

# **Opinions and behaviours contributing to household level food waste in Langley**

**by**

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or

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## **Abstract**

Across Canada, \$31 billion is spent each year on food that is never eaten, with just under half of this waste occurring at the household level (Gooch et. al, 2014). There are numerous environmental, social and economic implications of food waste, and a growing list of municipalities across Canada have implemented organics collection programs in an attempt to keep organic waste out of landfills. As an end-of-pipe solution, organics collection does little to address the upstream costs of food waste, nor does it facilitate the reduction of food waste in the first place. This study explores the behaviours and opinions that contribute to household-level food waste in order to develop better educational programming and policies to curb food waste. This research was conducted in Langley, British Columbia, a suburban municipality of approximately 110,000. The study consisted of an analysis of 141 surveys investigating food wasting opinions and behaviours, along with a more intensive week-long study involving 13 participating households. Participants in the week-long study kept a diary of their food waste instances and collected their food waste for analysis. Key findings include the need for standardized methodologies in food waste research, as well as the importance of distinguishing between avoidable and unavoidable food waste to better understand how much edible food waste is being thrown away. In Langley, households with children waste the most food; elderly individuals with no children in the house waste the least. Food wasted as a result of cooking, preparing or serving too much was the most common reason for wasting food. The financial loss inherent in wasting food was the number one driver for why individuals feel ‘bothered’ when they waste food. A noticeable lack of awareness about one’s household food waste was also discovered; individuals waste much more than they believe they do, signifying a need for more education and awareness of food wasting behaviours in the home.

**Keywords:** food waste; organics; waste reduction; household; survey; Canada.

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## **1. Introduction**

Food waste represents a significant environmental, economic and social issue throughout the world, with approximately 1/3 of all food produced for human consumption going to waste (Food and Agriculture Organization of the United Nations, 2013). The Food and Agriculture Organization of the United Nations (FAO) estimates that the carbon footprint of wasted food is 3.3 Gtonnes of CO<sub>2</sub> equivalent; if food waste was a country, it would be the third largest contributor to greenhouse gas emissions after the USA and China (FAO, 2013). Each year in Canada, hungry individuals will make 14,000,000 visits to Canadian food banks (Food Banks Canada, 2014) while \$31 billion is spent on food that is never eaten (Gooch et al., 2014). Food waste occurs at all stages throughout the food cycle, including during production, transportation, and retail, while nearly half of the total food waste occurs at the household level (Gooch et al., 2014). The economic implications of food waste are felt at the household level as well: uneaten food thrown in the trash costs each household approximately \$600 each year (Jones, 2004).

Despite the value in understanding why so much food is wasted at the household level (Sonesson et al., 2005) there has been relatively little study in this area, especially in Canada ([Parizeau et al. 2015] these topics will be discussed in more detail in sections 2.1 and 4.1.2). The solution to excess food waste in most parts of the world has been primarily focussed on end-of-pipe solutions such as backyard composting and municipal

food waste collection programs, leaving the ‘black box’ of household food waste largely ignored (Bulkley and Gregson, 2009). The environmental value of composting versus landfilling is rarely debated: food decomposing in landfills generates significant greenhouse gas emissions (Metro Vancouver, 2014b) and composting helps to decrease space requirements in local landfills (Metro Vancouver, 2010a). However, employing organics collection as the primary mechanism to manage food waste offer little to address the upstream environmental and economic implications of food waste (Bulkley and Gregson, 2009), and the addition of municipal organics<sup>1</sup> collection programs come at a significant cost to municipalities and taxpayers<sup>2</sup>.

In order to better understand how and why food is wasted at the household level, further research into individual habits and beliefs surrounding food waste in Canada is needed. My research aims to fill a small part of this gap by studying a variety of factors that may influence and contribute to household food waste in one municipality in the lower mainland BC. Specifically, this study asks ‘*What types and quantities of food do Township of Langley residents waste at the household level, and what opinions and behaviours contribute to this food waste?*’ It is hoped this study will add to the small but growing body of Canadian food waste research, and assist researchers and governments to develop and target educational programs/campaigns to help curb food waste from households.

<sup>1</sup> Organics collection programs differ by location but primarily accept compostable items such as food waste, yard trimmings and soiled paper products

<sup>2</sup> For example, the education/marketing element of the Township of Langley’s Green Can program totalled approximately \$100,000 in the first year (Township of Langley, 2013b).

## **1.1. Study Location**

The study was conducted in the Township of Langley (Township) which is situated south of the Fraser River in Metro Vancouver, British Columbia (see map, Appendix A). The Township is a municipality of approximately 110,000 residents and is comprised of pockets of urban and suburban development surrounded by rural land, much of which is dedicated to the Agricultural Land Reserve (ALR) (see map, Appendix B) (Township of Langley, 2014a). When broken out by household, the Township is made up of approximately 50% single family homes, 35% multifamily homes (primarily townhomes) and 15% rural properties (internal e-mail, October 30, 2014). The Township currently operates a municipal collection program for organic material called the Green Can, however this program is reserved for those living in more urban areas (as outlined by the coloured, labeled neighbourhoods in Appendix B) (Township of Langley, 2014b).

## **1.2. Regional Context and Urban Significance**

In Metro Vancouver<sup>3</sup>, the most densely populated and populous region in British Columbia<sup>4</sup> household food waste adds up to roughly 190,000 tonnes per year (Love Food Hate Waste Canada, 2015). According to the Metro Vancouver regional government, food waste in the region strains local landfill capacity and generates significant greenhouse gas (GhG) emissions through methane release from landfills (Metro Vancouver 2014b). A study completed for the Ministry of Environment showed that in

<sup>3</sup> Population 2.47 million in 2014 (Statistics Canada, 2015a)

<sup>4</sup> Population 4.63 million in 2015 (Statistics Canada, 2015b)

2008, BC landfills contributed 118,000 tonnes of methane into the atmosphere, which is equivalent to 2,474,000 tonnes of C0<sub>2</sub>(CO<sub>2</sub>e) or 825,000 automobiles (Golder Associates, 2008). In an effort to address the sheer volume of food waste and the associated environmental and landfill space issues, Metro Vancouver has been working with member municipalities to implement organics collection programs with the aim of diverting food waste away from end-of-life alternatives such as landfills and incinerators and towards composting facilities instead (Metro Vancouver, 2010a). Enforcement to ensure participation in organics diversion<sup>5</sup> programs has also recently been implemented in the region—as of January 1, 2015, Metro Vancouver implemented a ban on organic material at their regional landfill and transfer stations (Metro Vancouver, 2014c). Overall this is a positive move. There is no doubt that diverting organic waste to composting facilities eases pressure on landfill capacity, and proper composting sequesters carbon dioxide (C0<sub>2</sub>) producing slightly less than net-zero greenhouse gases<sup>6</sup> (Environmental Protection Agency, 2010). In order to support ban compliance, the vast majority of Metro Vancouver’s member municipalities, including Langley, have now implemented organics collection programs. Unfortunately, the supplementation of existing garbage and recycling collection programs with an organics collection program requires significant funding. Though the exact costing of adding organics programs is difficult to establish (Federation of Canadian Municipalities, 2004), most will require adding collection trucks, bins or carts for residents (approximately \$50-\$100/cart [personal knowledge]), as

<sup>5</sup> Diversion from the landfill

<sup>6</sup> The EPA estimates that centralized composting of organics results in net carbon storage of 0.20 MTCO2E per wet short ton of organic inputs composted

well as ongoing education and outreach to support the programs. Organics diversion programs can, over time, offer net cost savings compared to disposing of food waste in the garbage because disposal tipping fees for garbage are approximately double those for organics (\$109/tonne for garbage and \$65/tonne for organics [Metro Vancouver, 2014d]). Still, the Township of Langley tipped over 9,500 tonnes of residential organic material in 2014. If the organic material could be reduced through food waste reduction, tipping fee costs could be reduced as well.

Backyard composting is sometimes offered as a solution to food waste in the garbage. Indeed, backyard composting is quite cost effective, even when the composting units are subsidized by local governments (commonly at 50%) (FCM, 2004). Unfortunately, concerns over odours or pests have been identified as barriers to backyard composting (Lura Consulting, 2011; Walker et. al, 2004) and this can be exacerbated in urban areas where personal space is limited. For condo and apartment dwellers with no private yard space, backyard composting becomes nearly impossible. In-unit worm composting (or vermicomposting) is sometimes offered as a composting solution for condos and apartments, however usage is often low; the Township of Langley, for example, recently discontinued its worm composting program due to lack of interest (Township of Langley staff meeting, January 2015).

Throughout Canada, cities and regions are urbanizing and continuing to move into more dense living environments; currently 81% of Canada's population is considered 'urban' (Government of Canada, 2011). As of 2011 in Metro Vancouver, single detached homes only represented 34% of the total housing stock, down from 50% in 1991 (Metro

Vancouver, 2014e). In Langley, the total number of multifamily properties (condo and townhouse) more than doubled from 1996 to 2011 (6650 to 15295), while single-family homes increased a mere 9% (Metro Vancouver, 2014e). Increasing urbanization coupled with the pressure of the upcoming landfill ban has exposed the reality that on-site composting alone is not sufficient to properly manage household food waste in urban areas. As such, municipalities including Langley will need to find cost-effective and sustainable methods to manage the large volume of food waste generated by households. Organics collection programs (i.e. the Township's Green Can program) are no doubt a necessary element; however a reduction in the total amount of food waste should be seen as a valuable and complementary component of municipal waste management. As urban centres continue to multiply and grow, the environmental, economic and social problems associated with food waste will grow with them. Food waste reduction has the potential to greatly improve urban sustainability, yet it has been largely ignored by cities thus far. The following literature review will elucidate why food waste represents an obstacle to a sustainable urban food system and will reveal the importance of focused action to curtail food waste in cities.

## **2. Literature Review**

### **2.1. The Case for Food Waste Reduction**

Food waste is a significant problem in North America and throughout the developed world. Across North America, approximately 40% of all food produced goes to waste (Hall et al, 2009; Gooch et. al, 2010). Economically, Canadian food waste costs nearly \$31 billion, with approximately half of that waste coming from households (Gooch et al, 2014). With the cost of food continuing to rise, it should be an economic imperative to try and reduce food waste to save valuable money at the household level. Additionally, the supplementation of existing municipal garbage and recycling collection programs with organics collection programs comes at a financial cost for municipalities and tax payers (FCM, 2004). Though efforts are being made to reduce the financial impact of this additional organics collection service (e.g. many municipalities are choosing weekly organics collection and garbage collection every other week to reduce costs and increase diversion rates) (FCM, 2004), the fact remains that additional funding is required support education, ongoing support, and collection programs for organics diversion.

Environmentally, food waste has numerous negative effects with consequences existing at every stage throughout the life of a food product. At the production stage there is significant water use; for example, 1.7 billion cubic metres of water was used in

agricultural irrigation in Canada in 2012 (Statistics Canada, 2012). Pesticides used to grow conventional produce can also contaminate waterways (Kellogg et al. 2002). Furthermore, food production requires extensive land use: studies show that the global export of food products is driving tropical rainforest deforestation to make space for agriculture, which has significant implications for climate change (Defries et al., 2010). Other research has found that the vast majority (83%) of greenhouse gases generated in the food cycle occur at the food production stage with the production of meat products generating the most greenhouse gases (Weber et al. 2008). The transportation of food to retail markets (the average food item travels 1,640km) also contributes greenhouse gas emissions to the atmosphere, along with air pollution (Weber et al, 2008). The embodied energy in our food products is substantial: a study by Cueller and Webber (2010) estimated that wasted food accounted for 2% of the total US energy expenditure in 2007. So, each time an extra burger from a barbecue or some leftover rice is thrown away, one must consider the embedded water, energy and emissions that were inherently squandered in that wasted food.

The downstream waste generated out the back of grocery stores, restaurants, and households generates more environmental problems. For example, methane, a potent greenhouse gas, is released when food decomposes in a landfill environment (Metro Vancouver, 2014b). When food is disposed of in a landfill, the piling of waste material prevents oxygen and decomposing microbes and insects from assisting in the natural composting process. Methane is 20 times worse for global warming than carbon dioxide, and currently 67% of the methane generated in the Metro Vancouver region comes from

local landfills (Metro Vancouver, 2014b). Finally, the environmental implications (i.e. greenhouse gas emissions and air pollution) associated with truck-based municipal collection of food waste from households must also be considered.

In the developed world today, food waste is just beginning to receive the attention of researchers and governments. Examples of studies on household food waste exist from Greece (e.g. Abeliotis et. al, 2014), Australia (e.g. Farr-Wharton et. al, 2014; Jean-Baptiste et. al, 2011), and the US (e.g. (Buzby and Hyman, 2012), while Canadian researchers have only just begun to study the intricacies of household food waste. Available studies in Canada cover subjects such as food waste and value chain management (Gooch et al. 2010 and 2014), green waste composting programs (for example, the Township of Langley completed a study on household attitudes about backyard composting [see Lura Consulting, 2011]), and recent studies regarding food waste composition (Sustainability Victoria, 2014; Parizeau et al., 2015). The study of household level food waste behaviour and attitudes have been notably limited, though one study out of the University of Guelph was published in January 2015 (Parizeau et al, 2015).

The United Kingdom, by contrast, is leading in this area and represents one of the few places where food waste behaviours and attitudes have been more comprehensively examined. Of particular note is the Waste and Resources Action Program (WRAP) in the UK which has been conducting food waste research, and food waste reduction education and advocacy since 2007 (WRAP, 2012). Through funding received by UK governments, WRAP conducted a comprehensive food waste analysis in 2012 which included the

‘detailed measurement of the weight and types of food and drink waste from approximately 1,800 consenting households, a week-long food and drink diary involving 950 households and a synthesis of waste data from more than 80 local authorities’ (WRAP, 2012). One of the oft-cited findings of the WRAP program studies is that up to 60% of household-level food waste in the UK could be considered ‘avoidable’ (Quested et al 2013). This finding indicates that by changing food wasting behaviours at the household level, more than half of all household food waste (and corresponding environmental and economic implications) could be avoided. Further, WRAP found that in the UK, the top two reasons households reported wasting food were 1) food left on the plate and 2) ‘out of date’ foods (Ventour, 2008). The former finding has prompted WRAP, the United Nations Environment Program (UNEP) and the Food and Agriculture Organization of the United Nation (FAO) to release an educational tool called Think. Eat. Save which guides households, businesses and governments to design programs to prevent food waste (UNEP, 2014). The latter finding has stimulated government exploration into whether products with longer shelf lives could be exempt from the ‘best before’ date requirements (Council of European Union, 2014).

Canadian research into food waste should be prioritized, because the direct transfer of research from the UK to the Canadian context may not accurately reflect the differences between the regions. For example, grocery shopping frequency in the UK could differ from Canada which could impact how much food is brought into the home (and potentially wasted). Similarly, the UK could have different laws, policies and practices around food safety. For instance, in Canada, expiration dates are only required

for 5 specific categories of food (nutritional supplements, meal replacements, human milk substitutes, foods sold by pharmacists for a very low energy diet, and formulated liquid diets), all other foods are labelled with ‘best before’ dates which are not related to food safety (Canada Food Inspection Agency, 2014). The UK uses a ‘best before’ dates as well with similar parameters, however foods that are considered unsafe past a specific date carry ‘use by’ date labels (Department for Environment, Food and Rural Affairs [DEFRA], 2011). Differing terminology could impact how the food labels are understood and how waste-related decision-making is handled by consumers. The WRAP program determined that consumers are often confused by the difference between legally required date marks and those used by manufacturers and retailers (DEFRA, 2011). This experience could be similar (or different) in Canada.

Furthermore, land use and the spreading suburban landscape in North America may have a significant impact on household food waste. The less-dense nature of suburban design in many North American cities may impact food buying. For example, bulk store grocery items (e.g. from Costco) are much easier to manage by car than by foot or bicycle. A neighbourhood comparison in 2002 by the Canadian Mortgage and Housing Corporation (CMHC) showed that car ownership in the suburbs (e.g. Langley) was approximately 1.8/household versus 1/household in more urban areas<sup>7</sup> (e.g. the West End of Vancouver) (CMHC, 2002). Studies from the UK indicate that food offers (enticements such as two for the price of one) and discounts tempt people to buy more

<sup>7</sup> The study used the GVRD average household size of 2.6 people for each calculation

than needed, and users readily admit that some of these items get thrown away without being eaten (WRAP, 2007).

The wide-ranging economic and environmental implications of food waste coupled with the opportunity to discover why Canadian households-specifically waste food contributes to the value of this study on household food waste opinions and behaviours.

## **2.2. Culture of Food Waste in North America**

Food wasting behaviour is an incredibly complex issue that will not be easily explained by a few key drivers. This research will not likely find the ‘silver bullet’ to explain why people waste food at the household level; however it does seek to uncover some of the key reasons why individual households waste food. It is important to gather food waste data that is specific to the culture and lifestyle of Canadians and/or North Americans, as our cultural attitudes may differ from those in areas where food waste research is more extensive (e.g. the UK).

In the developed world, we have come a long way from the subsistence lifestyles of our ancestors. For a good portion of society, food is no longer merely a means of survival; many North Americans keep more food in the cupboard, refrigerator and freezer than they would conceivably need in a given week (or more). An example illustrating this cultural norm of home food storage can be understood via our refrigerators and freezers. For instance, the average refrigerator size in the US has grown from 19.6 cubic feet in

1980 to 22.5 cubic feet by 2012 (Crist, 2012). In many parts of Europe, by contrast, many refrigerators are designed to fit below the counter, though recently ‘American Style’ larger refrigerators are gaining popularity (Argos, 2014). Furthermore, approximately 27% of Canadian households have a second refrigerator (Natural Resources Canada, 2007), and 54% own a chest freezer (Natural Resources Canada, 2003) for which to store large quantities of food. To ensure the economic value of all of this stored food is not lost during a power outage, there’s even ‘coverage under virtually all homeowner policies for spoilage of freezer foods’ according to the Insurance Bureau of Canada (Carrick, 2003).

The pure abundance of available food in our culture—from 24 hour grocers and restaurants to food items from around the world—creates a mentality that we can, within financial reason, have whatever we’d like to eat, whenever we’d like to eat it. Studies show that there is a strong correlation between rising food availability and food waste in the US (Hall et al., 2009). This phenomenon could be referred to as a product of our culture of abundance. One of the early authors on this topic was historian David Potter. His 1954 book entitled *People of Plenty—Economic Abundance and the American Character* critically examines how each American’s distinctive character has been shaped by economic abundance (Potter, 1954). Potter contrasts the historical experiences of people surviving during the great depression and WWII—where grocery shelves sat barren and food options were scarce—to the post war abundance experienced during the 1950s. Potter explains that full grocery shelves and an abundance of food options in the post war periods were presented as proof to the world and to Americans that the US did not only survive the hard times but came out the other side incredibly prosperous.

In contemporary society the general acceptance of plentiful food as a symbol of prosperity and status still exists. Whether speaking of abundant food options or abundant food portions, North Americans tend to see more as better in the world of food. A study published in the *Journal of Consumer Research* showed that preference for food abundance (i.e. supersized portions) may have roots in the status-signaling value of larger options (Dubois et al, 2012). The study looked at the inherent socio-cultural desire for status, and how a relative lack of status (whether real or perceived) could drive individuals to purchase and serve more food—particularly in public situations—as a means of displaying social standing (Dubois et. al, 2012).

The seemingly endless opportunities to purchase more food only compounds this problem, since instead of eating what's in the fridge, individuals can choose to pick up whatever they fancy at that moment. Research has shown that one of the factors implicit in the rise of impulse purchasing behaviour is availability (Vohs and Faber, 2007): the more opportunities to purchase food, the more likely we are make impulse food purchases. The increasingly stressful nature of today's culture (Naylor et. al, 2010) may further increase the rate of impulse purchases as a mechanism to regulate mood (Youn and Faber, 2000). This cultural precedent of abundance puts food retailers under intense pressure to sustain enough food stock to offer wide-ranging menu choices at all times (Kantor, 1997). The WRAP program lists personal food desire and ‘spontaneous purchasing’ as top reasons for food waste in their extensive study into food waste behaviours in 2006 (WRAP 2007b, pp 2).

The problem of abundance is magnified by the enormous consumerism around food in North America. In 2009, the fast food industry alone spent more than \$4.2 billion on advertising (Harris et al, 2010). As a society, we are constantly bombarded with messaging around food, whether via television, print, radio, or more recent forms of communication such as websites, social media, video games and sponsored events (Harris et al, 2009). This creates a culture of constant food desire and, plausibly, an urge to purchase far more than is needed. In fact, a number have studies on obesity have linked food (particularly fast food) marketing to an increase in food purchases and weight (Seiders and Petty, 2004; Goldberg and Kunter, 2013).

A similar food waste-related cultural factor akin to the abundance and marketing of food is the general shift towards a culture of convenience in the last few decades. The microwave, the drive-thru window and the newly-revived grocery delivery services are all examples of how modern society is looking for ways to make eating more convenient. With a 77.9% employment rate for women aged 25-44 and 85.8% for men (Statistics Canada, 2013), modern families are working more than they were decades earlier (Turcotte, 2005) and often looking for ways to expedite routine chores such as grocery shopping and meal preparation. Research into the direct impact of convenience food preference on household food waste is inconclusive (Parizeau et al, 2015), however one study by Ganglebauer et al. (2013) in the UK and Australia revealed that a group of convenience food purchasers felt that their busy lifestyles and unplanned social engagements caused them to purchase more food than they could eat.

The low cost of food in North America (particularly the US) represents an economic factor contributing to food waste behaviour. When food prices are extremely low, it becomes easier to justify 1) their purchase, and 2) their waste. At present, food costs in the US are the lowest in history, representing a mere 10% of the average income (compared to about 25% in the 1930s) (Sturm and Ruopeng, 2014). The purchase price of many food products is kept artificially low through agricultural subsidization by governments. In Canada alone, an estimated \$8 billion is spent supporting Canadian agriculture, the majority going to dairy, poultry and egg producers (OECD, 2014). In the US, these subsidies rise to \$36 billion with the majority going to feed grains (particularly corn), cotton, soy beans, and wheat (OECD, 2014). When food prices are kept low, it becomes easier to purchase more than needed, which can ultimately lead to food waste. Many of the food products available in North America also travel from other countries where inexpensive labour obscures the true cost of the food production (Carolan, 2011). An abundant, cheap, and readily available food supply creates a culture where food is undervalued (and thus expendable) which could be easily tied to the propensity to waste food.

‘Buy one get one free’ deals, bulk items and wholesale retailers may also influence consumers to purchase more than they need (Gunders, 2012). The opportunity to get a deal (and the perception of saving money through bulk purchases and sale items) can be a very strong driver for consumers, easily trumping one’s consideration of whether they can truly use the extra food. Though researchers have noted challenges in documenting the link between promotional food purchases and food wasted from the

home, 44% of respondents in a WRAP survey agreed with the statement: “buying food on offer leads to more food being thrown away” (WRAP, 2011)

At this point it should be stated that by no means do all North Americans have the opportunity to over-purchase and waste food; many North Americans do not have an adequate food supply and rely on food banks for subsistence. According to Food Banks Canada, close to 850,000 people use the Canadian food banks every month, and hunger remains a major problem in both Canada and the US (Food Banks Canada, 2014). Still, most North Americans are able to participate in wasteful food waste behaviour which can have significant implications for the amount of food wasted at the household level.

The food waste puzzle is one that is extremely complex and no one explanation will account for all food wasting behaviour. Still, it is useful to understand the cultural context within which these food wasting behaviours and attitudes exist. With this understanding, targeted education and policies can be created in order to improve the likelihood of changing behaviour.

### **2.3. Difficulties in Perceiving and Prioritizing Reduction**

Finally, it would be useful to explore what systems-based, psychological and logistical barriers to food waste reduction might exist in order to better understand how food waste became so pervasive.

One major issue that hinders awareness and action around food waste is the linear nature of the food system as food flows in and out of cities. A clear disconnect

exists between cities and both the production of food (farming, processing etc.) and the food waste material generated. Growing food is largely absent in urban and suburban centres (though this has been increasing in recent years [Ladner, 2011]), city dwellers, instead are ‘harvesting’ their food in grocery stores (Girardet, 2015). On the waste disposal side, a truck comes by one’s residence (typically) weekly and collects the solid waste produced, quickly severing any connection with it.

Urban thinker and environmentalist Herbert Girardet is a prominent author on ‘urban metabolism’ and its implications for sustainability. In his 1999 book ‘Creating Sustainable Cities’, Girardet notes that resources are funnelled through the urban system without much thought to their origins or the destination of the waste. Cities take in various inputs (including goods, water, food etc.), utilize these materials as part of typical urban processes, and then expel the remnants from the urban core as waste product (Girardet, 1999).

Whether we are speaking of garbage, greenhouse gas emissions, or water pollution, the waste produced in cities has environmental (as well as social and economic) implications that are often felt beyond the city itself. This disconnect can drive unsustainable behaviours (such as food waste) in cities because the effects of these behaviours simply aren’t directly felt by urban dwellers. In cities, organized waste collection has roots in the maintenance of public health: unsanitary conditions and the spread of diseases such as cholera and typhus in urban centres were the catalyst for municipal waste services. The Public Health Act 1875 enacted in London, England (and others that followed in many urban areas) gave local authorities the power to provide the

collection of household refuse from properties (National Archives [UK]. 2015), a provision that endures today. Because of this, city-dwellers may never set foot in a landfill, compost facility or recycling facility. To them, the waste simply disappears, which makes it difficult to comprehend that waste (including food waste) has serious repercussions in the environmental, economic and social spheres. Even if it were understood that food waste is a generalized problem, it is not simply a matter that some external body should remedy it—individual households must be responsible for changing their behaviour. With nearly 50% of food waste coming from Canadian households (Gooch et al, 2014), city dwellers et al. need to understand that the ‘out of sight, out of mind’ perspective impairs their ability to identify the repercussions of food waste, and they must recognize their personal role in reducing the cumulative effects of this waste.

Beyond this disconnection, it can be quite challenging to perceive any reductions that are in fact taking place. Inherent in food waste reduction is the fact that food waste that was once present is now absent. But how easily can we perceive and value this reduction without strong visual cues? In an experiment designed to illustrate the problem of large portion sizes, experimenters fed soup to participants from bowls that refilled imperceptibly (Wansink et al., 2005). Participants with refilling bowls ate on average 73% more soup than the group with normal soup bowls, yet did not feel any fuller than the control group, nor did any of the participants notice that their bowls were refilling (Wansick et al., 2005). The conclusion of the researchers was the ‘importance of having salient, accurate visual cues’ to reduce food intake (Wansick et al., 2005) and how strongly linked our visual senses are to our perceptions. Parallels can be drawn to food

waste reduction: in the absence of visual cues, it becomes difficult to psychologically quantify our food waste reduction efforts, and thus food waste reduction is difficult to comprehend. One may contend that a reduction in the size of one's garbage bag or bin could be perceived, however this reduction is not as clearly observed as diversion to fill an organics bin might be. Diversion allows one to witness the garbage shrink while perceiving the organics bin fill up, which is arguably easier for an individual to grasp.

These perception difficulties have been supported by recent studies from the UK's WRAP program which show that households consistently underestimate the amount of food they throw away. A full 60% of over 2000 people surveyed thought they threw away 'a small amount', 'hardly any', or 'no food' while assessments of their garbage and green bins proved otherwise (WRAP, 2009). Even those households that claim they throw away 'hardly any' and 'no food' still threw away a respective 2.5kg and 1.7kg of avoidable food waste each week (WRAP, 2009). Clearly, our ability to understand and perceive reduction is difficult and this is likely to have an impact on overall food waste and mitigation efforts.

Perception is not the only issue affecting our ability to understand the value in reduction: prioritizing food waste reduction has also been troublesome. One matter is that recycling behaviour (which includes composting) has been given a normative 'green halo', wherein the behaviour is seen as virtuous and environmentally-friendly. The bottle and can recycling company Encorp, for example, uses advertising that plays on the social morality of recycling. The tag line 'every container you don't recycle says something about you' is meant to evoke guilt in those that don't recycle, while presenting the

message that good and moral people recycle (see Appendix C). The normative nature of recycling is also known to increase recycling rates. Curbside recycling in particular, as a visible behaviour, has been shown to apply noteworthy social pressure on non-recyclers to 'put their bin out' (Oskamp et al., 1991; Mackenzie-Mohr and Smith, 2008). Recycling in condo and apartment buildings (using mutual collection bins) is much lower (16%) than in single family homes (46%) with blue boxes at the curb (Metro Vancouver, 2010b), and the lack social pressure is often cited as one of the reasons for the disparity (Mackenzie-Mohr and Smith, 2008). In the case of food waste reduction, similar psychological and social feedback mechanisms are absent which makes the promotion and maintenance of this behaviour ever more problematic. In fact, if a single-family household generated so little waste that they did not need to put their organics bin out each week, this could be perceived by neighbours as lack of participation in the composting program.

Furthermore, individuals who recycle often feel proud of their recycling habits. In an American survey of 2022 individuals, 82% said they feel a sense of pride when they recycle (Environmental Industry Associations, 2013). Individuals who recycle in single-family homes can look to their curb and see multiple blue boxes and an organics bin and feel pleased with their recycling accomplishments. Counterintuitively, they should be proud to have less material out overall through reduction measures; however this does not have the same impact as viewing a full recycling or compost bin.

Complicating this effect are difficulties surrounding prioritizing and measuring reduction at the municipal level. For municipalities in the Metro Vancouver region and

world-wide, there has been general push towards the diversion of organic material from landfills with little corresponding emphasis on reduction. One issue is that local governments are specifically responsible for the ‘end-of-pipe’ section of the food waste chain which is the waste and recycling collection and disposal (Environment Canada, 2013a). The responsibility for the upstream environmental effects of food waste does not specifically fall under municipal jurisdiction. As such, the diversion of organics materials to composting facilities is often the municipal solution to dwindling landfill space and associated methane gas emissions (Environment Canada, 2013b).

As a general rule, organics diversion programs celebrate composting as an environmental achievement (see example advertisement from the Township of Langley, Appendix D). When compost collection bins are full, the perception is that things are being done right. Indeed, organics diversion and composting is preferred over sending food waste to the landfill, however the over-valuation of organics diversion could have unintended consequences on our perception of food waste and, consequently, on overall food waste.

Municipalities and regional governments regularly report on how much they have diverted from the landfill, including both recycling and organic material. Many municipalities participate in the National Solid Waste Benchmarking program (AECOM, 2011), and BC municipalities use organic material tonnage towards greenhouse gas offsets as part of their carbon neutrality commitments in the Climate Action Charter (Government of British Columbia, 2011). Most municipalities in the Greater Vancouver Regional District have also adopted Metro Vancouver’s diversion goals as outlined in the

Integrated Solid Waste and Resource Management Plan (ISWRMP): 70% landfill diversion by 2015, and 80% by 2020 (Metro Vancouver, 2010a; Township of Langley, 2014c). Explained slightly differently, the goal for the year 2020 is that 80% off all waste output from Metro Vancouver will be either recycled or composted. Measuring waste in terms of diversion rates such as these can be troublesome however. If, for example, a municipality reduced their organic material output by half through food waste reduction, this would mean that a greater percentage of the overall waste would go to the landfill (see example in Table 1). This example illustrates that Municipality B's diversion rate is lower despite having less total waste (see example in Table 1). A lower diversion rate would make it appear as though Municipality B (Table 1) was not doing enough to reach Metro Vancouver's goals.

**Table 1: Food Waste Reduction Expressed as Diversion Rate**

Municipality	Organics (tonnes)	Recycling (tonnes)	Garbage (tonnes)	Total Waste Material Generated	Diversion Rate (% of total recycled and composted)
A	10,000	8,000	12,000	30,000	60%
B	5,000	8,000	12,000	25,000	52%

Specifically measuring food waste reduction can also be challenging. Municipalities can report on reductions in garbage or organics tonnage, but it is nearly impossible to tie this directly to any food waste reduction. A reduction in garbage<sup>8</sup> tonnage, for example, could be attributed to the diversion of recyclable materials to depot

<sup>8</sup> Participation in Langley's Green Can program is approximately 30%. A large portion of food waste still ends up in the garbage stream.

drop-off locations (e.g. electronics). There is a growing list of Extended Producer Responsibility (EPR) programs in BC covering hundreds of items, many of which use drop-off depots as collection points (Recycling Council of BC, 2014). Additionally, a particularly wet or dry season can have a significant impact on tonnages, especially for organics material (such as grass and yard trimmings). Consequently, any success from food waste reduction programs would be very difficult to demonstrate. Still, the difficulties in perceiving food waste reduction and illustrating the success of any corresponding programs is not sufficient to warrant the lack of study or initiative in Canada. The economic and environmental impacts of food waste are more than enough justification to research and attempt to tackle this issue.

### **3. Methodology**

The methodology for the project included two study groups: the Food Waste Diary group and the Survey Only group. The details of each study group are outlined in Table 2 below.

**Table 2: Food Waste Study Design**

Study Group	Components	Participants	Personal Contact with Researcher?	Intensity-Level
Food Waste Diary	One-week food waste diary Food waste composition assessment Survey	13 <sup>9</sup>	Yes	High
Survey Only	Survey	400 surveys distributed	No	Low

#### **3.1. Ethics**

This research study was conducted with support from the Office of Research Ethics for Simon Fraser University. The research project was executed in partnership with the Township of Langley municipal government with which I am presently

<sup>9</sup> 14 participants completed the study, however one household did not follow the directions correctly and their results were excluded

employed. The primary data was collected for dual purposes: 1) for my SFU Urban Studies Master's thesis and 2) for use by the Township of Langley municipal government. The Township of Langley will use this information to help inform food waste education programs with the aim of reducing food waste in the Township.

Consent was obtained for all participant households in this study. Participants in the diary study each signed a consent form at the outset of their household research. Participants in the 'survey only' group received a 2 page explanation of the study, its risks and benefits, as well participant rights outlined at the beginning of the survey (Appendix G). Consent for the online survey was provided by a sentence at the end of this section that stated "by completing and returning the survey, it is understood that you understand the terms outlined above".

### **3.2. Research Support from the Township of Langley**

The Energy and Solid Waste Department at the Township offered some notable support to this study. For example, partnering with the Township provided the study status in the community which proved helpful in soliciting research participants. The Township also provided financial backing for specific components of the project (e.g. survey printing and postage), as well as some staff support from a Technical Assistant.

### **3.3. Diary Study**

#### **3.3.1. Research Background**

Food waste diaries are sometimes used in food waste research to help identify what types of food are thrown away, and why. Examples of other studies that have used food waste diaries include research from the UK (WRAP, 2012) and Australia (Jean-Baptiste et. al, 2011). The food waste diary offers advantages over a survey alone, since participants are reporting on their food waste at each instance of food wasting that occurs. This method reduces or removes the need to recall and generally estimate food waste over time. Some diary studies (such as Jean-Baptiste et. al, 2011) ask participants to both record their food waste and to weigh it using provided weigh scales. In order to reduce the time burden on participants, I elected to have participants simply record the food waste instance in the diary and to deposit the food waste in a provided container. The food waste would then be sorted and weighed by and my assistant and I after the one-week period was over (see more on the waste assessment in section 3.3.2).

The food waste diary design was drawn from the Love Food Hate Waste campaign which is an awareness and education campaign by the WRAP program (see example diary on the Love Food Hate Waste website [Love Food Hate Waste, 2013]). The simple table design asking participants to record their food waste under the headings ‘What?’ ‘Where?’ ‘How much?’ and ‘Why?’ was an easy-to-use format and thus appropriate for this study (see Appendix E for the Langley diary).

Week-long diary studies are time consuming and it can be difficult to recruit participants for a study. Willingness to participate can be influenced by a number of factors including the participant's available time and their general interest in food waste and/or environmental research. Because this food diary study included multiple visits with the participants as well as waste assessments, it was only feasible to conduct a small study (with a final total of 13 qualifying participants) within the scope of this project and available resources. For comparison, a similar Australian study (Jean-Baptiste et al., 2011) had 26 participants, while a study from Sweden (Sonneson et al, 2005) had 35. The UK's WRAP program was conducted on a much larger scale with 948 completed diaries (WRAP, 2013).

### **3.3.2. Diary Study**

Data collection for this study was completed between April and June of 2015. Food waste can fluctuate throughout the year, and it should be acknowledged that seasonality can influence study results (see section 5.3 Study Limitations). To recruit participants in the diary study, a listing of Langley addresses was provided by the Township. Then, using the randomizing website random.org, individual addresses were selected and searched on Canada 411 to retrieve phone numbers which were subsequently called. In order to incentivize participation, participants were offered the opportunity to be entered into a draw for a \$200 grocery gift card which was donated by the Township's collection contractor.

Once a household agreed to participate in the study, a time was arranged to meet (at their home, a Township building or another location of their choosing) to provide the necessary study materials. The materials provided included the food waste diary (see Appendix E), two small kitchen containers to put all food waste in (one for food, one for liquids in original containers) (see Appendix F), the food waste survey (see Appendix G), and a listing of Frequently Asked Questions (FAQs) (see Appendix H). Participants were asked to keep the diary in the kitchen near the provided food waste containers and to record each instance of food waste. They were also asked to include all forms of food in the diary and provided container, including both avoidable (e.g. leftovers, wilted lettuce) and unavoidable waste (e.g. egg shells, onion skins). This was done to help determine what percentage of disposed food product could have conceivably been avoided.

In the diary, participants were asked to list what food items were wasted, approximately how much was wasted, and why (see examples in Appendix E). They were then asked to place each food item in the provided containers. It was suggested that participants fill out the survey once the 7-day diary project was complete so that the questions themselves did not influence results, though it was not established when exactly participants chose to complete the survey (see Appendix G for survey questions, and section 3.4 for more on the survey). At the end of the study period, the food waste, diary, and survey were collected from the participants. Some participants elected for a follow up visit, some left the study components at the curb for pick up, and others dropped them off at the Township offices. Once the materials were received, the contents

of the food waste bins were taken to the Township Operations yard to be sorted and weighed (see section 3.3.3 for more on the waste assessments).

The amount of effort per day for each participant in the diary study was dependent on a variety of factors including how much food waste occurred in a given study household and experiences with teaching family members the new protocol. Approximate time investment estimates are presented in Table 3.

**Table 3: Participant Time Investment for Diary Study**

Study Component	Time Investment
Initial visit	10 minutes
Diary	5 min/day X 7 days = 35 minutes
Survey	10 minutes
Follow-up visit	10 minutes
Teaching family members to participate (may or may not be necessary)	10 minutes
Total time:	65-75 minutes

As mentioned, the time-intensive nature of diary study research made it only possible to reasonably recruit and manage a small number of participants (in this case, 13) effectively. It is acknowledged that the small sample size limits the statistical significance of any conclusions drawn. Despite this, I felt it was important to explore what types of food were being thrown away and the reasons associated. This type of information cannot be reasonably gained from a survey alone which was the research design alternative. It should also be acknowledged that participants in this study may have been subject to the Hawthorne Effect: a term coined after a series of employee satisfaction studies in the 1920s and 1930s in the Hawthorne suburb of Chicago where

‘researchers discovered that their presence affected the behaviour of the workers being studied’ (Babbie and Benaquisto, 2014, p. 209). Participants in my study were aware that their food waste would be assessed after the one-week period, and this may have caused them to adjust their normal food waste behaviour. For instance, participants may have chosen to delay throwing away older items from their fridge or pantry until after the study so their household appeared to waste less food. The Hawthorne Effect could have the consequence of showing lower food waste overall than studies where participants were not aware that their food waste was being monitored. This is a recognized limitation of this diary study, as well as with all similar studies using food waste diaries. The specific advantage of the food waste diary is to learn the reasons *why* individuals throw away food, which is more difficult to ascertain using other food waste research methodologies including surveys and curbside waste assessments. A more detailed discussion of the advantages and limitations of different methodologies will be discussed in section 5.3.

### **3.3.3. Waste Assessment**

The primary purpose of the waste assessments was to determine: 1) total avoidable vs. unavoidable food waste per household, and 2) waste composition (relative percentage of waste types- e.g. vegetables, grains, etc).

Participant food waste was sorted into 4 basic categories: avoidable, potentially avoidable, unavoidable, and miscellaneous. The 3 primary categories are consistent with the UK’s WRAP study from 2012 (WRAP, 2013), while the miscellaneous category

was added out of necessity during the assessments. Examples from each category are outlined in Table 4.

**Table 4: Food Waste Category Examples**

Waste Category	Example Items
Avoidable	Leftover meals, wilted vegetables, moldy/dry cheese
Potentially Avoidable	Potato peels, carrot peels, apple peels
Unavoidable	Coffee grinds, egg shells, meat bones, melon rind
Miscellaneous	Residuals that could not be sorted/identified

Separating the food into these categories allows us to distinguish between foods that are inedible (unavoidable) and those items that could have been eaten but were not (avoidable, potentially avoidable). Avoidable food waste is the primary target of food waste reduction campaigns such as WRAP's Love Food Hate Waste<sup>10</sup> and represents waste that can be actively avoided through behaviour change measures (such as meal planning and better portioning). Unavoidable food waste (such as onion skins), by contrast, would be a better target for a composting program such as the Township of Langley's Green Can program. Potentially avoidable food waste is edible food that individuals have thrown away at their discretion due to preference (e.g. potato peels). Potentially avoidable food waste could also be a target for food waste reduction education (e.g. promoting the nutritional benefits of apple skins [Lee et al., 2003]).

<sup>10</sup> See [www.lovefoodhatewaste.com](http://www.lovefoodhatewaste.com)

Each category was further sorted into a food type such as grains, dairy, vegetables etc. to determine what types of food were wasted (see Waste Assessment Data Sheet, Appendix I). These categories were drawn from the WRAP 2012 study but were not aligned precisely. The large scale of the WRAP study (which included 1,800 waste assessments) allowed for a variety of additional categories (for example ‘processed fruit’, ‘confectionery and snacks’ etc.) that were deemed less useful given this small sample size. It is notable that deciding on these sorting categories can be quite complex and subjective depending on the outcome desired. For example, prepared meals can be classified in a category of its own to establish the frequency of throwing out leftovers and cooked food, or, these items be sorted into their respective food types (e.g. meat, grains etc.) to establish the breakdown of these categories. A dinner salad could be considered a ‘prepared meal’, or ‘fresh vegetables/fruits’. In the case of the Langley study, I elected to classify leftovers into their individual food type categories to simplify the study. I did, however, separate each category into ‘raw’ and ‘cooked’ to offer the option of further analysis. The use of diaries also helps to capture the frequency of leftovers vs. non-leftovers since individuals must record the reasons why they threw an item away. This is discussed in greater detail in section 4.1.1.

## **3.4. Survey**

### **3.4.1. Research Background**

Surveys are commonly used in food waste research either alone or in conjunction with diaries and waste composition studies to gather additional data. Food waste surveys can help researchers understand the food waste ‘puzzle’ by gathering: demographic indicators, food waste-related behaviours (such as shopping habits) and food waste opinions (such as personal concern about food waste). Studies that have used surveys to look at behaviours and attitudes include WRAP 2012, Parizeau et. al, 2015, Abeliotis et al, 2014, Neff et. al, 2015, among others.

Surveys allow food waste researchers to further explore questions that can help us to understand what types of people waste the most and least food, and what habits, behaviours, and opinions lead them to waste more or less than the average food waster. With an improved understanding of these various factors, it is hoped that we can better target education programs and policies and to be able to suggest behaviours and personal motivators that can help to curb avoidable and potentially avoidable food waste.

The food waste survey employed in the Langley study was informed by a variety of research studies, notably Parizeau et. al, 2015 and WRAP 2012. Questions of personal interest were also included based on my experience working in the solid waste field and may have been directly or indirectly informed by previous research.

### **3.4.2. Survey**

A total of 400 food waste surveys were mailed out with postage paid return envelopes to a listing of randomized addresses provided by the Township (see Appendix G for survey). Four-hundred (400) surveys represented the maximum allowed within the project budget. Surveys included a series of demographic questions (such as age, income, housing type) and questions related to food waste opinions and behaviours. Example behavioural questions include frequency of meal planning and frequency of grocery shopping. Examples of opinion questions include how the respondent's food waste might compare to the national average, or whether they feel guilty wasting food. The survey was pre-tested by administering it to seven (7) Township of Langley staff who each provided a general comprehension assessment and feedback.

To increase the survey response rate, a draw prize for a \$200 grocery gift card<sup>11</sup> was offered. Individuals who wished to be entered in the draw returned a separate draw card with their survey which was subsequently removed and entered into the draw box to maintain anonymity. The time commitment required for the 'Survey Only' group respondents was minimal at approximately 10 minutes.

<sup>11</sup> Donated by the Township of Langley collection contractor

### **3.5. Statistical Analysis**

The data from the diary and survey were analyzed using SAS® statistical software version 9.4. Each survey question was first analyzed for frequency and percent. Then, the statistical analysis for association between pairs of variables was completed using the Pearson Chi-Square test or Fisher's Exact test. For the diary study, standard t-test was used to compare the mean avoidable food waste between survey responses and the continuous variable 'avoidable food waste'. P-values of  $< 0.05$  is considered to be statistically significant (95% confidence interval, or 1 in 20), those with  $< 0.01$  as highly statistically significant (99% confidence interval, or 1 in 100). Degrees of freedom (df) were calculated using the frequency tables:  $(\text{row} - 1) * (\text{column} - 1) = \text{df}$ .

## **4. Results**

### **4.1. Diary Study**

Overall, participants were able to follow the instructions for the diary well, and 13/14 of the recruited participants were able to complete the study in full, filling all diary pages and completing the survey in its entirety. During follow-up visits, participants were asked if they had any trouble with the study and all indicated that it was fairly easy. During the initial visit, I suggested that the food waste bin replace their current organics bin<sup>12</sup> for the week which likely simplified the disposal process. Similarly, it was suggested that they keep the diary in the kitchen in a convenient place to make it easier to record the food waste.

One participant unfortunately did not include their unavoidable food waste in the diary or the food waste container and it was decided to exclude them from the study. In fact, the bin only had 2 items in it, and the diary had 3 entries. This was very different from the other diaries which had 26-67 entries (average 45). The participant in question was ultimately excluded because 1) we could not devise a percentage of avoidable vs. unavoidable food waste which was important to the findings, and 2) the participant indicated in the survey that his Green Can (organics bin) is usually half full each week,

<sup>12</sup> If applicable. Not all Township of Langley residents have food scraps collection.

and there was no way to know whether items could have been mistakenly placed there instead.

#### **4.1.1. Reasons for Food Waste Disposal**

Each diary was analyzed using a coding method to compare avoidable and unavoidable food waste and to find common links between reasons listed for food waste disposal (i.e. what was written in the ‘Why?’ column of the diary). Unavoidable food waste (peelings, cores, stems, skins etc.) was the most commonly reported food type in the diary making up approximately 2/3 of the total incidents of food waste (see section 4.1.2 for more information).

Aside from a basic accounting of the number of instances of avoidable vs. unavoidable food waste, the decision was made to focus more concertedly on avoidable food waste because: 1) unavoidable food waste has virtually all the same ultimate cause—it is inedible, and 2) avoidable food waste is the target for behaviour change around reducing food waste<sup>13</sup>.

The reasons for disposal of avoidable food waste were divided into five (5) basic categories based primarily on emergent groups ascertained through numerous examinations of the diaries. The five (5) categories that were ultimately decided on were: 1) cooking, preparing or serving too much, 2) children, 3) food storage/over-buying, 4)

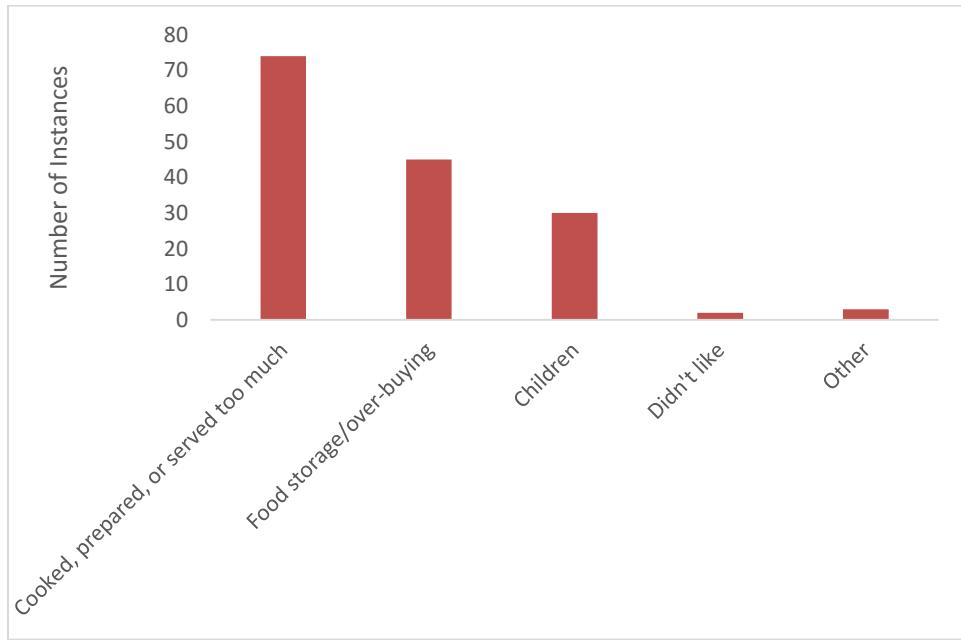
<sup>13</sup> If one were to target changing behaviours around unavoidable food waste, this would involve promoting composting methods and diversion from the landfill which is not specifically within the scope of this study.

didn't like, and 5) other (see breakdown in Table 5 and Figure 1). WRAP 2012 had very similar categories determined through coding analysis, however WRAP had a category called 'accidents' (e.g. burnt, dropped) which was not used in this study. Instead, I used a category called 'children' to quantify the high number of instances of child-related food waste that emerged in my study. 'Accidents' were reflected under 'other' in this study.

**Table 5:** Reasons for Avoidable Food Waste

Reasons for Avoidable Food Waste--Category	Description and Examples of Reasons within Category	Instances of Avoidable Food Waste (of 154 total)	Percentage of all Instances that were avoidable
Cooked, prepared/served too much	Cooking or preparing too much e.g. leftovers, left on plate, left over from party	74	48%
Children	Related to children e.g. picky child, child full, left over from school lunch	30	20%
Food Storage/Over-buying	Related to shelf life, abundant stock, proper storage e.g. in fridge too long, went bad, wilted, squished, past best before date	45	29%
Didn't Like	Related to preference e.g. didn't like	2	1%
Other	e.g. dropped on floor, tough piece of meat	3	2%

**Figure 1: Reasons for Avoidable Food Waste**



It was interesting to learn that the category ‘cooked, prepared or served too much’ was responsible for the largest number of instances of avoidable food waste: 48% of instances were attributed to this category versus 29% that were related to storage and excess stock. Conversely, WRAP (2012) found that food storage and overbuying was a more common cause of food waste (49% versus 31% for cooking and serving too much). This difference could be a result of the small sample size of the Langley study, or could be related to the culture of abundance in North America. This finding cannot be explained by the use of the ‘children’ category, since, had the ‘children’ category been redistributed it would have increased the ‘didn’t like’ and ‘cooked, prepared or served too much’ categories, which would have decreased the percentage of ‘food storage and overbuying’ even further. More extensive study would need to be conducted to further

explore whether Canadians do indeed waste prepared food more often than their European counterparts, as well as to determine if there is any link to cultural norms.

Food thrown away for reasons related to children was the second largest category of avoidable food waste. The WRAP program also found that families with children create more food waste overall than those without (WRAP 2007b). This information is valuable as families with children can represent a target market for food waste education programs.

#### **4.1.2. Waste Assessments**

The contents of the food waste bins were collected from each household at the end of their respective 7 day study period. The food waste was then taken to the Township of Langley Operations Building where the contents of each were sorted and weighed (see assessment photos, Appendix J).

##### ***Food Waste Categories***

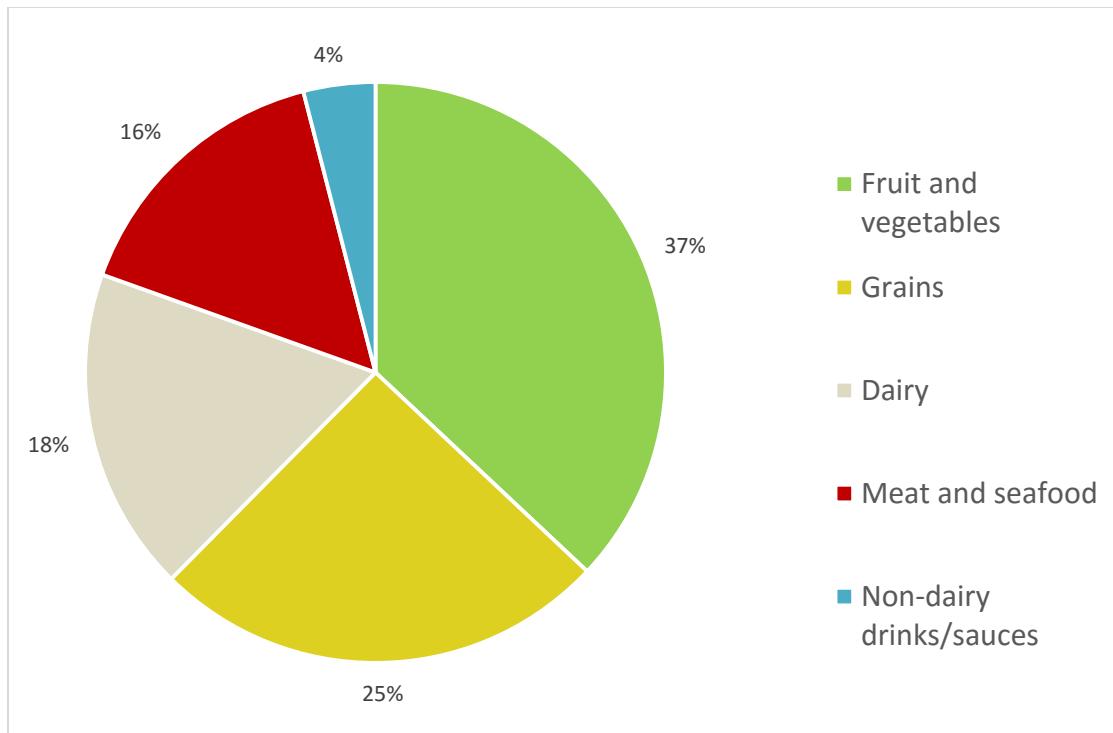
During the waste assessment, all food waste was broken down into 7 basic categories:

- fruit and vegetables
- grains
- dairy
- meat
- non-dairy drinks and sauces
- tea and coffee
- miscellaneous/fines for unidentifiable or unsort-able items<sup>14</sup>

<sup>14</sup> Though every effort was made to properly sort the food into the categories determined, a portion of the residual fine/small food particles such as rice, popcorn kernels, or flour was deemed too difficult or time consuming to sort and was put into a separate category

In an analysis of avoidable food waste, both the 'tea and coffee' and 'miscellaneous' categories were removed—used tea bags and coffee remnants were considered unavoidable and the miscellaneous category is too difficult to determine. The breakdown of avoidable food waste is illustrated in Figure 2.

**Figure 2: Avoidable Food Waste by Food Type**



Sorted avoidable food waste consisted of 37% fruit and vegetables, 25% grains, 18% dairy, 16% meat and 4% non-dairy drinks and sauces by weight. In comparison to WRAP program results (WRAP, 2008 pp. 41), the dairy and meat/seafood categories appear to greater in this study (see Table 7).

**Table 6: Avoidable Food Waste Categories—Langley vs. WRAP (2008)<sup>15</sup>**

Avoidable Food Waste Categories	Percent of Total Avoidable Food Waste (by Weight)	
	Langley	WRAP
Fruit and Vegetables	37%	39%
Grains	25%	19%
Dairy	18%	5%
Meat and Seafood	16%	7%
Non-dairy drinks and sauces	4%	7%

Fruits/vegetables and grains together represent 63% of the total avoidable food waste. These were also two of the largest categories in the WRAP studies which suggests that these categories should be targeted for future reduction education. Meat/seafood and dairy also represented a sizable portion of the avoidable food waste category (34% combined), and it is important to note that these animal products have a larger environmental impact, particularly during the production phase (Weber et al. 2008).

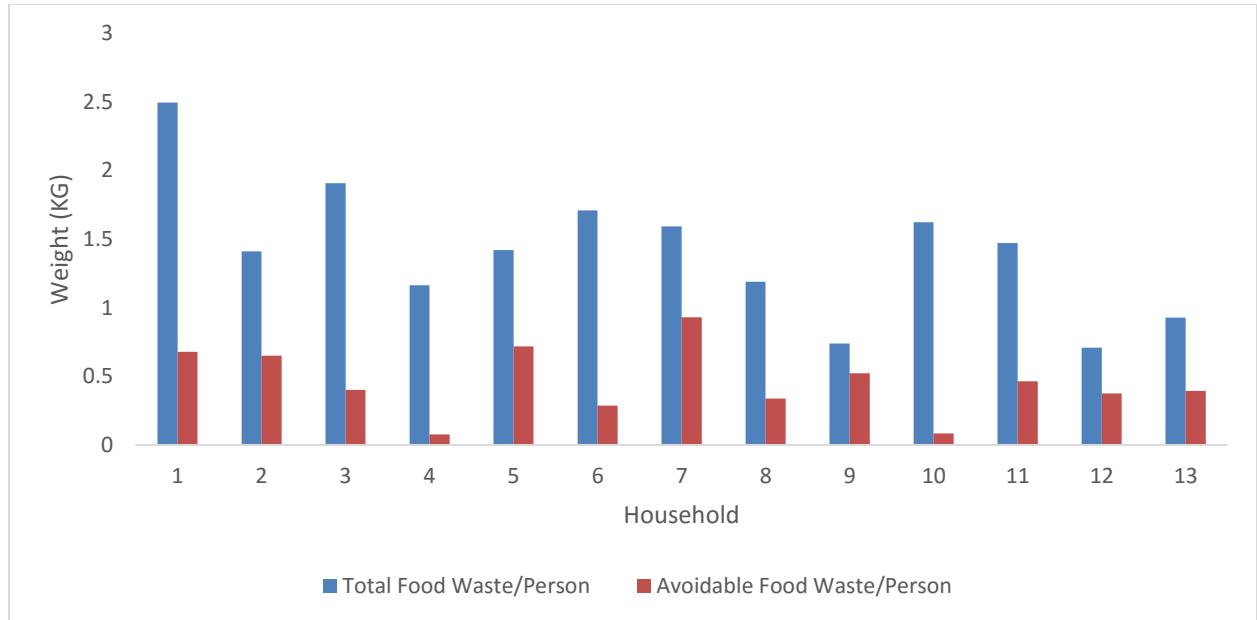
### ***Food Waste per Household/Person***

The average one-week total food waste per household in the sample of 13 participating households was 3.64 kg (8.02 lbs). When adjusted for number of people in the home, the average total food was per household member was 1.41 kg (3.11 lbs) or 73.32 kg (161 lbs) per year. The average weekly avoidable food waste per household in the study was 1.37 kg (3.02 lbs) or 71.24 kg (157.04 lbs) per year. When adjusted for household members, the average was 0.45 kg or 1 lb per person per week (23.4 kg or 52

<sup>15</sup> The WRAP study had more waste categories than the Langley study including ‘mixed foods’ and ‘desserts’. As such, the UK column in Table 6 does not add to 100%. For the purposes of the Langley study, ‘mixed foods’ etc. were sorted into the 5 categories which may account for differentials in the dairy and meat categories.

lbs per year) (see Figure 3 for household breakdown). As Figure 3 illustrates, this study showed a great deal of variability between households. The variability of food waste between households has been noted by other studies as well (including WRAP 2013 and Parizeau et al, 2015).

**Figure 3: Total and Avoidable Food Waste per Household Member per Week**



Though the sample size in the Langley study was not sufficient to draw any sound conclusions about how much food residents of Langley waste, one critical element that this research points out is the importance of distinguishing between avoidable and total food waste in food waste research. Case in point: the Langley study showed significant variability of avoidable food waste as a percentage of total food waste between study participants (see Figure 3). Participant households had as little as 5% avoidable food waste, up to 71% avoidable food waste in their food waste bin. Interestingly, household 10 with the least avoidable food waste (5%) had a higher total food waste output per

person than household 7 with the most avoidable food waste (71%). If this study was to focus purely on the total food waste, it would appear that household 10 wasted more food than household 7, yet household 10 wasted the least edible (avoidable) food and household 7 wasted the most of all study participants.

Studies that focus on total food waste are deceptive because they overinflate the food waste ‘problem’. The total food waste figures include the unavoidable food waste (peelings, pits etc.) which as mentioned in section 4.1.1, should be a target for composting programs, not food waste reduction education.

### ***Comparative Food Waste Studies***

Despite the fact that the waste assessment averages are not statistically significant in this study, I wanted to see where these results would lie compared to other studies worldwide. Unfortunately, the variability in study results and methodologies in food waste research makes it difficult to compare this study’s results other food waste study data. The lack of consistent methodologies in food waste research has been noted by others including Koivupuro et al, 2012. and Buzby and Hyman 2012. The total food waste per person can be estimated using data from the municipal to federal level, or using curbside waste composition studies and/or diaries. As shown in Table 6 the distinction is not always made between avoidable and unavoidable food waste. Even if the distinction is discussed, it is not always factored into the resulting average kg per person. To illustrate the comparative results and methodologies from a selection of food waste studies are broken out in Table 7.

**Table 7: Comparative Studies of Annual Food Waste per Person**

Year	Food Waste Study	Annual Household level Food Waste Per Person	Methodology	Distinguish Between Avoidable and Unavoidable Food Waste?
2007	UK (WRAP) (Ventour, 2008)	70 kg avoidable	Combination of municipal curbside data, waste composition studies, and diary studies	Yes
2009	Statistics Canada (2009)	154 kg <sup>16</sup>	Estimate using food availability <sup>17</sup> data and methodology used by the US Department of Agriculture's Economic Research Service (ERS)	No
2010	EU (Monier et al, 2010)	76 kg	Estimate using EUROSTAT food waste data	Somewhat. The document makes many references, however the 76 kg figure does not appear to adjust for avoidable vs. unavoidable food waste

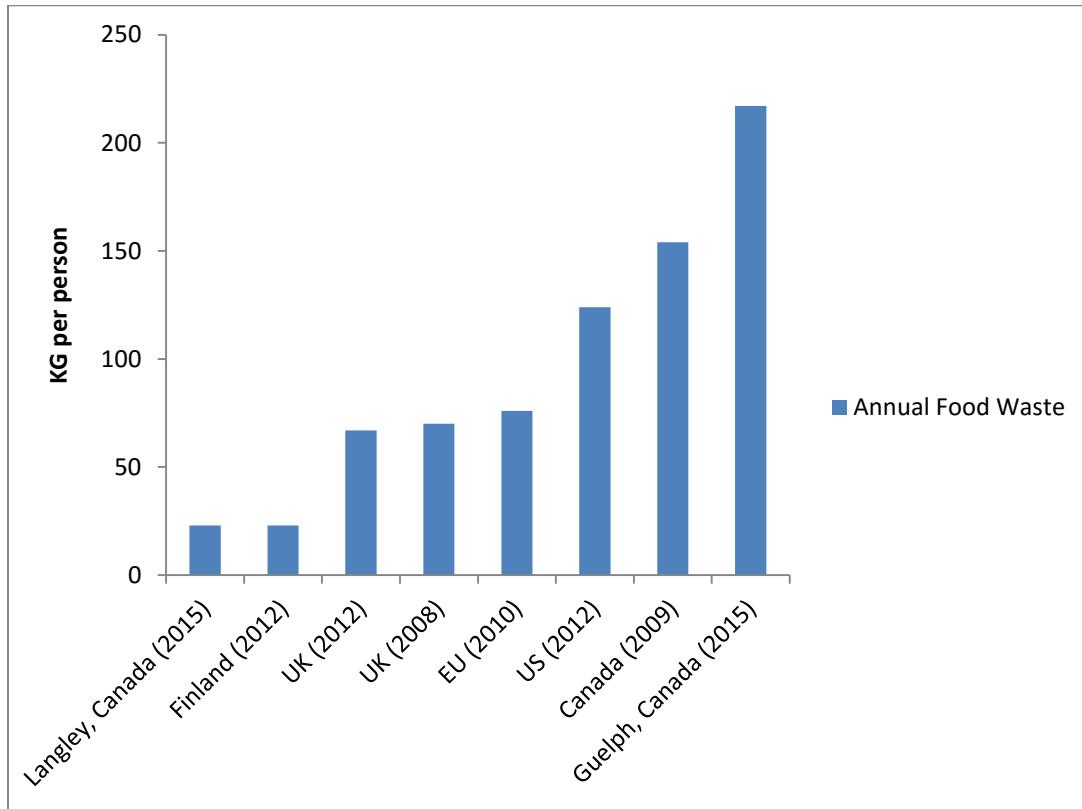
<sup>16</sup> Statistics Canada estimates were 183 kg per person including the retail level. 154 kg represents food waste per household member once adjusted for the retail sector (sector waste percentages retrieved from Gooch et al, 2010)

<sup>17</sup> According to Statistics Canada, the estimate methodology is as follows: "The supply-disposition approach is used to produce per capita food availability. All components of supply are added together and all uses (total disposition) other than domestic disappearance are deducted. This residual, which represents the amount of food available for human consumption, is referred to as "food available" (previously known as disappearance). To calculate total supply, imports, beginning stocks and Canadian production are added together. Domestic disappearance information is obtained by deducting ending stocks, exports, manufacturing uses, livestock feed, and waste where applicable from the total supply. This is then divided by the Canadian population to derive the per capita availability of the numerous food types." (Statistics Canada, 2009)

2012	US (Buzby and Hyman, 2012)	124 kg	Estimate using Loss-Adjusted Food Availability (LAFA) data from the US Department of Agriculture's Economic Research Service (ERS)	Somewhat <sup>18</sup>
2012	Finland (Koivupuro et al, 2012)	23 kg avoidable, drinks excluded	Food waste diaries	Yes
2012	UK (WRAP, 2012)	67 kg avoidable	Waste composition study (1800 households). Data synthesized with other sources including diary data and tonnages from waste composition studies from governments	Yes
2015	Canada (Parizeau et al. 2015)	218 kg total organic waste	Weighing curbside organics (includes soiled paper, yard waste, pet waste)	No. Discussed but not calculated.
2015	Langley Study	23 kg avoidable	Waste composition study	Yes

<sup>18</sup> Researchers acknowledge that they cannot specifically distinguish avoidable food waste using the data source but estimate that the total is mostly avoidable. “We suspect that most of the estimated food loss is avoidable waste because we have already removed the inedible (and thus unavoidable) portions from our estimates for each food in the data system. And from the remaining edible portions, we believe that cooking loss and other unavoidable losses are likely to be relatively small.” (Buzby and Hyman, 2012)

**Figure 4: Comparative Annual Food Waste per Person**



As noted in Table 7 and Figure 4 above, the differences in food waste research design and methods has produced strikingly variable results between studies. Not only does this variability cause one to question which method (if any) is bringing forth accurate food waste information, but this uncertainty makes comparisons between studies and locations virtually impossible. The graph in Figure 4 illustrates this well: the three studies completed in Canada, each using very different methodologies, occupy either side of the spectrum. I would argue that the state of knowledge about household food waste on a global scale remains largely unknown—particularly when trying to determine how much avoidable food waste is truly generated. A lack of consistent research methods between studies and geographical locations has resulted in too much variability between

studies, and therefore a lack of understanding and comparative value. Municipal waste assessments and organic material tonnages tell us that indeed, food waste makes up a large portion of our waste stream (Tetra Tech EBA, 2013), however we still do not know precisely what that food waste breakdown consists of, or how much of this waste can be considered avoidable.

Unfortunately, if the following questions were posed: ‘How much food do Canadian households waste? and ‘How does Canada’s household food waste compare to other countries?’ the answers would be unknown. This study did, however, illuminate the need for more study into household food waste using a more consistent methodology. Before any policy changes are proposed for Canada, Canadian researchers will need to conduct large-scale studies to realize more conclusive results<sup>19</sup>. A detailed discussion of the implications of this finding, as well as a model study will be described in sections 5.3 and 5.4 to help inform future research.

## **4.2. Survey**

400 surveys (see Appendix G) were mailed out to residents, and an additional 14 were provided to diary study participants. A total of 141 surveys were returned (including those from the diary study) for a return rate of 34%. 130/141 of the surveys were returned with the draw card included indicating that the prize draw may have

<sup>19</sup> Guelph researchers are in the process of completing a more detailed study based on the WRAP program methodology to address food waste calculation shortfalls in the first study. Results are expected to be published in 2016.

increased the response rate. A total of 141 surveys is not considered statistically valid representative sample relative to the total population of Langley (approximately 110,000). A sample size of approximately 400 would have produced a 95% confidence level with a 5% margin of error, however this was not realistic given time and budget constraints for this project. The data are inferential and should thus be used for exploratory purposes only.

#### **4.2.1. Household Demographics**

Surveys were sent to a randomized listing of properties in the Township of Langley to include the full spectrum of property types, incomes, and renters/owners. The average household size of respondents was 2.7 (median = 2) which is similar to the Langley average of 2.8 [Township of Langley, 2014d]). Respondents had an average of 0.6 children under the age of 18 (median = 0), which was lower than the Langley average of 1.1 [Statistics Canada, 2012b]). 71% of respondents lived in single family (detached) homes (Langley average: 59% [Statistics Canada, 2012b]), 20% lived in a townhome or row home, and the remaining 9% lived in apartments, mobile homes or cohousing units. A full 97% of respondents owned their properties vs. 3% who were renters (the Langley average is 86% owned [Township of Langley, 2014e]). The male to female ratio was relatively even with 54% female respondents female and 45% male. Respondent age ranges indicated a large percentage of older individuals completing the survey; 54% of respondents were 56 years of age or older. This age group is overrepresented: census demographic data shows only 23% of Langley residents are aged 55 and older (Statistics

Canada, 2012b). The full age breakdown from the study is listed in Table 8. Overall, this sample over-represents the older, single-family home-owning population of Langley.

**Table 8: Age Breakdown for Survey Respondents**

Age	Percentage of Respondents
19-25	0.7
26-35	7.2
36-45	20.3
46-55	17.4
56-65	26.8
>66	27.5

98.5% of respondents were either born in Canada or immigrated more than 10 years ago which is similar to the 96% figure available in census data [Township of Langley, 2013]). Language barriers could be a factor in completing surveys, though only about 6.7% of Langley residents speak a language other than English in the home (Fraser Health, 2010) which was the rationale for providing the survey in English only during the study's design phase.

#### **4.2.2. Shopping Behaviours**

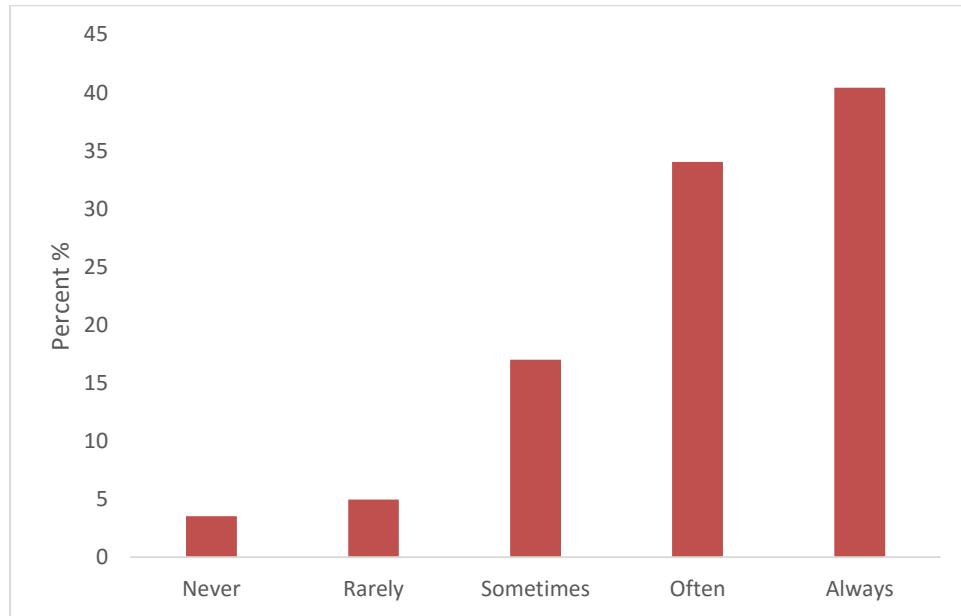
Survey takers were asked ten questions related to their grocery shopping habits, such as whether they shop with a list and whether they tend to buy more when items are on sale. This subset of questions was designed to establish common practices and to look for connections to their perceived food waste. Connections between perceived food waste and behaviours, habits and opinions will be discussed in section 4.2.5—Bivariate Analysis. This connection has been studied by other food waste researchers (e.g. Ventour

2008, WRAP 2013, Parizeau et al, 2015) and these studies helped to inform the questions in the Langley survey.

Respondents shopped for groceries an average of 1.7 times per week (median = 2 times/week). 46% of households report that they spend between \$100-\$149 on groceries each week, 25% spend \$50-99, and 19% spend \$150-\$199. When asked how respondents traveled to purchase the majority of their groceries, a full 98% indicated they travel by car which is indicative of the suburban nature of the Langley municipality. Respondents were also asked how much money they spend each week on restaurant and take-out food. The majority (65%) spend less than \$50 per week, followed by 21% that spend \$50-\$99 per week.

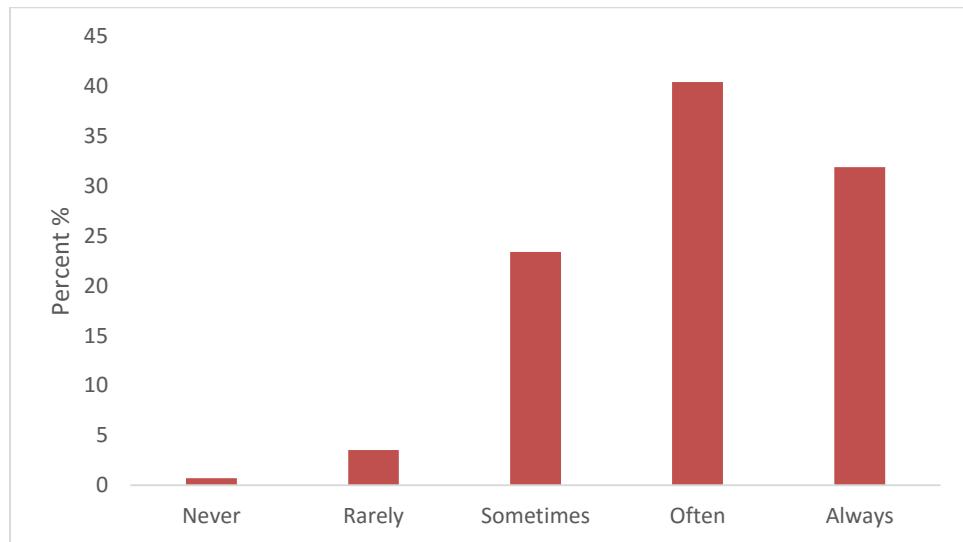
When asked whether they grocery shop with a list, 40% of respondents indicated ‘always’, followed by 34% who said they ‘often’ do (see Figure 5).

**Figure 5: Frequency of Shopping with a List**



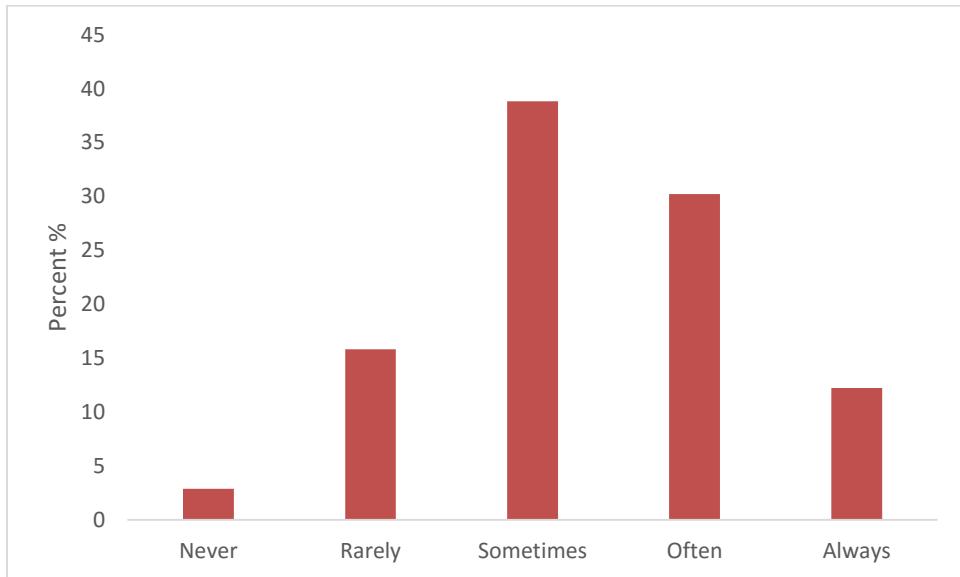
When asked how often they take inventory of what is already in the house before they shop, 40% of respondents say they ‘often’ do, followed by 32% who said they always take inventory (see Figure 6).

**Figure 6: Frequency of Taking Inventory Before Shopping**



The frequency of meal planning was also a point of interest in this survey: respondents were asked how often they plan the meals for the week before they shop for groceries. Meal planning proved to be a less common practice than shopping with a list and taking inventory. 39% of respondents indicated that they ‘sometimes’ plan their meals, followed by 30% that ‘often’ do (see Figure 7).

**Figure 7: Frequency of Meal Planning**



Participants were asked about their frequency of shopping at ‘big box’ bulk stores (survey prompt ‘e.g. Costco’). 43% of respondents said they ‘often’ shopped at big box stores, followed by 30% that ‘sometimes’ do. It was interesting to see that only 11% of respondents ‘never’ or ‘rarely’ shop at big box stores. I suspect the results would be quite different in a community like Vancouver which are less auto-dependent since vehicles are generally required to transport bulk purchases.

Households were also asked how often they purchase bulk and multipacks of items, and whether sales and ‘buy one get one free’ offers cause them purchase more than otherwise. ‘Sometimes’ was the most common response for these two questions (see Figure 8).

**Figure 8: Frequency of Bulk Purchasing**

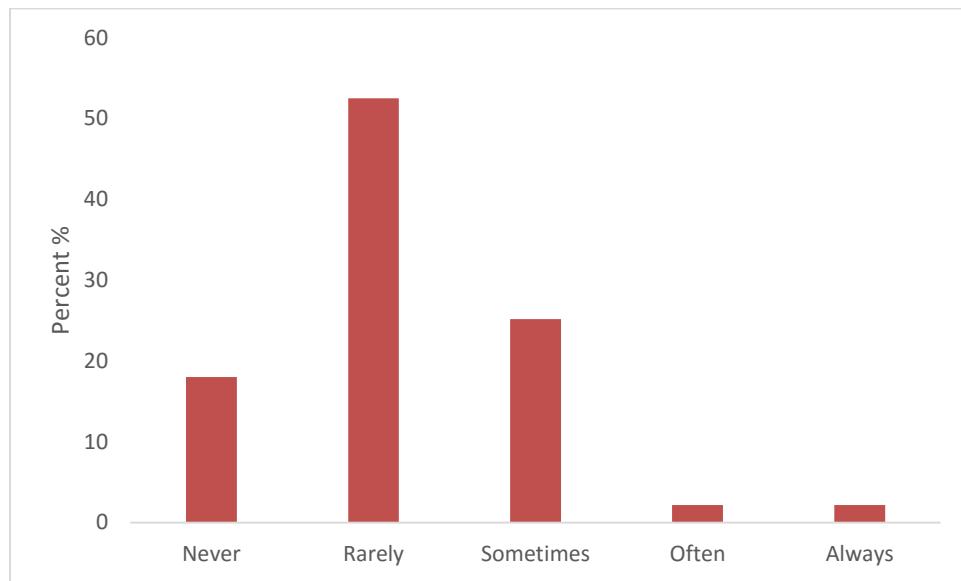


#### **4.2.3. Food Behaviours in the Home**

Langley residents were asked how frequently they eat dinner at home. The vast majority of residents say they eat dinner at home most of the time, with ‘often’ (5-6 times per week with 48%) and ‘always’ (7 days per week with 48%) responses making up 95% of total respondents. When asked how often they cook from scratch<sup>20</sup>, 78% did so at least 5 times per week. To determine the frequency of going to restaurants or getting take out when there was food that they intended to cook at home, 53% of respondents said they rarely do so, and 25% said they sometimes do (Figure 9).

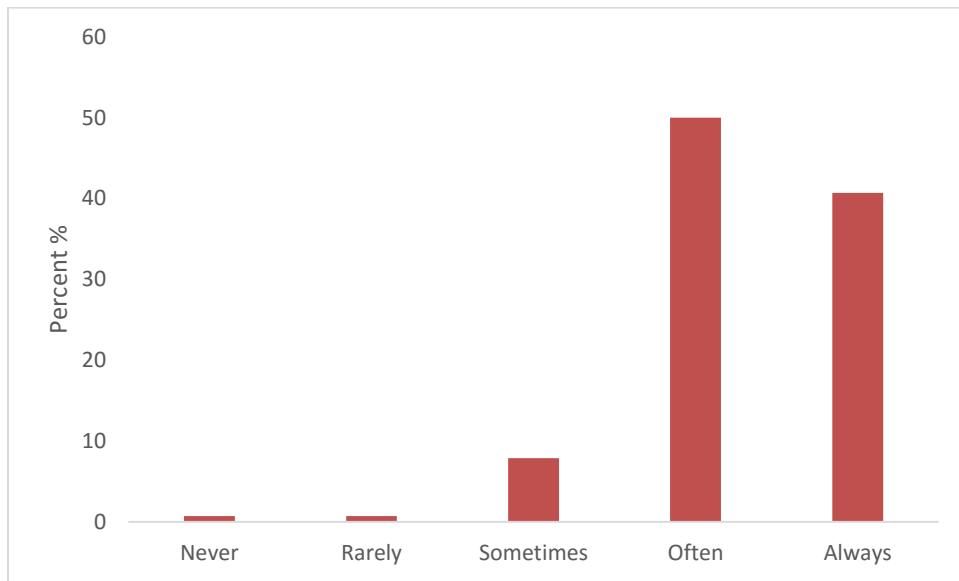
<sup>20</sup> The survey question defined ‘scratch’ as combining 3 or more ingredients.

**Figure 9: Frequency of Take-out or Restaurants When Food Intended to Cook at Home**



The frequency of eating leftovers may represent another factor in the food waste puzzle. The survey asked respondents whether their family tends to eat leftovers. 50% stated that they ‘often’ do, with an additional 40% saying they ‘always’ eat leftovers (Figure 10). Only 10% of respondents said they ‘never’, ‘rarely’ or ‘sometimes’ eat leftovers. Contrary to these results, the diary study found that cooking, preparing or serving too much was the number one cause of avoidable food waste (with an average of 5.7 incidents per household per week). I hypothesize that respondents may have some difficulty with their recall of the frequency of eating leftovers. It is also possible that people consider ‘leftovers’ to be full meals vs. smaller amounts (e.g. extra mashed potatoes at dinner, left over vegetables on a party tray).

**Figure 10: Frequency of Eating Leftovers**

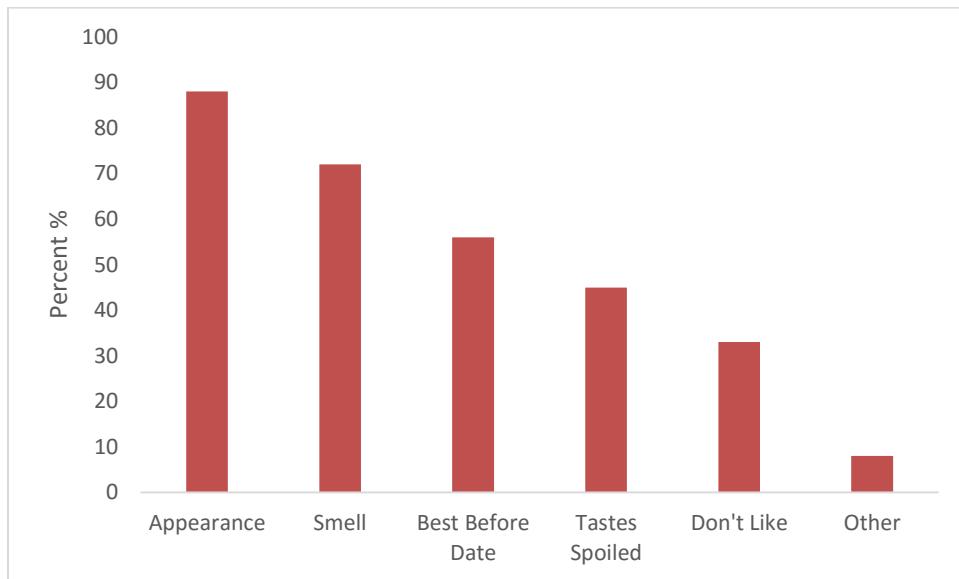


To determine what types of deciding factors typically cause households to throw out food, the survey asked people to check off all that apply from the following list:

- 1) Appearance—it looks moldy, dry, or otherwise unappealing
- 2) Past the best before date
- 3) Smell—it smells off
- 4) Taste—I do not like the taste
- 5) Taste—it tastes old or spoiled
- 6) Other—other reasons

Appearance was the number one reason for food disposal with 88% of people using this method. Smell was the second most common answer (72%). The full breakdown is in Figure 11 (chart responses have been reordered by rank).

**Figure 11: Deciding When to Throw Food Away**



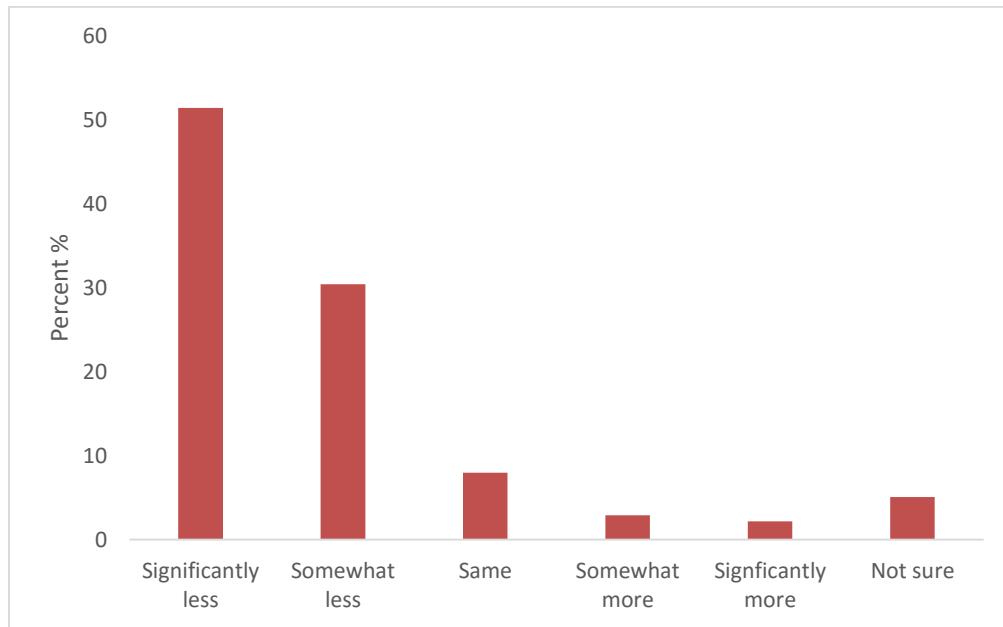
That 56% of respondents use the ‘best before date’ to decide whether to throw something away is an important finding, since best before dates are added by the manufacturer as an indicator of food quality—they are not related to food safety (Canada Food Inspection Agency, 2014). A lack of consumer awareness about food date labels was also found by WRAP (DEFRA, 2011). Educating consumers about best before dates and using other methods to determine whether to dispose of a food item (such as appearance and smell) could help to reduce unnecessary food waste.

#### **4.2.4. Food Waste Opinions**

The survey included questions to better understand individual’s opinions about food waste. For example, the survey asked respondents whether they thought their household’s food waste similar to, less than or more than the national average (see Figure 12). The question used a Statistics Canada per person food waste average<sup>5</sup> of 154

kg<sup>21</sup>/person/year. 51% of respondents said they wasted ‘significantly less’ than average, and a further 30% said they wasted ‘less’ than average.

**Figure 12: Household Food Waste Compared to Canadian Average**



Only 5% of survey respondents believed that they wasted more food than the Canadian average which is an intriguing result. Four reasons could account for this:

- 1) The Statistics Canada total food waste figure of 154 kg per person seemed very high and respondents were only considering their avoidable food waste
- 2) Households who chose to respond to a food waste survey are already conscientious about their food waste
- 3) Individuals are ashamed to admit they waste food, even in an anonymous survey
- 4) Individuals are not fully aware of their food waste

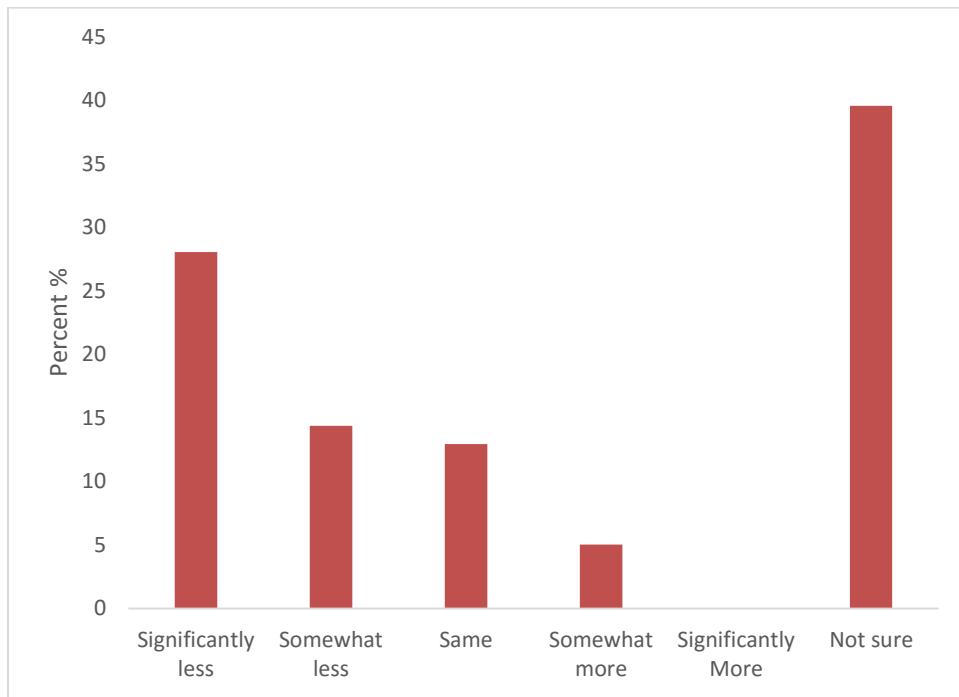
<sup>21</sup> The 154 kg figure represents *total* food waste, not specifically avoidable food waste. The true value of focusing on avoidable food waste did not become apparent until waste assessments of the diary study began. This appears to be a common issue throughout the available food waste literature.

I hypothesize that option 4 is the most probable reason as other studies from around the world have had similar results. The UK's WRAP program found that 43% of people believed they threw out 'hardly any' or 'no food' (WRAP, 2007b), and an Australian study found that 63% of individuals said they threw out 'very little' food (NSW, 2011). A recent US study published in 2015 had results very similar to my study, with 73% of their survey respondents reporting that they 'discarded less than the average American household', and only 3% who said they threw out more than the average (Neff et al, 2015). Attention to and awareness of one's food wasting habits seems to be lacking. The food waste diary may be a good method to have people track their waste and bring awareness to their food wasting, similar to dieters who track their calories with using diaries<sup>22</sup>.

When respondents were asked how they believed their food waste compared to that of their neighbours, the majority 40% said 'not sure' which was interesting since only 5% answered not sure when asked to compare themselves to the national average. Respondents may have not have a good sense of what their neighbours throw away (there was no comparative standard given), or perhaps they would be more hesitant to suggest that they waste less than their neighbours. 'Significantly less' remained the second most popular answer with 28%, and only 5% felt that they wasted more than their neighbours (Figure 13).

<sup>22</sup> A large-scale comprehensive weight loss study (Hollis et. al, 2008) showed that the awareness and accountability gained when using a food diary to track calories resulted in double the weight loss compared to dieters who did not journal.

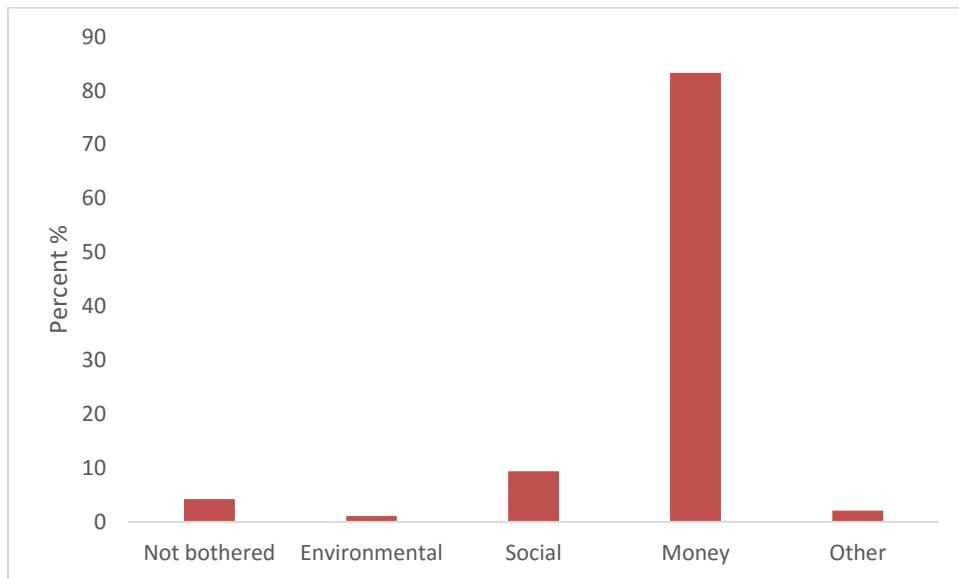
**Figure 13: Household Food Waste Compared to Neighbours**



Households were asked about how much wasting food ‘bothered’ them on a scale from ‘never’ to ‘always’. 84% of respondents indicated that they are ‘often’ or ‘always’ bothered when they waste food. Only 2% of respondents said they were ‘rarely’ or ‘never’ bothered. When asked to provide the primary reason they feel bothered, 83% indicated that losing money was the main source, followed by 9% who were bothered by the social implications<sup>23</sup> and only 1% felt that the environmental implications bothered them most (Figure 14).

<sup>23</sup> The survey question defined ‘social implications’ with the following example ‘some people may not have enough food’.

**Figure 14: Reasons for Feeling Bothered When Food is Wasted**



Despite being asked to check the ‘most important reason’ they were bothered when wasting food, 45 respondents checked more than one box indicating that people are often bothered for more than one reason<sup>24</sup>. The finding that money is the primary cause of guilt associated with wasting food is important to help tailor future education programs. First, this indicates that more education on the environmental and social implications of food waste may be needed, and second, it seems that education focused on saving money could be more likely to encourage behaviour change. A more detailed explanation of the implications of this finding will be discussed in section 5.0.

#### **4.2.5. Bivariate Analysis**

To gain a better understanding of what beliefs and behaviours might be associated with food waste, a bivariate analysis was conducted. The specific goal was to learn

<sup>24</sup> Households with more than one response were excluded from the results.

whether those who waste less food tended to have particular attributes and/or adopt specific behaviours or beliefs. Since budget and time constraints did not allow for a full waste analysis of each of the 141 survey-takers waste, demographic, behaviour and habit questions were instead linked to a respondent's perceived waste (survey question 14, Appendix G). As noted in Figure 12, only 9% of respondents believed that they wasted the same or more than the Canadian average. To realise useful results, the bivariate analysis divided respondents into two groups: those who thought they wasted 'significantly less' food than average, and a second group combined all other responses into one group. The breakdown was 71 respondents in the 'Less Food Waste' category (i.e. 'significantly less' respondents) and 60 in the 'More Food Waste' category (all other responses).

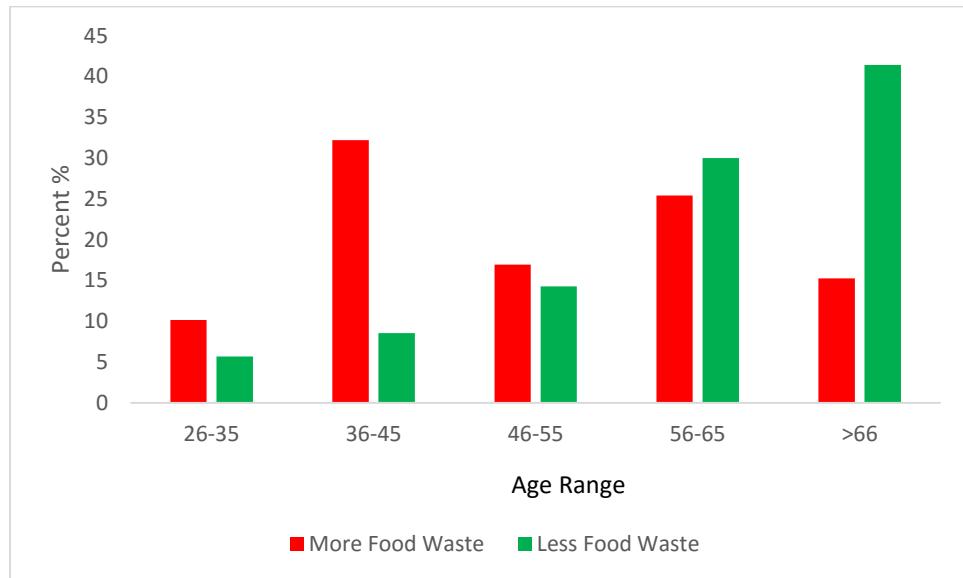
Survey questions 16-26 were also recoded from five (5) to three (3) categories to reduce the number of cells with low counts following a Frequency analysis. These survey questions were posed using a Likert scale of Never, Rarely, Sometimes, Often and Always to indicate the respondent's level of agreement with the survey question statement (see Survey, Appendix G). The three (3) recoded categories used were: Infrequently ('never' and 'rarely' responses), Sometimes ('sometimes' responses), and Frequently ('often' and 'always' responses).

### ***Demographics***

Respondent age was shown to have a high statistical significance when cross-tabulated with perceived food waste. The survey indicated that the young waste more food than older individuals ( $\chi^2_4 = 17.88$ ,  $p= 0.0013$ , see Figure 15 and Appendix K1).

The largest divide occurred in the 36-45 age group which had the highest percentage in the ‘more food waste’ category, and the >66 group had the most households in the low food waste category.

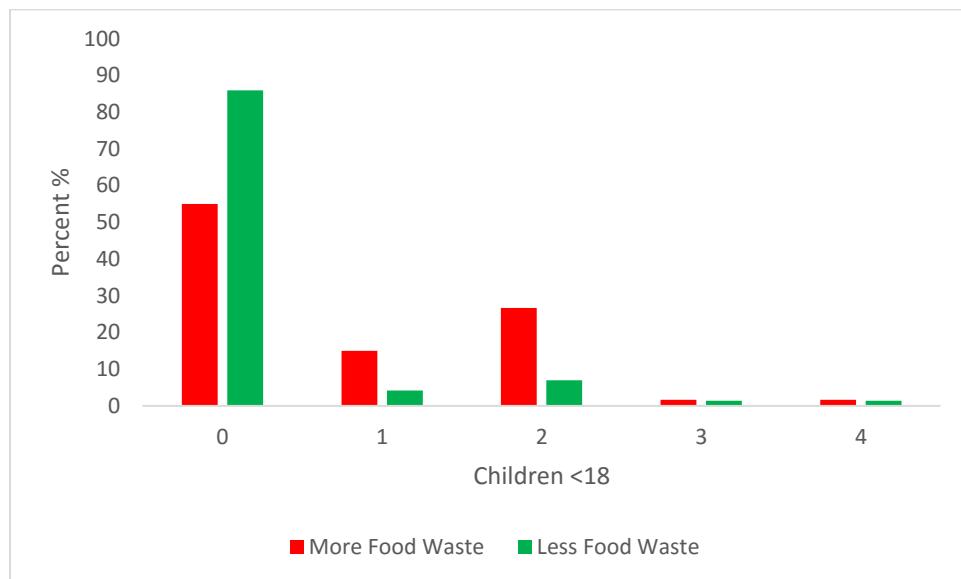
**Figure 15: Food Waste by Age**



These findings that older individuals waste less than those younger are similar to findings from the UK’s WRAP program (WRAP, 2014), however WRAP found that the age range of 18-34 had the highest food waste. The Langley study had very low representation for those under age 35 (7.9% of total respondents, see Table 8) which may account for this discrepancy. WRAP program research suggests that younger people “are more likely to report lower proficiency in some of the food management skills” (such as proper portioning and storage) and are more likely to report that they “ate what they could while on the go” (WRAP, 2014). Lack of time and food management skills are cited by WRAP as possible causes for this age divide.

Another possible explanation for the outcome in the Langley study is that those in the 36-45 age bracket are more likely to have children which may impact their waste output. The WRAP program found that the presence of children can indeed influence food waste: “fussy” children can lead to more food thrown away, and families with children use ‘best before dates’ more often out of concern for food safety (WRAP, 2014). Similarly, households without any children in the Langley study were significantly more likely to fall in the ‘Less Food Waste’ category than those with children (Fisher’s Exact Test,  $p = 0.0005$ , see Figure 16 and Appendix K2).

**Figure 16: Food Waste by Children <18 Years Old in the Home**

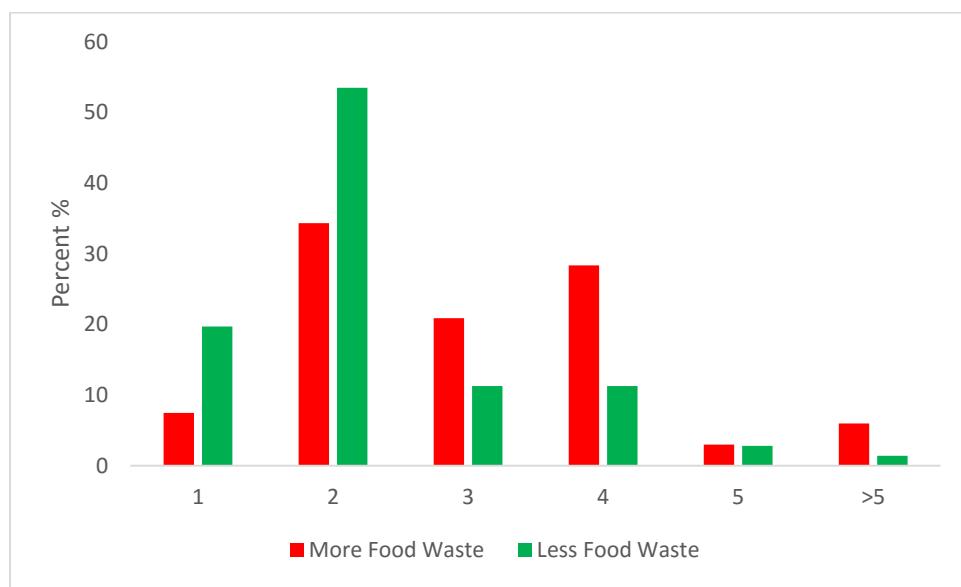


The diary study also showed young children’s preferences to be a common reason listed for throwing out food.

Food waste was also statistically associated with household size. Households with 1 or 2 occupants said they wasted less food than those with 3 or more members (Fisher’s Exact Test,  $p = 0.0166$ , see Figure 17 and Appendix K3). WRAP 2014 and Koivupuro et

al, 2012 also found that food waste increased with household size, however each study found that food waste per person was the highest in single occupancy households which differed from the Langley study. WRAP research suggests that single occupancy households have difficulties buying appropriately-sized food products for one person which can lead to more food being thrown away (WRAP, 2014).

**Figure 17: Food Waste by Household Size**



### ***Shopping Behaviours***

Shopping habits were also assessed for any connection to perceived food waste. Frequency of shopping (assessed by trips per week) did have some relationship with food waste (Fisher's Exact Test,  $p = 0.0331$ , Appendix K5); 'More Food Waste' households were more likely to shop more often. Similarly 'Low Food Waste' households were much more likely to shop less than once per week (13% vs 2%). Other studies on this topic have shown conflicting results. For instance, though some studies show more frequent shopping to reduce food waste as shoppers buy only what they need (e.g. Sonneson et al.,

2005), WRAP (2007c) suggested that shoppers who make regular trips to the grocery store may rely less on lists and planning and can be more enticed by spontaneous purchases that could lead to waste.

Respondents were asked how much money they spent on groceries per week. Money spent per week on groceries was significantly correlated with waste; households that spent more money on groceries had higher perceived food waste (Fisher's Exact Test,  $p = 0.0031$ , Appendix K6). This result is inferential; those that spend more on food are more likely to have more food to waste. Income could also be a factor, since those with low incomes can't afford to spend more money on food, or afford to waste it. 42% of respondents who fall into the 'Less Food Waste' category spend less than \$99/week compared to only 15% of those who waste more. Those who spend more per week on food may be overbuying and thus wasting more food, or they could be putting less value on the food they do buy.

Interestingly, the majority of shopping habits studied did not show any statistically significant connection to either the low or high food waste groups (Appendix K7-12) however low food wasters were often more likely to say they 'always' employed a particular habit linked with lower food waste. For instance, shopping with a list did not show a statistically significant connection, though low food wasters were more likely to say they 'always' shop with a list (48%, versus 30% of those who waste more). Similarly, taking inventory of household food before shopping did not show a connection, though low food wasters were more likely to say they 'always' take an inventory (38% versus 23%). A comparable outcome existed for the frequency of meal planning: households in

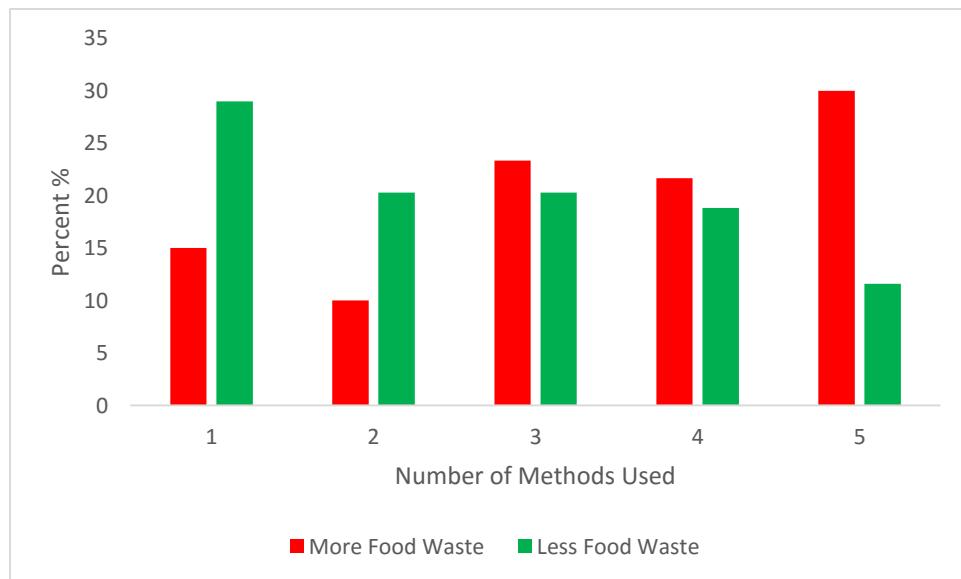
the ‘More Food Waste’ category were more likely to say they ‘rarely’ or ‘never’ planned meals compared to those who waste less food (29% versus 11%). The WRAP program had results that resembled these: list making and meal planning showed a ‘moderate’ association to food waste, checking inventory before shopping showed no association (WRAP, 2014).

The frequency of shopping at ‘big box’ stores was also a bit of a surprise. I had hypothesized that shopping at bulk stores could cause more to be purchased than necessary, thus resulting in food waste. The results of the survey showed instead that 89% of total respondents frequent the bulk stores at least ‘sometimes’, and there were twice as many households in the ‘Low Food Waste’ category who said they ‘always’ shop at ‘big box’ stores. Using the same premise that bulk buying leads to more waste, the question of whether respondents typically buy food in bulk/multipacks or who buy more food when it’s on sale was posed and the result showed little difference between the low and high food waste groups (Appendix K11 and K12). This was an unexpected finding, since several past studies have shown a connection between buying extra items on sale and food waste (Gunders, 2012; WRAP, 2011; Koivupuro et al, 2012). One UK’s WRAP study even listed ‘buying too much food in general, particularly driven by special offers (e.g. buy-one-get-one-free)’as one of the top 7 of 33 factors influencing food waste (WRAP 2007b, pp. 2). The implications of this finding will be discussed in greater detail in section 5.0.

## ***Food Waste Behaviours in the Home***

Survey question 7 asked respondents what criteria they use to decide whether or not a food item should be thrown away (refer to Figure 12 in section 4.2.3). The total number of criteria people use to decide whether to throw something away was statistically connected to their perceived food waste. For example, 69% of those who only use one criterion to decide (e.g. smell or appearance) fell into the ‘Less Food Waste’ category. The reverse occurred for those who use all 5 criteria to decide—69% of those who use all 5 criteria fell into the ‘More Food Waste’ category ( $\chi^2_4 = 10.64$ ,  $p = 0.0309$ , see Figure 18, Appendix K4).

**Figure 18: Food Waste by # of Methods Used to Decide Whether to Throw Food Away**



This result was similar to that of Parizeau et al. (2015) which found that the use of more strategies to identify food waste was positively correlated to the amount of organic waste produced by the average household. It appears that the more reasons employed

when deciding whether to throw food away ultimately results in more food waste. As discussed in section 4.2.3, educating consumers that best before dates are not indicators of food safety (Canada Food Inspection Agency, 2014) could help to reduce unnecessary food waste, as could advocating for the use of appearance and smell as good indicators of food quality.

The frequency of eating dinner at home did not show any association with food waste: 95% of respondents in both categories said they ate dinner at home ‘often’ or ‘always’ (Appendix K13). These findings were similar to those of Parizeau et al, 2015. Similarly, whether or not a respondent tended to ‘cook from scratch’<sup>25</sup> also did not show any statistical significance (Appendix K14). The frequency of eating leftovers did not show statistical significance (Appendix K16), however those with “Less Food Waste” were more likely to say they ‘always’ eat them (51% versus 30%). Eating leftovers has shown to be a factor in food waste in several other studies (Ventour, 2008; Koivupuro et al, 2012, WRAP 2014). This different result could be an issue of ability to recall how often they eat leftovers, or possibly what individuals consider to be leftovers. As discussed in section 4.2.3, individuals may mentally classify leftovers only as full meals as opposed to food left on the plate (e.g. extra vegetables from a platter).

A question that did show statistical significance asked how often respondents get take out or go to restaurants when there was food they intended to cook at home. I had hypothesized that those who are drawn in by restaurant/take out options would report that

<sup>25</sup> The survey described ‘cooking from scratch’ as combining 3 or more items.

they waste more food at home as a result. Interestingly, this study showed that people who get take-out or go to restaurants instead of cooking food at home had *lower* perceived food waste than those who do not (Fisher's Exact Test,  $p = 0.0026$ , Appendix K15). By contrast, the Guelph study (Parizeau et al, 2015) found that 'household spending on non-grocery foods was positively correlated with per capita generation of organic waste'. It is possible that the small sample size produced this unexpected result, as only 4% of respondents fell into the 'frequently' category of the analysis. Conversely, perhaps those respondents who frequently get take-out or go to restaurants do not keep as much perishable food at home, in which case the act of spontaneously purchasing non-grocery food would not necessarily have household food waste implications. This finding will be discussed in greater detail in section 5.2.

### ***Food Waste Opinions***

To determine whether or not low food wasters were more bothered by the act of wasting food, respondents were asked how often they felt bothered when food was wasted. This response did not show statistical significance (Fisher's Exact Test,  $p = 0.058$ , Appendix K17). However, 85% of respondents said that they 'often' or 'always' felt bothered when they waste food which suggests that feeling bothered is relatively wide-spread and may not be a strong predictor of food waste behaviour.

A final question of interest whether the positive 'green halo' effect of composting (using a backyard composter or a Green Can) affected food waste behaviour. First, a statistical analysis was run to see if composting households feel less guilt over wasting

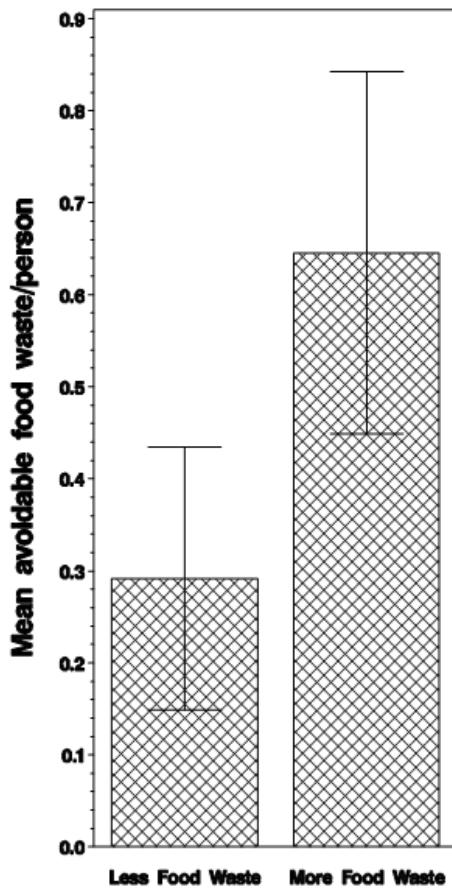
food.<sup>26</sup> The enquiry revealed that there was no association between disposal method and feeling ‘bothered’ about wasting food (Appendix K18). This finding may help to corroborate the finding that the loss of money is the primary driver of food waste guilt; the environmental advantages of composting one’s food scraps are not enough to trump feeling bothered over the money that was wasted. Correspondingly, I wanted to know whether there was any association between food waste and whether or not individuals compost. An analysis showed that there was no association between composting and perceived food waste (Appendix K19). Households are as likely to waste food whether they compost or not.

### ***Diary Study Survey and Waste Assessment***

Due to the limited sample size of the diary study (13 participants), a bivariate analysis will not produce statistically valid conclusions and results can easily be skewed by anomalous data. Still, one item of particular interest was whether one’s *perceived* food waste (i.e. whether they fell into the ‘More Food Waste’ or ‘Less Food Waste’ category) was linked to their *actual* avoidable food waste per person as determined through the waste assessments. A t-test of the mean avoidable food waste for the More Food Waste and Less Food Waste groups indicated that there was indeed a highly statistically significant connection: participants that fell into the ‘Less Food Waste’ group did have less food waste ( $t_{11} = 3.74$ ,  $p = 0.0033$  see Figure 19, Appendix K20).

<sup>26</sup> Kate Parizeau proposed this question as an opportunity for future research while presenting on the Guelph study in Metro Vancouver in 2014.

**Figure 19: Actual versus Perceived Food Waste at 95% Confidence Level**



This finding points towards the following possible conclusion: though the majority of households likely waste more than they believe they do (as discussed in section 4.2.4, Figure 12), those that rate themselves as having ‘significantly less’ food waste than average do indeed waste less food than those in the More Food Waste group. This suggests that using one’s perceived food waste in the survey as an indicator of actual food waste could be a sound measure. Those in the ‘Less Food Waste’ category may still waste more food overall than they believe they do, however their specific habits and behaviours should still result in a lower waste output than households in the ‘More Food Waste’ category. To determine this connection more conclusively, another larger study

using a combination of surveys and waste assessments would need to be conducted. More conclusive results would have been obtained if waste assessments were completed for all survey takers in this study, however this was not feasible given time and budget constraints. In order to create a study that statistically represents Langley's population as a whole, approximately 400 surveys and waste assessments would be needed. It is acknowledged that the budget and staff time needed to conduct 400 waste assessments is likely to be prohibitive.

## **5. Discussion**

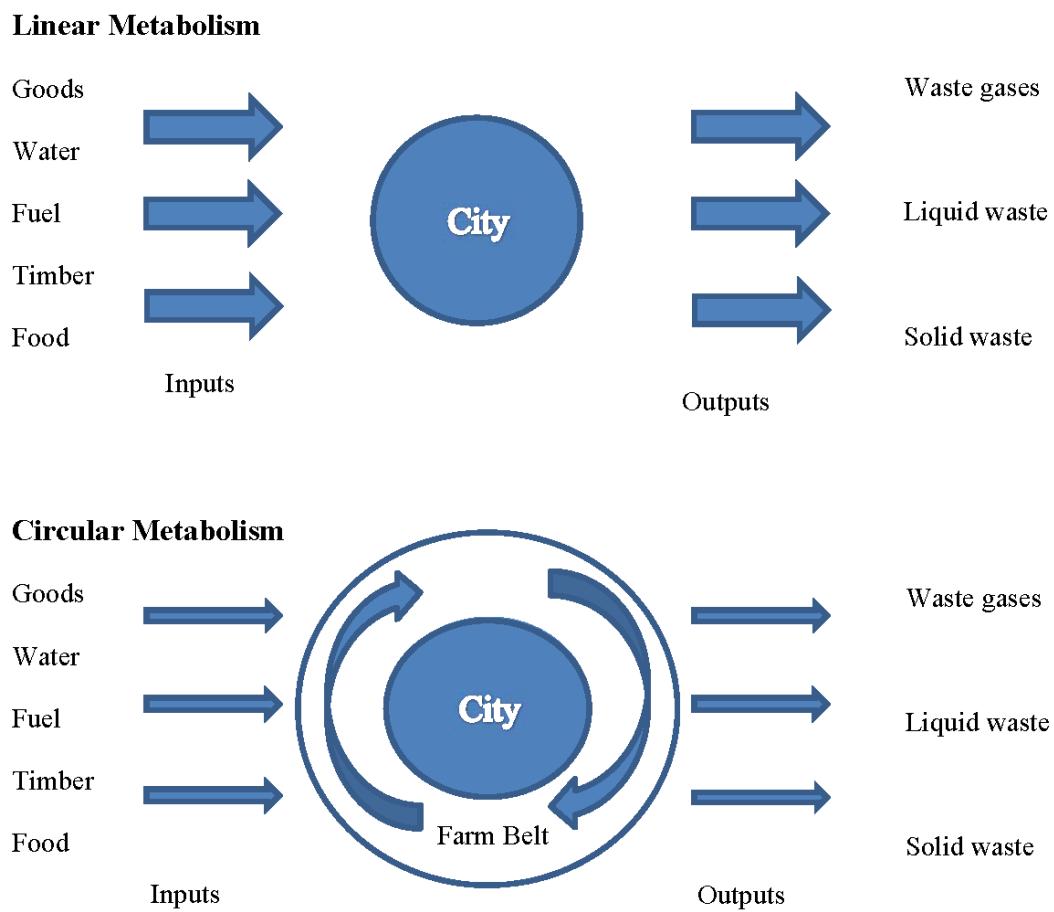
On the whole, this study explored a variety of key concepts that are useful to: 1) better understand household food waste, and 2) inform future food waste research. The following section will explore key findings and their implications, study limitations, and will provide suggestions for future study.

### **5.1. Food Waste Awareness**

One key result from this study is that household awareness of food waste is lacking. This study indicated that only 5% of the 141 households surveyed believed they wasted the same or more than the Canadian average. This has been a common trend in other food waste research (WRAP 2007b, WRAP 2014, NSW 2011, Neff et al. 2015). The lack of awareness could be attributed (at least in part) to the ‘out of sight, out of mind’ characteristic of waste in urban and suburban environments. As discussed in section 2.3, cities are noticeably disconnected from the food cycle: to the average consumer, food simply appears in grocery stores and restaurants, and food waste disappears from our curbs. Still, as Draper Kauffman notes in his book ‘Systems 1: An introduction to Systems Thinking’ (1980) “There is no ‘away’... In natural ecosystems, in particular, you can move something from one place to another, you can transform it into something else, but you can’t get rid of it. As long as it is on the Earth, it is part of

the global ecosystem” (pp 38). This disconnection is theorized to have consequences for the sustainability of humanity which is becoming increasingly urbanized (Girardet, 1999). Herbert Girardet endorsed the value of urban *circular metabolism*, contending that the solution to excess waste and to lessening the disconnect with waste is to adopt a more circular metabolism in cities, where urban outputs are regarded as potential inputs for local production systems (Figure 20).

**Figure 20: Linear and Circular Metabolism of Cities**



Adapted from Girardet 1999

So, for example, food waste from cities could be composted and the soil could be applied to local farms growing food for local markets. This model would bring the food cycle closer to the urban periphery. Langley could represent an interesting location for which to examine the value of this model since a good portion of Langley is made up of farmland (75% is zoned for agricultural use) (Township of Langley, 2014a). Along the same vein, Girardet (2015) advocates for addressing these issues at a ‘subtler’ level, (i.e. beyond urban planning) by increasing our awareness of these local systems, and increasing our interaction with the natural world. Indeed, this notion has gained popularity in the food sphere in recent years: the number of urban community garden plots have grown steadily and many schools are using on-site gardens as learning tools for the food cycle (both growing and composting) (Ladner, 2011). Recent food waste studies have supported these contentions: Guelph researchers for example found that households exhibiting ‘food awareness’ (which included having a vegetable/fruit garden) produced less food waste on average (Parizeau et al, 2015). The concept of connecting the act of growing food and food waste is one that warrants more research. Those with small hobby farms, backyard food gardens or community garden plots could be good subjects for future study<sup>27</sup>. Similar to the Guelph study, surveys could ask questions about household food growing, and then researchers can assess any connection with avoidable food waste output through waste assessments. One challenge in studying this connection would be trying to adjust for food waste loss via backyard composting: backyard composting is a common practice for gardeners, and community gardens tend to have

<sup>27</sup> Commercial farms may not be as useful since grocer standards such as size and shape of produce could impact food waste, and commercial farms tend to grow only a few crops at a time for multiple markets

onsite composters<sup>28</sup>. In this case, it might be best to employ a separate food waste bin as was done with the Langley study instead of completing curbside waste assessments. This method would specifically capture food waste that was brought into the home for consumption—whether from the grocery store or from one's own garden. Food waste diaries could also be a complementary measure.

In addition to increasing general food awareness, the lack of food waste awareness in individual households should also be addressed. As this and other studies have found (WRAP 2007b, WRAP 2014, NSW 2011, Neff et al. 2015), individual estimates of one's own food waste is often remarkably lower than the actual waste output. If individuals are not aware that they are wasting food, general education about the food waste problem will do little to curb their behaviour. Instead, food waste may seem like a problem for food retailers, or possibly other households, but not one's own. Distributing food waste diaries more widely may help households to increase awareness of their food waste habits. Similar to dieters using a calorie log to raise awareness of caloric intake, food waste diaries can bring attention to a household's food waste habits. WRAP researchers also came to this conclusion, finding that study households that originally underestimated their waste had the highest levels of waste in their food waste diaries (WRAP, 2014). The authors concluded that 'diaries could be a useful method for improving waste awareness for those generating the most waste' (WRAP, 2014). Though studies have been conducted to show successful weight loss attributable to calorie diaries

<sup>28</sup> Langley community gardens each have composting units on site

(Burke et al., 2012; Hollis et. al, 2008), investigation into the efficacy of using food waste diaries to *reduce food waste over time* could not be found<sup>29</sup>. In a literature review of food waste prevention programs, WRAP also found that studies demonstrating behaviour change over time are very limited (WRAP, 2011b). Future research could analyze the effectiveness of using a food waste diary to modify food waste output. Researchers could conduct a baseline waste assessment and then return to the household and conduct a follow-up waste assessment 6 months to one year after the diaries were used to assess any lasting behaviour change. Follow-up interviews or surveys could also be conducted to ask participants if the food waste diary experience had any bearing on their opinions or behaviours.

## **5.2. Opinions and Behaviours**

One interesting finding was that cooking, preparing or serving too much (e.g. leftovers, plate scrapings, food left after a party etc.) was the primary cause of diary households throwing away avoidable food waste. This finding was similar to that of other studies (Ventour 2008, Koivupuro et al, 2012, WRAP 2014). In terms of education and behaviour-change, making/serving too much food may prove difficult to confront since, as discussed in section 2.2, having and serving more food than necessary is often a cultural norm—particularly in social situations where one's status could be in question (Dubois et al, 2012). These cultural norms are bound to be challenging, though likely not impossible to overcome. With increased education comes an increased understanding of

<sup>29</sup> Food waste diaries are, however, widely used in food waste research and food waste reduction education

the negative implications of food waste, and history has taught us that changes to cultural norms can in fact be motivated by the environmental movement. Take car ownership, for example. Since cars became available to the masses about a century ago, they have been manifestations of social status (Gartman, 2004). Though there is no doubt that this convention still exists today, there has been some indication of a shift in this mentality in select cities such as San Francisco. When appropriate public transportation, cycling/walking opportunities, (and more recently) car-share opportunities exist, some urban areas are seeing individuals—even those who could easily afford a car—choosing more environmentally-friendly transportation modes (Belz, 2001). Similarly, many celebrities (who themselves could afford practically any vehicle they pleased) have chosen to demonstrate their status as ‘stewards of the environment’ by owning electric or hybrid vehicles and speaking publicly about this choice (e.g. Tom Hanks, Pope Benedict XVI, Leonardo DiCaprio) (EV News, 2015). I believe food waste has the potential to undergo a similar cultural shift, whereby with enough education and awareness, preparing too much or wasting food will be seen as inappropriate if not inherently wrong as it has been in other time periods (e.g. during wartime). Social pressure will be a key piece of this process (as it was for the recycling movement discussed in section 2.3). As awareness about the negative implications of food waste grows, social pressure can help ensure that food outlets and even households portion effectively and have plans for their leftovers. A complementary measure would be to educate individuals to properly portion meals, and provide recommendations for how to ensure leftovers are stored properly and are eaten (for example, leftovers can be frozen in individual portions to serve at a later date). Food waste education and proper portion sizing could be incorporated via a number

of different avenues: for instance, school education curriculums could add this content to cooking courses and home economics. Local food non-profit groups can also advocate for food waste reduction and provide suggestions for reducing food waste. Farm Folk City Folk, for example, is participating in the Foodprint project with the City of Vancouver as part of the Greenest City 2020 (Farm Folk City Folk, 2015). The project website offers food waste reduction education, including suggestions for how to properly portion food, utilize the freezer, and use up leftovers. The organization also invites the public to ‘join the foodprint conversation’ and share their tips on social media. Similarly, Metro Vancouver’s Love Food Hate Waste website offers food waste reduction assistance such as recipes that adjust the ingredient measurements depending on how many portions you plan to serve. As evidenced by the blue box recycling movement which has grown to have a participation rate of approximately 85% in Langley (Township of Langley internal curbside participation survey, 2013), social norms and social pressure can indeed have an influence over behaviour. Though it will take time, food waste prevention can become a standard and lauded practice as food waste knowledge and education is expanded and accepted as the norm.

This study also found that money is the primary reason individuals feel ‘bothered’ when they dispose of food waste. Similarly, WRAP (2007b) also found money to be the primary driver of food waste guilt. Interestingly, the Guelph study found food waste to be more of a ‘social problem’ for respondents versus an economic or environmental problem, though the survey questions posed were not connected to guilt or feeling

bothered which may led to this disparity<sup>30</sup>. Despite the many environmental ramifications of food waste, only one (1) individual in the Langley study indicated that the environment was the main reason they felt bothered. WRAP (2007b) researchers also noted that most people are not aware of the environmental consequences of food waste, and that there is widespread belief that there is no environmental issue associated because food waste is biodegradable. This could also explain the finding that individuals who compost do not feel less guilty than those that dispose of food waste in the garbage. It was hypothesized that composting could lead to ‘guilt-free’ food waste<sup>31</sup> because composting is environmentally-friendly, but if money is the primary reason food waste is bothersome, this will hold true whether the food is composted or disposed of in the garbage. These findings prompt a call for increased public education to improve and expand general knowledge about the many environmental impacts of food waste. As a complementary measure, targeting education around the financial benefit of reducing household food waste should prove useful to tap into this potential driver for behaviour-change. Cost can be a strong motivator for a number of sustainability-related behaviour changes. For example, Canadian households with water metering (using volume-based water pricing schemes) used 73% less water than those with flat rate pricing (Environment Canada, 2014). Similarly, since the carbon tax was introduced in BC, BC’s fuel use has dropped by 16% while use has risen 3% across the country (Pederson et al., 2015). Focussing on the financial impacts also has the benefit of being quite

<sup>30</sup> Researchers also noted that the study was conducted in a fairly wealthy part of the city which may have impacted this result (phone conversation)

<sup>31</sup> Kate Parizeau and Mike von Massow from the University of Guelph proposed this question as an opportunity for future research at the 2014 Metro Vancouver Food Waste Symposium

personal to most people—the externalized nature of the environmental implications of food waste could make it difficult to properly motivate some individuals. Educating households about the annual cost of their food waste (approximately \$600 by one estimate [Jones 2004]) may help. Furthermore, online food waste calculators exist but are primarily designed for the food service and retail industry<sup>32</sup>. These calculators could be modified for household use, or financial columns for calculating the dollar value of wasted food could be added to food waste diaries.

An unexpected finding in this study was that those who get take-out or go to restaurants when there was food they intended to cook at home had lower perceived food waste. This was surprising because I had hypothesized that individuals might buy groceries with good intentions of eating them, but this food could go to waste if they are frequently enticed by convenience or restaurant food instead. This hypothesis stemmed in part from the Guelph study which found that spending on non-grocery food was correlated to higher organic waste (Parizeau et al., 2015). My unexpected finding may have resulted from the small sample size, since only 4% of respondents fell into the ‘frequently’ category stating that they ‘often’ or ‘always’ get take out or go to restaurants (Appendix K15). Alternatively, it is possible that some respondents found the question itself to be unclear: ‘I get take out or go to restaurants when there is food that I intended to cook at home’ (Appendix C). It is also possible that there is a behavioural explanation for this result. For example, perhaps those respondents who frequently get take-out or go

<sup>32</sup> Example: The EPA’s ‘Tool for Assessing Wasted Food’: [www2.epa.gov/sustainable-management-food/tools-assessing-wasted-food](http://www2.epa.gov/sustainable-management-food/tools-assessing-wasted-food)

to restaurants do not keep as much perishable food at home, possibly even because they know they like to eat non-grocery food. Indeed, ‘food that I intended to cook at home’ could be a frozen meal, or some dried pasta with a jar of sauce. If this is the case, any household food waste implications from getting take-out or restaurant food instead would be limited. It seems that ultimately, the relationship between household food waste and the frequency of getting take-out or going to restaurants will be dependent on the types (perishable vs. non-perishable) and quantities of food items in the household inventory. Since the types of grocery items purchased were not assessed in the survey, it is difficult to draw any conclusions about this connection from my study. However, a more in-depth examination of the impacts of convenience and/or non-grocery food on household food waste (positive or negative) could represent an interesting topic for future research.

A second unexpected finding in this study was that shopping at box stores (e.g. Costco), buying in bulk, and buy-one-get-one free offers did not show any association with food waste. These results differed from other studies showing a stronger association (WRAP, 2007b; Koivupuro et al, 2012). This divergent result could be a product of the relatively small sample size (141 surveys), or could be related to the high level of box store shopping among Langley’s respondents. If most households frequent box stores for bulk items, this makes it more difficult to show any connection between the small percentage of those that do not and their relative food waste. Another possibility is that bulk shopping has less of an impact on food waste in Langley than hypothesized. For example, the survey found that most individuals felt most bothered by the money they lost when wasting food: perhaps these budget conscious box store shoppers avoid wasting

the food they do purchase to limit wasting money. Indeed, bulk shopping will not necessarily lead to food waste provided that the household food inventory is managed properly, and bulk shoppers may be more budget conscious in general. More extensive study would need to be conducted to confirm or refute any connection between bulk shopping and household food waste in Canada.

It was interesting to learn that many of the behaviours hypothesized to have a connection to food waste did not show a statistical association in this study. These included: shopping with a list, taking household inventory before shopping, meal planning, buying more items on sale, buying in bulk, shopping at bulk stores, eating dinner at home, eating leftovers, and cooking from scratch. As discussed in section 4.2.5, low food wasters were often more likely to say they ‘always’ employ certain behaviours—such as shopping with a list or taking household inventory before shopping—however overall it appears, at least in this study, that these behaviours are not good predictors of household food waste. This finding highlights the intricacies and difficulties in attempting to understand the behaviours associated with household food waste. For example, one person who buys more items on sale might be very skilled at handling household food inventory and may never waste that extra food, while another enticed by buy-one-get one free offers forgets about the extra food in the back of the fridge and it ends up spoiling. It is important to understand that these behaviours do not exist in isolation; they are each a piece of a chain of behaviours and life events, and are further influenced by cultural norms, demographics, personal philosophies etc. We must be cautious not to expect that specific behaviours will result in less or more food waste

because this is not necessarily the case. It has become clear during this research that the problem of household food waste is extraordinarily complex, and the diversity of food waste drivers makes it very difficult to determine what – if any – specific behaviour modifications will result in a reduction in household food waste. WRAP (2014) published a study entitled ‘Household Food and Drink Waste: A People Focus’, where they examine this very concept. WRAP studies showed some connections between food waste and behaviours, including strong evidence of association with eating leftovers, and moderate evidence of association with meal planning, list making, and buying more on sale, yet they found no correlation between food waste and other behaviours such as using the freezer. The authors hypothesize that ‘this may be due to the fact that, by their nature, questionnaires are not able to capture the full richness in how activities are implemented within the home, and some behaviours may be more or less important to specific groups or circumstances’ (p.4). They go on to state that a ‘lack of correlation is not necessarily a reason to stop promoting them as strategies for food waste prevention’ (p.4). I am inclined to agree with the authors’ assessment. Despite the complexities around conclusively correlating food waste and behaviours, I believe there remains value in educating the public about certain strategies<sup>33</sup> that may help to curb food waste in their households. Different strategies may be effective for different households depending on their individual circumstances, and it may be worth providing a range of options to suit individual household needs and conditions.

<sup>33</sup> Of the behaviours assessed in this study, eating dinner at home, cooking from scratch, and shopping at bulk stores should be omitted from educational materials because these are not known to have any specific impact on food waste in the literature. These could be assessed further in future research.

## **5.3. Study Limitations**

This study has identified a number of limitations and complexities within food waste research that should be acknowledged. In many ways, this study uncovered more questions than answers, and illustrated how difficult it can be to conduct quality food waste research and compare the resulting data with existing studies.

### **5.3.1. Methodological Limitations**

One notable realization during this project was the marked variability between methodologies and food-waste-per-person figures in the literature. The lack of consistent methodologies in food waste research has been noted in several studies including Koivupuro et al, 2012 and Buzby and Hyman 2012. Of the studies assessed in Table 6 (section 4.1.2), food waste per person ranged from 23 kg/year to 218 kg/year depending on the methodology used and whether the distinction between avoidable and unavoidable food waste was made. The differing methods and results make it challenging to compare studies and to understand whether the culture or policies of the country (or city) where the study was executed has any bearing on the results. At the outset of this project, it was my hope to explore whether Canada has a bigger, similar, or lesser food waste problem compared to other parts of the world. Not only did the study variability in the literature review illuminate that this expectation was highly questionable, but I also concluded that comparisons between countries and cities is not as straightforward as one might anticipate.

First, let's examine the impacts of methodology choice in this study. The following is by no means a full analysis of the benefits and drawbacks of each of the food waste methodologies chosen, however it will illuminate some of the key limitations and benefits of some of the primary methods.

This study employed surveys as one component of the study. Surveys are useful because the time intensity for participants is low, and surveys can gather a large amount of data about demographics, as well as self-reported behaviours and opinions. Drawbacks of this method include the inability to gather data on the amount of food thrown away (i.e. food waste per person), and survey-takers must self-assess their behaviours which may not prove accurate. For instance, this study found that the majority of survey respondents thought they wasted far less than the Canadian average, which most likely is not the case. Even if it were true that only 5% of respondents wasted more than average, there would be no way to prove it without corresponding waste assessments. In this researcher's opinion, surveys are an excellent tool for food waste research, however they should be combined with waste assessments to realize more useful data for comparison. Waste assessments and their linkages to other methodologies will be discussed in more detail below.

Diaries were also used in this study to analyze food waste. Diary studies can be incredibly resource and time intensive, as this research revealed. Indeed, this study could

only reasonably have 13 participants given time and budget restraints<sup>34</sup>. Another major drawback of food waste diaries is that they can suffer from underreporting, where up to 40% of food waste can go unreported (Quested et. al, 2011). Similar to surveys, diaries also cannot provide accurate weight data (i.e. food waste per person) because users are estimating the amount of waste they throw away. Conversely, a major benefit of diaries is that they are excellent for understanding *why* food waste is thrown away (WRAP, 2013), which is important for understanding human motivation and designing behaviour-change programs. The food waste diary also offers advantages over a survey alone, since participants are reporting on their food waste at each instance of food wasting that occurs. This method reduces or removes the need to recall and generally estimate food waste over time. Finally, diaries also capture food that is backyard composted, fed to animals, or poured down the drain which would not be collected if curbside waste alone was assessed (WRAP, 2013). In the case of this study, it was noted that diaries also helped to inform the waste assessment portion of the research. If an item in the food waste bin was difficult to recognize, the food waste diary could often assist in identifying it which helped to ensure it was weighed into the correct category.

Waste assessments were also used in this food waste study. Waste assessments have a number of key benefits, including obtaining accurate food waste weight data, and the ability to distinguish between avoidable and unavoidable food waste. As discussed in several sections in this paper, the distinction between avoidable and unavoidable food

<sup>34</sup> However, this study combined diaries with waste assessments which increased the time and resource needs of the study group. Food waste diaries utilized without waste assessments would require fewer resources.

waste is important, because each type has a different impact (environmental, economic, and social) and a different educational approach. Avoidable food waste is the target of food waste reduction education, which aims to reduce the waste of food that was meant for human consumption. Unavoidable food waste (e.g. the peels) should be the focus of education promoting composting programs, since reducing this waste is nearly impossible (e.g. bananas do not grow without their peels). To obtain useful information about food waste, we must first establish a baseline percentage of total food waste that is avoidable, and then work towards lowering this percentage through education and policy. Waste assessments are integral to gathering this baseline data and for being able to assess any future change. The WRAP program suggests that 60% of total food waste could be avoided; my study suggests only 32%. Unfortunately the sample size in this study is too small to draw any definitive conclusions about avoidable food waste in Langley.

Waste assessments are also valuable for complementing both surveys and diaries. If waste assessments and surveys are combined, researchers can look for connections between food waste and demographic indicators, behaviours and opinions. In this study, I assessed survey information relative to a participant's *perceived* food waste as indicated in their survey, however waste assessments of each survey-taker's waste would have elicited much more accurate data. Unfortunately, time and budget did not allow for this. Waste assessments can also complement diary studies by addressing underreporting. My research indicated that some items ended up in the food waste bin but were not recorded in the diary, and the waste assessment helped to capture this waste. In my study, waste assessments required participants to separate out their food waste from their organics bins

and/or garbage bins, which creates both limitations and advantages. Because organics bins, garbage bins, and recycling bins were not also assessed for food waste, it is possible (even likely) that some household food waste was not captured<sup>35</sup>. In many ways, conducting waste assessments of all curbside waste bins is preferable to having households separate their own waste like they did in this study because it reduces the impacts of human error (e.g. throwing some food in the garbage instead of the study's food waste bin). Also, curbside waste assessments could be conducted without the prior knowledge of participants which would reduce the Hawthorne Effect, a phenomenon that describes the impact of research on the study's subjects (Babbie and BenAquisto, 2014, p. 209). This social research effect may have influenced study participants to throw out less food than they normally would, which may have contributed to my relatively low result of only 23.4 kg of avoidable food waste per person per year (see Table 7 and Figure 4). Conversely, the method employed in this study may have captured some food waste that curbside waste assessments alone would not, including food that would otherwise be backyard composted, or liquids that may have been poured down the drain. Ultimately, this research project has shown that no one method is without its benefits and drawbacks, however a certain combination of methods can deliver the best results possible. A combination model of methods will be discussed in greater detail in section 5.4.

<sup>35</sup> Guelph researchers indicated that a good portion of food waste was entering the garbage and recycling streams in their latest study (results expected in 2016) (phone conversation with Kate Parizeau, 2015)

### **5.3.2. Study-Specific Limitations**

The small sample size of 13 participants in the diary study and 141 participants in the survey-only group is a noted study limitation. These participant totals are not considered statistically significant relative to the total population of the Township of Langley (approximately 114, 000). A sample size of approximately 400 would have produced a 95% confidence level with a 5% margin of error; however this was not realistic given time and budget constraints on this project. Any findings should therefore be considered exploratory in nature.

Other study limitations include the study length. The diary study duration was limited to one week, and data gathered during this limited time period may not exemplify common food waste practices in each household. For example, participants may only choose to clean out their fridges once a month, or empty their pantries once a year. Additionally, food waste can increase or decrease depending on frequency of entertaining guests, and/or eating out at restaurants. Variability in household food waste week-to-week is a recognized limitation of this study and can be extrapolated to food waste research in general. Though the study could be adjusted in length, a longer study may deter interested participants, or could become cost prohibitive. Correspondingly, it would be difficult to determine how precisely how long a study would need to be in order to capture food waste variation over time while still keeping costs manageable. One week's worth of waste may be an appropriate standard given the time and cost-intensive nature of waste assessments. The WRAP program, for example, audits one week's worth of curbside waste for properties with weekly collection, and two weeks for properties with

garbage collection every second week (WRAP, 2013). Another similar study limitation is the chosen time of year that this study was conducted (spring). Households might have more food waste during holidays or during other periods when they entertain more frequently. Seasonal differences in the types of food purchased can also impact results (WRAP 2013). Though my sample size was too small to show value for making seasonal adjustments, the WRAP program adjusts for these seasonal food purchase trends in their research (WRAP, 2013).

Selection bias is yet another limitation of this study. Only certain types of people in certain life stages or situations, or of particular interests, will be willing to invest the time and energy needed to participate in a study such as this one. The diary study group was too small to draw any conclusions about which groups might be over or under-represented, however the survey group was shown to over-represent older, home owning households compared to Langley averages (section 4.2.1).

A final study limitation noted is that Langley, BC may not be representative of Canada as a whole. A variety of factors may impact whether Langley's experience with food waste may differ from Canadian averages. Housing costs, for example, are relatively high in BC (average cost \$779,419) compared to the Canadian average (\$503, 057) (Canadian Real Estate Association, 2016). Higher housing costs may impact the amount of remaining income that can be spent on food (and food waste). We must be careful not to extrapolate data from this study and assume that it is representative of the country. This is likely true of any food waste study that uses data from a single location versus country-wide waste data. Therefore, Table 7 and Figure 4 which illustrate variability

between food waste per person in example studies worldwide should be used to illustrate the impact of *methodological* differences, not differences in location.

### **5.3.3. General Limitations**

A few other generalized limitations to gathering accurate and comparable food waste data still remain. For example, participation in this study's waste assessments revealed that, without a strong consensus on what precisely is avoidable and unavoidable, a level of arbitrary or preferential decision-making comes into play. In one instance, a participant had used a large amount of flour and spices to make a dredge for fried chicken. During the waste assessment, my assistant and I had trouble coming to a consensus on whether this was avoidable (did they really need to use this much?) or unavoidable (once it has raw chicken in it, it couldn't possibly be used again!). In the end we placed it in the 'potentially avoidable' category, however this experience revealed that these situations are not so clear cut. Our experience with this dredge material also illustrated that without a diary to correspond to this food waste, it can be very difficult to identify the food waste. The material had become damp with liquids from the bin and appeared more like a casserole. Had this food waste been assessed as part of curbside waste assessments, it would be unlikely to have been properly identified.

Similarly, cultural differences could have an impact on how food waste data is gathered and assessed. What is considered unavoidable food waste in one location might be deemed avoidable in another. Fish skin, for example, could be more commonly eaten in some cultures, yet considered unavoidable food waste in others. The same could be

said for specific types or cuts of meat, including organs. The question of whether researchers around the world could come to a consensus cross-culturally on food waste might be more difficult than many (including myself) would like to believe. It may not in fact be feasible to derive a global standard for food waste research; however I do believe there is value in standardizing food waste research within a country, and in understanding the benefits and drawbacks of study methodologies prior to embarking on food waste research regardless of where the study is conducted.

## **5.4. Future Opportunities**

In the UK, recent studies have shown that household food waste is decreasing, and it is believed that education programs such as WRAP's Love Food Hate Waste are responsible. From the launch of Love Food Hate Waste in 2007 until studied again in 2012, the UK saw a 21% reduction in avoidable food waste from households (WRAP, 2012). WRAP credits widespread education and stakeholder engagement (with industry, governments, and non-profit groups) with this success (WRAP, 2012). In addition to being an educational resource, WRAP also worked with industry on the Courtland Commitment which was designed to improve efficiency and reduce waste in the grocery sector (WRAP, 2015). Among other waste reduction initiatives, the Courtland Commitment inspired: food storage tips on fresh produce bags, an increased shelf life for over 1500 food products through efficiencies in delivery and storage, and the switch to reseal-able packaging to reduce food waste (WRAP, 2015). The wide reach of the WRAP program represents a successful model to reduce food waste in all sectors

including the household. If Canada could adopt a similar model, it would help to consolidate food waste reduction efforts and scale up research into Canadian food waste. Whether or not Canada would need to complete this at a scale comparable to the WRAP program is debateable: current government investment in the UK's WRAP program is very high. WRAP's model is that of a charitable non-profit that is primarily funded by UK and EU governments with budgets of £40.7 million in 2014/2015 and £66.3 million the previous year (WRAP, 2015b). Fortunately for Canada and other countries around the world, a lot of the leg-work has already been completed by the WRAP program, such as developing a sound research methodology. For example, 'Methods used for Household Food and Drink Waste in the UK 2012' (WRAP, 2013) can be used as a high quality standard methodology for food waste research (see more on this below). WRAP has also completed studies that highlight the economic value of investing in food waste reduction, such as their report entitled 'Strategies to Achieve Economic and Environmental Gains by Reducing Food Waste' which illustrates the significant economic costs of food waste and calls on governments and businesses to invest in food waste prevention (WRAP, 2015c). The WRAP program can offer Canadian researchers and governments an excellent head start by learning from their experience and approach, however Canada will still need to invest in a few specific ways:

### **1) Standardized research into household food waste in Canada**

It would be highly beneficial to adopt a standard methodology and indicators for food waste study in Canada to assist researchers and policy makers to compare and contrast results. If standardized Canadian studies show that one location is producing less

food waste than another, it becomes easier to ask ‘What makes this place different?’ and look for the behavioural and cultural variances that could have an impact. As discussed, Canada lacks any concrete understanding of our avoidable household food waste. Without data on how much avoidable food waste we produce at the household level, it becomes difficult to justify economic investments and challenging to compare data across Canada. Canadian researchers need to establish a baseline understanding of our food waste in order to rationalize how to begin to solve the food waste problem. In order to promote consistency in research design between studies, I would advocate for utilizing a consistent and harmonized research methodology such as the one used by the WRAP program. The WRAP program provides a detailed description of their methodological processes and rationale in their 2013 Methods document (see WRAP 2013). WRAP consolidates research from three (3) primary areas of study: food waste diaries (with surveys), waste assessments (with surveys), and municipal waste data. With the exception of municipal weight data, each method was discussed in section 5.3.1 and exhibits benefits and drawbacks. When combined together, however, these methods offer some of the best opportunities to obtain good data on household food waste. Municipal waste data, though not employed as part of my study, can provide added value to the research by helping to complete the full picture of food waste in a location. Though municipal waste assessments tend to sort only one food waste category which is comprised of total food waste (both avoidable and unavoidable, see example: Tetra Tech, 2013), percentages of avoidable and unavoidable food waste obtained through curbside waste assessments can be applied to municipal totals to “scale up” to the total number of households (WRAP, 2013) for a broader understanding of the impact of food waste

across a municipality or region. WRAP studies also integrated surveys into both the diary and waste assessment components which are helpful to tie specific demographics, opinions and behaviours to household food waste. Overall, the WRAP methodology offers a quality, multi data-source research design that can be replicated relatively easily using publicly available methodology documents. Governments will need to invest in these studies in order to obtain useful Canadian data. Though it would be useful to have a single body coordinating this research as the WRAP program did, I do not believe it is necessary to achieve good results in the preliminary stages. Provided that governments and researchers commit to following an agreed-upon methodology (such as WRAP's), smaller studies can be completed across Canada and consolidated at a later date. This structure would also help to spread the financial burden of the research across locales. I would suggest that 100 household waste assessments and up to 100 completed diaries and surveys should be conducted at each location if possible. Of course, more would always be preferable, and ideally, all studies would have a statistically significant number of participants relative to the population (e.g. approximately 400 participants per 100,000 population). Unfortunately, the cost and time intensive nature of food waste research (especially waste assessments) will no doubt limit the study sizes. Like all studies, researchers will need to assess the available budget and staff time to determine whether more participants can be assessed within known constraints.

## **2) Coordinating food waste reduction efforts**

Once research has been completed and data collected, a coordinated effort to translate research into policy and action will be beneficial. Individual governments can also

choose to do this alone, however there is value in organizing and synchronizing efforts within regions, provinces and across Canada. Governments could choose to invest in a new group like UK governments did, or perhaps Canada's newly formed National Zero Waste Council's (NZWC) Food Working Group founded by Metro Vancouver could be an excellent platform to begin this effort. The NZWC's Food Working Group 'brings together representatives of key sectors to collaborate in the development of policies, actions and harmonized approaches that address "avoidable" food waste, nationally' (NZWC, 2015). The working group's first major endeavor is a piece of advocacy work started in October of 2015 which seeks a federal tax incentive to encourage businesses to donate edible food to charity (NZWC, 2015b). Though the group has yet to complete any major projects on household food waste, the NZWC could be a good association to spearhead this work. Detailing the intricacies of funding sources, staffing etc. are beyond the scope of this paper, however this format is one that should be considered to leverage existing federal coordination on the issue of food waste.

As illustrated above, Canadians would benefit from more education on the environmental, economic and social impacts of food waste, which as discussed in section 2.1, are substantial. Fortunately, the food waste dialogue is gaining momentum in Canada, and it should be noted that while the Langley study was underway (spring 2015), Metro Vancouver launched the Canadian version of WRAP's 'Love Food Hate Waste' campaign<sup>36</sup> as an educational resource for food waste education and reduction. Similarly,

<sup>36</sup> [www.lovefoodhatewaste.ca](http://www.lovefoodhatewaste.ca)

Canada's first Feeding the 5000 event was hosted in May 2015 in Vancouver, BC. This event, which has taken place in other European cities including Brussels, Amsterdam and London, provides a free lunch (prepared by culinary students) made entirely of food that was considered too close to its 'peak freshness' to sell to restaurants and grocers (Feeding the 5000 Vancouver, 2015). Additionally, Metro Vancouver's Zero Waste Conference held October 29, 2015 in Vancouver (with satellite participation from Toronto), dedicated two instructional modules to food waste: Food Waste and the Supply Chain, and Food Waste and the Consumer (Metro Vancouver, 2015). It is encouraging to see that the important topic of food waste is beginning to garner attention and momentum in Canada.

## **6. Conclusion**

Overall, this study adds to a very small but growing body of literature that explores the complex intricacies of household food waste and its economic, environmental and social implications. Food waste research is truly in its infancy in Canada, and we are likely quite far from science-based policy development. As this research project has illustrated, there are numerous cultural, behavioural, psychological, and awareness issues at play in this growing field, and there is no doubt that more work needs to be done to scale up this inquiry and build capacity around food waste reduction education. Municipal organics collection programs are simply not sufficient to address the food waste problem: they do not address any of the numerous upstream costs of food waste, nor are they able to reduce this waste in the first place. The food waste conversation has just recently gained momentum in Canada, and it is hoped that this trajectory continues. As public interest builds, governments should invest in programs and research similar to that of the UK's WRAP program. First, Canada is in need of research on a much larger scale than was accomplished here in this exploratory study. This research should use a standard methodology (such as that employed by the WRAP program) and should include waste assessments that specifically distinguish between avoidable and unavoidable waste to achieve more valid data on household food waste in Canada. The use of food waste diaries in this research would also be beneficial to further explore reasons for food disposal and to increase awareness of one's food waste habits.

which is often lacking. Once this research has been completed, a coordinated group dedicated to food waste reduction involving governments, industry, educators and the public should be convened to consolidate research data and expand food waste education, awareness and advocacy across Canada. A noticeable lack of awareness about household food waste is pervasive—a key discovery in this study—which signifies a strong need for more education and awareness of household food wasting behaviours. The impressive avoidable food waste reductions realized in UK households (21% reduction from 2007-2012) is a shining example of what can be achieved; with more research and a harmonized effort between government, industry and individuals, Canada may be able to achieve the same.

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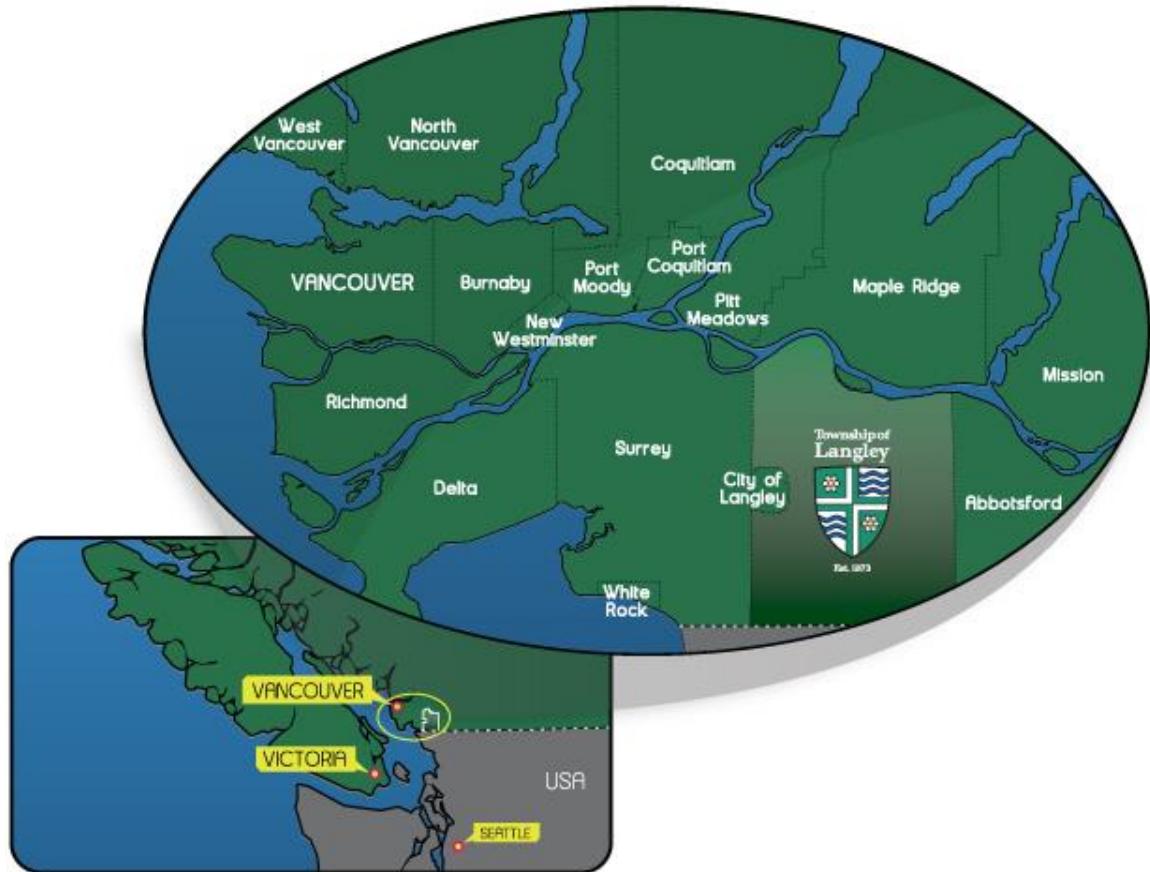
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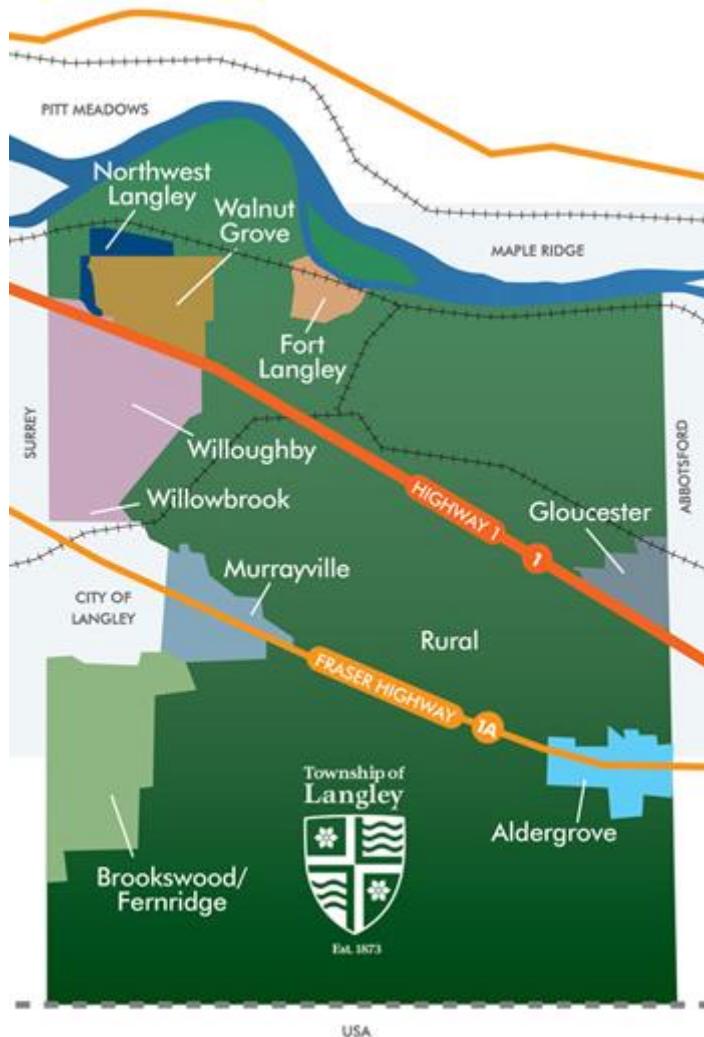
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## Appendix A: Township of Langley's location in Metro Vancouver



(Township of Langley, 2014)

## Appendix B: Map of Township of Langley



(Township of Langley, 2014)

## Appendix C: Encorp Advertisement



(Encorp, 2014)

## Appendix D: Township of Langley Advertisement



You are making a difference! 

*Each time you participate in the Township of Langley recycling and Green Can programs, you prevent waste from going to the landfill. Now that's something to feel good about!*

How are we doing? 

In 2012...

	
Green Can increased 16%	Recycling increased 2%
	
	Garbage decreased 6%

**Diverted from Landfill**

Last year, Township residents reduced the amount of garbage headed to the landfill by 663 tonnes. Way to go!

That's equivalent to 83 fewer garbage trucks full of trash. **83 fewer to landfill**

.....

*Together we do make a difference!*

Engineering Division 604.532.7300 tol.ca

(Langley Student Success Magazine, Spring 2013)

## Appendix E: Food Waste Diary



Cover

DAY 3

Date:

**BREAKFAST:** What food did you throw away from breakfast?

If table is left blank state why:  No food waste  Meal eaten out  Meal skipped  
 Other \_\_\_\_\_

**LUNCH:** What food did you throw away from lunch?

If table is left blank state why:  No food waste  Meal eaten out  Meal skipped  
 Other \_\_\_\_\_

**DINNER:** What food did you throw away from dinner?

If table is left blank state why:  No food waste  Meal eaten out  Meal skipped  
 Other \_\_\_\_\_

**OTHER/SNACKS:** What other food have you thrown away today?

If table is left blank state why:  No food waste  
 Other \_\_\_\_\_

### Example: Day 3

## **Appendix F: Food Waste Containers**



## Appendix G: Food Waste Survey



## Food Waste Survey

### The Research Project

The Township of Langley and Simon Fraser University (SFU) invite your household to participate in exciting new research to study household food waste in the Township of Langley. The purpose of the research is to determine what types of food are wasted in the home, and why exactly this food goes to waste. Each household throws away about \$600 worth of food per year and there are many environmental problems associated with food waste (such as unnecessary transportation of food and food waste). It is hoped that this information will help us to better understand how to stop food from going to waste in the first place.

### The Researchers

This project is a collaborative effort between the Township of Langley and the Simon Fraser University Urban Studies Program. The primary contact is Krista Daniszewski, Solid Waste Coordinator with the Township of Langley and SFU Urban Studies Master's student.

### What's expected of you?

This research project involves completing the attached survey and mailing the survey back to the Township of Langley in the enclosed postage-paid envelope. The time expected to complete the survey is approximately 10 minutes.

### Your Rights and Confidentiality

Please be aware that you are under no obligation to participate in the survey. Surveys received will have no connection to your name or address and any other identifying information will be removed to ensure the confidentiality of your results. If the survey data is shared at any point at the Township or with any third party, your household will be listed as a number (e.g. Household #7) and will have no indication of your address or contact information. Should you have any ethical concerns with the design or execution of this research project, contact Dr. Anthony Perl at SFU; see Primary Contact Information (right).



### Contact Information

#### Primary Contact

Krista Daniszewski  
Solid Waste Coordinator  
Engineering Division  
Township of Langley  
  
[REDACTED]

#### Secondary Contact

Tanya Drouillard  
Technical Assistant  
Engineering Division  
Township of Langley  
  
[REDACTED]

#### SFU Supervisory Contact

Dr. Anthony Perl  
Senior Supervisor  
Urban Studies Faculty  
  
[REDACTED]

## Risks and Benefits

This study has been designated low risk. The study may arouse moderate feelings of guilt which may be inherent in the process of wasting food. Your contact information will be removed from all data so there is no risk of being identified for your food waste habits or amounts.

Benefits of the research for your household may include a better understanding of your household food waste and the potential for reduced food waste in the future (which could save you money). The Township of Langley will also benefit from this better understanding of food waste which will help to design food waste reduction programs. Food waste reduction will have environmental and economic benefits for society.

Survey participants are eligible to win a \$200 grocery gift card\* by random draw. If you wish to be entered in the draw, please fill out the enclosed draw card and return it to the Township of Langley with your survey.

## How will this information be used?

The information collected in the diary and the corresponding survey will provide us with information to understand what types of food Township of Langley residents waste and why. The study will also seek to uncover whether there are connections between certain habits and behaviours (such as making grocery shopping lists) and food waste. The data will be used in an analysis for an SFU Master's thesis in Urban Studies as well as for the Township of Langley's internal purposes. Results of the study will help the Township to create programs and education to help reduce food waste. These results may also help other municipalities to design food waste reduction programs and/or policy changes.

By completing and returning this survey, it is understood that you understand the terms outlined above.

\*Donated by Sierra Waste Services Ltd.





## Food Waste Survey

1. Your age range:

- 19 – 25 years
- 26 – 35 years
- 36 – 45 years
- 46 – 55 years
- 56 – 65 years
- 66 years or older

2. Your gender:

- Female
- Male
- Other/prefer not to say

3. Do you currently rent or own your home?

- Rent
- Own

4. What type of home do you currently live in?

- Single family (detached) home
- Townhouse or row home
- Apartment or condo
- Mobile home
- Other (please specify): \_\_\_\_\_

5. How many people in your household share the same grocery/food purchases?

Note: rental tenants or roommates that do not share groceries are excluded

- 1 (me only)
- 2
- 3
- 4
- 5
- 6
- 7
- 8 or more



6. How many children under the age of 18 years share the same grocery/food purchases?

- 0
- 1
- 2
- 3
- 4
- 5
- 6 or more

7. How do you typically decide if food should be thrown out? (check all that apply)

- Appearance - It looks moldy, dry, or otherwise unappealing
- Past the best before date
- Smell - It smells off
- Taste - I do not like the taste
- Taste - It tastes old or spoiled
- Other (please specify): \_\_\_\_\_

8. How many times per week, on average, does your household shop for groceries?

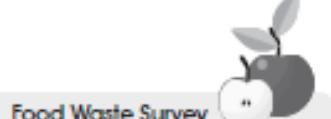
- Less than once a week
- Once a week
- 2 times per week
- 3 times per week
- 4 or more times per week

9. How much money, on average, does your household spend on groceries per week?

- Less than \$50
- \$50 - \$99
- \$100 - \$149
- \$150 - \$199
- \$200 - \$249
- \$250 - \$299
- More than \$300

10. How do you generally travel to purchase groceries?

- Bicycle
- Drive
- Public transit
- Walk
- Other (please specify): \_\_\_\_\_



**11. How much money, on average, does your household spend per week on non-grocery food, e.g. take-out, restaurants?**

- Less than \$50
- \$50 - \$99
- \$100 - \$149
- \$150 - \$199
- \$200 - \$249
- \$250 - \$299
- More than \$300

**12. How do you currently dispose of food waste in your home? (check all that apply)**

- Backyard composter
- Feed domestic or wild animals
- Garburator
- Garbage
- Township Green Can program
- Private contractor collects food scraps
- Other (please specify): \_\_\_\_\_

**13. Do you currently have access to a program for separating your food scraps from the garbage? (check all that apply)**

- No, I do not have access to a program
- Yes, a backyard composter
- Yes, the Township Green Can program
- Yes, a private contractor collects food scraps
- Yes, I have another method (please specify): \_\_\_\_\_
- Don't know/not sure

Use this space to provide comments about questions 12 and 13 above.

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14. The average Canadian wastes 154 kg (340 lbs) of food each year.  
Compared to this average, do you believe the members of your household waste:
- Significantly less food than the average
  - Somewhat less food than the average
  - The same amount
  - Somewhat more food than the average
  - Significantly more food than the average
  - Not sure
15. When comparing your household's food waste to that of your neighbours, do you believe your household wastes:
- Significantly less food than your neighbours
  - Somewhat less food than your neighbours
  - The same amount
  - Somewhat more food than your neighbours
  - Significantly more food than your neighbours
  - Not sure

For each of the following questions, indicate what best describes your household's typical habits.

16. When I grocery shop, I shop with a list:  
 Never       Rarely       Sometimes       Often       Always
17. Before I grocery shop, I take inventory of what I already have in the house:  
 Never       Rarely       Sometimes       Often       Always
18. Before I grocery shop, I plan the meals that will be made that week:  
 Never       Rarely       Sometimes       Often       Always
19. I shop at big box grocery stores:  
 Never       Rarely       Sometimes       Often       Always
20. I buy bulk and multi-packs of food items:  
 Never       Rarely       Sometimes       Often       Always
21. When I see food items on sale, I buy more than I would otherwise:  
 Never       Rarely       Sometimes       Often       Always
22. On an average week, my household eats dinner at home:  
 Never       Rarely       Sometimes       Often       Always



**23. My household cooks meals from scratch (combining 3 or more ingredients):**

- Never       Rarely       Sometimes       Often       Always  
0 times/week      1-2 times/week      3-4 times/week      5-6 times/week      7 times/week

**24. I get take-out or go to restaurants when there is food that I intended to cook at home:**

- Never       Rarely       Sometimes       Often       Always

**25. When there are leftovers, my household eats them:**

- Never       Rarely       Sometimes       Often       Always

**26. I feel bothered when I waste food:**

- Never       Rarely       Sometimes       Often       Always

**27. If you feel bothered when you waste food, what is the main reason?**

(check the most important reason)

- I do not feel bothered  
 Environmental Implications  
 Social Implications (e.g. some people may not have enough food)  
 Wasted money  
 Other (please specify):

---

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**28. What could your household do to decrease your food waste? (check up to 2)**

- Plan meals in advance  
 Buy less food  
 Buy fewer bulk items  
 Better preserve food (e.g. use the freezer more often)  
 Take a better inventory of household food before shopping  
 Eat at home more often  
 Eat out more often  
 Make an effort to eat leftovers  
 Other Ideas (please specify):

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**29. State how long you have lived in Canada:**

- I was born in Canada
- I immigrated to Canada within the past 5 years
- I immigrated to Canada between 5 and 10 years ago
- I immigrated to Canada more than 10 years ago

**30. State your education level:**

- Less than high school diploma
- High school diploma
- Some college or trades school
- College or trades school degree
- Some university
- Undergraduate university degree
- Higher than an undergraduate degree
- Prefer not to say

**31. What is your approximate combined pre-tax household income?**

- \$0 - \$19,999
- \$20,000 - \$49,999
- \$50,000 - \$79,999
- \$80,000 - \$119,999
- \$120,000 - \$159,999
- \$160,000 and above
- Prefer not to say

Thank you for your participation!

Please return the survey to us in the postage-paid envelope provided. If you would like to be entered in the draw to win a \$200 grocery gift card\*, please complete and return the draw card along with your survey.

\*Donated by Sierra Waste Service Ltd.

Krista Daniszewski  
Solid Waste Coordinator  
Engineering Division, Township of Langley  
kdaniszewski@tol.ca  
604.533.6090 ext 2208



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RN015-110

Engineering Division | 20338 – 65 Avenue, Langley, BC V2Y 3J1 | t. 604.532.7300 | f. 604.532.7310 | opsinfo@tol.ca | tol.ca

## **Appendix H: Frequently Asked Questions**

### **FOOD WASTE DIARY: FREQUENTLY ASKED QUESTIONS**

#### **What counts as “food waste” for this study?**

All food is included. Cooked and uncooked food, beverages, sauces, and even food scraps (i.e. vegetable and fruit peelings, eggshells, rinds, meat bones, fish skin etc.) Please also include coffee grinds and tea bags. Other compostable material such as soiled paper (i.e. paper towel) and yard trimmings are not included in the study.

#### **How should I record beverages, liquids, and sauces?**

When possible, please keep all beverages, liquids, and sauces in their original containers and place the entire container in either the food waste bin or the blue box provided. Please also record this in your diary.

#### **Should I include food that I throw away at work or outside my house in my food diary?**

Yes, please document all food that you throw out over the 7 day study period in your food waste diary, even food that is thrown away outside the home.

#### **Do I need to bring food waste from work or outside the house back home to throw away in my food waste bucket?**

No, only household food waste needs to be disposed of in your food waste bin. Please record any food thrown away outside the home in your diary.

#### **What happens if my food waste bin becomes full before the 7 days are over?**

Change the bag out of the food waste container and replace with the extra bag provided. Staff will collect all food waste at the end of the 7 days.

#### **What do I do when the 7 day study is over?**

Please complete the survey provided and stop separating your food waste into the provided bin. Staff will arrange for a follow up meeting to collect the food waste, diary, and survey.

#### **Can I keep the food waste bin from the study?**

Yes you are welcome to keep the bin if you wish. When staff visit to collect the food waste, they can take the bag and leave you with the bin.

## Appendix I: Waste Assessment Data Sheet (Example)

### Food Waste Audit

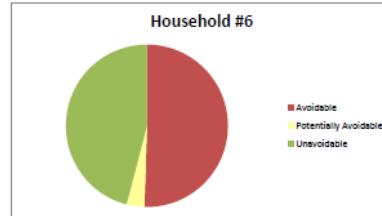
Date: April 24

Household #: 6

Auditor Name(s): Krista and Tanya

Food Type Category	Avoidable (e.g. bread slice)		Potentially Avoidable (e.g. apple peelings)		Unavoidable (corn cob)	
	Weight (KG)	Comments	Weight (KG)	Comments	Weight (KG)	Comments
Fruit and Veg (fresh)	0.415	parsley, raspberries, tomato, spinach	0.101	apple peel, potato peel	0.412	onion skin, banana peel, yam peel, apple core
Fruit and Veg (cooked)	0.208	yam casserole				
Grains (uncooked)						
Grains (cooked)	0.199	bread, bun				
Dairy (uncooked)						
Dairy (cooked)						
Meat, fish, eggs (raw)						
Meat, fish, eggs (cooked)	0.613	chicken, hot dog			0.184	egg shells, chicken bones
Non-dairy drinks, sauces						
Coffee grinds, tea bags					0.709	tea, coffee
Misc/Fines						
Total:	1.435		Total:	0.101	Total:	1.305

Avoidable	1.435
Potentially Avoidable	0.101
Unavoidable	1.305
Total Weight (KG)	2.841
Total Weight (lbs)	6.26332542



## Appendix J: Food Waste Assessment Photos



Technical Assistant Tanya Drouillard Sorting



Scale



Avoidable Grains



Avoidable Meat



Unavoidable Fruit and Vegetables



Liquid Waste (cereal and milk)

## Appendix K: Statistical Tables

**Table K1.** Perceived Food Waste by Age

Table of q14_2cat by Q1s						
q14_2cat	Q1s(Age)					
Frequency	26-35	36-45	46-55	56-65	>66	Total
Row Pct						
Col Pct						
<b>More Food Waste</b>	6 10.17 60.00	19 32.20 76.00	10 16.95 50.00	15 25.42 41.67	9 15.25 23.68	59
<b>Less Food Waste</b>	4 5.71 40.00	6 8.57 24.00	10 14.29 50.00	21 30.00 58.33	29 41.43 76.32	70
<b>Total</b>	10	25	20	36	38	129
<b>Frequency Missing = 2</b>						

Statistic	DF	Value	Prob
Chi-Square		17.8783	0.0013
Likelihood Ratio Chi-Square		18.6475	0.0009
Mantel-Haenszel Chi-Square		15.0328	0.0001
Phi Coefficient		0.3723	
Contingency Coefficient		0.3489	
Cramer's V		0.3723	

**Table K2. Perceived Food Waste by Children Under 18 in Household**

Table of q14_2cat by Q6s						
q14_2cat	Q6s(Number < 18)					
Frequency	0	1	2	3	4+	Total
Row Pct						
Col Pct						
<b>More Food Waste</b>	33 55.00 35.11	9 15.00 75.00	16 26.67 76.19	1 1.67 50.00	1 1.67 50.00	60
<b>Less Food Waste</b>	61 85.92 64.89	3 4.23 25.00	5 7.04 23.81	1 1.41 50.00	1 1.41 50.00	71
<b>Total</b>	94	12	21	2	2	131

Statistic	DF	Value	Prob
Chi-Square	4	16.2935	0.0026
Likelihood Ratio Chi-Square	4	16.7426	0.0022
Mantel-Haenszel Chi-Square	1	10.2590	0.0014
Phi Coefficient		0.3527	
Contingency Coefficient		0.3326	
Cramer's V		0.3527	
<b>WARNING: 40% of the cells have expected counts less than 5. Chi-Square may not be a valid test.</b>			

Fisher's Exact Test	
Table Probability (P)	<.0001
Pr <= P	0.0005

**Table K3. Perceived Food Waste by Number of People per Household**

Table of q14_2cat by Q5s								
q14_2cat	Q5s(People/Household)							
Frequency	1	2	3	4	5	6	>8	Total
More Food Waste	5 8.33 26.32	21 35.00 35.59	12 20.00 60.00	17 28.33 68.00	2 3.33 50.00	2 3.33 66.67	1 1.67 100.00	60
Less Food Waste	14 19.72 73.68	38 53.52 64.41	8 11.27 40.00	8 11.27 32.00	2 2.82 50.00	1 1.41 33.33	0 0.00 0.00	71
Total	19	59	20	25	4	3	1	131

Statistic	DF	Value	Prob
Chi-Square	6	13.7078	0.0331
Likelihood Ratio Chi-Square	6	14.3280	0.0262
Mantel-Haenszel Chi-Square	1	10.9309	0.0009
Phi Coefficient		0.3235	
Contingency Coefficient		0.3078	
Cramer's V		0.3235	
WARNING: 43% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

Fisher's Exact Test	
Table Probability (P)	<.0001
Pr <= P	0.0166

**Table K4. Perceived Food Waste by Number of Disposal Methods Used**

Table of q14_2cat by Q7_a						
q14_2cat	Q7_a(Decision)					
Frequency Row Pct Col Pct	1 chosen	2 chosen	3 chosen	4 chosen	5 chosen	Total
<b>More Food Waste</b>	9	6	14	13	18	60
	15.00	10.00	23.33	21.67	30.00	
	31.03	30.00	50.00	50.00	69.23	
<b>Less Food Waste</b>	20	14	14	13	8	69
	28.99	20.29	20.29	18.84	11.59	
	68.97	70.00	50.00	50.00	30.77	
<b>Total</b>	29	20	28	26	26	129
<b>Frequency Missing = 2</b>						

Statistic	DF	Value	Prob
Chi-Square	4	10.6425	0.0309
Likelihood Ratio Chi-Square	4	10.8887	0.0278
Mantel-Haenszel Chi-Square	1	9.3713	0.0022
Phi Coefficient		0.2872	
Contingency Coefficient		0.2761	
Cramer's V		0.2872	

**Table K5. Perceived Food Waste by Grocery Shopping Frequency**

Table of q14_2cat by Q8s						
q14_2cat	Q8s(Shop frequency)					
Frequency	< 1/week	1/week	2X/week	3X/week	4 or more X/week	Total
Row Pct						
Col Pct						
<b>More Food Waste</b>	1 1.67 10.00	21 35.00 43.75	21 35.00 44.68	12 20.00 60.00	5 8.33 83.33	60
<b>Less Food Waste</b>	9 12.68 90.00	27 38.03 56.25	26 36.62 55.32	8 11.27 40.00	1 1.41 16.67	71
<b>Total</b>	10	48	47	20	6	131

Statistic	DF	Value	Prob
Chi-Square	4	10.2975	0.0357
Likelihood Ratio Chi-Square	4	11.4379	0.0221
Mantel-Haenszel Chi-Square	1	7.8539	0.0051
Phi Coefficient		0.2804	
Contingency Coefficient		0.2700	
Cramer's V		0.2804	
<b>WARNING: 30% of the cells have expected counts less than 5. Chi-Square may not be a valid test.</b>			

Fisher's Exact Test	
Table Probability (P)	<.0001
Pr <= P	0.0331

**Table K6. Perceived Food Waste by Dollars Spent on Groceries per Week**

Table of q14_2cat by Q9s								
q14_2cat	Q9s(Dollars on groceries)							
Frequency							More than \$300	
Row Pct	<\$50	\$50 - \$99	\$100 - \$149	\$150 - \$199	\$200 - \$249	\$250 - \$299	More than \$300	Total
Col Pct								
<b>More Food Waste</b>	0 0.00 0.00	9 15.25 26.47	17 28.81 42.50	17 28.81 65.38	7 11.86 63.64	2 3.39 40.00	7 11.86 77.78	59
<b>Less Food Waste</b>	5 7.04 100.0 0	25 35.21 73.53	23 32.39 57.50	9 12.68 34.62	4 5.63 36.36	3 4.23 60.00	2 2.82 22.22	71
<b>Total</b>	5	34	40	26	11	5	9	130
<b>Frequency Missing = 1</b>								

Statistic	DF	Value	Prob
Chi-Square	6	18.7389	0.0046
Likelihood Ratio Chi-Square	6	21.0348	0.0018
Mantel-Haenszel Chi-Square	1	13.3115	0.0003
Phi Coefficient		0.3797	
Contingency Coefficient		0.3549	
Cramer's V		0.3797	
<b>WARNING: 50% of the cells have expected counts less than 5. Chi-Square may not be a valid test.</b>			

Fisher's Exact Test	
Table Probability (P)	<.0001
Pr <= P	0.0031

**Table K7. Perceived Food Waste by Frequency of Grocery Shopping with a List**

Table of q14_2cat by q16_cat				
q14_2cat	q16_cat			
Frequency Row Pct Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	39 65.00 39.80	6 10.00 60.00	15 25.00 65.22	60
<b>Less Food Waste</b>	59 83.10 60.20	4 5.63 40.00	8 11.27 34.78	71
<b>Total</b>	98	10	23	131

Statistic	DF	Value	Prob
Chi-Square	2	5.7288	0.0570
Likelihood Ratio Chi-Square	2	5.7530	0.0563
Mantel-Haenszel Chi-Square	1	5.4872	0.0192
Phi Coefficient		0.2091	
Contingency Coefficient		0.2047	
Cramer's V		0.2091	

**Table K8. Perceived Food Waste by Frequency of Taking Household Food Inventory Before Shopping**

Table of q14_2cat by q17_cat				
q14_2cat	q17_cat			
Frequency				
Row Pct				
Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	39 65.00 41.94	2 3.33 40.00	19 31.67 57.58	60
<b>Less Food Waste</b>	54 76.06 58.06	3 4.23 60.00	14 19.72 42.42	71
<b>Total</b>	93	5	33	131

Statistic	DF	Value	Prob
Chi-Square	2	2.4707	0.2907
Likelihood Ratio Chi-Square	2	2.4671	0.2913
Mantel-Haenszel Chi-Square	1	2.2709	0.1318
Phi Coefficient		0.1373	
Contingency Coefficient		0.1361	
Cramer's V		0.1373	
WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

Fisher's Exact Test	
Table Probability (P)	0.0168
Pr <= P	0.2821

**Table K9. Perceived Food Waste by Frequency of Planning Weekly Meals Before Shopping**

Table of q14_2cat by q18_cat				
q14_2cat	q18_cat			
Frequency	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	21	17	21	59
	35.59	28.81	35.59	
	38.89	68.00	42.00	
<b>Less Food Waste</b>	33	8	29	70
	47.14	11.43	41.43	
	61.11	32.00	58.00	
<b>Total</b>	54	25	50	129

Statistic	DF	Value	Prob
Chi-Square	2	6.2945	0.0430
Likelihood Ratio Chi-Square	2	6.3493	0.0418
Mantel-Haenszel Chi-Square	1	0.1288	0.7197
Phi Coefficient		0.2209	
Contingency Coefficient		0.2157	
Cramer's V		0.2209	

Fisher's Exact Test	
Table Probability (P)	0.0013
Pr <= P	0.0491

**Table K10. Perceived Food Waste by Frequency of Shopping at Box/Bulk Stores**

Table of q14_2cat by q19_cat				
q14_2cat	q19_cat			
Frequency Row Pct Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	37 62.71 48.68	4 6.78 28.57	18 30.51 45.00	59
<b>Less Food Waste</b>	39 54.93 51.32	10 14.08 71.43	22 30.99 55.00	71
<b>Total</b>	76	14	40	130

Statistic	DF	Value	Prob
Chi-Square	2	1.9328	0.3804
Likelihood Ratio Chi-Square	2	2.0006	0.3678
Mantel-Haenszel Chi-Square	1	0.2675	0.6050
Phi Coefficient		0.1219	
Contingency Coefficient		0.1210	
Cramer's V		0.1219	

Fisher's Exact Test	
Table Probability (P)	0.0139
Pr <= P	0.4045

**Table K11. Perceived Food Waste by Frequency of Buying Bulk/Multipack Groceries**

Table of q14_2cat by q20_cat				
q14_2cat	q20_cat			
Frequency Row Pct Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	18	13	29	60
	30.00	21.67	48.33	
	41.86	39.39	53.70	
<b>Less Food Waste</b>	25	20	25	70
	35.71	28.57	35.71	
	58.14	60.61	46.30	
<b>Total</b>	43	33	54	130

Statistic	DF	Value	Prob
Chi-Square	2	2.1643	0.3389
Likelihood Ratio Chi-Square	2	2.1674	0.3383
Mantel-Haenszel Chi-Square	1	1.4581	0.2272
Phi Coefficient		0.1290	
Contingency Coefficient		0.1280	
Cramer's V		0.1290	

Fisher's Exact Test	
Table Probability (P)	0.0090
Pr <= P	0.3717

**Table K12. Perceived Food Waste by Frequency of Buying More Food Items When on Sale**

Table of q14_2cat by q21_cat				
q14_2cat	q21_cat			
Frequency Row Pct Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	19 31.67 47.50	12 20.00 44.44	29 48.33 45.31	60
<b>Less Food Waste</b>	21 29.58 52.50	15 21.13 55.56	35 49.30 54.69	71
<b>Total</b>	40	27	64	131

Statistic	DF	Value	Prob
Chi-Square	2	0.0727	0.9643
Likelihood Ratio Chi-Square	2	0.0726	0.9643
Mantel-Haenszel Chi-Square	1	0.0395	0.8424
Phi Coefficient		0.0236	
Contingency Coefficient		0.0235	
Cramer's V		0.0236	

Fisher's Exact Test	
Table Probability (P)	0.0265
Pr <= P	0.9733

**Table K13. Perceived Food Waste by Frequency of Eating Dinner at Home**

Table of q14_2cat by q22_cat				
q14_2cat	q22_cat			
Frequency Row Pct Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	58 96.67 46.40	0 0.00 0.00	2 3.33 40.00	60
<b>Less Food Waste</b>	67 94.37 53.60	1 1.41 100.00	3 4.23 60.00	71
<b>Total</b>	125	1	5	131

Statistic	DF	Value	Prob
Chi-Square	2	0.9309	0.6279
Likelihood Ratio Chi-Square	2	1.3115	0.5191
Mantel-Haenszel Chi-Square	1	0.2146	0.6432
Phi Coefficient		0.0843	
Contingency Coefficient		0.0840	
Cramer's V		0.0843	
WARNING: 67% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

Fisher's Exact Test	
Table Probability (P)	0.1835
Pr <= P	1.0000

**Table K14. Perceived Food Waste by Frequency of Cooking From Scratch  
(combining 3 or more items)**

Table of q14_2cat by q23_cat				
q14_2cat	q23_cat			
Frequency				
Row Pct				
Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	43 72.88 42.57	1 1.69 50.00	15 25.42 57.69	59
<b>Less Food Waste</b>	58 82.86 57.43	1 1.43 50.00	11 15.71 42.31	70
<b>Total</b>	101	2	26	129

Statistic	DF	Value	Prob
Chi-Square	2	1.9191	0.3831
Likelihood Ratio Chi-Square	2	1.9147	0.3839
Mantel-Haenszel Chi-Square	1	1.9042	0.1676
Phi Coefficient		0.1220	
Contingency Coefficient		0.1211	
Cramer's V		0.1220	
<b>WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.</b>			

Fisher's Exact Test	
Table Probability (P)	0.0343
Pr <= P	0.3451

**Table K15. Perceived Food Waste by Frequency of Going to Restaurants/Take Out When Food At Home**

Table of q14_2cat by q24_cat				
q14_2cat	q24_cat			
Frequency	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	0	37	22	59
	0.00	62.71	37.29	
	0.00	40.22	66.67	
<b>Less Food Waste</b>	5	55	11	71
	7.04	77.46	15.49	
	100.00	59.78	33.33	
<b>Total</b>	5	92	33	130

Statistic	DF	Value	Prob
Chi-Square	2	11.1759	0.0037
Likelihood Ratio Chi-Square	2	13.1045	0.0014
Mantel-Haenszel Chi-Square	1	10.8128	0.0010
Phi Coefficient		0.2932	
Contingency Coefficient		0.2814	
Cramer's V		0.2932	
WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

Fisher's Exact Test	
Table Probability (P)	0.0003
Pr <= P	0.0026

**Table K16. Perceived Food Waste by Frequency of Eating Leftovers**

Table of q14_2cat by q25_cat				
q14_2cat	q25_cat			
Frequency Row Pct Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	52 86.67 43.33	1 1.67 100.00	7 11.67 70.00	60
<b>Less Food Waste</b>	68 95.77 56.67	0 0.00 0.00	3 4.23 30.00	71
<b>Total</b>	120	1	10	131

Statistic	DF	Value	Prob
Chi-Square	2	3.8367	0.1468
Likelihood Ratio Chi-Square	2	4.2469	0.1196
Mantel-Haenszel Chi-Square	1	3.0766	0.0794
Phi Coefficient		0.1711	
Contingency Coefficient		0.1687	
Cramer's V		0.1711	
<b>WARNING: 50% of the cells have expected counts less than 5. Chi-Square may not be a valid test.</b>			

Fisher's Exact Test	
Table Probability (P)	0.0335
Pr <= P	0.1079

**Table K17. Perceived Food Waste by Frequency of Feeling Bothered When Wasting Food**

Table of q14_2cat by q26_cat				
q14_2cat	q26_cat			
Frequency				
Row Pct				
Col Pct	Frequently	Infrequently	Sometimes	Total
<b>More Food Waste</b>	48 80.00 43.24	0 0.00 0.00	12 20.00 66.67	60
<b>Less Food Waste</b>	63 88.73 56.76	2 2.82 100.00	6 8.45 33.33	71
<b>Total</b>	111	2	18	131

Statistic	DF	Value	Prob
Chi-Square	2	5.1396	0.0766
Likelihood Ratio Chi-Square	2	5.9199	0.0518
Mantel-Haenszel Chi-Square	1	2.7613	0.0966
Phi Coefficient		0.1981	
Contingency Coefficient		0.1943	
Cramer's V		0.1981	
WARNING: 33% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

Fisher's Exact Test	
Table Probability (P)	0.0111
Pr <= P	0.0580

**Table K18. Disposal Method (Composters vs. Non-composters) by Frequency of Feeling Bothered When Wasting Food**

Table of Disposal_method by Bothered						
Disposal_method	Bothered					
Frequency	Never	Rarely	Sometimes	Often	Always	Total
Row Pct						
Col Pct						
<b>Composters</b>	2 1.94 100.00	1 0.97 100.00	13 12.62 65.00	32 31.07 78.05	55 53.40 73.33	103
<b>Non-composters</b>	0 0.00 0.00	0 0.00 0.00	7 19.44 35.00	9 25.00 21.95	20 55.56 26.67	36
<b>Total</b>	2	1	20	41	75	139
<b>Frequency Missing = 2</b>						

Statistic	DF	Value	Prob
Chi-Square	4	2.2677	0.6867
Likelihood Ratio Chi-Square	4	2.9753	0.5620
Mantel-Haenszel Chi-Square	1	0.0350	0.8516
Phi Coefficient		0.1277	
Contingency Coefficient		0.1267	
Cramer's V		0.1277	
<b>WARNING: 40% of the cells have expected counts less than 5. Chi-Square may not be a valid test.</b>			

Fisher's Exact Test	
Table Probability (P)	0.0084
Pr <= P	0.7407

**Table K19. Disposal Method (Composters vs Non-composters) by Perceived Food Waste**

Table of Q12s by q14_2cat			
Q12s	q14_2cat(Versus average)		
Frequency	Less Food Waste	More Food Waste	Total
Row Pct			
Col Pct			
<b>Composters</b>	52 53.61 73.24	45 46.39 76.27	97
<b>Non-composters</b>	19 57.58 26.76	14 42.42 23.73	33
<b>Total</b>	71	59	130
<b>Frequency Missing = 1</b>			

Statistic	DF	Value	Prob
Chi-Square	1	0.1564	0.6925
Likelihood Ratio Chi-Square	1	0.1568	0.6921
Continuity Adj. Chi-Square	1	0.0373	0.8469
Mantel-Haenszel Chi-Square	1	0.1552	0.6936
Phi Coefficient		-0.0347	
Contingency Coefficient		0.0347	
Cramer's V		-0.0347	

Fisher's Exact Test	
Cell (1,1) Frequency (F)	52
Left-sided Pr <= F	0.4248
Right-sided Pr >= F	0.7241
Table Probability (P)	0.1489
Two-sided Pr <= P	0.8399

**Table K20. T-Test (Mean Comparison) of Perceived Food Waste and Actual Food Waste**

Q14_2cat	N	Mean	Std Dev	Std Err	Minimum	Maximum
More Food Waste	6	0.6453	0.1874	0.0765	0.3755	0.9303
Less Food Waste	7	0.2913	0.1543	0.0583	0.0770	0.4625
Diff (1-2)		0.3540	0.1702	0.0947		

Q14_2cat	Method	Mean	95% CL Mean	Std Dev	95% CL Std Dev		
More Food Waste		0.6453	0.4486	0.8420	0.1874	0.1170	0.4597
Less Food Waste		0.2913	0.1486	0.4340	0.1543	0.0994	0.3398
Diff (1-2)	Pooled	0.3540	0.1456	0.5624	0.1702	0.1205	0.2889
Diff (1-2)	Satterthwaite	0.3540	0.1389	0.5691			

Method	Variances	DF	t Value	Pr >  t
Pooled	Equal	11	3.74	0.0033
Satterthwaite	Unequal	9.7539	3.68	0.0044

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	5	6	1.48	0.6443