Abstract:

As a form of urban boosterism, cities will host large scale events in hopes of rebranding or garnering national or international attention. In an effort to rebrand and market itself as a ‘Winter City’, Prince George, BC, Canada hosted the 2015 Canada Winter Games. Even though urban boosterism has historically emphasized the economic impacts of hosting events, there is an increasing consideration of environmental impacts seen in reports from events like the Canada Games and the Olympics. This study assessed how efforts to employ sustainability through waste management were employed within the context of the limitations and challenges specific to Prince George. By conducting a waste audit, this study examined waste types and sources. In addition, participant observation and key interviews were used to provide context and reasoning for the results of the waste audit. Without prioritization and sufficient budgeting, implementing comprehensive waste management presented a unique set of challenges leading to only modest diversion rates. Future events should focus on the local context, including local staff, to be better prepared to prioritize and budget effectively for waste management planning.
TABLE OF CONTENTS

Abstract ............................................................................................................................ i
Table of Contents .......................................................................................................... ii
List of Tables ................................................................................................................ vi
List of Figures ............................................................................................................... v
Acknowledgements ..................................................................................................... vi

Chapter 1: Introduction and Background .................................................................... 1
  1.1 Introduction: Purpose of Study ............................................................................. 1
  1.2 Introduction: Literature Review ......................................................................... 4
    1.2.1 Urban Boosterism through Sporting Events ................................................. 4
    1.2.2 Sport Tourism and Waste ............................................................................ 6
    1.2.3 Public Participation in Waste Management ................................................. 7
    1.2.4 Waste Management in Canadian Sporting Events ..................................... 10
  1.3 The Case Study: 2015 Prince George Canada Winter Games ............................ 13
    1.3.1 Canada Games ............................................................................................ 13
    1.3.2 Prince George, BC ...................................................................................... 14
    1.3.3 Waste Management in Canadian Winter Games ....................................... 16
  1.4 References ......................................................................................................... 17

Chapter 2: Research Design and Methods ................................................................. 20
  2.1 Introduction ....................................................................................................... 20
  2.2 Mixed Methods ................................................................................................ 21
  2.3 Sample Sites .................................................................................................... 24
  2.4 Participant Observation and Interviews ........................................................... 26
    2.4.1 The Interviews ........................................................................................... 29
  2.5 Quantitative Waste Sampling and Sorting ....................................................... 33
  2.6 The Waste Audit ............................................................................................... 35
    2.6.1 Collection ................................................................................................... 35
    2.6.2 Characterizing ............................................................................................ 37
  2.7 Methods Conclusion ......................................................................................... 40
  2.8 References ....................................................................................................... 40

Chapter 3: Results ....................................................................................................... 42
  3.1 Sustainability and Waste Management Planning ............................................. 42
LIST OF TABLES
Table 2.1: Data Sources as related to the Research Questions .............................. 23  
Table 2.2: Interview Participants: their roles and the organizations they belonged to .... 29  
Table 2.3: Sample Data Collection Schedule ................................................................... 35  
Table 3.1: Garbage and Recycling Weights: Volunteer recordings compared to actual recycling and approximation of actual garbage weight .......................................................... 53

LIST OF FIGURES
Figure 3.1: Civic Centre Recordings of Garbage, Paper and Container Recycling ...... 54  
Figure 3.2: CN Centre Recordings of Garbage, Paper and Container Recycling ............ 55  
Figure 3.3: Northern Sport Centre Recordings of Garbage, Paper and Container Recycling ................................................................................................................................. 56  
Figure 3.4: Otway Recordings of Garbage, Paper and Container Recycling ................. 57  
Figure 3.5: Waste Categories of All Samples ................................................................ 59  
Figure 3.6: Civic Centre Waste Characterization by Weight ............................................. 60  
Figure 3.7: CN Centre Waste Characterization by Weight ............................................. 62  
Figure 3.8: Northern Sport Centre Waste Characterization by Weight .......................... 63  
Figure 3.9: Otway Nordic Ski Centre Waste Characterization by Weight ...................... 64  
Figure 4.1: Waste Hierarchy .......................................................................................... 78
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Chapter 1: Introduction and Background

1.1 Introduction: Purpose of Study

National level sporting competitions provide opportunities and encourage participation in competitive sports for junior athletes (NCYS, 2016). While nurturing a culture of sport and activity, these mega-events are also avenues for host cities to highlight and rebrand themselves (Ostapenko, 2010). Hosting large scale events leads to a temporary increase in visitors and tourism (Horne & Manzenreiter, 2006). In a short period of time, the strong impact of tourism leads to heavy use of services in the hospitality industry. Tourism is often an avenue for revenue generation for a city or region, but it can come with an environmental cost (Matheson, 2006). In recognition of this, several recent events have reported or marketed sustainable or environmentally friendly practices; including the Canada Games (CGC, 2014; IOC, 2016; ENOC, 2016).

The Canada Games, a national level sporting competition, has increasingly included sustainability in their final reports by their hosting organizations. This trend shows a growing importance of hosting sustainable events (Halifax, 2011; Sherbrooke, 2013). Following a strong sustainability component in final reports for the 2011 and 2013 Canada Games, the 2015 Prince George Canada Winter Games aimed to continue this trend by working closely with their Environmental Services Committee (Halifax, 2011; Sherbrooke, 2013).

This research aimed to assess the level of sustainability initiatives and how they were prioritized in the 2015 Games, focusing on waste management as a measure of sustainability. Although there are numerous definitions, the 2015 Games defined
sustainability as “[meeting] the needs of the present without compromising the ability of future generations to meet their own needs” (Bruntland, 1987). Waste disposal and management has become a main component of sustainability strategies in events as a sudden influx of people is likely to generate high volumes of waste and would need to be managed in a way that would not be a detriment in the future. In past events, such as the Vancouver, British Columbia (BC) based Winter Olympics and the Alberta Winter Games, there were strong efforts to minimize and monitor levels of waste (AWG, 2014; VANOC, 2010). These initiatives were paired with purchasing and procurement policies that accounted for waste diversion by limiting disposable materials (AWG, 2014; VANOC, 2010). However, some of the challenges that have arisen in the past include a lack of reporting and a lack of accountability (Halifax, 2011). The Halifax Canada Winter Games, for example, had admitted that not all waste was accounted for due to operational challenges such as insufficient volunteer staffing (Halifax, 2011). These events will often aim for higher level initiatives, but can be limited by operational or organizational failures.

Therefore, in specific, the purpose of this study was to assess the waste management practices implemented for the 2015 Canada Winter Games in Prince George, BC, Canada. It examined efforts made by organizers to most effectively manage the influx of waste from hosting this 18 day event. This research took a mixed method approach which included a waste characterization study and an in depth analysis of the planning process.

This study examined the following research questions:
1. How were plans for the 2015 Prince George Canada Winter Games to be a sustainable event, through Waste Management, carried out by the Host Society?

   A. What were the goals and initiatives as articulated by the Host Society and Key volunteers?

   B. What were the limitations and barriers? For example, did the northern, rural context of the host community impact waste management?

2. How was waste managed in the 2015 Games?

   A. How much waste was actually diverted and how much could have been diverted with the facilities available to the region?

   B. What types of waste were generated? What were the sources of high waste generation?

The second set of questions were addressed through a quantitative waste characterization study that identified the composition of waste collected from four sample sites that were official venues for the event. The first set of questions used qualitative methods to develop an understanding of how organizers planned for waste management through participant observation, in depth interviews and policy analysis. Using this mixed methods approach, the research sought to determine factors influencing waste management planning in a northern rural context for a large scale sporting event. The use of mixed methods complements each research question and helped fill gaps not answerable through a single type of method.
1.2 Introduction: Literature Review

1.2.1 Urban Boosterism through Sporting Events

Whether it is a local music festival or a large scale mega-event, cities are becoming more likely to host events that will boost their image. Events like these have the potential to draw national and even international attention. This ‘festivalization of urban politics’, as termed by Haubermann and Siebel (1993), comes with the hope that events will spur economic development and rejuvenate aging infrastructure (Roth & Frank, 2000; Hiller, 2000). However, urban boosterism, a tool used to promote a city with goals to improve its image, focuses on economic influx and financial sustainability with little attention to environmental sustainability (Matheson, 2006). Hosting mega-events results in a significant influx of visitors over a short period of time (Hiller, 2000). To accommodate the dramatic increase in a city’s population during a mega-event, it is important to consider the concomitant environmental burden, particularly in terms of the waste generated over the duration of the event and the need to dispose of it safely and properly.

Quite often, urban booster events will be sport focused, such as the Olympic Games, Alberta Games and Canada Games. Individual cities will bid to host these large-scale events as an opportunity to promote and rebrand. For the city of Prince George, a bid to host the 2015 Canada Winter Games included the desire to be highlighted and showcased to a wider audience represented the desire for growth; both in population and industry. There is a temporary sudden influx of tourism and focus on the host city during the sporting event which is an opportunity to brand the city in a new way (Ostapenko, 2010). In the 2015 Games, Prince George took on the branding as a
‘Winter City’ with the slogan “we are winter” (CWG, 2014; Kurjata, 2015). The hope was that visitors would be enticed by winter recreation activities and either return for visits or relocate to Prince George. Cities will continue to host such events to compete for industry, investment and tourism, but it is important that the environmental impact be considered along with the opportunity for urban boosterism (Roth & Frank, 2000).

The public is more conscious of environmental matters now than in the past; this gradual change has been seen in the Olympics since the 2000 Sydney Games to the most recent 2012 London Games (Cox, 2012; Muller, 2011). Perhaps in response to this increased awareness, organizing bodies are beginning to include sustainability and environmental consideration into planning. This has resulted in sustainability reports produced by the organizations as seen in the Vancouver Winter Olympics, several Alberta Games and Canada Games. When incorporating sustainability initiatives, it is important to “balance costs, risks and benefits (pg. 1662)” for truly sustainable decisions (Apitz, 2010). Often, these efforts fail to meet the balance as outlined by Apitz (2010) emphasizing the importance of prioritizing in planning. In many cases, events will have only partial success in meeting goals, and efforts related to sustainability. Muller (2011) argues that it is best to emphasize positive achievements and avoid minimizing the negative impacts. He has found that public perception in minimizing the impact of negative side-effects of hosting events can be received with more cynicism by the public than by reporting honest outcomes and admitting failures or challenges (Muller, 2011). To maintain confidence from the public, his research argues it is important to be transparent and honest in the reporting (Muller, 2011).
There has been an increasing public awareness of the environmental impact of sports (Cox, 2012; Muller, 2011). Football\(^1\) clubs in the United Kingdom “have seen quite a revolution” (pg 6, Styles, 2011), in terms of sustainability. These efforts have ranged from reduction in energy consumption to implementing low-carbon, healthier menu options for sale at games. Styles notes that this pressure to monitor and reduce their carbon footprint has been driven by local “green groups” or groups with environmental focuses; partnerships between green groups and football clubs have been effective in reaching wider audiences (Styles, 2011). Public perception of the Games has driven the football club owners to implement sustainability initiatives and reduce their impact.

In Canada, there has been a trend towards reporting related to sustainability and environmental efforts in hosting large scale events. This was seen in the Vancouver Olympic Games, the Alberta Winter Games and in Canada Games (AWG, 2014; Halifax, 2011; VANOC, 2010). An increase in reporting suggests that organizers of sporting events are becoming more conscious of their environmental impact on a hosting city. The sustainability reports for these sport events have included reporting efforts around waste diversion efforts, measuring an events’ carbon footprint and education and awareness campaigns (AWG, 2014; Halifax, 2011; VANOC, 2010).

1.2.2 Sport Tourism and Waste

The effect on cities of hosting large scale events is comparable to the impacts of tourism and hospitality. Large scale events have a shorter, but much more abrupt impact on their host cities (Horne & Manzenreiter, 2006). A significant influx of event

\(^1\) Referred to as soccer in North America
participants in a short period of time maximizes use of services such as hotels and restaurants; services contributing to excess waste generation.

There has been some research on the environmental impacts of tourism with food waste being one of the most prevalent focuses. Pirani (2004) highlights the amount of food waste generated in the tourism industry. In his article, *Solid Waste Management in the Hospitality Industry*, he identifies that more than half of the waste generated in the hospitality industry is food waste (Pirani, 2014). Even though the ratio of organic waste is decreasing, it is not an indicator of waste reduction; it simply means that there are greater amounts of packaging. There are tools to combat waste generation in the hospitality industry including waste mapping and monitoring.

Organizers of large scale sporting events are leaning toward addressing the environmental impact and other issues of waste accumulation resulting from hosting these events. This awareness has led to waste monitoring, measuring and mitigating as a sustainability initiative in many events. With efforts to monitor waste accumulation, initiatives to reduce and divert waste have developed and have been used in a number of Canadian sporting events including the Vancouver Olympics, previous Canada Games and the recent provincial Alberta Winter Games (AWG, 2014; Halifax, 2011; VANOC, 2010). To be successful in implementing and executing waste management plans, they must be prioritizing environmental and human health.

**1.2.3 Public Participation in Waste Management**

Reduction or monitoring efforts of waste management in events is heavily reliant on the consumer/public and their cooperation. To be successful in enforcing waste
diversion efforts, awareness and education is critical. The most critical groups to target are school aged children that will grow up with a culture of recycling (Hasan, 2004). In most places, the management authority for waste is the local municipality which suggests that waste separation/ recycling strategies could vary from one municipality to another; even neighbouring municipalities can be unique (Bolaane, 2006). This suggests that, even if there is a strong culture of recycling, events attracting guests from varying regions need to implement educational strategies specific to their site.

In some cases, it has been effective to use educational institutions as tools for encouraging and educating children and the public on waste management (Hasan, 2004; Jibril, 2012). Targeting children for education on these issues leads to life-long environmental awareness (Hasan, 2006). However, educational institutions play a larger role than just at the primary level, higher education institutions (HEI) are viewed as the leaders in environmentalism (Hasan, 2004; Jibril, 2012). In many cases, HEIs are viewed as the progressive, driving forces in change including integrated solid waste management (Jibril, 2012). HEIs have been leaders in waste management by implementing comprehensive recycling and compost options, but also through outreach and educational efforts (Hasan, 2004). Many universities will also conduct waste audits that allow for effective restructuring of waste management plans (Hasan, 2004).

Education and awareness are not the only tools needed for effective waste management; they must be paired with appropriate enforcement tools or legislation as well as adequate funding and appropriate technical support (Hasan, 2004). Universities can contribute to moving legislation forward by leading by example and pressuring the
local government (Hasan, 2004). As most decisions are made at the municipal level, HEIs have opportunity to influence their local government (Bolaane, 2006).

HEIs have also been involved heavily in influencing sustainability involvement in sporting events hosted by their home city. This was seen in the Sherbrooke, Quebec, Canada Summer Games in 2013 when the University of Sherbrooke employed a Sustainability Manager for the Games (Sherbrooke, 2013). Many of the environmental services volunteers were recruited by the Sustainability Manager and belonged to the university community; from students to faculty and staff. In this case, the Sustainability Manager was allotted a budget of $100,000 to carry out sustainability initiatives including waste management (Sherbrooke, 2013). It was the combined efforts of designating a position for sustainability, sufficient volunteer involvement and funding that made their initiatives possible.

A major role taken on by the environmental volunteers at the 2013 Sherbrooke Games was environmental education and advocacy (Sherbrooke, 2013). In their report, they have attributed waste management success to sufficient volunteer staffing that was able to engage with the public and educate them on proper waste diversion plans (Sherbrooke, 2013). A critical component of effective waste management is public participation (Hasan, 2004). Research has shown that waste management in events has been more successful when paired with education and awareness efforts; it is helpful in reaching targets and reducing contamination (Hasan, 2004; Hottle, 2015). However, it is argued that it must be combined with an understanding of the benefits of recycling (Bolaane, 2006). Habits of recycling are enforced more effectively when there is either an incentive (such as deposit refunds) or an understanding of the
environmental benefits to recycling, individuals are more likely to develop a long-term habit of recycling (Bolaane, 2006).

In events, it is also important to strategically place the waste receptacles for greater public participation (Bolaane, 2006). Clearly labeled receptacles will make it easier for the public to separate their paper from refundable beverage recycling. The visibility and clarity of waste separation is vital in meeting waste diversion goals. Visibility and accessibility will contribute to increased public participation (Bolaane, 2006; Hottle, 2015).

1.2.4 Waste Management in Canadian Sporting Events

The Vancouver Olympics Committee (VANOC) reported that they had effectively achieved the sustainability goals that were set out early in the planning process (VANOC, 2010). By implementing sustainability into their vision: “to build a stronger Canada whose spirit is raised by its passion for sport culture and sustainability,” VANOC exemplified a strong commitment to sustainability (VANOC, 2010). Using a sustainability scorecard, they monitored waste that was accumulated or diverted during events as well as any waste produced in the preparation leading up to the events, beginning in 2006. The final year of the score card (2010), which was inclusive of the Olympic events, showed a 77% diversion of waste from landfill; 63% of which was recycled or composted with the remaining 14% used to produce energy through the waste to energy facility (VANOC, 2010).

The Alberta Winter Games (AWG) is another example of a sporting event that reported success in implementing a sustainability strategy that encompassed waste management. In 2014, AWG hosted athletes from all corners of the province in Banff
and Canmore (AWG, 2014). From the outset, the AWG committed to hosting a sustainable event, an idea initiated by the towns of Banff and Canmore, rather than the Alberta Sport Connection, the provincial governing body (AWG, 2014). Much like VANOC, the AWG integrated sustainability initiatives into their Games framework by implementing the ‘2014 Alberta Winter Games Environmental Sustainability Advisory Committee’ during the early planning stages (AWG, 2014). This voluntary advisory committee implemented a ‘Towards Zero Waste’ initiative that included public education campaigns prior to the event. The efforts of this committee were not included within any budget, but through partnerships and sponsors, the advisory committee was able to generate enough funds to finance all sustainability initiatives (AWG, 2014). Final reports revealed that the ‘Towards Zero Waste’ campaign yielded an outcome of 84% waste diversion from landfills (AWG, 2014). Both VANOC and AWG reported high rates of waste diversion; this could be attributed to both the early prioritization of this initiative and access to funding or sponsorship. It is, however, important to note that all data from these organizations was self-reported.

The 2011 Halifax Canada Winter Games are the most comparable example to the 2015 Canada Winter Games in Prince George. The Nova Scotian capital has a population that is nearly four times that of Prince George, and held an event with similar budget and infrastructure. Much like VANOC and AWG, the 2011 Halifax Games prioritized sustainability; this heavily contributed to their transfer of knowledge efforts for subsequent Canada Games (Halifax, 201). The Halifax Games were the first Canada Games to allocate an entire organizational committee for environmental services (Halifax, 2011). This committee sought to quantify the amount of waste accumulated
and diverted for the first time in a Canada Games event (Halifax, 2011). The final reports from the host society showed a diversion rate of 39% which was based on volume. The environmental services committee also provided a document that outlined a list of challenges with meeting their targets of 50% diversion including training and coordination with janitorial staff and insufficient staffing of volunteers and environmental services representatives. One other major issue that the ESC encountered was that, due to sponsorship from Coca Cola, encouraging reusable water bottle use was challenging (Halifax, 2011).

The Vancouver Winter Olympics, the Halifax Canada Winter Games and the Alberta Winter Games all show examples of waste management planning for large scale winter sporting events. Final reports for each of these Games were created within their organization and raw data was not accessible to the public. VANOC and the Alberta Games showed high rates of waste diversion in their reporting, while Halifax raised challenges in meeting those targets.

The Canada Games implemented a ‘Transfer of Knowledge’ legacy piece to help maintain consistency between Games (CGC, 2014). The Halifax Winter Games and the Sherbrooke Summer Games had initiated and followed through with ‘Transfer of Knowledge’ efforts with a focus on the environment and sustainability. One of the legacies of the Halifax Winter Games was the creation of the Environmental Services Committee that played a role in the subsequent Sherbrooke Summer Games as well as in the Prince George Winter Games. As mentioned, the University of Sherbrooke played an important role implementing a Sustainability Manager for the Games; this piece was transferred into the 2015 Prince George Games. Prince George’s university, the
University of Northern British Columbia (UNBC), employed the Sustainability Manager for the 2015 Games.

1.3 The Case Study: 2015 Prince George Canada Winter Games

1.3.1 Canada Games

In February 1967, 1,800 athletes from ten provinces and the then two territories gathered in Quebec City to participate in 15 different sports marking the inception of the Canada Games (CGC, 2014). Since then, the Canada Games have been held every two years, alternating between summer and winter, giving each province and territory equal opportunities to host (CGC, 2014). Since the first Games, over 100,000 athletes that qualify as the best in their age group have competed in Canada Games (CGC, 2014). Today, it is the largest multi-sport competition to allow junior athletes to compete on a national level in the world (CGC, 2014). The Canada Games Council (CGC), a private non-profit organization established in 1991, acts as the governing body for the Canada Games (CGC, 2014). One of the primary goals of the CGC is to implement and execute an effective Transfer of Knowledge program. This governing body also makes decision on which cities will be selected to host the Games (CGC, 2014).

With an official bid to host the 2015 Canada Winter Games made in June of 2009, the CGC announced on September 17, 2010 in Vancouver that Prince George had been selected as the host city for BC (BC, 2010). Prince George was selected over two other British Columbian cities, Kelowna and Kamloops. The CGC made this decision based on the city’s pre-existing sport infrastructure and perceived knowledge of hosting sports (BC, 2010). Southern BC had previously hosted Canada Games in
New Westminster/Burnaby (1973) and in Kamloops (1993); Prince George was the first city selected to host for Central/Northern BC (CGC, 2014).

After the Chief Executive Officer, Stuart Ballentyne, was hired in 2011, the 2015 Host Society adopted the following vision:

“Together, we’ll write a northern story of spirit and passion inspiring unique and magical experiences for all Canadians” (CWG, 2014).

The emphasis of “writing a northern story,” was also in the original bid proposal, in which the Games marketed the proposed event as “a truly northern Games”, instead of a Prince George Games. This was also the first time that the local First Nations, the Lheidli t’enneh, were an official host First Nation. The Host Society highlighted the northern communities by including them in the Torch Relay and by showcasing local and regional talent in the north (CWG, 2014).

1.3.2 Prince George, BC

As the meeting point of the Nechako and the Fraser Rivers, Prince George is commonly referred to as the “Gateway to the North” or the Northern Capital of BC (PG, 2014). As the regional hub for shopping, arts and sport, it is the largest city in Northern BC, even though it is actually centrally located in the province (PG, 2014). The sport infrastructure used by the 2015 Games was, for the most part, pre-existing with only a few upgrades required. For a city of 76,000, there is a wide availability of sport facilities including multiple indoor ice rinks, multi-sport facilities, aquatic centers, and ski resorts.

Prince George is a unique urban centre that is rurally located. Even though it is a medium sized city, it acts as the access point to many areas for services and amenities.
Certain amenities are harder to access in Prince George due to its isolation from other large urban centres, including comprehensive waste management. A northern climate can contribute to limitations in food waste disposal, given outdoor compost is stalled during winter months and wildlife considerations in the spring and summer. Historically, the city has heavily relied on landfills for waste management (TRI, 2007).

Prior to this research project, reports show that municipally and regionally there were efforts to restructure waste management plans in Prince George through the Regional District of Fraser-Fort George (RDFFG), which is responsible for waste management in the region including Prince George (TRI, 2007; RDFFG, 2011). In 2007, a waste audit was conducted at the Foothills Boulevard landfill. Waste was separated to conduct an analysis of the content of solid waste. The RDFFG contracted Technology Resource Incorporation to produce the report: *Waste Characterization Study of Foothills Boulevard Landfill* (TRI, 2007). In 2011, using the information provided from the 2007 assessment, the RDGGF produced another report titled: *A feasibility study on enhancing waste diversion from the residential curbside solid waste stream in the city of Prince George*, in support of the Regional Solid Waste Management Plan (RDFFG, 2011). These reports were published by the RDFFG and then made publicly accessible through the RDFFG website (www.rdffg.bc.ca). As evidenced by these two reports, there was strong interest in restructuring waste management at both the regional and municipal level.

The waste audit conducted for RDFFG may not have independently generated the support needed to restructure regional waste management plans but another local initiative, a waste audit at UNBC, had lasting impacts in the university (Smyth et. Al,
HEIs tend to be viewed as the leaders and innovators of sustainability initiatives, including waste management and can have an influence in restructuring waste management in their local municipality (Bolaane, 2006).

Even though several reports indicated a strong interest in a renewed waste management system at a local and regional level, it was the provincial government that initiated restructuring. Curbside recycling in residential areas was introduced to the city of Prince George in September 2014, a requirement imposed at a provincial level (McCallum, 2014). Although drop off recycling facilities exist throughout the region, reports from 2007 show that they were heavily underused (TRI, 2007). The community also has minimal services for limited composting\(^2\), including a drop off service available at the UNBC, but this is limited to personal or residential use; businesses are not permitted to make use of this service (PGPIRG, 2014). REAPS, (Recycling & Environmental Action Planning Society), is another option for limited forms of composting. Local businesses, such as Books and Company, make use of this service, at a charge (REAPS, 2014).

1.3.3 Waste Management in Canada Winter Games

In February 2015, Prince George, British Columbia was host to the Canada Winter Games, an 18 day event that attracted approximately 8,000 people to the city from every province and territory in Canada. In the span of 18 days, 21 venues across the Prince George area hosted 19 official sports that were accompanied by nightly festivities and fireworks. While events celebrating young athletes and encouraging the growth of sport and recreation across the country are commendable, the events must

\(^2\) Does not include food waste
be manageable for the host cities. While there was an emphasis on economic sustainability in hosting the Prince George Games, there was uncertainty around the environmental impacts as these were not addressed in the strategic legacy platform and excluded from the budget.

Waste management was a main focus within the operational area of environmental services for the 2015 Games; this study sought to examine the waste management procedures and how they were impacted by a rural, northern location. The purpose of the research was, in part, to assess the consideration and prioritization of environmental impacts when hosting large scale events as well as to understand the waste that is generated. The methods chapter will outline reasons and rationale for using mixed methods and describe how the study was conducted.

1.4 References


Planning: www.reaps.org/programs/projects.html


2.1 Introduction

This study sought to triangulate the case study through multiple methods in an effort to understand the planning process and to contextualize the findings. This research design used mixed methods to combine quantitative and qualitative data collection. This chapter discusses the use and selection of methods and details how they were carried out. It also provides reasoning for the choice of each method and how it relates to the following research questions:

1. How were plans for the 2015 Prince George Canada Winter Games to be a sustainable event through waste management carried out by the Host Society?

   A. What were the goals and initiatives as articulated by the Host Society and key volunteers?

   B. What were the limitations and barriers? For example, did the northern, rural context of the host community impact waste management?

2. How was waste managed in the 2015 Games?

   A. How much waste was actually diverted and how much could have been diverted with the facilities available to the region?

   B. What types of waste were generated? What areas were sources of high waste generation?
2.2 Mixed Methods

This study employed a mixed methods approach that included both quantitative and qualitative methodology within a case study context: the 18 day event. The quantitative study included a waste audit that was completed within the 18 day span. The qualitative study involved reviewing policies and other documents, participant observation and interviews with key informants. The qualitative research was conducted before and after the events occurred.

Using the case study as an approach to research design helps triangulate quantitative and qualitative research (Yin, 2009). Case studies strengthen the mixed methods argument by essentially filling the gaps in research that the other methods leave. Case study research answers “how” and “why” questions instead of “what” questions; it helps researchers better understand the phenomena (Yin, 2009). Typically, how and why questions will come out when the researcher aims to gain a stronger understanding of the case, the event in this context. This research sought to contextualize and determine implications of waste management in the 2015 Games; to understand how the procedures were carried out, the outcomes and their subsequent implications. In order to tell this story, case study research was necessary to emphasize the singularity of this event and reflect the context specific indicators. The “how” questions contextualized this research while the “what questions” contributed to broader research in events.

Using mixed methods helped compensate for limitations, such as time and resources, in collecting data using a single method study. This study looked at the composition of the waste in order to determine the amount of waste that could have
been diverted from landfills, hence the quantitative analysis that sought to answer the second set of research questions. It was, however, important to review reports and policies in identifying the plans to be carried out; this was important in understanding the prioritization of waste management in the planning process. Interviews with key informants gave context and perspective of barriers in waste management planning and execution. They aimed to answer the first subset of questions.

There has been some controversy in using mixed methods in the past and there are arguments that mixed methods cannot be used to triangulate between datasets, but modern research is beginning to rely more heavily on mixed methods (Creswell & Clark, 2007; Sale, Lohfeld & Brazil, 2002). Using complementary mixed methods is common research practice in areas such as health care research (Sale, Lohfeld, & Brazil, 2002). The argument that qualitative research was not comparable to quantitative research as it included bias has since been countered in the argument that all research has bias; identifying and managing bias are the important considerations (Creswell & Clark, 2007).

The table below summarizes how research was collected and how that data related to the research questions.
The qualitative research sought to understand the implications for waste management within its context of a northern rural community. The aim was to identify variables or barriers in planning a comprehensive waste management plan for a large scale sporting event occurring in a northern, rural context. The study therefore looked at the Games’ organizational structure, budget, strategic plan and the policies in place.

In the quantitative research component, a waste audit and waste characterization study sought to identify how much waste was diverted from landfills and into either
recycling or compost and to assess how much could have been diverted based on the recycling facilities available to the city within the Fraser Fort George Regional District.

2.3 Sample Sites

For consistency, the focus of all methods was on four sample sites that were most representative of the 19 venues utilized to host the 2015 Games. In choosing these sites, there was consideration of the types of events being hosted, whether they were outdoor versus indoor venues and site ownership. The four sampling sites chosen were: the Civic Centre, the CN Centre, Northern Sports Centre, and Otway Nordic Ski Centre.

The Civic Centre was part of a greater venue known as Athlete’s Village that also encompassed various hotels in the downtown area that hosted all of the athletes participating in the Games. The Civic Centre was designated as the feeding centre for athletes, coaches and mission staff. Most meals consumed by participants from the Games were served at the Civic Centre. As a City owned venue, waste was already collected by the City and it had some pre-existing recycling infrastructure in place: only a small number of bins were brought in for additional recycling during the Games. Even though the Civic Centre is host to several catering events, the facility does not have an option for food waste diversion. The Civic Centre’s original waste management plans are comparable to some other City owned venues, including the CN Centre.

The CN Centre was host to many of the hockey games and other festivities or ceremonies throughout the two week period. This venue is also owned and operated by the City. Waste from this venue was primarily directed to the landfill. There were a few
receptacles for refundable recycling\textsuperscript{3} throughout the concourse among the 40-50 waste bins. This facility required significant upgrades to its recycling for the Games which involved adding 20-30 recycling receptacles. The CN Centre has some food vending shops as well as a full service kitchen. The Games brought food in regularly to volunteer lounges and served granola bars and juice boxes to athletes in the changing rooms that only housed garbage bins with no recycling. For a City owned venue, the original waste management was minimal, particularly in comparison to another City owned venue: the Northern Sport Centre.

The Charles Jago Northern Sport Centre (NSC) is a unique venue that is owned by the City, but operated by UNBC. This venue hosted several indoor sporting events and served as the final feeding centre for athletes and coaches following the closing ceremonies. To coincide with university operations, there are some multi-material waste/recycling bins that accept paper, plastic, refundable plastics and garbage. This venue did require some additional bins to be brought in by the Host Society to meet the waste management plans for the Games. The facility itself invested in an additional four-tiered waste bin set to supplement the current bins. At the time of the Games, the Northern Sport Centre had a small Café that served hot drinks, packaged sandwiches and other snacks. This venue also had no form of food waste diversion available initially, but a Jora\textsuperscript{4} composter was temporarily implemented for the Games and accepted raw fruits and vegetables. The composter was in operation for the second week of the Games. The Northern Sport Centre has more of a comprehensive waste

\textsuperscript{3} Also known as refundable beverage containers; accepted for a deposit refund in the Province of British Columbia

\textsuperscript{4} Continuous-use compost tumbler
management plan that other City owned properties in this study as it is operated by and heavily influenced by the university.

Otway Nordic Ski Centre was the only sample site that was an outdoor venue. Otway is situated just outside of the city and offers nearly 55 km of trails for skiing, snowshoeing and other winter recreation. This venue is comprised of a small cabin and a day lodge that offers amenities such as washrooms, a kitchen, and a small concession. Otway Nordic Ski Centre is operated by the Caledonia Nordic Ski Club, a non-profit organization comprised of a volunteer board of directors. Initially, Otway had no waste diversion with all waste directed to landfills; this was not uncommon for privately owned or non-profit venues. To host events, all recycling receptacles needed to be brought in by the Host Society.

With an outdoor venue, a multi-purpose venue, a feeding centre and an ice rink, these sites attempted to represent the variety of venues utilized in the 2015 Games. Their data was site specific and only used for a very general understanding of the waste generated at the overall 2015 Games.

2.4 Participant Observation and Interviews

A characteristic of case study research that distinguishes it from historical research is the opportunity for the researcher to become a part of the research (Kawulich, 2005). When case study research involves contemporary or current events, it allows for direct observation. I was able to participate in the planning process of the 2015 Canada Winter Games and to make connections within the organizing teams that allowed for an insightful research project.
In September 2014, I joined the Environmental Services Committee (ESC) to represent the Northern Sports Centre and UNBC. As a planning volunteer, I met with this group approximately twice per month for regular team meetings and other training events leading up to the Games. In these months leading up to the Games, the team worked to ensure the proper implementation of environmental services.

While there was no documented data from direct observation or participant observation, my involvement with the ESC helped form the research questions and build relationships with key informants. Attending the planning meetings and observing the interactions and relationships between ESC and the Host Society also identified components of waste management plans and process to investigate. Research questions were derived from a stronger understanding of the planning process and the already identified limitations and barriers. Conversations that took place in meetings or other interactions, with the understanding that my involvement with the ESC was related to my project, helped to inform the larger research questions as well as the interview questions.

As part of a mixed methods research design, interviews helped further the understanding of the waste management planning in the 2015 Games. There were a fairly balanced number of interviews from both the ESC and the Host Society. In total, I conducted five interviews with the staff of the Host Society: the Manager of Venue Operations, the Sustainability Manager and the staff members, and venue coordinators associated with my four sample sites; one coordinator was responsible for two of my venues. One of these venue coordinators was also the environmental services
coordinator. I interviewed six ESC volunteers: the four planning representatives associated with my sample sites as well as the two ESC leads.

There was a strong sense of comradery within the ESC as we worked very closely in the weeks leading up to the Games. As the researcher, I became heavily invested in this team which could contribute to personal bias. Even though the Host Society was supportive of the research, there was less interaction and involvement with staff than with ESC volunteers.

Through my involvement with the ESC and the interviews, the research questions the study sought to investigate through these methods were:

How were plans for the 2015 Prince George Canada Winter Games to be a sustainable event, through Waste Management, carried out by the Host Society?

A. What were the goals and initiatives as articulated by the Host Society and key volunteers?

B. What were the limitations and barriers? For example, did the northern, rural context of the host community impact waste management?
2.4.1 The Interviews

Table 2.2: Interview Participants: their roles and the organization they belonged to

<table>
<thead>
<tr>
<th>#</th>
<th>Host Society</th>
<th>#</th>
<th>Environmental Services Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manager of Venue Operations</td>
<td>2</td>
<td>Committee Leads</td>
</tr>
<tr>
<td>1</td>
<td>Sustainability Manager (UNBC Employee)</td>
<td>1</td>
<td>Venue Representative: Civic Centre</td>
</tr>
<tr>
<td>1</td>
<td>Venue Coordinator: Civic Centre</td>
<td>1</td>
<td>Venue Representative: CN Centre</td>
</tr>
<tr>
<td>1</td>
<td>Venue Coordinator: CN Centre</td>
<td>1</td>
<td>Venue Representative: Northern Sport Centre</td>
</tr>
<tr>
<td>1</td>
<td>Environmental Services and Venue Coordinator: Northern Sport Centre, Otway</td>
<td>1</td>
<td>Venue Representative: Otway</td>
</tr>
<tr>
<td>5</td>
<td>Total Interviews</td>
<td>6</td>
<td>Total Interviews</td>
</tr>
</tbody>
</table>

The six interviews with the ESC, outlined in Table 2.2, were all semi structured. There were guiding questions for each interview, but conversations were not limited to these questions. The purpose of conducting interviews was to delve deeper into the planning process so as to develop a richer understanding than what was provided in the formal reports. These interviews answered questions that could otherwise not be answered through document analysis and the waste audit. They sought to provide
insight and context to the case study with a local and engaged perspective. The study focused on the four sample sites throughout the research for consistency. The ESC representatives for the Civic Centre, CN Centre, Northern Sport Centre and Otway Nordic Ski Centre were interviewed to provide details of the waste management procedures at their respective venue. The interviews with the ESC leads were included in the research to determine organizational details relating to waste diversion options and to understand their relationship with the Host Society. An ESC lead had also recruited and comprised the committee and could provide organizational insight. Part of the role of the ESC leads was to work with the Host Society to develop unified goals and initiatives for the 2015 Games.

Working alongside the ESC for the five months leading up to the Games gave me a sense that there were limitations and barriers in seeking waste diversion options. It also revealed that the ESC had little authority in the organizational aspects, but that there was a strong knowledge base in both waste management and the options available to them in the region. Several of the members of the ESC were employed by the municipal, regional or provincial government. Membership included the Executive Director of the Recycling and Environmental Action Planning Society as well as the Regional District’s Waste Diversion Program Leader. Having this information and insight regarding the ESC allowed me to produce a set of questions that would highlight their knowledge and strengths as a committee.

In contrast, my relationship and interaction with staff of the Host Society was limited and minimal. On occasion, I would work at the offices, but spent little time working with any of the employees, with the exception of the Sustainability Manager. In
part, it was a fast paced work environment, but there was also less investment in the research. This allowed for less participant observation than with the ESC. The five interviews with the Host Society were selected because their positions were either related to the operations at the selected sample sites or were related to environmental service functions. Even though the Sustainability Manager is listed as a Host Society employee in Table 2.2, she was also a UNBC employee and a member of my master's project committee. She was more invested and involved in the research than any other employee at the Host Society. The Sustainability Manager acted as a liaison for me with the Host Society which allowed me access to the research sites when required. The other four interviews were with the Manager of Venue Operations and three of the Venue Coordinators; their primary skillset and previous experience related event planning and management. One of venue coordinators was responsible for two of my venues, the Northern Sport Centre and Otway, but she was also the environmental services coordinator and liaison with ESC; the environmental services committee communicated primarily with this coordinator. The roles of the Venue Operations team were primarily in operational execution.

All interviews were semi structured; they were recorded for accuracy, with permission, and transcribed. Transcribed copies of the interviews were sent to the participants for approval if it had originally been requested. The questions were only guides that prompted discussion surrounding waste management procedures as they were carried out during the event. The questions related to the interviewee’s role in the

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5 Worked jointly with the Host Society in the role as a result of a UNBC/Host Society partnership
6 The question guide can be found in Appendix B
Games, their knowledge of sustainability and waste management and their familiarity with the Prince George area. These interviews were intended to gain a stronger understanding of the planning process for waste management in large scale events.

There was some discrepancy in timing of the interviews, following the Closing Ceremonies, there was only a week or two before some of the venue coordinators completed their employment contracts and so these interviews were conducted shortly after the Games. The interview with the Manager of Venue Operations and the Sustainability Manager were conducted within a month following the Games as their contracts were longer. Once the Games were over, the ESC dispersed and it became difficult to schedule. These interviews were held between May and July of 2015. The timing of these interviews could contribute to the responses recorded and their memory of the experience. Interviews that were delayed may not have been able to provide as much detail of the events as the interviews conducted earlier. Research shows that both short term and long term memory decay over time and this can impact interview responses (Sudman & Bradburn, 1973).

The interviews and participant observation provided one data set of the research as the participant observation led to the interviews. This was used to further complement and inform the quantitative research collection. The qualitative data set helped provide context for the quantitative waste sampling and sorting as detailed in the next section.
2.5 Quantitative Waste Sampling and Sorting

There have been numerous studies conducted on waste management that suggest using waste audits as a tool to assess waste generation and diversion. The province of Ontario requires all post-secondary institutions to conduct a waste audit and to develop a waste management/reduction plan (Waste Reduction Group Inc., 2014). This was an effective tool for re-evaluating and updating waste management at McMaster (Waste Check, 2011), Brock University (Waste Reduction Group Inc, 2014) and Queen’s University (Queen’s University, 2011). There is also a standardized waste audit manual available for use, but without ongoing updates, it is not commonly utilized and many institutions create their own framework (Fenco MacLaren Inc., 1996). Non-mandated waste audits in Prince George have included the Foothills Landfill as well as at UNBC (Smyth et. al., 2010; TRI, 2007).

Even though waste audits are common and have been conducted in various forms, there are not many cases of comprehensive waste audits at large scale sporting events; waste tracking is more common. Outside of a waste audit a study of single-day University baseball games hosted by Arizona State University, literature on waste audits in large-scale sporting events is limited (Hottle, 2015). To account for the diversity in the venues of the Games, given that they were spread throughout the city, a strategic research design was required to sample within the 18 day time frame to address research time restraints.

Below are the research questions investigated related to quantitative waste sampling and sorting:

How was waste managed in the 2015 Games?
A. How much waste was actually diverted and how much could have been diverted with the facilities available to the region?

B. What types of waste were generated? What areas were sources of high waste generation?

The initiative to weigh all waste associated with hosting the 2015 Games was taken on by the Environmental Services Committee (ESC); a volunteer operational committee. This committee aimed to calculate the amount of waste generated and to determine the rate of diversion. They had set out to weigh all three streams of waste, paper recycling, container recycling and garbage, at each venue by volunteers. Their aim was to quantify the amount of waste generated and diverted. I was completely dependent on the ESC to collect this data.

Determining the potential for waste diversion was based on the samples and the approximated rate of diversion through available diversion streams. The samples that were collected represented what was being directed to landfills (the diversion percentage provided by the ESC) and within that percentage, the study sought to determine how much of that potentially could have been diverted. The characterization study sorted the waste into categories that are generally the greatest areas of waste generation in other studies. This was based on waste audits conducted on Foothills landfill and an earlier study of UNBC waste (TRI, 2007; Smyth et. al., 2010). These two studies indicate that approximate breakdown of waste generated in the region. It was in line with other literature relating to waste audits (Waste Reduction Group Inc., 2014). The categories then also accounted for waste that could have been recycled according to the facilities available in the region.
2.6 The Waste Audit

2.6.1 Collection

While the ESC sought to collect data on all waste that was generated, this study focused on a composition study through a waste audit during the event days. The four sample sites that were selected in an attempt to represent the overall Games were sampled six times each week of the Games for a total of 48 samples; this resulted in 12 samples from each location. The six days of sampling each week were chosen based on events; February 21 and 22 were scheduled as ‘turn around’ days where week 1 athletes would depart and week 2 athletes would arrive. As such, sampling on these days did not occur as these days did not accurately represent the level of activity throughout the competition days.

Table 2.3: Sample Collection Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Sample #</th>
<th>Venues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 14, 2015</td>
<td>1</td>
<td>Civic Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northern Sports Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Otway</td>
</tr>
<tr>
<td>Feb 15, 2015</td>
<td>2</td>
<td>Civic Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northern Sports Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Otway</td>
</tr>
<tr>
<td>Feb 16, 2015</td>
<td>3</td>
<td>Civic Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northern Sports Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Otway</td>
</tr>
<tr>
<td>Feb 17, 2015</td>
<td>4</td>
<td>Civic Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northern Sports Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Otway</td>
</tr>
<tr>
<td>Feb 18, 2015</td>
<td>5</td>
<td>Civic Centre</td>
</tr>
</tbody>
</table>
The samples were indiscriminately collected bags of garbage that had been generated at undisclosed areas of each facility. Samples were either collected directly from the dumpster or they were set aside by the volunteer team that was responsible for weighing the waste to be collected. There was a staggered schedule of collection to account for the different types of waste that was generated throughout the day. The variation in sampling times was primarily to account for the Civic Centre as it had four

<table>
<thead>
<tr>
<th>Date</th>
<th>Sample No.</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 19, 2015</td>
<td>6</td>
<td>Civic Centre, CN Centre, Northern Sports Centre, Otway</td>
</tr>
<tr>
<td>Feb 20, 2015</td>
<td>7</td>
<td>Civic Centre, CN Centre, Northern Sports Centre, Otway</td>
</tr>
<tr>
<td>Feb 23, 2015</td>
<td>8</td>
<td>Civic Centre, CN Centre, Northern Sports Centre, Otway</td>
</tr>
<tr>
<td>Feb 24, 2015</td>
<td>9</td>
<td>Civic Centre, CN Centre, Northern Sports Centre, Otway</td>
</tr>
<tr>
<td>Feb 25, 2015</td>
<td>10</td>
<td>Civic Centre, CN Centre, Northern Sports Centre, Otway</td>
</tr>
<tr>
<td>Feb 26, 2015</td>
<td>11</td>
<td>Civic Centre, CN Centre, Northern Sports Centre, Otway</td>
</tr>
<tr>
<td>Feb 27, 2015</td>
<td>12</td>
<td>Civic Centre, CN Centre, Northern Sports Centre, Otway</td>
</tr>
</tbody>
</table>
scheduled times for feeding. All sites were sampled within two hours and were affected by the staggered schedule.

In accordance with the safety plan\(^7\), most samples were processed once collected, but on occasion, this was delayed. If samples were collected from the sample sites at night, they were processed the next morning and stored in a cooled temperature location overnight. To account for any variation in weight, the samples were weighed at the point of collection and again before processing. Anyone involved in the processing was dressed appropriately in protective gear as outlined in the safety plan. Researchers were dressed in Tyvek suits and equipped with goggles, face mask and gloves. The characterizing and sorting was conducted at UNBC’s Enhanced Forestry Lab (EFL) on raised benches. Tarps covered the benches and the samples were emptied onto the surface that was washed off after each sample. After processing samples, they were collected in industrial strength garbage bags before being disposed of into the UNBC dumpsters.

2.6.2 Characterizing

There is a wide range of research on waste audits, primarily focusing on either institutional waste or residential waste. There have been studies conducted at the regional landfill level as well as the university level for Prince George (TRI, 2007; RDFFG, 2011). In 2007, a report documented that the content of residential waste in Prince George was comprised primarily of paper products, plastics and organic matter; occupying approximately 75% of the overall waste in weight (TRI, 2007). A study at the UNBC had similar results in its waste audit report. Drawing from these reports, this

\(^7\) Attached in Appendix C
study characterized waste into the following categories: paper and paper products (recyclable and non-recyclable), plastics (recyclable and non-recyclable), organic/food waste, mixed materials and ‘other’. Some waste audits will include more categories, but due to time and resource constraints, this research targeted categories in which the most waste was projected to generate (Fenco MacLaren Inc., 1996).

**Paper**

Paper and paper products were a standalone category, and were then subcategorized into recyclable and non-recyclable. The items would fit into the recyclable category if the item was accepted, in any form, within the Regional District of Fraser Fort-George (RDFFG). Non-recyclable paper products were generally associated with food service and were categorized based on the amount food contamination. In characterizing the samples, it was estimated what items would have been intact if they had not entered a bag of garbage; this was very approximate. Due to hygienic restrictions, paper towel was included in the non-recyclable sub category.

**Plastics**

There are a variety of plastics that are accepted within the RDFFG that are described in the Multi-Material BC handbook. Most materials are recyclable with the exception of thin Polyvinylidene Chloride (PVC) materials and high or low density polyethylene (HDPE; LDPE) garbage bags. Depots in the RDFFG will accept grocery bags or salad bags that are HDPE or LDPE, but not garbage bags proper. Plastic bottles were in the refundable beverage category.

**Refundable Recycling/ Refundable beverage containers**
Refundable beverage containers included any item accepted at depots for a deposit refund. This included tetra pak juice boxes, plastic soda bottles, aluminum cans and glass bottles. These items were separated from the other categories to assess the rate of recycling when items are viewed as commodities. These items have a value attached and in turn this could have influence on the rate of diversion.

**Mixed Materials**

Mixed materials were a widely ranging category that encompassed materials that were still distinguishable, but not enough of a contributor to waste to be a full category. As a miscellaneous category, it contained items that ranged from batteries to aluminium foil to tin cans. Polypropylene such as aluminium foil-lined plastic that was generally from granola bars was placed in this category instead of plastics as it was not entirely made of a plastic. Other items that were comprised of multiple materials were placed in this category as well.

**Other**

The 'Other' category included all items that were not identifiable or were not permitted to be disposed of in the samples. This included, but was not limited to medical waste, used feminine hygiene products, ends of cigarettes and various other minor items that were deteriorated beyond recognition. Items that were not permitted to the landfill included any form of medical waste.

After separating and characterizing the samples, each category was weighed individually. The data sheets also included observations identifying details on contents. The observations were to approximate the location and source of the waste. The data
sheets also included number counts for certain items such as paper cups and Styrofoam serving bowls. This data was recorded in order to approximate waste composition that was difficult to portray through weight alone. All waste was safely disposed after processing. A sample data sheet is included in Appendix D.

2.7 Conclusion

This chapter has outlined the steps that were actually taken to collect data leading up to, during the event as well as the interviews that followed. There were some changes from the proposal that were influenced by the resources available and other limitations or restrictions; these are discussed in the results and discussion chapters. The steps taken to collect this data give context for the findings and results that can be found in the next chapter.

2.8 References

Queen’s University. (2011). Queen’s University Waste Audit Summary. Kinsgton: Queen’s University.


Chapter 3: Results

This chapter is broken into two main sections: sustainability and waste management planning and waste diversion. The two sections reflect the methods taken to collect data. While section 3.1 focuses on the results of the qualitative research, section 3.2 discusses the quantitative findings.

3.1 Sustainability and Waste Management Planning

3.1.1 Goals and Initiatives for Waste Management

Through my involvement with the ESC and encounters with the Host Society staff, it quickly became clear that there was a disconnect between the two groups. It was important to determine what the goals and initiatives were for each of these stakeholders and if they aligned. The goals and intentions for waste management varied between interviewees from the ESC and the Host Society. For the Host Society Operations Manager, who had held several similar event based roles in the past, the goal was to have some form of waste diversion in the venues. In her previous experience, venues had already been equipped with receptacles and pre-existing waste management plans. For the Sustainability Manager, the hope was to implement a waste management plan that would adhere to national and international event standards: CSA\textsuperscript{8} and ISO\textsuperscript{9} to be comparable to the previous Canada Games, the 2013 Sherbrooke Games that had been certified by a Quebec specific organization BNQ\textsuperscript{10}. Certification of these standards allow for guidance and accountability of reporting. There was no

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\textsuperscript{8} Canadian Standards Association
\textsuperscript{9} International Standards Organization
\textsuperscript{10} Bureau de normalisation du Quebec
budget for certification, but these standards were addressed in the Final Sustainability Report.

The ESC had a vested interest in the Games relating to sustainability. The members were hopeful that this event could be an opportunity to restructure waste management in the city of Prince George and to promote a culture of recycling. In their interviews, the ESC leads expressed their desire to create a legacy through the Games that would improve and upgrade waste diversion infrastructure for the venues that hosted the events. The original target goal for waste diversion was set at 80% by the ESC, but they had reduced the goal to 60% when a food waste diversion option could not be secured.

For the remaining ESC representatives and the Host Society venue coordinators, the goals were simply to administer the waste management plan. Their goals were to ensure that bins were placed at their respective venues and that the waste was weighed and recorded each day. The ESC volunteers had expressed that they originally had the desire to incorporate education and awareness efforts, but during the Games, their focus shifted to simply to capture all the weights. This was, in part, attributed to low volunteer staffing.

One of the ESC leads, who was also the first member of the ESC, helped recruit and build the team of environmental professionals. He explained that:

“when coming into it [sic] that I could leverage some of my experiences to bring more light to some of the larger sustainability and stewardship issues as well.”

He also went on to say:
“most people were again more looking for the engagement and educational opportunities also some of the stewardship elements. Most of them didn’t realize it would be limited to the poop and trash, as I call it.”

The other lead for the ESC had similar comments:

“I perceived the role to be educators on sustainability and to be stewards of the environment and sustainability initiatives, to leverage the Games to make a legacy in terms of any sort of sustainable, environmental projects we could get off the ground for Prince George and we would be dealing with the recycling and the composting and the waste removal supplemental to what was already in place at the venues.”

These comments from the ESC chairs indicated that there were issues of communication between the Host Society and the ESC on the goals for waste management as well as a misunderstanding of the positions held. The ESC felt that their roles encompassed broader sustainability stewardship initiatives as opposed to an operational committee. They had entered the committee with hopes of creating sustainability legacies through the Games. The discrepancy in goals and initiatives for waste management between the two groups resulted in limitations in reaching those goals. These issues of disparity stemmed from the inconsistency in environmental knowledge and background and led to limitations for the planning process which included a lack of communication, operations and execution challenges as well as logistical limitations.
3.1.2 Limitations in Planning: Environmental Background

As outlined in the previous chapter, 11 interviewees were selected based on the positions they held in relation to waste management. The operational staff had the majority of the decision making power; their skillset focused on event planning with minimal experience or knowledge of sustainability and environmental management. The ESC team was comprised of individuals employed in the environmental field and was familiar with and established in the northern, rural context, but who did not work in the event planning industry.

The venue operations staff faced a steep learning curve from the lack of background in environment and sustainability. “It was brand new to me here. Brand new, brand spanking new” was the response of the Manager of Venue Operations when asked about her background in sustainability. The environmental services venue coordinator, who acted as the liaison for the ESC and the Host Society, only had basic custodial involvement when hosting events in the past. The two other venue coordinators that were interviewed explained that their roles and responsibilities were to ensure that a plan was executed but had little involvement in making that plan which involved implementing two forms of recycling and measuring all waste generation.

The Sustainability Manager did not have an environmental background and was not familiar with Prince George when hired on to her position 11 months before the event, but had worked in community development. As an employee of UNBC for the Games, her position focused, in part, on student and faculty involvement in sustainability related legacies for UNBC and the wider northern region. This position did
not have a budget and thus support for sustainability initiatives rested on investment from other operational budgets within the Host Society and UNBC.

The Sustainability Manager was not the decision maker for the waste management plans. The lack of knowledge or background in sustainability was not perceived as the greatest barrier in meeting goals, although it did provide a steep learning curve for the Sustainability Manager. For the Games to be adequately prepared in waste management would have required decisions to be made prior to her arrival including prioritizing and budgeting.

3.1.3 Limitations: Communication and Conflicting Expectations

Communication was a recurring barrier identified in the interviews, both from the ESC and Host Society. The roles of each stakeholder had not been clearly communicated between the ESC and the Host Society. As mentioned, the ESC had understood, as communicated by the Host Society initially, that these Games would be an opportunity for environmental stewardship and education; however, both the leads indicated that the title of the committee was misleading. The Operations Manager of the Host Society had difficulty clarifying that it was only an “operational committee as opposed to a sustainability committee.” She went on to say that “I think the biggest challenge was what the committee was called which is what we inherited and the focus of what the group was hoping to achieve as opposed to what we really needed to achieve.” She attributed some of the lack of understanding and miscommunication to decisions made prior to her arrival with the Host Society, as the ESC was initiated before there was a Host Society lead for Environmental Services.
There was also misunderstanding over the role of the Sustainability Manager. Although, it did pertain to other areas, the primary purpose of this position was to include UNBC into the sustainability portfolio. The title led to misunderstanding of expectations of the Sustainability Manager by the ESC and even some of the Host Society staff which led her to disconnect from the ESC entirely: “I removed myself from the environment meetings because it was creating conflicts with communication”. The Sustainability Manager attended meetings until the environmental coordinator was hired. There was initially some conflict when the environmental coordinator began meeting with the ESC, the coordinator had explained that “there was a lot of friction”, but that it “progressed a lot” and by the end they “definitely started working well as a team.”

3.1.4 Limitations: Budget

A major recurring barrier for the ESC and Sustainability Manager was that a budget was never communicated to them for waste management. The budget for the entire Games was also framed in a way that only allowed sponsorships for areas that were already in the budget. This proved a challenge for the Sustainability Manager in acquiring in-kind donations related to sustainability (such as fair-trade coffee), as sponsorship privileges and recognition could be afforded on a ‘special-case’ basis by the CEO of the Host Society.

Despite difficulty in acquiring sponsorship privileges for items that were not budgeted, receptacles were sponsored by Multi-Material BC (MMBC) by an exception was granted by the Chief Executive Officer of the Host Society to recognize Multi-Material BC as a sponsor for providing recycling receptacles. Nearly 600 receptacles
were donated to the Host Society to use for the events; these would be placed across all venues. Both the ESC volunteers and the Host Society staff viewed the size of these receptacles as a barrier in recycling. The receptacles were too large to fit into certain areas of the building such as change rooms at the CN Centre. Without donation of receptacles, there may have been 0% waste diversion at certain venues.

3.1.5 Limitations: Logistics and Operations

Logistical and structural limitations

The CWG events were spread across 19 venues that had little consistency in their original waste management plans prior to the 2015 Games. Implementing a unified system across the various types of venues was also challenging due to the absence of established waste management in Prince George.

The lack of infrastructure and consistency was an unexpected challenge for the Operations Manager, who had previously been planning events for almost ten years. As a previous resident of Vancouver, she had not come across implementing waste management in her hosting venues as they were generally equipped with the infrastructure. The Sustainability Manager quickly noted this would be a challenge on her arrival in Prince George with little time for substantial planning. On her first tour of the venues, she noticed many garbage bins, but very few other receptacles.

As noted earlier, even though receptacles had been secured for each venue through an MMBC donation, their size was not suitable for all areas within the venues. The ESC representative at the CN Centre explained the difficulty in placing the bins in smaller areas such as athlete change rooms. Athletes were served some food and
beverages implying a need for container recycling, at least. “It was up to the teams to move out to the appropriate spot. We couldn't go into the dressing rooms.” Access to change rooms was restricted and ESC volunteers were not permitted to collect any materials. The ESC representative recalled that the athletes in many of the change rooms would collect the juice boxes in any spare boxes they could find as they had wanted an opportunity to recycle the tetra paks. Due to the difficulty in collecting the tetra paks or juice boxes, “I think in the end lots of it went in the garbage” the representative for CN Centre explained.

Volunteer Reliability Limitations

In general, most of the interviews with ESC volunteers noted a general lack of volunteers as a barrier in meeting waste diversion targets. With minimal volunteer staffing, priority was given to weighing the waste while other ESC roles including public education and awareness had to be overlooked. Many of the ESC representatives explained that their volunteers spent time sorting through the receptacles to combat cross contamination of recyclables and opportunities to educate and inform the public on the recycling streams were rare.

The Northern Sport Centre was an exception; the ESC representative felt they were staffed with sufficient volunteers most days even though he needed to personally cover many of shifts. In his experience, education and awareness efforts allowed for less cross contamination. He would try to greet all spectators at the building entrance and explain the three streams of waste. This education upon entrance, combined with even a minimal ESC volunteer presence at the receptacles, contributed to effective waste diversion as he felt it reduced the need for volunteers to sort the garbage and
recycling. He also explained that when it was not possible to greet the public as they entered, contamination between the streams was more likely to occur. However, the quantitative data collected from the Northern Sports Centre did not explicitly show these trends although the recycling stream was not examined in the study.

Relying on volunteers for recording and reporting proved to be a limitation in collecting reliable data for the Games which had aimed to quantify the total amount of waste generated and diverted. Appendix F shows the raw weights of each category that were recorded at each venue daily. The recording was not consistent on each day and at each venue. The raw data sheets also show gaps in recording without explanation. Finally, the data that was recorded by volunteers for recycling differed from what the collection company had indicated. This disparity meant that data collected on waste weights was not reliable and that there was lack of communication between the ESC volunteers, the ESC representatives and the Host Society. The ESC volunteers were meant to record the weight, while the representatives reported them to the Host Society. The absence of data reflects some breakdown in communication in that process.

Communication and an insufficient training of volunteers led to some operational failures when it came to food waste diversion initiatives. It had been determined early on in the planning process that food waste diversion would not be an option, but a food redistribution strategy had been implemented to be executed through the Food Services Committee. Food Services functioned in the same capacity as the ESC with their area of responsibility being: providing food. The food redistribution strategy aimed to collect edible and salvageable food from food service areas of Games’ venues and deliver it to local charitable organizations. Food redistribution can be considered a form of diversion
that fell under the responsibility of the ESC. Due to lack of communication between the committees, ESC leads were not informed of this initiative. During the first week of the Games, ESC leads learned that the Food Services Committee intended to execute this initiative, but that it was not being carried out and the volunteers were not aware that this was part of their role. The Sustainability Manager confirmed that food was redistributed to a local organization, St. Vincent de Paul, in the second week, but there was no recorded data. Without having an option for food waste diversion, meeting waste diversion targets was challenging.

Signage for Waste and Recycling Receptacles

Many of the ESC volunteers indicated that the signage provided by the Host Society was problematic. They indicated that the signs provided were neither clear nor easy to read, presenting challenges for the public. During the Games, volunteers made efforts to update and improve the signage of the recycling receptacles and even resorted to taping recyclable materials to the bins to make things clear. Appendix G shows an example of the signage used for receptacles.

3.1.6 The Context

A barrier that was consistent across both the ESC and the Host Society was the context and setting of the 2015 Games. As mentioned earlier, prior to the Games, many venues were not equipped with recycling or composting and relied heavily on directing waste to landfills. Most of the interviews cited difficulty in engaging an unfamiliar public in the recycling process and nurturing a culture of recycling and waste minimization or diversion.
There has not been a strong history of recycling in Prince George. Curbside recycling was only implemented in the City of Prince George in September of 2014 (5 months prior to the Games). Most of the interview participants felt that this absence of a more established and advanced waste management plan in the city contributed to the lack of public participation in waste diversion. Both groups felt that the limited waste management facilities in Prince George were a barrier in meeting desired diversion rates.

3.2 Waste Diversion

3.2.1 Waste Generation

To determine total waste generation and the total diversion, this study relied heavily on data provided by the Host Society. This data was collected in conjunction with the waste audit by the ESC volunteers. The ESC had reported low volunteer turnout at many of the venues and the lack of reliable volunteers limited the reliability of the raw data. The raw data, found in Appendix E, shows some gaps and absences in reporting. Appendix F shows a summary specific to the sites in this study of the raw data collection.

The Host Society provided raw data on waste and recycling collection and it can be found in Appendix E. In the data recorded by the volunteers and provided by the Host Society, it shows that waste generation between all the venues over the full duration was 14,700 kg with container and paper recycling generating 3,400 kg. Data provided from Emterra\textsuperscript{11} may provide more accuracy due to their need to track recycling collection company contracted by the Host Society to service all venues
accumulation for billing purposes. The total weight of recycling collected by Emterra was 4,600 kg. The data provided by Emterra, which was presumably more accurate, was 25% higher than figures provided by the Host Society. This difference suggests that the figures on waste must not be an accurate depiction of actual amount of waste generated. If the same proportion is applied to the data on waste generation then, the amount may be closer to 18,600 kg (Table 3.1), but this is an estimate. No firm conclusions can be drawn from this data, however, realistic diversion rates might be 19.8%. The Host Society had published a diversion rate of 24% in which they had used the volunteer recorded data for garbage, but the Emterra data for recycling.

Table 3.1: Garbage and Recycling Weights: Volunteer recordings compared to actual recycling weights and approximation of actual garbage weight

<table>
<thead>
<tr>
<th></th>
<th>Volunteer Recorded (kg)</th>
<th>Estimated Actual (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garbage</td>
<td>14,700</td>
<td>18,600(^{13})</td>
</tr>
<tr>
<td>Recycling</td>
<td>3,400</td>
<td>4,600(^{14})</td>
</tr>
<tr>
<td>Diversion Rates</td>
<td>18.8%</td>
<td>19.8%</td>
</tr>
</tbody>
</table>

In addressing the research question inquiring the amount diverted: the findings are 4,600 kg as determined by Emterra (Table 3.1). However, the research question: “how much waste could have been diverted?” was not a question that could be measured accurately, making it a less feasible research question given the barriers in gathering data on overall waste generation. The data on waste generation required

\(^{12}\) Measurements converted from pounds to kilograms from original data  
\(^{13}\) Projected and approximated value  
\(^{14}\) Data collected by Emterra (recycling collection company)
heavily relying on volunteers to gather the data and for the Host Society to record and store that data. The data provided and the gaps within it, however, provide insight into the systemic issues at play when an organization reports their own data.

The following graphs (Figures 3.1-3.4) show the waste generation, based on the raw data recordings from Appendix F, summarized. The paper and container are depicted through the secondary axis while the garbage is displayed on the primary axis. The poor reporting makes it difficult to discern any trends or relationship between garbage, recycling and containers.

**Figure 3.1: Civic Centre Recordings of Garbage, Paper and Container Recycling**

Of all four venues, the Civic Centre generated the most waste, but this could also be attributed to confirmation of data recording by the ESC representative for the Civic Centre. In her interview, she had confirmed that most of the garbage was weighed each morning, but was not able to provide certainty for the recycling, explaining the gaps in recording. The Civic Centre shows some consistency for the Garbage category, but
recordings for paper and container recycling have no apparent trend. There is a possibility that the recycling for this venue was weighed with the Games Village waste due to the overlap in these venues.

Figure 3.2: CN Centre Recordings of Garbage, Paper and Container Recycling

There were some challenges in recording data at the CN Centre, in part due to the shortage of volunteers. The CN Centre representative expressed that there was some difficulty in communicating with venue staff. While the majority of the weighing was conducted the morning after for the previous day, the venue staff members were instructed to simply collect, but not dispose of, the waste from the facility at night. There is a possibility that staff members disposed of the waste before ESC volunteers were able to record the weight. Regardless, there appears to be some consistency, despite the uncertainty of collection, at the CN Centre; container recycling was much more minimal, but this could be attributed to preexisting refundable recycling at the CN Centre (Figure 3.2).
The consistency in reporting data for the Northern Sport Centre could be a product of sufficient volunteer staffing (Figure 3.3). The ESC representative for this venue had indicated that there was sufficient staffing most days for weighing the waste streams. There were no Canada Games events held on February 20\textsuperscript{th} and 21\textsuperscript{st}, explaining the gap within the data. The paper waste collected on February 13\textsuperscript{th} was likely associated with preparations and was not necessarily reflected at other venues.
The data retrieved from Otway has minimal recordings. It is difficult to determine whether the container recycling at Otway on February 20\textsuperscript{th} was the recording from the accumulation throughout the week because this is not reflected in the paper stream recording. There were a variety of challenges at Otway that could have contributed to the lack of data. The ESC representative for this venue reported low volunteer staffing. He had also indicated that, due to low volumes, recycling was not weighed every day. It is plausible that the recycling was only weighed at the end of the first week, but the difference for total weights from week 1 to week 2 suggests that data is missing and in turn, no conclusions can be drawn; the number of events and participants did not change substantially between week 1 and 2.

As an outdoor venue, there were some challenges regarding bin placement and distribution. Due to wildlife concerns, the bins were brought indoors overnight and the volunteers were not always available to place them back out each morning. One piece of the data that could not be captured in the ES data collection was an initiative taken
on by one volunteer who collected all Styrofoam disposable cups and bowls. The recycling offered by the Games did not encompass Styrofoam, but a volunteer collected the Styrofoam and transported the bags to a recycling depot. She had collected six 95 gallon garbage bags; her rough estimation, in weight, was 3 pounds per bag. Very approximate calculations indicate that 8.2 kg were diverted.

Without clearly outlining how much waste was diverted, it is difficult to approximate how much could have been diverted in the overall Games, but the data collected through the waste audit can provide a rough estimate of how much could have been diverted from the waste samples.

### 3.2.2 Waste Content

The key purpose of the waste audit was to determine how much of the waste directed to landfills had a potential to be diverted, given the alternative options in Prince George. This was assessed by determining how much of the samples collected contained materials that were available for recycling.
The chart of waste categories for all samples (above), shows a summary of the categories (Figure 3.5). The chart of all 48 samples from the four identified venues summarizes the waste ratios for all four sample sites/venues which show that recyclable paper, recyclable plastic and refundable beverage containers occupied 23% of the waste stream by mass; this is approximately the percentage of waste that could have been recycled. Based on the statistics collected by the ESC volunteers, this would mean that approximately 3,400 kg that was directed to the landfill could have been diverted, on top of the already diverted 4,600 kg of recycling, based on the recycling facilities available in the region. With those same approximated statistics, there would have been 8,100 kg diverted from the landfill, or 47%, even without food waste diversion options. With availability of food waste diversion, there was potential for 82% diversion which would have been above the original targets of 80%. These statistics are loosely based off of the content of the 48 bags of waste that were characterized and the
volunteer recorded data (14,700kg of garbage and 3,400 kg of recycling materials) provided by the Host Society.

3.2.3 Waste Diversion by Venue

Since the functional purpose of the Civic Centre was primarily to serve as a feeding centre for athletes and coaches, it was expected to generate a higher ratio of food waste. When comparing the ratio of food waste content for the Civic Centre alone to the data of all venues, there is only a small increase, however. Figure 3.6 shows the ratios of the waste categories for the Civic Centre.

**Figure 3.6: Civic Centre Waste Characterization by Weight**

![Pie chart](image)

At the Civic Centre (Figure 3.6) the food waste category occupied 63% of the 12 bags of waste that were sampled as compared to 55% of all combined sites presented in the chart depicting all samples (Figure 3.5). Even though the food waste was limited to one category, large components of the other categories contained waste associated with food emphasizing the contribution of food waste both directly and indirectly. In the
category of recyclable plastic, we found many bulk food containers. The mixed materials category often included large aluminum tins; this was accepted in the recycling provided at the venues. It was my impression from the 12 samples that the majority of the waste was collected from the kitchen end of the venue based on the composition of waste. There appeared to be no bags that would have been collected from other areas in the Civic Centre. Due to an overlap with another venue, the Games Village, it is possible that waste from other areas of the Civic Centre was sent into the Games Village waste stream; there was no confirmation of this through interviews.

It was important to examine the content of waste at the Civic Centre in comparison to the overall waste category ratios as it was a unique venue. At the CN Centre, Northern Sport Centre and Otway Nordic Ski Centre, I expected there to be less food waste accumulation than from the Civic Centre. Looking at Figure 3.5 and 3.6, we can see that there was not a substantial difference in food waste occupancy and that rates of food waste would have been high at other venues as well.

The CN Centre, which primarily held hockey games, shows the category breakdown in Figure 3.7. Food waste occupied slightly more than half of the overall content of the waste generated at this sample site. While this venue held a pre-existing concession and kitchen facility, the samples appeared to be derived primarily from volunteer lounges based on the composition of the waste. The samples were primarily composed of packaging and food from the food services in the volunteer lounges. Even though the athletes were provided with snacks in the change rooms, the ESC representative felt those snacks, primarily comprised of juice boxes and granola bars, would not have contributed substantially to the waste generation. Refundable beverage
containers occupied the smallest percentage of the waste; this could be due to previously established recycling opportunities in the facility. The high rate of recycling for refundable bottles could also be related to strong signage. Recyclable plastic was primarily composed of plastic drinking glasses that were provided for the water refill stations.

**Figure 3.7: CN Centre Waste Characterization by Weight**

The food waste accumulation at the Northern Sport Centre, as seen in Figure 3.8, was comparable to the Civic Centre and higher than the average of all sites. Non-recyclable paper and recyclable plastic were the second highest components of the waste stream. Refundable beverage containers occupied the smallest component of the waste stream as 1% of the overall waste collected at the Northern Sport Centre. This low percentage could have been a result of an already established recycling system at the facility or the low contribution of refundable beverage containers to the waste stream.
The samples collected from Otway Nordic Ski Centre are shown in Figure 3.9; this provided the most contrasting ratios of waste to the overall data. There were a variety of venues that comprised the Games, many of which were outdoor venues. This venue aimed to represent the waste management at the outdoor venues. Prior to the Games, this venue had no outdoor recycling receptacles and only had garbage bins close to the building infrastructure. The representatives at this venue also reported low volunteer turnout as well as difficulty in training volunteers.
3.3 Chapter Summary

The three data sets, (the interview transcripts, primary quantitative data and secondary quantitative data) start to explain the wider implications of waste management at such events. The data sets complemented each other and helped provide triangulation in this case study. The interviews provided explanations for inconsistencies in data recording and waste management procedures in general. They also provided explanations for the types of waste that was accumulating.

The results of this study have found that food consumption and disposal are an important component of event planning to consider. The low reliability on the data provided by the Host Society can be attributed to inadequate preparation and operational challenges. This will be discussed in the next chapter.
4.1 Discussion

4.1.1 Minimizing the Impact

In identifying the impact large scale events will have on host cities, organizers are taking steps to address environmental impacts rather than just economic impacts. There is a heavy focus on the economic benefit in attracting and hosting events with minimal consideration of environmental challenges early on in the planning process. As a result, any environmental or sustainability efforts tend to be implemented far too late in the planning process. To host low-impact events, there needs to be a stronger consideration of the environmental impact in the proposal stage, including estimating the likely influx of waste associated with the event early in the planning for an event.

With a focus toward implementing sustainability efforts in large scale sporting events, the 2015 Canada Winter Games attempted to measure waste generated in all of their events while implementing waste reduction and diversion efforts. Research conducted in events suggests that these efforts need to be prioritized and budgeted for with sufficient time allowed. Unfortunately, there was no budget for sustainability and the position for sustainability initiatives was only filled 11 months prior to the event start presenting challenges for implementing sustainability efforts.

The environmental impact of the tourism and the hospitality sector is similar to the impact of hosting large scale events; it is magnified in a shorter period of time. Much like some of the findings for waste management in the hospitality sector, this research found that food waste occupied more than half of all waste generation. Pirani’s research
in the hospitality industry found that at least half of all waste generation was either food waste or related to food waste (Pirani, 2014).

### 4.1.2 Waste Generation and Diversion

One of the most notable findings of this research was that even when waste is not organic or food waste, it is related to food either through packaging or serving. Originally, the research had not set out to determine the waste generation areas, but this finding helps conceptualize future waste content in events. With the greatest waste generation areas of the venues being the feeding centres for athletes and volunteers, the majority of the waste was either composed of food or associated with food. Waste audit reports project approximately 30-40% of food in a waste stream, but research in the hospitality sector suggests closer to 50%; confirming that food is a major contributor to waste in events and otherwise. The plastic and paper categories of the waste characterization study were comprised primarily of materials used to serve, package or store food. This was consistent across all four sample sites.

The waste audit and characterization study was not an accurate depiction of the content of waste as it was only a measure of wet weight. The plastic category would have occupied a greater proportion of the waste if it had been measured in volume. For example, Styrofoam materials with low specific weight represented only 13% of the overall mass total waste. For a better depiction of waste content in sporting events, it is beneficial to consider other metrics. Volume is only one other measurement consideration in considering options for measuring environmental impacts such as characterization based on toxicity. There are opportunities to use waste audits as
assessments for materials’ toxicity or their ability to degrade. This could include calculating and ranking materials with the greatest emissions and impact from disposal.

The research design of this project also failed to address the potential for diversion within the mixed materials category. There were materials characterized in this category that were accepted for recycling within the RDFFG that were excluded from the overall potential for diversion. Even though the ‘Mixed Materials’ category only occupied 8% of the overall waste collected, there was strong potential for diversion that the research design excluded from calculation.

The Host Society had the opportunity to identify or predict the types of waste that would be generated through their purchasing and procurement. As food services ordered Styrofoam materials to serve meals, it was apparent that the need for Styrofoam recycling existed. In many cases, the recycling streams were not in line with the type of waste that would be generated. When planning for waste management, it is important to align the diversion streams with the types of materials that are expected to be generated.

4.1.3 Food Waste

As discussed briefly in the results chapter, food waste was a large component of all the waste collected. This could have been, in part, attributed to systemic failures where the food services committee was meant to redistribute any uneaten, edible food to charitable organizations. Food redistribution is increasingly employed as a mechanism for waste prevention. Typically this is successful when there is a social business or third party organization that is able to monitor and distribute the food
(Schneider, 2013). In the 2015 Games, without any accountability or responsibility placed on an external organization, this task was either not completed or there was no record of it. There is also no measure or benchmark for how much of that food was eligible for redistribution. While the findings suggested there was opportunity to salvage packaged sandwiches and muffins, there could have been other reasons for disposing of those items in the garbage such as expiry or improper storage.

Many food items in the garbage reflect consumer behaviour and a lack of value for food, as seen through partially or minimally eaten food. As Evans describes, North American households tend to be ‘throwaway societies’ (Evans, 2011). Even though the focus is on household food waste, the lack of value for food and a disposable culture can apply to this case study. At most of the locations, food was provided to the volunteers for free and this study suggests that when readily available without charge, food is viewed as being of less value. Lack of provisioning or planning for food is true in households as well as in events. There is some connection between the ideas that Evans presents and this research could show that humans view food with little regard which speaks to a material and consumer society. While perception to food or waste was not the focus of the study, it would be beneficial to incorporate this into further research related to events.

4.1.4 Challenges

Reporting

This project sought to examine efforts of sustainability in hosting large scale sporting events in small sized cities. Initiatives including collecting metrics of waste generation, have been in place in several previous Games, but it has only been
conducted and reported by the organization. In 2011, the Halifax Winter Games did admit that their measurements for waste generation could be flawed and missing some of the waste measurements, thus admitting that actual measures of waste did not encompass all waste that was generated (Halifax lessons learned document).

The Sherbrooke Summer Games reported strong diversion rates and had some accountability for it. To meet Level 1 classification of being environmentally responsible for the Bureau de Normalization du Quebec (BNQ), the Sherbrooke Games committed to and achieved high rates of diversion (Sherbrooke, 2013). With accountability for reporting to the BNQ and outlining ways the diversion rates were met, it is clear that there was commitment to collecting this data. However, all of the metrics for waste were reported by the organization itself and the accuracy cannot be guaranteed. Accreditation by the BNQ would only strengthen the Sherbrooke Reports if there was third party confirmation of their diversion rates.

In the Prince George 2015 Canada Winter Games, this research makes clear that self-reporting for organizations can lead to inaccurate and unreliable data. As seen in the results chapter, it appears that there are missing measurements for waste. For recycling, the external company was able to provide the actual tonnes of recycling collected. The Host Society used the garbage weights, not necessarily reflecting actual generation, and the recycling company’s weights to calculate the diversion. Knowing that volunteer recording was not completely accurate, the diversion rate may have been falsely calculated and potentially inflated.

The original set of research questions had set out to determine how much waste was diverted in these Games and how much could have been diverted. Without a
stronger data source, this research question was not feasible. Measuring how much could have been diverted was dependent on how much waste was generated. To have stronger or more accurate reporting from Games organizations, there needs to be certain levels of accountability and external confirmation. The Prince George Games have shown that misleading or inaccurate information regarding the environmental impact can be published without validation or confirmation from an external source.

Budget

The interview results showed that the budget for the Games was a perceived barrier for many of the key informants in this study. In part, there was no budget for the environmental services or the sustainability manager and the waste management budget was not communicated. There have been successful environmental initiatives in other Games that were not budgeted for. The Prince George Games were limited to a budget offset framework that did not allow this kind of sponsorship for any items that were not already prioritized or budgeted.

The Alberta Winter Games had no budget, in the beginning, to implement any of their sustainability initiatives. The organizers were able to fundraise and source fourteen different sponsors that allowed them to implement a wide variety of initiatives including the “Towards Zero Waste” program. In the 2013 Sherbrooke Games, the Sustainability Manager had access to a budget of $100,000 as well as sponsorship (Sherbrooke, 2013). Even though, in the end, there was an exception granted to allocate sponsorship toward receptacles in the 2015 Games, the inability to acquire sponsorship for environmental initiatives presented challenges. This only allowed for low cost or cost free initiatives.
Operational Challenges

Fewer volunteers had registered for environmental services than originally expected. Due to low volunteer availability and issues with the online scheduling program, certain roles, primarily around stewardship, were eliminated. As identified in the results chapter, the Northern Sport Centre was able to provide some educational and awareness efforts that the ESC representative for that venue found beneficial, but few other sites reported this.

There were some site-specific operational challenges related to shortages of volunteer staffing as well. For example, it was difficult to ensure that waste at the CN Centre was specific to that standalone venue, as it was connected to other venues hosting similar events with comparable facilities. The intention of the ESC was to isolate waste collection and weighing for each standalone venue, but a shortage of volunteers and reliance on custodial staff meant that this could not be guaranteed. The custodial staff collected waste from all areas of the facility and were instructed to leave the bags of garbage in front of the waste compactor to be weighed and discarded by the ESC volunteers the next morning. It could not be guaranteed that bags collected from the connecting buildings were separated from the waste accumulated at the CN Centre.

Unlike in Prince George, the Sherbrooke Games can attribute some of their success in meeting their environmental goals to sufficient volunteer staffing. Some of the Sherbrooke Games’ volunteers were as young as ten years old, while in Prince George the strict age requirement was 15 years, thus reducing the potential volunteering capacity (Sherbrooke, 2013). The Halifax Games were also able to implement some educational pieces into their waste diversion efforts (Halifax, 2011).
Time

It can also be argued that the efforts to measure the environmental impact were implemented too late. The interviews showed that many of the Host Society staff required time to familiarize themselves with the context of Prince George and facilities or amenities available within it. The issue of time, combined with issues of non-local staffing, were noted as barriers in meeting waste management goals. The recommendations from the Sustainability Manager were to initiate these efforts sooner to best implement them in the planning process. With hiring for the Sustainability Manager, Operations Manager and environmental coordinator less than a year before the Games, time was a major limitation and challenge for waste management planning especially when entering an unfamiliar context. In contrast, the Sustainability Manager in the Sherbrooke Games was hired nearly two years prior to the 2013 Games (Sherbrooke Report).

In the results chapter, it was briefly discussed that the lack of familiarity with the local context presented a challenge. This meant that the employees required more time becoming familiar with the host city in order to understand their roles with the Host Society. It is beneficial to hire locally, due to familiarity of context and culture, but often the skilled expertise is brought in from other cities when not readily available in the host city. In these cases, longer contracts would have enhanced the quality of their performance. While spending time simply becoming familiar with the governance structure, the sustainability manager found that sustainability initiatives were difficult to implement as many areas, including the budget, had already been finalized. The Operations Manager, coming from Vancouver, BC, was surprised to learn that
equipping venues with recycling receptacles was part of her role because in the past, venues would already be equipped. The environmental services coordinator had only 5 months to complete her tasks and familiarize herself with the local context.

Communication

It was clear that there was strong dedication and environmental experience in the ESC, but there needed to be stronger communication and collaboration with the Host Society to develop and execute sustainable initiatives. The reported lack of communication and interpersonal friction, as described by the environmental services coordinator, created challenges in carrying out the desired waste management plans. The ESC may have been comprised of professionals employed in the environmental sector, but without event planning skills, expertise, and decision making authority, they were reliant on the Host Society. In reality, none of the people interviewed were actual decision makers around waste management. As identified earlier, waste management must be environmentally focused and budgeted for in order to reduce actual waste. These actions, prioritizing and sufficiently budgeting, would have needed to occur much earlier in the planning process. None of the positions in the interview, ESC or Host Society, were active or employed for more than a year prior to the Games. Even if there had been stronger environmental knowledge in the environmental coordinator and the Sustainability Manager, their 5 months and 11 month terms, respectively, limited the amount of planning possible. The waste management was, therefore, reliant on the senior positions in the Host Society.

The Host Society was, in part, comprised of individuals that had moved from community to community to host similar events. Many had never been exposed to a
context without comprehensive waste management. There was a need, in the early planning stages, to advocate for a budget that could encompass implementing waste diversion in all venues. Without a strong working relationship, along with a lack of time, it was difficult to successfully implement waste management.

4.1.5 Limitations of the Study

Time Constraints

The research for this study was initiated in September of 2014, less than six months before the Games were set to begin. This condensed period limited my opportunities as a researcher to engage in or observe the complete planning process. This included loss of opportunities for expansion of the participant observation component of the study. Even though my role with the ESC began in September, participant observation was not permitted until December, 2014. There was strong potential for research collection through participant observation that would have informed the planning process for waste management to better understand the systemic barriers in collecting data related to waste management.

Study Sites

Due to resource and time restrictions, only four sites could be included in the study. The four sites sought to be representative of all the venues included in the Games, but may not have been representative of all waste generated at the Games. The Civic Centre was included to ensure a food venue was part of the study and represented one quarter of the sample sites. In reality, a food venue, even though an instrumental component of the Games’ venues, represented much less than a fourth of
the venues. There was no venue that captured the unique nature of the Games Village, a venue that held nightly events with several food vendors. This venue had a site-specific challenge related to glass and was not formally included in this study.

With capacity to only focus on four sites, this study excluded more than 15 venues that composed the 2015 Games. Even though the four sites sought to represent all the venues, the unique composition of sites reflected site specific challenges that could not be captured in this study.

4.2 Recommendations

4.2.1 Recommendations for Future Waste Audits

There is no single process or protocol for conducting waste audits as they can vary from one project to another. Even though a waste audit manual was prepared for the Canadian Council of Ministers of the Environment which researched and referenced waste audit procedures across the country to formulate a standardized waste audit manual, it has not been updated since 1996 (Fenco MacLaren Inc., 1996). Without a standardized practice with current and up to date resources available, this study referenced other methods and procedures mostly typically employed. It would be beneficial to have an updated version of the Fenco Maclaren report available for future studies.

A waste audit hand book that encompasses various types of waste audits would be beneficial in standardizing waste audit procedures. Depending on the objectives of a waste audit, a unified manual could provide the proper methods to undertake for each circumstance. While waste audits are most commonly conducted in post-secondary
institutions, there are limited other resources available for reference. Another method of conducting an audit would be to measure and compare volumes of materials rather than only the weight. This allows a different type of comparison and accounts for low weight materials such as thin plastics. Measuring and comparing the content based on its toxicity would also enhance the waste audit. Making these guides and tools available for users would significantly enhance the quality of waste audits.

4.2.2 Recommendations for Future Games

In the preceding Games, in Halifax, Sherbrooke, the Alberta Winter Games and even in the Vancouver Olympic Games, the focus within waste management planning has been in diversion, whereas preventative waste minimization is far more favourable (Enviro Centre, 2009). According to the waste hierarchy, seen in Figure 4.1., the most favourable options are prevention and minimization. Tracking waste generation, an initiative that has been seen in all the previously mentioned Games, is a tool for minimization as it makes organizations aware of their impact. However, as events tend to be short term with minor transfer of knowledge, tracking waste generation rarely allows for waste reduction efforts. A stronger focus in minimization in these events would allow for meaningful waste reduction.

Minimizing the impact and focusing on waste reduction would mean understanding the waste output of an event. Most often, the environmental initiatives are an afterthought and not always given sufficient time for planning substantial efforts. Initiatives should be implemented, planned and budgeted for in the early planning process. For the Canada Games, there could be a requirement in the application or
bidding process for perspective host cities to indicate an environmental impact assessment and mitigation plan. An early commitment to reducing the environmental impact would allow for efforts such as sustainable procurement or food service plans that include minor disposable cutlery for serving. It could allow the organization the opportunity to assess areas of waste generation that could then be avoided.

Even for waste diversion efforts, consideration and commitment at an earlier stage could potentially enhance results. One of the consistent messages by key informants was that the lack of history and culture of recycling in Prince George was a barrier for stronger waste diversion rates. Implementing recycling at the venues prior to the Games could have allowed the general public and venue staff to become more familiar with diverting. At an earlier implementation stage, there is opportunity to identify failures and successes to improve recycling plans for the event itself. The volunteers found that the signage on the recycling receptacles presented challenges, knowing this earlier could have allowed opportunities to correct signage in time for the event.

Organizers of these large scale events are generally not held accountable to external bodies. Without any form of regulation, reporting can be unintentionally inaccurate. Generally, final reports tend to report waste diversion as a reduced environmental burden or an area of reducing greenhouse gases. While diverting waste into recycling is most often a preferable management option, there are environmental costs associated with recycling.

Events are not the only area where regulation tends to fall short in waste management. Even though the waste hierarchy has been embedded in many solid waste management frameworks, solid waste managers in government or industry have
little control over packaging and production. This makes waste reduction challenging for organizers, but requires a stronger focus on strict procurement policies. The 2015 Games had outlined a sustainable procurement purchasing policy, but the final Sustainability Report showed little use of it. This research shows that there needs to be a stronger connection between the developers of the purchasing policy and the waste management planners. Stronger communication in these two areas of planning would help avoid oversights such as supplying all volunteer lounges with Styrofoam cups and plates, but without providing any options to recycle Styrofoam at any venue.

**Figure 4.1 Waste Hierarchy (Enviro Centre, 2009)**

Another important consideration for future events is hiring local and qualified employees. None of the interviewees from the Host Society had worked in either the sustainability or environmental sector. With the majority of the decision making and planning power in this group, it would be beneficial to hire staff that is familiar with the
context of the region and with some knowledge or background in sustainability. It was clear through the composition of the ESC that a wealth of knowledge existed in Prince George that could have contributed to stronger waste management plans. Familiarity with the context when planning the budget for the 2015 Games would have indicated a need to upgrade facilities and mitigate removal.

Often, the local municipality of the host city can influence an event’s sustainability. The values of the local municipality can guide the direction for planning events as seen in cities like Vancouver. The local government in Vancouver has adopted a sustainability vision, to be the greenest city by 2020, which had a profound impact in planning for the 2010 Vancouver Olympics (City of Vancouver, 2009). Other municipal governments have had similar effects in the hosting of large scale events. The municipalities of Banff and Canmore conditionally agreed to host the 2011 Alberta Winter Games to ensure that their values would be upheld throughout the planning process, (AWG, 2014). As a result, the 2011 Games implemented a Zero Waste initiative, (AWG, 2014). These values need to be identified and prioritized by cities looking at hosting.

4.2.3 Recommendations: Areas for Further Research

4.2.3.1 Research Venues

This study, in part, draws attention to the efficiency or inefficiency of waste management systems currently employed at Prince George venues. There were several venues that required significant upgrades to meet the 2015 Games protocol. Some locations, including Otway Nordic Ski Centre (an outdoor venue), only held waste bins with no other waste stream options.
One of the hopes for the 2015 Games was to leave a waste management legacy in Prince George and in the venues it would occupy. The ESC interviews indicated a desire to nurture and further a culture of recycling in Prince George. This would only be possible with an availability of recycling receptacles in local facilities. For the sites that were included in this study, it would be beneficial to conduct further research and a standalone waste audit to identify the need for a restructured waste management plan. The findings of this study do not reflect usual operations at each venue nor do they address the waste content typically generated. To move forward in addressing waste management, it would be beneficial to conduct a waste audit in order to determine the most suitable plan.

For Otway Nordic Ski Centre, it would be advisable to implement recycling receptacles as they currently only offer waste bins. The presence and availability of waste diversion options at local facilities would contribute to a stronger culture of recycling. This effort would be more effectively started through a waste audit that would determine the needed diversion streams.

The Civic Centre would benefit from carrying out an individual waste audit, but because this venue regularly holds events catering to a similar range of participants, some assumptions from this study can be used. The data collected in this study suggests an alarming need for food waste management. A food redistribution policy or plan could help the Civic Centre reduce its food waste significantly and contribute to local charitable organizations.

While this study focused on only four of the venues, it is clear that there is a range in the level of waste diversion currently in place at each. To further enhance
waste management and to reduce the waste impact, it would be beneficial for all venues to hold individual waste audits. This could help determine areas to reduce waste and to help shape purchasing policies.

### 4.2.3.2 City of Prince George

One of the barriers reported by many of the interviews was that there was not a strong culture or habit of recycling in the city. Both groups, the ESC and Host Society, felt that this led to lack of participation in recycling which contributed to low diversion rates. The Regional District of Fraser Fort George conducted an assessment of diversion rates since implementing curbside recycling and they found less than a 5% increase in the first year (RDFFG report). With curbside recycling already implemented within city limits in Prince George, the next advisable step would be to enhance community engagement activities and awareness surrounding the importance of diversion to effectively further a legacy of the 2015 Games.

Encouraging participation in curbside recycling involves social and behavioural change. Studies have shown that to make meaningful social change, strong efforts of engagement and outreach are required. These interventions include prompts, public commitment, normative influence, goal setting, removing barriers, rewards and feedback. Some of the actions taken by the case study highlighted by Schultz included door to door initiatives where researchers provided information on recycling as well as feedback sessions (Schultz, 1999). This study found that informational visits were not an effective tool in increasing curbside recycling. The study suggests that a combination of feedback, removal of barriers and rewards are necessary. This kind of engagement
and educational intervention could significantly impact recycling behavior in Prince George.

There have already been recommendations for the City of Prince George to implement composting at the municipal level. This was presented in both RDFFG reports, in the waste study and in the feasibility report (both reports). Most studies find that food waste comprises 30-40% of all waste directed to a landfill. Sometimes, food waste is unavoidable as it is composed of kitchen scraps as opposed to edible food (Parfitt et. al, 2010). Composting options would be a feasible and realistic solution to diverting this component of the waste from the landfill. This would be a local level initiative where compost would be collected and handled municipally.

Continuing the waste diversion dialogue with residents of Prince George would significantly further the waste management legacy of the 2015 Games. Unfortunately, the short employment contracts for both the Sustainability Manager and the environmental coordinator did not allow for further outreach once the Games were over. The 2015 Games were a starting point for waste diversion outside the four sites included in this study and the 19 venues that hosted the events. Implementing waste diversion was an avenue for education through the volunteers and the spectators as well as exposure to recycling. It would be beneficial to the RDFFG and the City of Prince George to further a legacy initiated by 2015 Games.

4.3 Conclusion

This study examined efforts to implement sustainability into the 2015 Canada Winter Games by focusing on waste management. Drawing from previous events of
similar composition and organization, it is clear that Prince George had a unique set of barriers to overcome. The northern, rural context of the 2015 Games presented challenges in implementing comprehensive waste management at all of the event venues.

In the end, this research demonstrates that it may be relatively unimportant to calculate or report the actual waste diversion rates to assess sustainability efforts in the 2015 Games. There were some flaws in the data collection, recording and reporting processes based on a variety of challenges. The importance of the data collected in this study is emphasized in the types of waste that are associated in these events and the insight around the planning process. This study highlights the importance of aligning a waste management strategy with the purchasing and procurement guides. It also confirms that waste management must be prioritized and planned for early in the process with a suitable budget.

There are many positive legacies of hosting the 2015 Prince George Canada Winter Games. It was an avenue for many venues to receive the upgrades they needed as well as an opportunity to build and nurture community pride and spirit. There are even certain environmental legacies outlined in the final sustainability report and possibly future waste management restructuring in the host venues.

This study has shown that the Host Society employees associated with waste management were not as invested or familiar with the city's amenities. Their interviews reflected a lack of connection and attachment to this host city while the volunteers of the ESC have shown strong commitment and dedication to their home city. Prince George may lack a strong culture of recycling, but it has dedicated citizens committed to
environmental change. This was seen through individual efforts of select volunteers that went above and beyond their required roles such as the volunteer at Otway who personally collected Styrofoam materials and delivered them to a recycling facility. The position for the Sustainability Manager itself was initiated at a local level and she was then employed by the local university. Universities or other Higher Education Institutions (heis) can often play a large role in mobilizing environmental action (Hasan, 2004; Jibril, 2012).

There might be passion and commitment through volunteer citizens, but a need to work closely with skilled event planners is required. Much like many other sporting event organizations, the mobile Host Societies need strong relationships and collaboration with the host city. This is generally the case with the International Olympic Committee and European Olympic Committee. Staffing certain positions locally, particularly those requiring experience in hosting mega-events is often not possible. There is a need to balance the recruited non-local employees with local, invested citizens.

The 2015 Games may have had challenges in meeting or even clarifying waste management goals, but it created a premise for enhanced diversion plans. This is not an uncommon use of a mega-event. Games can be used as a tool to forward sustainability. Since the 1970s, the Olympic Winter Games have increasingly pressured the International Olympic Committee to adopt a stronger environmental rhetoric (Chappelet, 2008). These initiatives were mobilized from local organizations of the host cities. A similar trend has been spurred from within the Canada Games, as seen through efforts in Halifax and Sherbrooke. After Sherbrooke was granted BNQ
designation for its efforts of sustainability, the 2015 Games adopted international standards for guidance (ISO and CSA). This could eventually lead to the adoption of stronger policies by the Canada Games Council through continued grass root, local efforts.

4.4 References


## Paper

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers and flyers</td>
<td>Daily and community newspapers and advertising flyers</td>
<td>Plastic bags used to cover newspapers/flyers (take to <a href="#">MMBC recycling depot</a>)</td>
</tr>
<tr>
<td>Magazines, Catalogues</td>
<td>All types</td>
<td>Hardcover or paperback books (donate or sell)</td>
</tr>
<tr>
<td>Telephone books</td>
<td>Phone books; directories</td>
<td>Non-paper gift wrap</td>
</tr>
<tr>
<td>Paper gift wrap and greeting cards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing/home office paper and correspondence</td>
<td>Note pads: loose leaf paper; white or coloured computer, copier and printer paper; printed paper; plain and window envelopes; shredded paper</td>
<td>Padded envelopes</td>
</tr>
</tbody>
</table>

**Some items are recyclable outside of MMBC’s program. To find out where you can recycle something other than packaging or printed paper, please contact the [Recycling Council of BC](#). In the Lower Mainland, call 604-RECYCLE or BC toll free 1-800-667-4321.**

Last updated: March 29, 2016
## Paper Packaging for Dry Goods (cont.)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
</table>
| Multi-layer paper bags | Multi-layered bags for pet food, flour, sugar, etc.  
|                   | Bags can include a plastic film layer                                     | Bags with a foil layer       |

## Cartons and Paper Cups

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
</table>
| Paper cups        | For hot and cold beverages  
|                   | Empty and rinse cups                                                      | Straws                       |
|                   | Remove lids and place loose with container recycling                      |                              |
|                   | Recycle paper sleeves separately                                           |                              |
| Gable-top cartons | For milk, milk-type beverages, cream, substitute eggs, sugar, molasses, etc. | Juice cartons (return for deposit refund) |
|                   | Empty and rinse cartons. If carton includes plastic screw cap, remove cap and place loose in recycling container |                              |
| Aseptic boxes or cartons | For milk, milk-type beverages, cream, soup, broth, sauces, etc.      | Juice/drink boxes (return for deposit refund) |
|                   | Add loose to recycling container                                           | Straws                       |
|                   |                                                                        | Stand up pouches             |

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Last updated: March 29, 2016
# MMBC Materials List

## Cartons and Paper Cups (cont.)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen dessert boxes</td>
<td>For ice cream, frozen yogurt, etc.</td>
<td>Empty and rinse cartons</td>
</tr>
</tbody>
</table>

## Containers

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty aerosol cans</td>
<td>For food, air fresheners, shaving cream, deodorant, hairspray, etc.</td>
<td>Spray paint cans**</td>
</tr>
<tr>
<td></td>
<td>Empty cans.</td>
<td>Aerosol cans with any contents remaining**</td>
</tr>
<tr>
<td></td>
<td>Remove caps and place loose in recycling container.</td>
<td>Propane cylinders**</td>
</tr>
<tr>
<td>Spiral wound cans and metal lids</td>
<td>For frozen juice concentrate, potato chips, cookie dough, coffee, nuts, baby formula, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remove lids and place loose in recycling container.</td>
<td></td>
</tr>
<tr>
<td>Aluminum cans and lids</td>
<td>For food, e.g., seafood, cat food, etc.</td>
<td>Propane tanks or 1 lb. propane bottles**</td>
</tr>
<tr>
<td></td>
<td>Empty and rinse cans.</td>
<td>Deposit cans (return for deposit refund)</td>
</tr>
<tr>
<td></td>
<td>Labels OK.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Put metal lid inside can and squeeze slightly.</td>
<td></td>
</tr>
</tbody>
</table>

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Last updated: March 29, 2016
<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrugated cardboard boxes</td>
<td>Shipping boxes, grocery and liquor store boxes, pizza boxes&lt;br&gt;Empty boxes&lt;br&gt;Flatten large corrugated boxes and cut down to no larger than 30&quot; wide (78 cm) X 30&quot; tall (78 cm); staples and tape OK</td>
<td>Cardboard boxes with wax coating, e.g., empty shipping boxes made available for residents to transport their groceries home</td>
</tr>
<tr>
<td>Cardboard/boxboard</td>
<td>Boxes for cereal, shoes, tissues, pizza, frozen entrees, desserts, detergent, etc.&lt;br&gt;Carrier trays for bulk bottled water, soft drinks, cans, food, etc.&lt;br&gt;Cores for paper towel and toilet tissue&lt;br&gt;Flatten and place boxboard directly into the collection container, not inside another box&lt;br&gt;Remove liner bags and food residue</td>
<td>Paper towels or napkins (include with green waste, if applicable)&lt;br&gt;Tissues</td>
</tr>
<tr>
<td>Moulded boxboard packaging</td>
<td>Egg cartons, take-out beverage trays, empty paper-based garden pots, etc.</td>
<td>Dirt in garden pots</td>
</tr>
<tr>
<td>Paper bags (kraft paper)</td>
<td>Any colour, including brown grocery sacks, white prescription bags, brown envelopes</td>
<td>Padded envelopes&lt;br&gt;Foil-lined bags, e.g., packaged cookies</td>
</tr>
</tbody>
</table>

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Last updated: March 29, 2016
### Containers (cont’d)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
</table>
| Steel cans and lids          | For food including pet food; tins for cookies, tea, chocolates, etc.; include metal lid.  
**Empty and rinse cans. Labels OK.**  
**Remove lids, drop into can and squeeze slightly.** | Steel beverage cans (return for deposit refund)  
Steel paint cans**  
Coat hangers (return to dry cleaners)  
Pots, pans and baking trays**  
Propane cylinders **  
Metal toys**  
Appliances**  
Metal hardware or other scrap metal**  
Wiring or metal cords, extension cords** |
| Aluminum foil and foil take-out containers | Foil wrap and take-out containers including pie plates, food trays, etc.  
**Empty and rinse containers.** | Chip or foil bags  
Foil wrap with paper backing for butter, cigarettes, etc.  
Foil-lined cardboard take-out containers or lids |
| Plastic jugs with screw tops | For milk, cooking oil, laundry detergent, fabric softener, cleaning solutions, cleaning products, body care products, windshield washer fluid, etc.  
**Empty and rinse jugs. Labels OK.** | Jugs for flavoured tea, juice, other beverages (return for deposit refund) |
| Plastic clamshells           | For baked goods, fruit, produce, eggs, etc.  
**Containers are clear with hinged or click-closed tops.**  
**Empty and rinse containers.**  
**Labels OK.** | Packaging labelled biodegradable or compostable  
Liquid-absorbing pads |

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Last updated: March 29, 2016
# MMBC Materials List

## Containers (cont.)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
</table>
| Plastic bottles and caps | For food, dish soap, mouthwash, shampoos, conditioners and other personal care products, pills and vitamins, laundry products, household cleaners, automotive cleaners, e.g., glass cleaner, windshield washer fluid, etc.  
Plastic bottles have screw caps, spray pump or pull-up tops.  
Empty and rinse bottles.  
Labels OK.  
Remove caps, spray pump and pull-up tops, and place loose in recycling container. | Beverage bottles (return for deposit refund)  
Stand up pouches  
Containers for motor oil, vehicle lubricant, or antifreeze products ** |
| Plastic jars and lids | For peanut butter, jam, nuts, condiments, vitamins and supplements, personal care products and cosmetics, pharmaceuticals, etc.  
Plastic jars have wide mouths with screw-top lids.  
Empty and rinse jars. Labels OK.  
Remove lids and place loose in recycling container. |ство |

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Last updated: March 29, 2016
## MMBC Materials List

### Containers (cont.)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic trays and tops</td>
<td>For deli chicken, single serve meals, prepared foods, baked goods, housewares and hardware, e.g. screws, picture hangers, etc.</td>
<td>White, black or colour foam trays (take to MMBC recycling depot)[1]&lt;sup&gt;1&lt;/sup&gt; Soft plastic packaging for perishable foods, e.g. meat, poultry, fish or cheese, etc. Plastic/foil packaging for items like chewing gum and pills</td>
</tr>
<tr>
<td></td>
<td>Containers are clear or have black bottom trays with clear domes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Empty and rinse trays.</td>
<td></td>
</tr>
<tr>
<td>Plastic tubs and lids</td>
<td>For margarine, spreads, yogurt, cottage cheese, sour cream, ice cream, etc.</td>
<td>Packaging labelled biodegradable or compostable Plastic or foil lids from coffee and tea pods Coffee grounds (include with green waste, if applicable)</td>
</tr>
<tr>
<td></td>
<td>Empty and rinse tubs. Remove lids and place loose in recycling container.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For single-use coffee and tea pods: Empty and rinse pods. Remove lids and do not include lids with recycling. Grounds can be composted.</td>
<td></td>
</tr>
<tr>
<td>Plastic cold drink cups with lids</td>
<td>Beverage take out cups Empty and rinse cups Remove lids and place loose in recycling container.</td>
<td>Foam cups (take to MMBC recycling depot) Plastic packaging labelled biodegradable or compostable Napkins (include with green waste, if applicable) Straws</td>
</tr>
<tr>
<td>Plastic garden pots and trays</td>
<td>For bedding plants, seedlings, vegetable plants, etc. Remove remaining soil from garden pots and trays.</td>
<td>Ceramic plant pots Lawn edging, tarps, plastic furniture or toys** Garden hoses** Plastic string or rope</td>
</tr>
</tbody>
</table>

---

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Last updated: March 29, 2016
Containers (cont.)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic pails</td>
<td>For laundry detergent, ice cream, pet food, etc.</td>
<td>Plastic paint cans**</td>
</tr>
<tr>
<td></td>
<td>**MMBC accepts pails that are less than 25L; larger pails should be</td>
<td>Plastic pails larger than 25L**</td>
</tr>
<tr>
<td></td>
<td>disposed of via a commercial hauler.</td>
<td>Pails for lubricants and oils**</td>
</tr>
<tr>
<td>Microwavable bowls &amp;</td>
<td>For soups and entrees **Remove lids and place loose in recycling container.</td>
<td>Bowls with metal rims</td>
</tr>
<tr>
<td>cups</td>
<td></td>
<td>Napkins (include with green waste, if applicable)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cutlery</td>
</tr>
</tbody>
</table>

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Last updated: March 29, 2016
Glass Containers
(May be collected separately from curbside or multi-family buildings - check with your collector)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-deposit glass bottles</td>
<td>Clear or coloured</td>
<td>Drinking glasses, dishes, cookware, whole or broken window glass or mirrors**</td>
</tr>
<tr>
<td>and jars</td>
<td>* Check with your recycling collector for instructions.</td>
<td>Ceramic mugs or other ceramic products**</td>
</tr>
<tr>
<td></td>
<td>* Empty and rinse bottles and jars. Labels OK.</td>
<td>Deposit glass bottles (return for deposit refund)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light bulbs and light fixtures**</td>
</tr>
</tbody>
</table>

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Last updated: March 29, 2016
Plastic Bags and Outerwrap (Depot only)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic bags and overwrap</td>
<td>Plastic bags for groceries, dry cleaning, bread, newspapers and flyers; bags for produce, dry bulk foods, and most frozen vegetables; outer bags and wrap for diapers, feminine hygiene products, paper towels, tissues, soft drink can flats; bags for water softener salt, wood pellets and garden products; overwrap on mattresses, furniture and electronic equipment. Empty bags of food</td>
<td>Crinkly cellophane wrap, for tea, floral arrangements, etc. Stand up pouches Bags for pre-washed salad Kitchen stretch wrap or plastic wrap for meat, poultry, fish or cheese Chip or snack bags Zipper-lock sandwich and freezer bags Plastic shipping envelopes Packaging labelled biodegradable or compostable Soft packaging for perishable foods, e.g. bacon, deli meats, cheese slices, fish, etc. Lumber or construction wrap Garbage bags or any bag sold as a</td>
</tr>
</tbody>
</table>
# Foam Packaging (Depot only)

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Do not include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foam food containers and trays</td>
<td>Meat trays, foam egg cartons, foam clamshells, foam cups and bowls for take-out food; etc.</td>
<td>Liquid-absorbing pads, Shrink wrap for meat, poultry, fish, cheese, etc., Napkins (include with green waste, if applicable)</td>
</tr>
<tr>
<td></td>
<td>Remove food residue and liquid-absorbing pads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sort white and coloured foam into appropriate collection container at depot</td>
<td></td>
</tr>
<tr>
<td>Foam cushion packaging</td>
<td>Foam cushion packaging used to protect electronics, small appliances, etc.</td>
<td>Labels, tape, Paper and cardboard (recycle separately), Foam peanuts, packing chips or noodles, Blue or pink foam board insulation, Squishy or flexible foam, Foam furniture (e.g. sofa cushions)</td>
</tr>
<tr>
<td></td>
<td>Remove labels, tape paper, cardboard</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sort white and coloured foam into appropriate collection container at depot</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B Interview Questionnaire
Mike and Julie (chair and 2ic Environmental Services Committee)

Can you provide a brief description of your background related to environment and sustainability?

Please describe how you were recruited to volunteer for your position and the formation of the committee. What were your primary responsibilities?

What were the goals set out when the committee was formed?

What did you imagine the role of the Environmental Services Committee would be upon its formation?

What were the original goals for waste management? If they changed, how did they change and what do you think influenced these changes?

Please describe your interaction with host society staff.

Please describe your interaction and relationship with the committee members.

Are you familiar with the ISO/CSA standards? Were you provided with copies of these? To what extent did ISO/CSA standards guide waste management for the games?

How were the waste management plans developed? How was this different from previous Canada Games?

How does the actual waste management of the games compare to previous expectations/goals?

Do you feel there were any limitations in waste diversion? If so, please describe.

How does waste diversion in the 2015 Prince George CWG compare to previous Canada Games?

Do you think that hosting this event in Prince George, in a northern context, contributed to limitations in waste diversion?

Were there opportunities for food waste diversion?

What was the budget for waste management? Did this limit the goals and expectations for waste diversion?

What, if any, will be a legacy for waste management in Prince George?

Do you have any other comments regarding waste management and diversion?

Emily (Sustainability Manager) CWG/UNBC
Can you provide a brief description of your background relating to environment and sustainability?

How do you define sustainability?

When you began your position as Sustainability Manager, what materials were you given to work with? What were the responsibilities of the position?

Were you given a sustainability strategy?

How did you use these strategies and other sustainability documents?

In what ways do you feel that the host society prioritized sustainability?

Can you describe your role in engaging the host society with sustainability initiatives?

What was your involvement with Environmental Services Committee?

What was your role in implementing the ISO/CSA standards to the 2015 CWG?

Were there challenges? If so, can you provide some examples?

To what extent did the ISO/CSA standards guide the sustainability practices? Waste management?

How often were sustainability initiatives discussed in meetings with staff? With managers?

Who did you report to? What was their attitude toward sustainability initiatives?

Did you try to implement a waste management stream for food waste? Can you describe your efforts? Were there any challenges?

- food redistribution

Can you describe your experience in gaining sponsorship for waste management? Were there any limitations? If so, what were some of the limitations?

What was the budget for waste management? What costs did this cover?

What role do you think hosting the games in a northern/rural context play in waste management planning?

What do you feel will be the legacy for waste management in Prince George?

**Dan Adamson (former sustainability manager) City of Prince George**

Can you provide a brief description of your background relating to environment and sustainability?

How do you define sustainability?

What were the dates of your secondment from the city with the 2015 CWG?
What were your contributions to sustainability within that time frame?

What was the host society’s attitude towards implementing sustainability into their functional areas?

Did you introduce the ISO/CSA standards? Why did you choose these standards even though they had not been used before in Canada Games?

[AFTER describing actual waste management within the 2015 CWG] Do you think that hosting this event in Prince George, in a northern context, contributed to limitations in waste diversion?

Do you feel that CWG missed opportunities for waste diversion? What do you think were the reasons? How could these reasons have been combatted?

**Kalli Quinn (Venue Operations Manager) CWG**

Can you provide a brief description of your background relating to environment and sustainability?

How do you define sustainability?

What role does the environmental services committee play in the planning process for the CWG?

What is your role in waste management planning?

Are you familiar with ISO/CSA standards? How did these guide the planning for waste management?

What was the budget for waste management (outside snow removal)? Was this enough to cover costs of waste removal? What was the actual cost for removal? If there were any gaps, how were they met/fulfilled?

How often did you meet with environmental services regarding the waste management of your venues?

How was the communication between the host society and the ESC?

Can you briefly describe the waste management plans for venues?

Were waste management plans across all venues identical? If not, what were some differences and why?

Do you think the games will leave a waste management legacy at any of these venues? Do you expect an increase in diversion at any venue?

**Maegan Clark (Coordinator-environment/ Venues: Otway and NSC) CWG**

Can you provide a brief description of your background relating to environment and sustainability?
How do you define sustainability?

Can you describe your experience with the Environmental Services Committee?

Did you face any challenges in implementing waste diversion at the venues?

Do you feel that all waste was weighed at each venue? Is there a measure for this?

Can you describe the waste management procedures at your venues?

What were the barriers in meeting waste management at each respective venue?

How compliant were the venues in increasing/decreasing waste receptacles?

How compliant were the venues in weighing all waste?

Do you think the venues regarded waste management as a priority?

Do you think the games will leave a waste management legacy at any of these venues?

Do you expect an increase in diversion?

Brian/Dave (Venue Coordinators: Civic Center/Cn Center) CWG

Can you state your role and responsibilities as they relate to CN Centre/Civic?

Can you describe the waste management procedures at your venues?

How often did you consult with Environmental Services representatives regarding waste management? I.e. Every venue meeting? Who did they normally report to?

Do you know of any barriers in meeting waste management at each respective venue?

How compliant were the venues in increasing/decreasing waste receptacles?

How compliant were the venues in weighing all waste?

Do you think the venues regarded waste management as a priority?

Do you think the Games will leave a waste management legacy at any of these venues?

Do you expect an increase in diversion?

Hilary/Andrew/Shaun/Adam ESC Representatives

Can you describe the waste management procedures at your venues?

What were the barriers in meeting waste management at each respective venue?

How compliant were the venues in increasing/decreasing waste receptacles?

How compliant were the venues in weighing all waste?

Do you think the venues regarding waste management as a priority?

Do you think the games will leave a waste management legacy at any of these venues?

Do you expect an increase in diversion?
Appendix C Safety Plan

UNBC Waste Audit Safety Plan

Name of Study/Project:
Sustainability and waste management assessment of the 2015 Prince George Canada Winter Games

Audit Supervisor (name, phone, email):
Annie Booth, 250.960.6649, annie.booth@unbc.ca

Audit Personnel (name, phone, email):
Jessy Rajan, 778.983.0861, rajan@unbc.ca

Description of Audit Process

1. Waste Collection (including transport):
Waste will be collected at the weighing station at four CWG venues: Otway Nordic Ski Center, Civic Center, Northern Sports Center and CN Center. Weighing station: CWG volunteers will be weighing all waste in a designated area within the venues. All waste samples will be collected by the researcher and transported to UNBC’s Enhanced Forestry Lab (EFL) in a 2008 Toyota Yaris.

2. Waste Processing
Samples will be stored in the shed located behind the EFL until ready for processing. When processing, all waste will be emptied onto a flat surface, researcher will never reach inside the bag. Waste processing will include separating and sorting waste types into buckets for weighing. Once completed the waste will be disposed into large, industrial bags.

3. Waste Disposal
Once collected into industrial bags, waste will be transported to the dumpster located outside the EFL entrance on EFL carts. Sharps and glass will be disposed of in their appropriate containers.

Special Concerns Regarding Waste:
Protective gear must be worn at all times

Personal Protective Equipment (PPE):
- Safety glasses, Tyvek coveralls, nitrile-dipped work gloves, shoes that cover the entire foot.
- Secure long hair.
- Wear a face shield if the materials being sorted could splatter.

First Aid:
- Security provides first aid at the Prince George campus. Arrangements must be made for first aid availability at other locations (contact Risk & Safety for more information).
- All injuries must be reported to first to security and then to the supervisor and an Incident Investigation Report filled out.

**Personnel Precautions:**
- Personnel must have a current tetanus vaccination.

**Sharps Handling:**
- Sharps should be handled with forceps (vice grip) to avoid inadvertent needle sticks or cuts from blades.
- Sharps must be placed in a designated sharps container (available for free from Chemstores).
- Sharps containers must be disposed through Chemstores.

**Glass Handling and Disposal**
- Broken glass should be handled with care.
- Glass slivers should be handled with forceps.
- Broken glass waste must be placed in a puncture-proof container.

**Liquid waste:**
- Chemical wastes found during the audit will need to be disposed of correctly (Chemstores or regeneration/Product Care Association).
- General water solutions can be disposed to the sewer.

**Decontamination**
- Work area—Wash with soap and water. If the surface will be used for general purposes (i.e., table tops), wipe with disinfectant.
- PPE—Wash non-absorbing PPE (e.g., safety glasses) with antibacterial soap.

**Unexpected Items in Found in Waste**
1. Documents containing personal information
   - Set aside in a secure manner and destroy in confidential manner
   - Report to supervisor and contact entity that produced them if they appear to confidential (e.g., patient records)
2. Illegal items or items that appear to have been used for the purposes of a crime
   - Report to supervisor and RCMP immediately
3. Items that appear to be lost
   - Report to supervisor and RCMP
Appendix D Data Collection Sheet
Sample number: _____  Sample site:___________________

Date, time and weight at collection  ______________________________

Date, time and weight before analysis ______________________________

Weight of paper products _______________ grams
Notes on content:
# of coffee cups:

Weight of plastic materials_______________ grams
Notes on content:

Weight of refundable/beverage container ________________ grams
Notes on content:
# of cans:
# of bottles:
Weight of liquid from containers
Weight of other: _______________ grams
Notes on content:
### Appendix E CWG Data Collection Summary of Garbage and Recycling (Container and Paper) Generation

In kilograms

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<th>Date</th>
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<th>Container</th>
<th>Date</th>
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WASTE DIVERSION 14.65% 8.76% 24% 7.50
## Appendix F CWG Raw Data Collection of Garbage and Recycling (Container and Paper) Generation by Venue

In kilograms

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<th>Date</th>
<th>Civic Centre Garbage</th>
<th>Civic Centre Paper</th>
<th>Civic Centre Container</th>
<th>CN Centre Garbage</th>
<th>CN Centre Paper</th>
<th>CN Centre Container</th>
<th>NSC Garbage</th>
<th>NSC Paper</th>
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<th>Otway Garbage</th>
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<td>227.3</td>
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<td>242.5</td>
<td>118.6</td>
<td>310</td>
<td>72.3</td>
<td>71.8</td>
</tr>
</tbody>
</table>
CONTAINER RECYCLING
RECYCLAGE DE CONTENANTS

Aluminum Containers
Contenants d'aluminium

Plastic Containers
Contenants de plastique

Paper Packaging
(contained liquids)
Emballages de papier
(pour liquides)

Steel Packaging
Emballages en acier

Glass Bottles and Cans
Bouteilles de verre et cannettes