeled mobility users.

The Winter 'n' Wheels Study Team

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Winter 'n' Wheels Study

Key Definitions

This section contains working definitions of specific terms that are used in the winter 'n' wheels study.

Critical Incident. Critical incident is defined as the situation where an accessibility problem is confronted due to flawed person-environment interaction or occurrence of any other problematic event that hinder the mobility of a participant. For example, a situation or event that necessitates the detour from decided sidewalk route like closed sidewalk.

Dynamicity. The term dynamicity in the study refers to the real-time experiences of WMD users that are shaped by constantly changing micro-landscapes (e.g. snow and ice formation on sidewalks) during winter. The changes in micro-landscapes are shaped by the factors like fresh snow, melting of snow, ice formation, presence of puddles, snow accumulations and other meteorological factors.

Travel Chain. The travel chain represents the series of links that enable the individual's travel outside the home. Travel chain essentially connects the three vital components of any travel: person, the vehicle or mode of travel and the built environment (Lavery et al., 1996). If all the three components of travel chain are not efficiently connected, the travel or journey cannot be completed efficiently (Lavery et al., 1996). For WMD user, who simple goes out for a grocery shopping near home, the travel chain may include: user, wheeled mobility device (and/or - bus/taxi/private transport) and the surrounding built environment such as sidewalk.

Travel Route. Travel route in this study represents the selected stretch of path or sidewalks that WMD users uses in order to visit their community destination. WMD users will themselves decide the travel route in the study following selection of one community destination that they regularly visit in winter months. The selected travel route will be marked on the city of Winnipeg map and will be used for go-along interview sessions.