The Role of the Environment in Mental Health Promotion: Investigating Mental Well-Being in the Credit River Watershed

Alexandra Elizabeth Belaskie

Supervisor: Dr. Martin Bunch

10 April 2015

A Major Paper submitted to the Faculty of Environmental Studies in partial fulfillment of the requirements for the degree of Master in Environmental Studies

York University

Toronto, Ontario, Canada

Student Signature: _____ Supervisor Signature: _____

Abstract

As more and more individuals are moving to and living in cities, the mental health burden of illness is rising, having individual, social and economic ramifications across the entire population (Srivastava, 2009). This raises the question of how to prevent, mitigate or reduce the effects of urban stress on individuals living in cities as the population continues to rise.

This question was approached within the context the Credit River Watershed. 107 household surveys were administered in two contrasting urban neighbourhoods to discern the habits of respondents with regards to attending different types of natural spaces, and how relaxing those spaces are. These responses showed that overall, respondents found blue space, i.e. being near water features like rivers, ponds, and lakes, to be the most relaxing of all types of space, followed by looking out of windows at natural spaces, and private green space.

Factor analysis was conducted on the responses of how relaxing different natural spaces are. This revealed four different factors within the data, which have been named “Self-Reported State of Mental Well-being,” “Wilderness and Personal Spaces,” “Designed Spaces,” and “Relaxing Activities.” These factors, excluding the “Self-Reported State of Mental Well-being” factor, were used in designing an Environmental Index of Mental Well-being (EIMWB), which could be used as a way of monitoring the impact of environmental management on mental well-being over time.

The information from EIMWB monitoring and other data about the effects of natural spaces on mental well-being could be used together within the context of mental health promotion. Due to the more subjective nature of data connecting mental health with the environment, mental health promotion has not been embraced fully by public health agencies, where most health promotion strategies are positioned. Assuming that the requirement for hard scientific data will not be changed, alternative

venues within which to place mental health promotion should be considered. This paper thus concludes that environmental management and design within urban areas can provide a setting for environmentally-based mental health promotion.

For my family, Nanuk, and
all stewards of the land

There is pleasure in the pathless woods,
There is rapture in the lonely shore
There is society, where none intrudes
By the deep sea, and music in its roar;
I love not Man the less, but Nature more.
From these our interviews, in which I steal
From all I may be, or have been before,
To mingle with the Universe, and feel
What I can ne'er express, yet cannot conceal
-Lord Byron

One touch of nature makes the whole world kin
-William Shakespeare

There is new life in the soil for every man.
There is healing in the trees for tired minds
and for our overburdened spirits,
there is strength in the hills, if only we will lift up our eyes.
Remember that nature is your great restorer.
-Calvin Coolidge

Acknowledgements

I would like to extend my deepest thanks to everyone who has contributed to my life and my education over the past few years. First and foremost, I would like to thank my family, who has been at my side throughout my life, encouraging me to follow my passions… ones which led me to the MES door. I want to thank my momma and dad, who have been great inspirations to me. You both have encouraged me to keep my head up and keep truckin' throughout my degree, because you believe I am capable of anything I put my mind to. Dad, I want to thank you for always reminding me that the beer always tastes better with friends at the end of a good day's work. Momma, I want to thank you for all of the coffee and crochet moments we've shared over the past year. I want to thank my brother, JJ, for being such an inspiration, for knowing how to keep me grounded when I get derpy and for being an amazing support. I love you all so much!

I would like to give a huge thank you to my advisor, turned supervisor, turned mentor, Dr. Martin Bunch. The first time I met him, I sat in his office spewing how I wanted to study everything around health, culture and the environment but had no idea of how to connect all of my ideas together. He recognized a bit of his own crazy systems thinking mind in me and steered me in the direction of ecohealth, which I am forever thankful. You've provided me with so many different opportunities, from joining your project team to working with CoPEH-Can, and I can't even begin to express how invaluable those experiences have been. Your faith in me as your student has been extraordinary and helped to encourage me to pursue avenues I would not have previously felt comfortable doing. I am so happy that I was able to meet and work with you because you've made this whole master's experience phenomenal.

Next, I would like to thank Julie Mallette. Out of the many hours we've spent together commuting, sharing croissants, going on adventures and just plain chatting, you've become not only a fantastic research partner, but an extraordinary friend. Through it all, you have been able to reign in my crazy at the right moments and let it free at others. I am so happy you decided to join the research project and that we so quickly became a part of each other's lives. I could not imagine having to have gone through the past few years without you!

I would like to thank Dr. Karen Morrison, Mike Puddister (CVC) and Tatiana Koveshnikova (Credit Valley Conservation), who graciously adopted me into the project team near the beginning, and have helped to guide and mentor me throughout the time we've worked together. Karen, I would like to thank you for your encouragement over the past few years, and for the opportunities you have facilitated in providing me. Mike and Tatiana, I thank you in particular for inviting me to work at CVC and learn more about how conservation authorities work.

I would like to thank Iftekhar Ahmad and Mitch Harrow for being amazing people and still liking me even though I took away all your evenings and weekends to survey in the snow and cold. I thank you for your persistence and dedication to the project, as it really helped to make it so much more fun. Iftekhar, you have taught me to be more patient and to speak with intention. Mitch, you have taught me how to come out of my shell, to laugh and share with others. I have learned so much from both of you over the past year.

I would like to thank former alumni of the Ecohealth training course in Canada, who together have formed the GTA boundless group. This group includes: Esther Tong, Chris Buse, Rachel Hirsch, Lesley Johnston, Matthew Faegan, Ben Brisbois Marta Berbes-Blazquez, Kaleigh McKellar and Liwei Philip Chen. All of you have provided me with such great inspiration and motivation to create space for myself as a creative young researcher and activist in this world. It has been a truly empowering experience to be a part of this group, and I look forward to continuing to grow together with you.

I would like to thank the members of the Community of Practice in Ecosystem Approaches to Health, specifically Dr. Margot Parkes, Johanne Saint-Charles, Céline Surette, Dr. Martin Bunch, Dr. Karen Morrison and Jenna Webb, who gave me the opportunity to help organize, develop content for and teach at the 2014 Ecohealth course. Working with all of you has been an exceptional experience, for which I am forever thankful.

I would like to thank Eric Miller and Dr. Peter Victor for introducing me to and challenging me to think about ecological economics and how health and well-being can fit into it. You both have also encouraged me to become a part of the Canadian Society for Ecological Economics, which has been an amazingly enriching experience. In that light, I would like to thank Andreas Link (president of CANSEE 2014/5) and the rest of the CANSEE executive team who have taken me under their wing to learn more about ecological economics and spread the great word.

I would like to thank all of the other teachers who have taught me throughout my MES, including Dr. Paul Wilkinson, Dr. Ray Rogers and Graham Mitchell. All of you have inspired me to become a better, more well-rounded individual and scholar, and for that I am thankful. In addition, I would like to thank York University for giving me the opportunity to continue my education.

I would like to thank my friends for being crazy and supportive people over the last few years. You all have encouraged me to pursue my dreams both at school, and outside of it. I am thankful to my close friends who have really been there for me throughout all the good and not so good times these past couple years, particularly Allison Jackson, Laura Maessen, Rebecca Haigh, Natalia Kaplan, Thomas Blaine, Daniel Cadieux and Ionatan Waisgluss.

I would also like to thank my southern mommas (Mrs. Peggy Erdos and Mrs. Lynne Youngblood) and my northern mommas (Vicki Bradfield, Carolyn Bradley, Anna Belaskie, Shirley Belaskie, Lisa Bradley, Peggy Hayden and Judy Mulvihill) for being strong, spicy and friendly as all get out. I also want to thank my mommas past (grandma Carol Bradley and great-grandma Rosamond Hayden), who have been great inspirations to me. You all have played an integral part in making me the woman I am today, and I am forever thankful for your love.

I want to also thank my male mentors who have been great role models, including Elbert Belaskie, Matthew Bradley, Chris Bradley, Dave Bradley, Ron Belaskie, Tom Erdos and my late grandfather, Stanley Belaskie. All of you have shown incredible drive and persistence in following and never giving up. You all have truly inspired me and encouraged me to relentlessly follow my dreams.

I am also thankful to those people who have encouraged me to be my whole self over the past year. I am thankful to the little old ladies I spend my Tuesday evenings with, singing song after song. All of you, particularly Una Jevtic, bring music and laughter into my heart and into my bones, and I am so thankful. I am thankful to the team of people I was able to meet and work with on the farm this year, specifically Mélisanne Loiselle-Gascon and Haley Anderson, who have helped me to become a better steward of the earth and realize how important it is for me to slow down, breathe and grow. All of you have humbled me and helped me to realize what is most important in life- and that is the people and the world you get to spend it in. Thank you.

All in all, the past few years have been a truly marvelous and at times, chaotic. In this time, I have been profoundly changed by my experiences, both academic and otherwise. I am eternally grateful to everyone in my life who has provided me with numerous opportunities, encouraged me, let me cry on their shoulder, laughed with me and provided guidance and mentorship along the way. Without all of you, this experience would have been so different, and I honestly wouldn't change a thing.

Lots of love,

Alexandra

Table of Contents

List of Tables

List of Figures

Foreword

My plan of study's area of concentration is "The Environmental and Economic Management of Well-Being in Conservation." Throughout my degree, I wanted to build upon my scientific and anthropological knowledge of the environment, culture and health, by focussing on learning more about politics, management and ecological economics. When combined with my undergraduate education, this information has provided me with the ability to address problems within complex socio-ecological systems.

Early in my degree, my supervisor Dr. Bunch introduced me to the ecohealth approach, which is an approach to addressing these complex socio-ecological systems. I quickly became fascinated with the approach and the field, which has harnessed many different opportunities for me throughout my degree, including attending a field school at the University of Northern British Columbia in 2013, joining a project team focussed on ecohealth that eventually helped me to produce this research, participating in an Emerging Scholars and Practitioners Research Group, present research at conferences, becoming the course coordinator for the 2014 edition of the ecohealth field school and even being able to facilitate some of the sessions within the field school. Dr. Bunch's guidance, and the support of everyone else I have worked with in the field of ecohealth have helped to shape me and my research.

In addition to work outside of school, the coursework I did throughout my degree has also helped to guide me through this research. In investigating where mental well-being promotion could be situated, I researched about the mandates and actions of many different government and near-government authorities working within the study areas, thus enhancing my understanding of how local government works and is organized (component 1.1). In addition, while working with Credit Valley Conservation, I researched the laws surrounding the creation and workings of conservation authorities, to gain a broader understanding of their role as environmental managers (component 1.2).

The overall research project between CVC and York University focuses on communicating the connections between environmental goods and services with human well-being outcomes. Throughout this project, I have researched non-monetary methods of environmental valuation and contributed to the development of ecosystem-based indicators of well-being (component 2.2).

In writing my literature review, I discussed some of the philosophies and epistemologies that underpin transdisciplinary research (component 3.1), and then I applied these ideas and frameworks in developing the methodological design of this research (component 3.2).

Through combining my academic and non-academic pursuits over the past three years, "The Role of the Environment in Health Promotion: Investigating Mental Well-Being in the Credit River Watershed" fits well within my plan of study entitled "The Environmental and Economic Management of Well-Being in Conservation."

Chapter 1: Introduction

1.1 What's the problem?

Mental health and mental illness contribute greatly to Canada's current burden of illness. At present, it is estimated that 1 in 5 Canadians will be affected by mental illness during their lifetime (United Way Peel Region, 2014), the direct costs of which were estimated at $42.3 billion and indirect costs of which were estimated at $6.3 billion as of 2011 (Risk Analytica, 2011).

One major factor contributing to these costs is that of stress. Mental stress can become somaticized, impacting cardiovascular, immune and digestive function, for example (Mayo Clinic, 2013). When occurring over a long period of time, chronic stress can cause more permanent changes to physiology, leaving individuals more susceptible to diseases of civilisation, such as COPD, obesity, diabetes and heart disease (Carlson, 2004). Given these cascading effects, the economic and social burden of mental health issues surpasses the traditional definitions of mental illness.

In addition, when living in an urban environment, personal, social and environmental stresses increase, further increasing an individual's overall mental stress (Peen et al., 2009). This has contributed to more individuals in cities experiencing mood and anxiety disorders (Peen et al., 2009), and individuals who are born and raised in cities having a higher prevalence of schizophrenia (Krabbendam & van Os, 2005; Mortensen, 1999; Pedersen & Mortensen, 2001).

Therefore, mental health and well-being is being significantly affected by living in urban areas. This raises the question of how we as a society can try to improve and promote the mental well-being of urban populations, and do so in an economical way. Given that stress levels have been recorded to be lower when people spend time in nature (Ulrich et al., 1991), and that nature can provide a setting for

restoration (Kaplan, 1995), one potential moment of intervention is through environmental management and design.

1.2 The Approach

Credit Valley Conservation (CVC) is a watershed management organization that oversees the health and management of the environment within the Credit River watershed. One of their primary goals as an organisation is to "promote land uses, development approaches and infrastructure that factor in the importance of the natural environment to society, the economy and the well-being of residents," (CVC, 2014: 23). Although well-being is a primary objective of the organization, CVC realised it did not have a systematic way of monitoring how their management and stewardship actions affected resident well-being (Koveshnikova, 2013).

Mike Puddister and Tatiana Koveshnikova of CVC started to explore the present resident's understandings of how ecosystem services affect well-being in their work entitled "The Importance of Ecosystem Services to Human Well-Being in the Credit River Watershed" (Green Analytics, 2011). This report highlighted the need to develop a comprehensive monitoring system to show how well-being can be affected by ecosystem services and features (Green Analytics, 2011). Thus, the project entitled "Human Well-Being, Ecosystem Services and Watershed Management in the Credit River Valley: Web-Distributed Mechanisms and Indicators for Communication and Awareness" was borne, connecting CVC with faculty and graduate students at York University.

The principal researchers at York University include Dr. Martin Bunch and Dr. Karen Morrison, who both have previously researched the effects of watershed governance on human well-being in various contexts through the lens of ecohealth. Ecohealth, or ecosystem approaches to health, is a research approach that focuses on understanding the complexities of socio-ecological systems and how health acts as an emergent property of the function of these systems (Charron, 2012).

In support of the larger research project, this paper approaches the question of "How do residents of urbanized parts of the Credit River Watershed understand how natural features and settings affect their mental well-being?" By researching this question, I aim to provide information on what kinds of natural features and settings currently provide restorative experiences, and identify the spaces that have yet to realize their restorative potential. In addition, it may be possible to provide some guidance on how to approach environmentally-based mental health promotion in these areas.

1.3 Methodologies

After identifying two comparable study areas within the Credit River Watershed, a 20-minute survey was administered door-to-door by a team of six graduate students. The survey had a total of 33 questions, two of which were specifically related to mental well-being, and 9 post-survey questions, which were about the respondent's residence. The questions on the survey were of multiple forms, including open ended questions, yes or no questions and likert-scale questions. In addition, some of the stories or quotes respondents told that were not related directly to the questions were recorded. The survey data was analysed using a statistical program called "R". Many tests were conducted to identify significant similarities and differences between demographic and residential characteristics, and responses to the survey questions. This information was then used to guide the development of environmental guidelines in the discussion section of this paper.

1.4 Roadmap

Immediately following this chapter, the literature review will provide the necessary theoretical background information to understand the purpose and results of this study (Chapter 2). In Chapters 3 and 4, the reader will be provided with a geographic and political understanding of the areas chosen for the overall research project and this study. Chapter 5 will focus on the methodologies that were utilized throughout the duration of this study, and chapter 6 will present the results. In the discussion and

conclusions of Chapter 7, an in-depth interpretation of the results will occur, linking mental well-being with the natural environment and providing a case for environmentally-based mental health promotion.

Chapter 2: Literature Review

The following chapter will explore the background knowledge required to understand the subsequent research. The concepts of health and well-being will be introduced, with special attention to mental well-being. Previous knowledge about the connections between mental well-being and various environments will be introduced, as will mental health promotion. Lastly, some conceptual frameworks that have supported the thought processes in this research will be presented.

2.1 Health and Well-Being

Health is defined by the WHO (2014) as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Often health is viewed as something that is based on the physiological state of the body. Thus, to encapsulate all things that could affect health, regardless if they are physiological, the term well-being is often used.

2.1.1 Determinants of Health

According to the World Health Organization, determinants of health are, "the conditions in which people are born, grow, live, work and age," (WHO, 2013). A list of some determinants of health can be found in Table 1.

Table 1: Categories and examples of determinants of health (Reading and Wien, 2009)

Category	Determinant of Health	Example
Proximal	Health Behaviours	Personal Health Practices Coping Skills Personal Behaviours Healthy Child Development
	Physical Environments	Indoor Air Quality Working Environments Access and Availability of Potable Water Housing
	Employment	Employed, Underemployed or Unemployed
	Income	Personal/Household Income Level Income Distribution in Society
	Education	Personal Education Level
	Food Security	Access and Availability of inexpensive nutritious foods Proximity to closest food outlet (grocery store, convenience store, or farmers market)
	Personal Characteristics	Gender Culture Race Age Disability Status
Intermediate	Health Care Systems	Access and Availability of Health Services Cultural Differences
	Educational Systems	Availability of secondary and post-secondary education
	Community Infrastructure, Resources and Capacities	Social support networks Social Status Maintenance of community infrastructure Continuation of community cultural identity
Distal	Historical Position	Historical prosecution or discrimination of particular people or communities

These different physical, social and environmental situations can produce different amounts of stress on an individual, family or society. For example, a person can experience acute episodic stress in the case of a sudden financial strain, which results in them having loss of sleep, indigestion and back pain, or a person can experience chronic stress in the case of prolonged food insecurity.

2.2 Mental Well-Being

2.2.1 What is Mental Well-Being?

According to the World Health Organization (WHO), mental health is defined as "a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully and is able to make a contribution to her or his community" (WHO, 2014). Mental health is a component of overall health that has cascading effects over all other parts of health, i.e. physical and social well-being statuses are dependent on the mental well-being status and vice versa. The term mental health often refers to either a *state* of mental health or a *state* of having mental illness. However, mental health is less a category and more a continuum of experiences. Thus, in this paper, the term mental well-being (MWB) will be used, as it is a neutral term that neither indicates the mental illness status of an individual, nor denies the dynamism of that status.

MWB has many different components, including, but not limited to: stress levels, satisfaction with life, concentration, productivity, spirituality, sense of wonder, contribution to community, forming and sustaining relationships motivation, happiness, and the ability to cope. For the purposes of this study, MWB is "related to your productivity, concentration, stress and satisfaction with life."

2.2.1.1 Stress

The physiological definition of "stress" was originally coined by Hans Seyle in 1936, as the "non-specific response of the body to any demand for change" (The American Institute of Stress, 2015). This definition has since become more specific, and is considered to be a "physical, mental or emotional factor that causes bodily or mental tension… [that] can be external (from the environment, physiological or social situations) or internal (illness, or from a medical procedure)" (MedicineNet Inc., 2014). Stress can be considered an emotive state as well as a physiological one, which makes it a difficult term to define and a difficult concept to measure.

To enter into a state of stress, the body or mind must interact with a stressor. There are five different categories of stressor, including: acute time-limited stressors, brief naturalistic stressors, stressful event sequences, chronic stressors and distant stressors, each of which operate over two dimensions- duration and course (Segerstrom & Miller, 2004). A brief description of these different types of stressor can be found in Table 2.

Table 2: A list of different types of stressor, adapted from Segerstrom and Miller (2004)

Type of Stressor	Duration	Course	Example of Stressor
Time-Limited Stressor	Short- unexpected stress; have an end	Lab-based challenges	Public Speaking
Brief Naturalistic Stressor	Short- expected stress; have an end	Dealing with a real-life, short-term challenge	Writing academic exams
Stressful Event Sequences	Long period of time, isolated event; have an end	Sequence of stressors acting in succession	Loss of Spouse Major Natural Disaster
Chronic Stressors	Long period of time, not isolated event; may not end	Causes a restructured identity or role around the action of the stressor in their life	Physical Disability Being a Refugee
Distant Stressors	Long period of time; may not end	Causes long-term cognitive and/or emotional repercussions	Being a Prisoner of War Childhood Sexual Abuse

Each of the experiences or behaviours described in Table 2 instigates a physiological reaction within the body, which is called the 'stress response.' This stress response is primarily guided by the action of three hormones: adrenaline (epinephrine), noradrenaline (norepinephrine) and cortisol, and secondarily by estrogen, testosterone, dopamine and serotonin.

In acute stressful situations, i.e. fight or flight situations, these hormones collectively increase heart rate, increase blood pressure, improve visual acuity, cause perspiration and suppresses non-vital processes, such as digestion. When stress is experienced in the short-term, the effects of these hormones do not cause harm to the body. In chronic stress situations, however, the prolonged elevated levels of these hormones, and the inability of the body to relax and recover, can cause a slew of physical problems

including, but not limited to: cardiovascular issues, high blood pressure, immunosuppression, skin problems, musculoskeletal pain, diabetes, obesity and infertility (Carlson, 2004). Some of these psychosomatic issues will be further explored in relation to different environments later in this chapter.

2.2.1.2 Satisfaction

According to the OECD's Better Life Index, life satisfaction "measures how people evaluate their life as a whole rather than their current feelings [that] captures a reflective assessment of which life circumstances and conditions are important for subjective well-being," (OECD, 2015).

Many studies have discussed the relationship between life satisfaction and varying domains of life (Rojas, 2006; Praag, Frijtersvan & Ferreri-Carbonell, 2003). Domains of life include, but are not limited to: material well-being, physical health, spousal and social relationships, standard of living, productivity, community, income security and spirituality (Argyle, 2001; Day, 1987, Flanagan, 1978; Cummins, 1996; Headey & Wearing, 1992). Rojas (2006) argues that the relationships between life satisfaction and domains of life are highly complex; each domain of life holds a different ability to affect life satisfaction, and can come to affect other domains of life as well (Rojas, 2006). In addition, satisfaction does not increase at a set rate, rather it depends on how satisfied the individual is already within that domain of life; satisfaction increases at a lower rate beyond a specific threshold within each domain of life (Rojas, 2006). Thus, life satisfaction is affected by many different domains of life, which also can affect stress levels, making satisfaction an important component of someone's overall mental well-being.

2.2.1.3 Concentration

Concentration, or directed attention, is defined as the "act or power of carefully thinking about, listening to, or watching someone or something," (Merriam-Webster Inc., 2014). According to Kaplan (1995), this kind of attention requires mental effort and therefore can be depleted. Attention Restoration Theory, which connects the ability to concentrate with the physical environment, will be discussed later in this chapter. Directed attention fatigue is now a recognised neurological symptom, whereby the part of the

brain which contributes to concentration is fatigued (Bio-Medicine, 2012). This directed attention fatigue can contribute negatively to one's overall state of mental well-being, by increasing distractibility, forgetfulness, impaired judgement, apathy and crankiness, amongst other symptoms (Bio-Medicine, 2012).

2.2.1.4 Productivity

Productivity is considered the ability of a person to complete a directed task within a specific time frame. When experiencing high levels of stress, one's mental acuity suffers, resulting in a loss of productivity. This could form a positive feedback loop, causing someone to become more stressed due to the lack of progress made on a particular task. Extensive research has been conducted on the effect of mental well-being, particularly stress, on workplace productivity (Colligan & Higgins, 2006; Kalia, 2002). In addition, there has been much research into indoor work environments and their effect on workplace productivity, with particular emphasis on how natural elements can help to improve productivity (Tennessen & Cimprich, 1995; Lorh et al., 1996; Shibata & Suzuki, 2001). The relationships between productivity and the physical environment will be discussed later in this chapter.

2.2.2 Measuring Mental Well-Being

Mental well-being is a very difficult thing to measure as it is composed of a variety of different components, including productivity, concentration, stress and satisfaction with life, for example. Many of these components are measured using surveys that rely on self-reported subjective well-being measures, such as the SF-36 and the Canadian Community Health Survey- Mental Health, which are explored below.

Constituents of mental health and well-being, such as stress levels, can also be determined using physiological studies that measure blood cortisol levels, blood pressure or sleep patterns, for example. The scientific information generated from these studies requires quantitative information about participants to provide a full picture of the reactions being represented physiologically.

2.2.2.1 SF-36

In many studies related to well-being, the SF-36 test is used. The SF-36 test is a questionnaire with 36 questions that can provide a general understanding of the functional health and well-being of respondents. A list of some questions found on the SF-36 test that are related to Mental Well-Being can be found in Appendix A: Sample Questions from Mental Health Surveys.

The survey produces summary measures of both physical and mental well-being. The physical and mental well-being summary measures are each composed of 4 domains, which can be seen in Table 3. Each of these domains, as well as the summary scores, can be calculated for each survey completed to provide a general health score. Since this survey does not ask specific questions about particular diseases or ailments, results from differing populations can be compared, i.e. from a healthy population and a population with an ailment.

Table 3: A table showing how the SF-36 measurement model is arranged by summary measures, domains of health and components of those domains (Ware, 2000)

Summary Measures	Domains	Components	
Physical Health	Physical Functioning	Vigorous Activities	Bend, Kneel
		Moderate Activities	Walk Mile
		Lift, Carry Groceries	Walk Several Blocks
		Climb Several Flights	Walk One Block
		Climb One Flight	Bathe, Dress
	Role-Physical	Cut Down Time	Limited in Kind
		Accomplished Less	Had Difficulty
	Bodily Pain	Pain- Magnitude	Pain- Interfere
	General Health	EVGFP Rating	Health to Get Worse
		Sick Easier	Health Excellent
		As Healthy	
Mental Health	Vitality*	Pep/Life	Worn Out
		Energy	Tired
	Social Functioning*	Social- Extent	Social-Time
	Role-Emotional	Cut Down Time	Not Careful
		Accomplished Less	
	Mental Health	Nervous	Blue/Sad
		Down in Dumps	Happy
		Peaceful	
*** Significant correlation with other summary measures**			

The SF-36 has been used in thousands of studies across the world. It provides a relatively standardised representation of general mental well-being of each respondent, and thus each population being questioned. The SF-36 only addresses specific experiences or feelings that are directly related to physical and mental health, and thus exclude many determinants of health from its analysis.

2.2.2.2 Canadian Community Health Survey- Mental Health

In Canada, Statistics Canada occasionally conducts the Canadian Community Health Survey- Mental Health (CCHS-MH). This is a very comprehensive survey containing questions related to experiences, behaviours and self-reported mental well-being status. The survey covers the following domains:

a) General Health
b) Health Care Services
c) Lifestyle and Social Conditions
d) Mental Health and Well-Being
e) Prevention and Detection of Disease

(Statistics Canada, 2013)

While the SF-36 elicits general mental well-being information, the CCHS-MH is much more comprehensive, asking questions that are much more specific (see Appendix A: Sample Questions from Mental Health Surveys for sample questions from the survey). In addition, there are many questions related to self-identified mental health issues, as well as sections on health services. See Appendix A: Sample Questions from Mental Health Surveys for the complete list of the sections in the CCHS-MH.

The comprehensive nature of the CCHS-MH allows for various determinants of health to be evaluated alongside the physical manifestations of mental health issues. This allows for a broader and more specific evaluation of mental health status than the SF-36. Therefore, if using the SF-36 in a Canadian study, it would prove useful to support the information gathered with corresponding information from the CCHS-MH survey.

2.3 Mental Well-Being and the Environment

2.3.1 History of Health and the Environment

Prior to the advent of antibiotics and sedentary lifestyles, people primarily had to stave off infection, physical trauma and infectious diseases. Many infections and infectious diseases have an environmental component. For example, human and animal effluent in water caused outbreaks of cholera and diphtheria, and areas of stagnant water provide optimal breeding grounds for malaria-carrying mosquitoes (WHO, 2015a; WHO, 2015b). In the 18th and 19th centuries, it was understood that these kinds of miasmas "carried the environment's imbalance, disturbance or putrefaction into the depths of the body, expressing within the individual the sickly tendencies of the locale," (Bonnell, 2010: 95).

The natural environment could also provide restorative and relaxing qualities. Charles Sauriol, an environmentalist in Toronto, wrote about how he "sought out the valley regularly as a temporary retreat, pursuing the health benefits of outdoor recreation… or realizing a 'back-to-nature' impulse to unpack the week's stresses within 'a scene of simple pleasure and untroubled quiet'" (Bonnell, 2010: 295). In addition, James Murton claimed,

> *Life outside the city was understood to be slower, more natural and more in line with human rhythms. The idea of the country held connotations of virtue and wholesomeness. It was beautiful and peaceful, calming and relaxing. At the same time, farming represented simple values, hard work, and hardy individuals, along with a sense of community* (Bonnell, 2010: 166)

In addition, in the 19th century, it was also believed that outdoor work in rural environments could act as a form of "therapy and social regeneration" (Bonnell, 2010: 166).

These recollections show how in the 18th century through the early 20th century, the connection between one's well-being and the natural environment was rather intuitive. Thus, it seems as if many of the decisions regarding environmental management at this time were guided by, and had implications for, the health of populations living in and around those areas.

2.3.1.1 A Changing Disease Profile

The discovery of penicillin and subsequent antibiotics radically changed the disease profile of the 20th century. These antibiotics provided a mechanism through which bacterial infections could be treated (Antibiotic Awareness, 2012), no longer relying solely on the ability of an individual's immune system to stave off infection itself. This discovery led to the advent of modern biomedicine, which is focused primarily on the acute treatment of the physiological cause and effect of disease and trauma.

The rapid profusion of these antibiotics through the western world drastically reduced the mortality of individuals fighting infection, especially amongst infants, people experiencing physical traumas and the elderly. Along with advancements in sanitation, these two factors contributed to the decline in overall morbidity and mortality, and an increase in life expectancy (CDC, 2001).

Alongside antibiotics and sanitation advances, many post-war changes in the structure of society had an effect on health, including: the invention of the grocery store, the proliferation of the automobile, the rise in suburban living and the shift from an industrial economy to a service-based economy, amongst other things. These changes resulted in a shift away from active to more sedentary lifestyles.

All of these factors together meant that by the mid-20th century, the disease profile had changed from primarily infectious disease to diseases of civilization, which include diseases such as: chronic obstructive pulmonary disease, atherosclerosis, heart disease, diabetes and obesity (Carrera-Bastos et al., 2011). However, there has recently been a resurgence in multi-drug resistant infectious diseases (CDC, 2001), though those will not be discussed here.

With the then current state of biomedicine, these newly prevalent diseases were approached using a similar clinical model to infectious disease, i.e. acute treatment of a physiological symptom to achieve relief. Thus, many clinical trials commenced testing the effects of various medicines on people suffering from these diseases. These encouraged doctors to follow the same medical prescription-based

treatment methods as before, and encouraged patients to undergo 'lifestyle changes' such as eating healthier and exercising more but without providing adequate support.

However, many chronic diseases of civilization have multiple causes and multiple effects. Many of these causes could be from the previously discussed social and environmental determinants of health. Thus, the prevalent single cause-single treatment paradigm has become inadequate. In addition, many chronic diseases have affiliated with them mental stressors, e.g. obesity often is accompanied by psychological issues related to food addiction and high stress. Therefore, the now prevalent diseases of civilisation require multi-faceted treatments that include lifestyle changes, biomedical treatments as well as psychological supports.

2.3.2 Mental Well-Being and Urban Lifestyles

Modern urban living produces a particular challenge to the body, which is not hard-wired to deal with a high prevalence of mental stress and a lower prevalence of stress related to physical danger. In modern society, it has been shown that the constant bombardment of mental, visual, auditory, etc. stimulation has caused the baseline levels of adrenaline and cortisol to rise. Therefore, instead of being present in the blood stream only when a fight or flight reaction is warranted, adrenaline and cortisol are constantly being produced. This results in subtle, but significant, increases in heart rate, interrupted sleep and suppression in digestion, leaving the body in an excited state for prolonged periods of time (Mayo Clinic, 2013). Therefore, as an urban society, we are more stressed on average than our 19th century counterparts.

In addition, urban environments also expose people to greater amounts of social stress than rural environments, which are considered a risk factors for the development of mental disorders, such as schizophrenia (Lederbogen et al., 2013). Although urban stressors can come from many different sources, including: infrastructure (e.g. population density, access to green space), economic issues,

environmental pollutants and social conditions (e.g. density of social networks) (Ledergoben et al., 2013), social conditions are shown to contribute the most to the mental well-being of residents. The different character of community structures found in urban areas as compared to smaller towns or rural areas can also contribute to feelings of isolation and aloneness within cities, a concept that has different effects depending on whether you are male or female.

2.3.3 Theories Connecting Mental Well-Being and the Environment

There are a variety of theories connecting mental well-being with the environment. These theories largely follow two trains of thought including Attention Restoration Theory (as proposed by Kaplan, 1995) and restorative environments (as proposed by Ulrich et al, 1991). These two theories are presented below.

2.3.3.1 Attention Restoration Theory

According to Kaplan (1995), individuals possess two different kinds of attention: directed and voluntary. Directed attention, or concentration, requires effort to focus on something, and therefore can be exhausted and replenished. Involuntary attention does not require effort to focus and therefore cannot be exhausted. It is upon the idea of these two different types of attention that Kaplan (1995) proposes Attention Restoration Theory. Attention Restoration Theory holds that while a person is using their directed attention, their ability to concentrate is slowly depleted; conversely, if that person is using their involuntary attention, their directed attention is able to be restored (Kaplan, 1995). This attentional restoration requires that the environment within which a person is placed to be restorative, i.e. possess qualities that are tailored toward the restoration of that person (Kaplan, 1995). These qualities (Kaplan, 1995) include:

a) Cognitive separation of place or “being away”
b) The ability for the experience of being in that space to be mentally consuming
c) The purpose of going to that space must align with what that space can offer
d) Degree of fascination, i.e. the ability to be transfixed by something such that it empties the mind (soft fascination) or fills the mind fully (hard fascination)

Kaplan did not believe that all of these conditions could be met in every natural setting (Kaplan, 1995). However, it is possible to gain at least a partial restorative experience from all natural settings.

2.3.3.2 Stress Relief and the Environment

Another approach to restoration is the stress relief. Ulrich et al. (1991) suggest that different environments are able to relieve stress to different extents. In this study, participants were all exposed to the same stressor, then shown a video of one of six different settings- two natural and four urban- with different noises and visual stimuli (Ulrich et al., 1991). In every instance, those viewing natural environments experienced faster physiological relaxation responses, including fast decline in fluctuations in skin conductance, reduced blood pressure, reduced muscle tension and a slower heart rate than those viewing urban settings (Ulrich et al., 1991). Thus, it can be deduced that the visual and auditory stimuli in natural environments prove more physiologically restorative than urban environments.

Ulrich's stress relieving research and Kaplan's research on attention are different, but complimentary. Ulrich et al. (1991) claim that the idea of fascination does not always illicit a stress relieving or restorative experience; for example, a person can develop a hard fascination staring at some snakes and spiders, but could be scared by the situation, therefore not receiving restorative benefits. Thus, not all natural settings are restorative. This difference in restorative capacity will be discussed further later in this chapter.

2.3.3.3 When Natural Play is Discouraged: The Case of Nature-Deficit Disorder

In 2008, Richard Louv introduced the concept of 'Nature Deficit Disorder' (or NDD) in his famous book Last Child in the Woods. NDD is not a biomedical classification of an illness or disease and thus is not found in the Diagnostic and Statistical Manual of Mental Disorders upon which diagnoses are based. Instead, NDD is a concept described as "the human costs of alienation from nature, among them: diminished use of the senses, attention difficulties, and higher rates of physical and emotional illnesses,"

(Louv, 2008: 36) that can occur across social scales and affect society as a whole. In addition, the overstimulation of the brain in urban and indoor environments can contribute to a change in overall behaviour patterns, which has cascading effects on an individual's/family's/community's/society's overall well-being.

In his book, Louv (2008) focuses his attention on the effects of nature deprivation on children. It is believed that outdoor play and engagement in natural areas is pivotal for early and middle childhood development, having effects on activity level, the development of motor skills, attention capabilities and social development. Thus lack of engagement in natural spaces has a prolonged effect on people across age ranges.

2.3.3.4 Physical Activity and Mental Well-Being

Exercise can provide a means of therapy for patients experiencing major depression. Blumenthal et al. (1999) showed how a 16-week group exercise program was as effective in reducing symptoms of depression as a 16-week course of sertraline, an antidepressant. In addition, the relapse rate for patients was much lower in the exercise group (8%) than in the group with sertraline treatment only (38%) or the group given sertraline and exercise (31%) (Babyak et al., 2000). This shows the extent to which exercise can have a positive impact on alleviating personal mental illness burdens.

In instances where individuals are healthy, regular physical activity can serve to reduce stress, and therefore act as a protective barrier against the development of depression (Mobiliy et al., 1996). However, in instances where there is very low or very high amounts of physical activity per week, it is less likely the individual will experience those same mental health benefits (Kim et al., 2012).

2.3.4 Natural Spaces, Urban Design and Mental Well-Being

2.3.4.1 Accessibility and Availability

Integrating built and natural features together could provide the opportunity for restoration. By providing built access to natural features, for example paths, sidewalks and benches, people could be

encouraged to spend more time in those spaces, thus increasing the probability of a person receiving restorative benefits from surrounding flora and fauna. The design of the streets themselves is also important. For example, walking is encouraged in spaces that are mixed commercial and residential areas with street intersections forming a grid, while walking is discouraged in low-density residential areas with long winding streets.

The design of urban spaces can influence the well-being and attitudes of individuals living in those areas, through being inviting spaces in which to spend time, and thus from which to receive restorative benefits. Ulrich (1984) pointed out that someone did not have to physically be in a natural environment to experience restorative benefits, but could also just be looking at a natural feature or setting. He examined how the view from a hospital window could influence post-operative recovery. Patients recovering in a room with a view of a brick wall experienced higher stress levels, required more pain relieving medication and took longer to be discharged than patients who recovered in a room with a view of trees (Ulrich, 1984). Thus, not only does spending time in a natural environment provide restorative benefits, but just being able to look through a window at a natural feature or setting can provide similar benefits.

2.3.4.2 Types of Natural Setting

The amount of natural space, as well as the kind of natural space, affects people's preference. In White et al. (2010), the impact of blue space on restoration in a variety of settings was tested. The order of preference of different kinds of environment can be found in Table 4 with the least favoured environment listed first, and the most favoured environment listed last. This study shows how blue space has the most potential to be restorative, as preference and restorative capacity are highly correlated (Nordh et al., 2009).

Table 4: According to White et al. (2010), this table shows how respondents ranked their preferences for different kinds of space.

(High) Preference (Low)
Built environment only
Built environment with some green space
Green environment with some built space
Green environment only
Built environment with some aquatic space
Aquatic environment with some built space
Green environment with some aquatic space
Aquatic environment only
Aquatic environment with some green space

2.3.4.3 Restoration Differs by who is in That Space

Roe and Aspinall (2011) have taken these previous works work one step further, to discuss how urban and rural environments have variable abilities to act as restorative environments depending on the mental health status of the individual in that space. In their study, individuals were classified as having 'good' mental health, i.e. no previous diagnosis of a mental illness, or 'bad' mental health, i.e. a previous diagnosis of a mental illness such as depression or anxiety (Roe & Aspinall, 2011). They found that rural walks promoted restoration greater for the "bad" mental health group than the "good" mental health group (Roe & Aspinall, 2011). Urban walks did not provide any discernable restorative capacity for the good mental health group, but did prove restorative to the bad mental health group (Roe & Aspinall, 2011). This is believed to be due to the social nature of the walk, i.e. being in a group, rather than the physical setting of the walk (Roe & Aspinall, 2011). Overall, this study shows how rural or natural settings can promote greater restoration for those who experience depression, anxiety and/or other mental illnesses.

2.3.4.4 Design of Natural Spaces

There is an increasing tension between the want for natural spaces in urban environments and the drive for densification. Nordh et al. (2009) explored how different design components of small pocket parks, i.e. hardscape, grass, lower ground vegetation, flowering plants, bushes, trees, water and size, influenced the degree to which respondents believed the areas contributed to feelings of being away,

fascination, restoration and preference. Each participant was asked to answer different questions related to these four components of mental well-being for each photo of different park spaces (Nordh et al., 2009). A brief summary of features that contributed to well-being are summarized in Table 5.

Table 5: This table shows some different components of a landscape that contributes to feelings of well-being, according to Nordh et al. (2009).

Feeling	Part of Landscape Attributed to that Feeling (In order)
Restoration	Size of space, presence of grass, presence of bushes and presence of trees
Fascination	Waterscapes, size of space
Being Away	Presence of grass, presence of bushes, presence of trees, size of space
Preference	Size of space, presence of grass, presence of bushes and presence of trees

Nordh et al.'s (2009) study shows how different parts of a park landscape can influence the restorative experience, and that densification pressures need not prevent the presence of restorative natural spaces. This study did not have participants spending time in the space, however, so questions of adjacent built landscapes, crowdedness and noise may affect how well these design features can improve the restorative experience.

In addition to the presence of different landscape components, the restorative nature of that space is also dependent on how those components are arranged. Gatersleben and Andrews (2013) showed how not all natural settings are restorative by discussing the concepts of prospect and refuge. Prospect refers to one's visual lines, i.e. is the path ahead of you relatively open and well-lit, or is the path dark with dense vegetation. Refuge refers to the ability to conceal, i.e. the ability for someone to be hiding behind a bush. Participants found areas with high levels of prospect and low levels of refuge to be the most restorative, while areas with low levels of prospect and high levels of refuge to be the least restorative (Gatersleben & Andrews, 2013). These observations are relevant in urban settings, as well, as sense of security and safety are better achieved in open, well-lit areas.

2.3.4.5 Too Many People, Too Few Spaces: Quantity and Quality of Natural Spaces

Another challenge associated with urban parks is the effects of overuse of the space on the restorative capacity of that space (McPherson, 2006). As urban areas continue to densify, parks that once served a relatively small population are now seeing much more foot traffic. The overuse of natural spaces can lead to the deterioration of that space's ecological integrity, leaving the plants susceptible to disease from being stressed, and leaving ground cover susceptible to being trampled (McPherson, 2006). Not only does this affect the visual effect of the park, but also reduces the ability of that space to provide much-needed ecosystem services. Thus, the quantity and distribution of natural spaces also proves an integral part of ensuring a space can both maintain ecological integrity and provide a restorative environment.

2.4 Mental Health Promotion

Health promotion has been defined as: "the process of implementing a range of social and environmental interventions [that] includes promoting healthy behaviours, creating supportive environments and encouraging healthy public policies, enabling people to increase control over, and to improve, their health," (Public Health Ontario, 2014). Health promotion first came to the fore after the 1986 International Conference on Health Promotion in Ottawa, which produced the Ottawa Charter for Health Promotion. This document holds that in order to achieve a state of health, one must have the following: peace, shelter, education, food, income, a stable ecosystem, sustainable resources, social justice and equity, thus calling for creating supportive socio-ecological environments as a health promotion strategy (WHO, 1986). Thus, health promotion requires striving for an optimal status for all of those components of health.

Mental health promotion is a less understood part of health promotion (CMHA, 2015). It focuses on the following: enhancing the capacity to take control of life and health, promoting the ability to cope

amongst individuals and communities, relying on inter-agency collaboration and taking a positive perspective that focuses on MHP in a positive light (CMHA, 2008).

In 2008, the Canadian Mental Health Association published a call to action to help to alleviate some of the mental illness burden in Canada (CMHA Ontario, 2008). They identified three high priority determinants of mental health, including: social inclusion, freedom from discrimination and violence, and access to economic resources (Keleher & Armstrong, 2006). A summary of mental health promotion tactics relevant to the environment can be found in Table 6.

Table 6: A table showing the Ontario Mental Health Promotion objectives that are related to the environment (CMHA Ontario, 2008)

Theme	Objective
Promote Social Inclusion in Ontario	1.1: Strengthen social interaction for individuals, families and groups in their communities by ensuring access to free space for recreational and other activities
	1.2: Develop activities that involve social interaction as part of the implementation of Ontario's Health Eating and Active Living Strategy
Ensure All Ontarians Live Free from Discrimination and Violence	2.3 Develop urban planning policies that support a health-promoting built environment. Appropriate zoning, good lighting, well-maintained housing and street-scaping all generate a sense of safety and comfort while spending time in the external environment. Structural changes can also reduce barriers to access
Ensure All Ontarians have Access to Economic Resources	3.3 Increase access to affordable housing and safe housing environments

2.4.1 Pillars of Mental Health Promotion

Downie, Tannahill & Tannahill (2000) claim that there are three pillars upon which health promotion should rely, including: prevention, education and protection. Kauhanen et al. (1998) defines three different levels of prevention as it relates to health promotion (see Table 7).

Table 7: The purposes of primary, secondary and tertiary stages of health promotion (Kauhanen et al., 1998)

Stage	Target Audience	Purpose
Primary	Individual or Community	Prevent initial exposures to things that could affect health negatively
Secondary	Individual	In early stages of an illness or disease, start working toward changing the course of that illness or disease, for example through changed lifestyle
Tertiary	Individual	After an illness or disease has already been established, this phase focusses on maintaining the functional abilities of the individual in an effort to prevent comorbidities

Secondly, health education is defined as, "any combination of learning experiences designed to help individuals and communities improve their health, by increasing their knowledge or influencing their attitudes," according to the WHO (2014).

Lastly, health protection "is aimed at increasing the potential for people to live in healthy environments and to support healthy lifestyles" (Sempik, Hine & Wilcox, 2010: 101). The greatest potential for environmental intervention comes in this last pillar of health promotion.

2.4.2 Green Care and Mental Health Promotion

One approach to mental health promotion is through "green care," (Sempik, Hine & Wilcox, 2010). This type of care is based upon a salutogenic approach, which focuses on what contributes to an individual's state of health, rather than focusing primarily on symptom alleviation, which is the dominant paradigm in biomedical care (Sempik, Hine & Wilcox, 2010). Green care integrates the access to and experiences in healthy environments as part of its prevention and treatment (Sempik, Hine & Wilcox, 2010).

In Sempik, Hine & Wilcox (2010), each of the five actions for health promotion that were defined in the Ottawa Charter for Health Promotion are discussed with reference to green care (see Table 8).

Table 8: This table shows some of the connections between green care and health promotion. Adapted from Sempik, Hine & Wilcox (2010)

Component of Health Promotion	Relevance to Green Care	Examples
Healthy Public Policy	Incorporating health into public policies to make healthy choices more accessible to people	Providing park space for physical recreation and exercise, which can reduce health care burdens
Supportive Environments	Expand the skillset of individuals so they can become more independent	Provide accessible green space where individuals can develop their skills independently and socially
Community Action for Health	Undertake activities that could encourage communities to take their health into their own hands	Providing space for allotment and community gardens, where social groups can form and food can be grown
Life Skills and Health Literacy	Life skills- individual abilities to develop positive attitudes and behaviours when dealing with life challenges Health literacy- the ability of individuals to gather and interpret knowledge related to their health and behaviours	Life skills- teaching individuals coping and adaptation skills Health literacy- teaching people how to manipulate their environments to meet their health needs e.g. through gardening
Development of Health Services	Invest in the training and awareness of green care, and provide spaces for it in various therapeutic settings, e.g. hospitals and assisted living facilities	Green care simultaneously provides multiple benefits to individuals (physiological, psychological, social) and thus can reduce long term rehabilitation and therapeutic costs

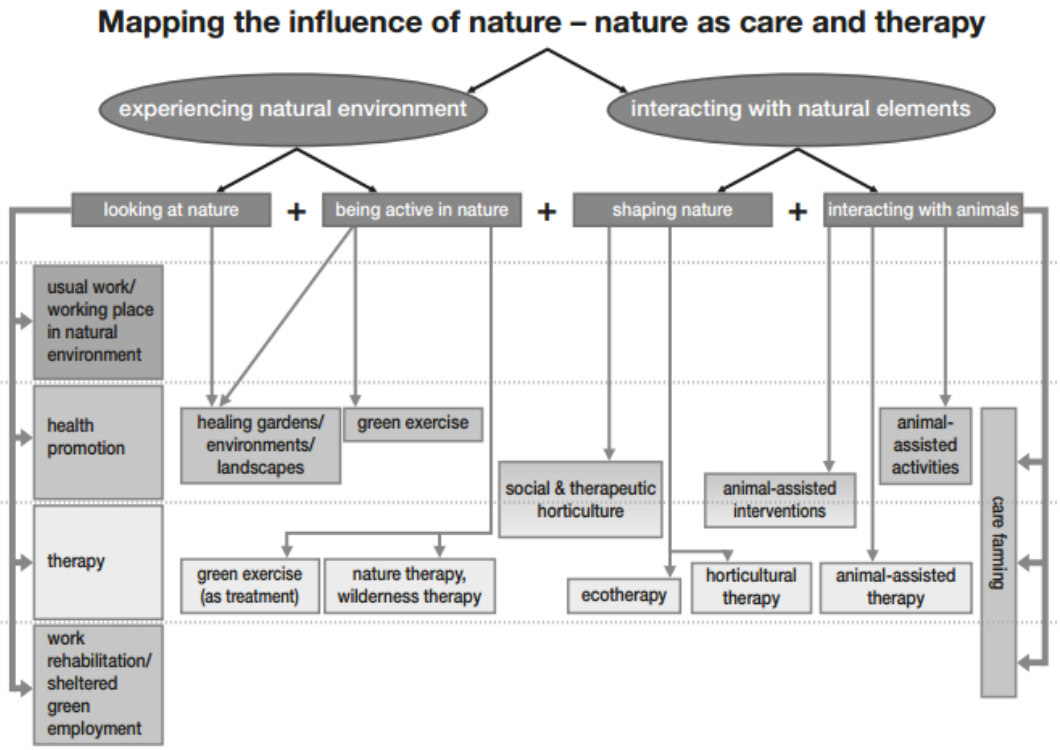


Figure 1: Visual representation of connections between nature and therapeutic care (Sempik, Hine & Wilcox, 2010: 28)

Sempik, Hine & Wilcox (2010) define two different kinds of experiences that happen in natural environments, including passive and interactive experiences (see Figure 1). Passive experiences include spending time or being active in nature without the primary intent of being in that space is the activity rather than the physical context (Sempik, Hine & Wilcox, 2010). For example, passive experiences could include a walk through a natural area, or having a barbeque outdoors. Interactive experiences include activities that influence the environment, and can include experiences such as gardening, or interacting with animals. Both passive and interactive experiences in nature have the ability to influence mental well-being, but to varying extents (Sempik, Hine & Wilcox, 2010).

2.5 Ecohealth

Ecohealth (or Ecosystem Approach to Health) is an emerging field of study which investigates the relationships between human health and well-being, and various environments, i.e. physical, physiological, social, political and/or economic. According to Charron (2012), ecohealth "formally

connects ideas of environmental and social determinants of health with those of ecology and systems thinking in an action-research framework applied mostly within a context of social and economic development," (p. 6). Research in this field is action-oriented, that not only reports back on the aforementioned relationships, but also develops strategies for change, i.e. governance strategies and/or ecosystem management strategies, to improve health and other outcomes over time. Bunch et al. (2011) further emphasise how this action-based research and work requires the collaboration of multiple stakeholders from multiple different disciplinary backgrounds. Currently, there are six key principles to ecohealth, including: systems thinking, transdisciplinarity, participation, sustainability, gender and social equity, and knowledge to action (Charron, 2012).

2.6 Integrated Watershed Management

Integrated Watershed Management (IWM) is, "a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems," within the watershed context (Global Water Partnership, 2010). IWM uses a multi-sectoral, cross-boundary approach to managing a watershed, bringing to the cascading systemic effects of effective watershed management, e.g. healthy people and economic benefits, to the fore. In Canada, there are three primary objectives surrounding incorporating IWM into management practices, including promoting intra- and inter-governmental cooperation between stakeholders acting within a watershed, designing and implementing effective and efficient programs, basing decisions on sound scientific and economic data and creating an effective monitoring system (Environment Canada, 2010).

2.7 Conceptual Frameworks

Throughout the subsequent research presented in this paper, various conceptual frameworks which connect the environment, health and society have been used to guide the thought process. These frameworks are presented below.

2.7.1 DPSEEA Framework

Another way of coming to understand the links between the environment, society and health is through the DPSEEA framework (see Figure 2: The DPSEEA framework). This framework was developed jointly by the World Health Organization, the United Nations Environment Programme and the United Nations Environmental Protection Agency (Parkes et al., 2008). The DPSEEA acronym stands for D-driving forces, P-pressures, S-state, E-exposure, E-effects and A- actions (Parkes et al., 2008).

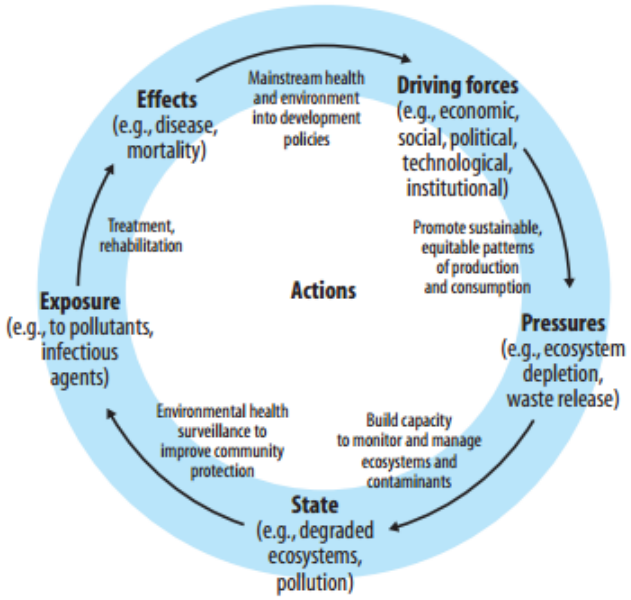


Figure 2: The DPSEEA framework (Carniero, 2006)

The usually linearly portrayed model has been adapted by Carniero (2006) to depict the feedback loops present through the model (Figure 2: The DPSEEA framework (Carniero, 2006)). Due to the usual linear nature of this model, health is portrayed as an end product of multiple relationships and factors rather than an emergent property of them (Parkes et al., 2008). Thus, although it is a good model to begin thinking about ecosystem, society and health relationships, it will not be used in this research.

2.7.2 The Butterfly Model

The butterfly model was developed by VanLeeuwen (1998) and can be seen in Figure 3. This model depicts the world as two separate, yet interacting, complex systems- namely the biophysical environment and the socio-economic environment (VanLeeuwen, 1998). This model does not have a

unidirectional flow from the environment to the health response, but instead recognises the complexity and interconnectedness of the two systems that have reciprocal interactions producing health outcomes (Parkes et al., 2008).

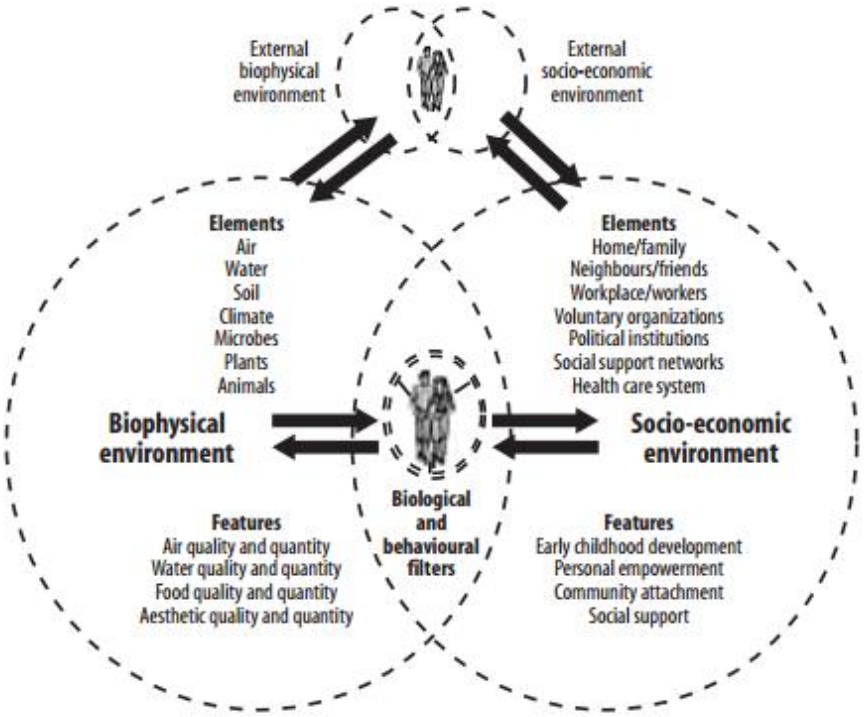


Figure 3: A depiction of the butterfly model (VanLeeuwen, 1998)

2.7.3 The Watershed Governance Prism Model

The prism model is yet another way of depicting the complex relationships between socio-economic systems and ecological systems (see Figure 4). Parkes, Panelli & Weinstein (2003) describe the framework as making "explicit the public health implications of governance, power and development processes as drivers of social and ecosystem change" (Parkes, Panelli & Weinstein, 2003: 2).

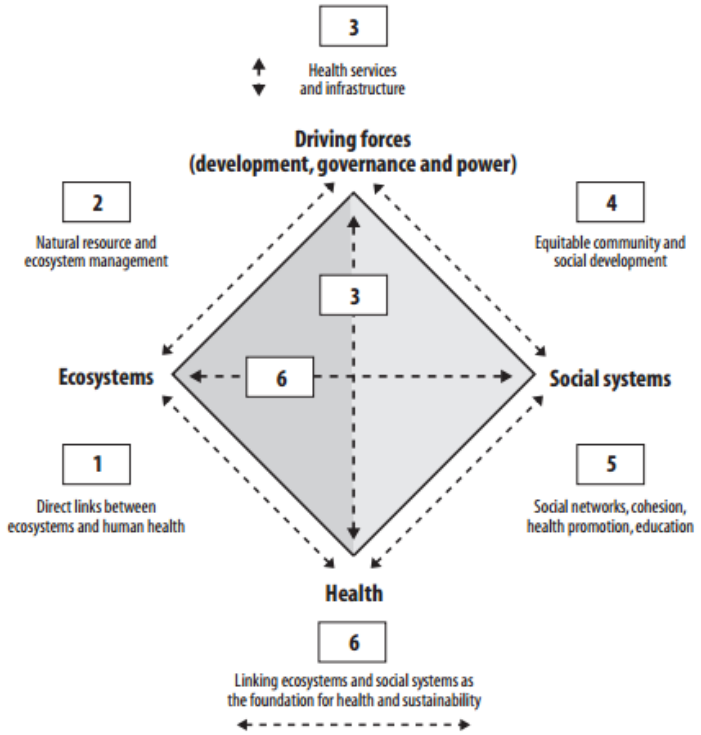


Figure 4: Prism framework of health and sustainability (Parkes et al., 2008:8)

Both the butterfly model and the prism model acknowledge the reciprocal interactions happening between the socio-economic systems and ecological systems, in a way that is not depicted in the DPSEEA model, which emphases a unidirectional flow from driving forces through to health responses (Parkes et al., 2008).

The DPSEEA model lacks in acknowledging the reciprocal relationships and complexity of interactions between social-economic and ecological systems by offering a unidirectional flow from driver through health outcome. On the other hand, the butterfly and prism models both acknowledge the complexity of the systems they are attempting to describe. Parkes et al. (2008) summarized how they can achieve this through recognising that a single driving force or pressure to result in multiple cascading effects on social and health systems (McMichael et al., 2008), that policies affecting social change can have both an effect on health outcomes (Marmot, 2007; Stansfeld, 2006) as well as environmental drivers, and that policies and actions centred around both society and the environment are able to affect many

determinants of health and work toward sustainable development (McMichael, 2006; Parkes, Panelli & Weinstein2003).

2.7.3.1 The Watershed Governance Prism

The watershed governance prism was developed by Parkes et al. (2010) as a way of specifically using the prism framework above in a watershed context (see Figure 5). This prism is based upon ecohealth's claim that human health outcomes are dependent on effective ecosystem management and on the idea that watersheds are effective geographic boundaries for ecological management (Parkes et al., 2010).

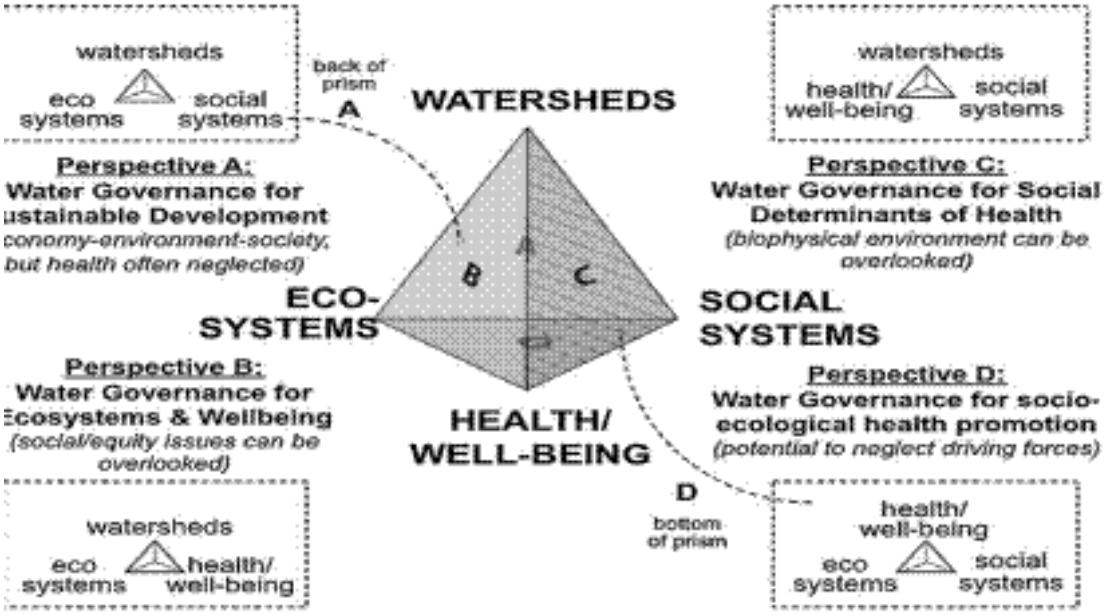


Figure 5: Watershed governance prism (Parkes et.al., 2010)

The prism visually depicts how taking particular perspectives on a watershed-based issue could lead to other perspectives being overlooked. For example, perspective D orients itself toward creating healthy people, communities and environments (Parkes et al., 2010) but lacks in grounding that orientation within the ecological context within which it is taking place, i.e. making direct links to ecosystem services that are affecting healthy people, communities and environments (Parkes & Horowitz, 2009). By making

these potentially overlooked elements explicit, the use of this prism can encourage watershed governance to occur in a more holistic fashion

2.7.4 Millennium Ecosystem Assessment Framework

2.7.4.1 Ecosystem Services

Ecosystem services can be understood in four categories: supporting, provisioning, regulating and cultural services. Supporting services are the baseline services required for all other ecosystem services to function, including nutrient cycling, soil formation and primary production (MEA, 2005). Supporting services do not directly impact human well-being, however a change in a supporting service would cause a change in provisioning, regulating and/or cultural services and thus affect human well-being through that systemic pathway. Provisioning services are goods produced by various ecosystems, including fuel, fresh water and food (MEA, 2005). The services that regulate ecosystem processes are called regulating services, and include climate regulation, water regulation, pollination and storm protection, for example (MEA, 2005). Lastly, cultural services are "nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" (MEA, 2005: 58) and can include aesthetics, sense of place, ecotourism and cultural heritage values, for example. These different services act across a variety of spatial and temporal scales, and often in conjunction with one another, to contribute to the overall ecosystem functions.

2.7.4.2 MEA Framework: Linking Ecosystem Services with Well-Being

In the Millennium Ecosystem Assessment Framework (MEA), well-being is separated into 5 different components including basic materials for a good life, security, health, good social relations and freedom of choice and action, which "provide the conditions for physical, social, psychological and spiritual fulfilment," (MEA, 2005: 73). A summary of these different components of well-being can be found in Table 9.

Table 9: The different components of well-being as defined by the Millennium Ecosystem Assessment (2005)

Component of Well-Being	Definition/Examples
Security	Secure access to resources, personal safety, security from natural disasters
Basic Material for a Good Life	Food security, shelter, income
Health	Good physical and mental health, healthy environment providing clean air and water
Good Social Relations	Good family relations, social cohesion
Freedom of Choice and Action	Having decision-making power, and/or control over personal situations, the ability to vote

Each of these different components of well-being are linked to ecosystem services. For example, if someone goes for a swim at a local clean watering hole, they can be assured they will not leave with swimmer's itch. This is an example of how the cultural service of having a recreational space and the regulating service ensuring good water quality come together to allow the swimming experience to be a healthy experience. For a diagrammatic representation of these linkages, see Figure 6.

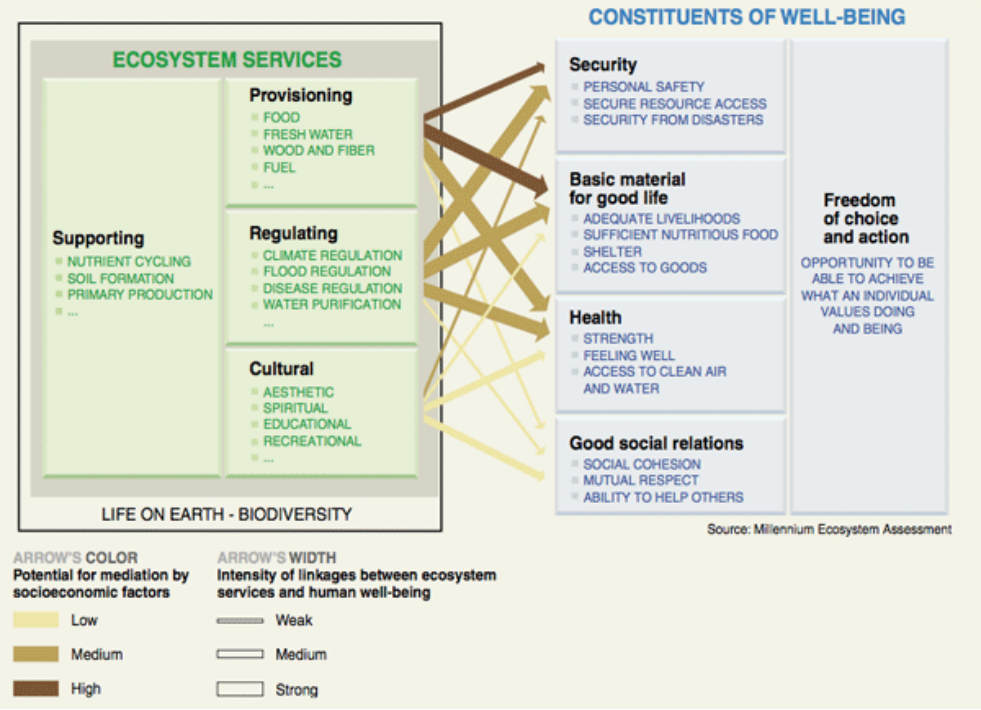


Figure 6: Millennium ecosystem assessment framework- relationships between ecosystem services and components of well-being (MEA, 2005)

The MEA framework goes further than showing how ecosystem services are related to human well-being. It also incorporates how these relationships are affected by direct and indirect drivers of change that act across spatial and temporal scales (see Figure 7: Diagram of how direct and indirect drivers of change affect the aforementioned ecosystem service and well-being relationships (MEA, 2005). Direct drivers of change cause direct measurable effects on an ecosystem, for example, changes in land use or climate change (MEA, 2005). Indirect drivers of change do not cause direct changes to ecosystem services, but affect direct drivers of change, which then have cascading effects on ecosystem services, for example sociopolitical climates or technological innovations (MEA, 2005). Of particular interest for this research are sociopolitical drivers (indirect) and changes in land use and land cover (direct).

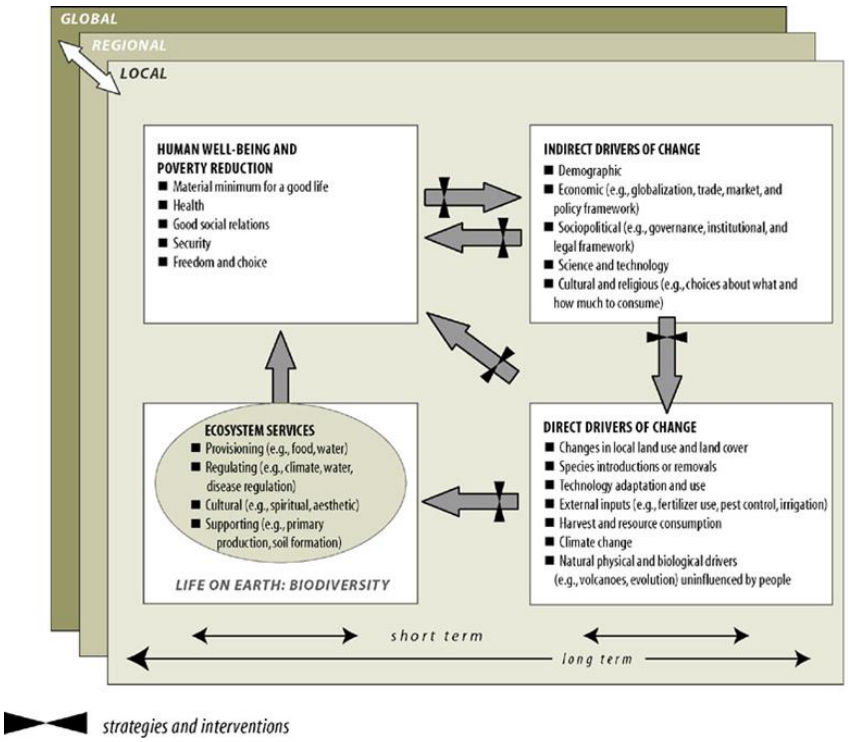


Figure 7: Diagram of how direct and indirect drivers of change affect the aforementioned ecosystem service and well-being relationships (MEA, 2005)

The ideas of direct and indirect drivers of change allow for you to see how the connections between ecosystem services and well-being are not static, but can be influenced by individual, social and political

decisions. The different drivers of change are also leverage points where interventions can occur to change components of the system.

2.7.7 EPA Ecohealth Browser

The previously introduced frameworks are embedded in academic and other literature, and thus are not easily available or understood by the public. The United States Environmental Protection Agency developed a web-based interactive tool to visibly explore the relationships between ecosystem services and human well-being based upon the linkages shown in the MEA framework in Figure 6. The EPA Browser allows the user to explore relationships from the point of the ecosystem type, i.e. having the ecosystem in the middle with associated benefits surrounding it, or from the point of the facet of well-being, i.e. having a physical ailment in the centre with associated nature-based benefits surrounding it (see Figure 8 for a screen shot of the browser).

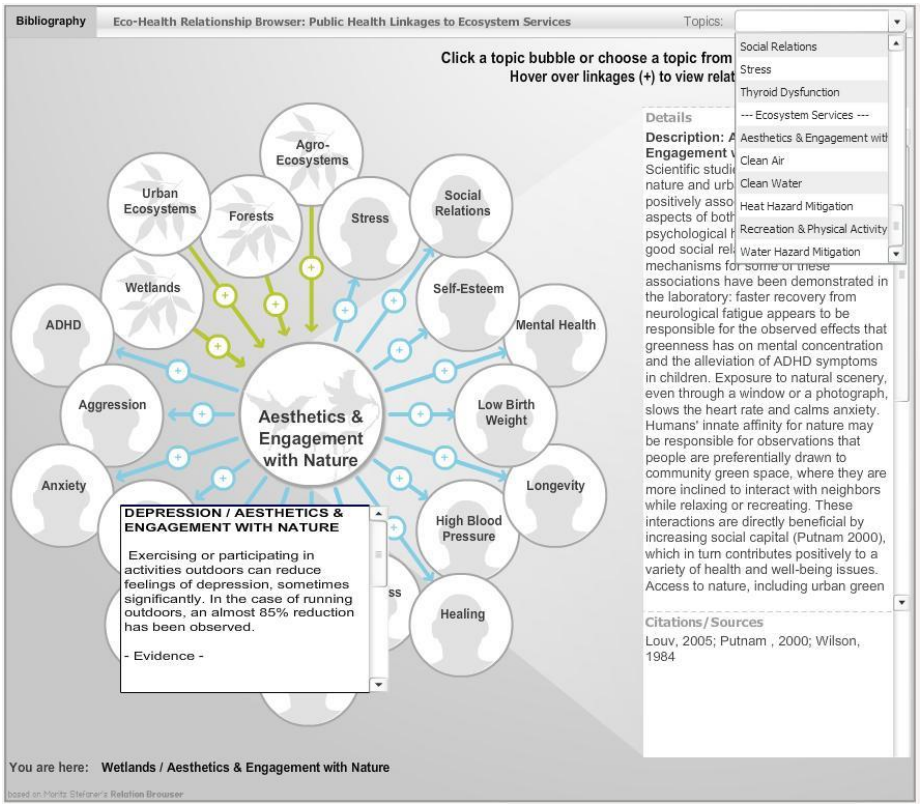


Figure 8: Screenshot of the EPA ecohealth relationship browser (US EPA, 2013)

This browser is useful in exploring the relationships between health and the environment. However, it does not allow users to establish a personal connection to the information, as it is not rooted in any particular place. This issue is being addressed in the development of the Watershed Well-Being Browser in the overall research project, which will be discussed later in Chapter 4.

This chapter has provided an introduction to some of the existing literature available on the concepts of mental well-being and its connection with various environments, mental health promotion, and conceptual frameworks. The subsequent chapter will provide an overview of the methods employed in this research.

Chapter 3: Context

The following chapter will outline the different features of the study areas, including the geographic, governmental and legislative contexts of this research.

3.1 Geographic Context

This study focusses on investigating well-being and environment relationships within the Credit River Watershed. A watershed is an area of land that drains into a river or lake, whose boundary is determined by areas of high elevation (CVC, 2003). It is a self-contained geographic unit that makes sense as a boundary for environmental management. See Figure 9 for a map of the watershed.

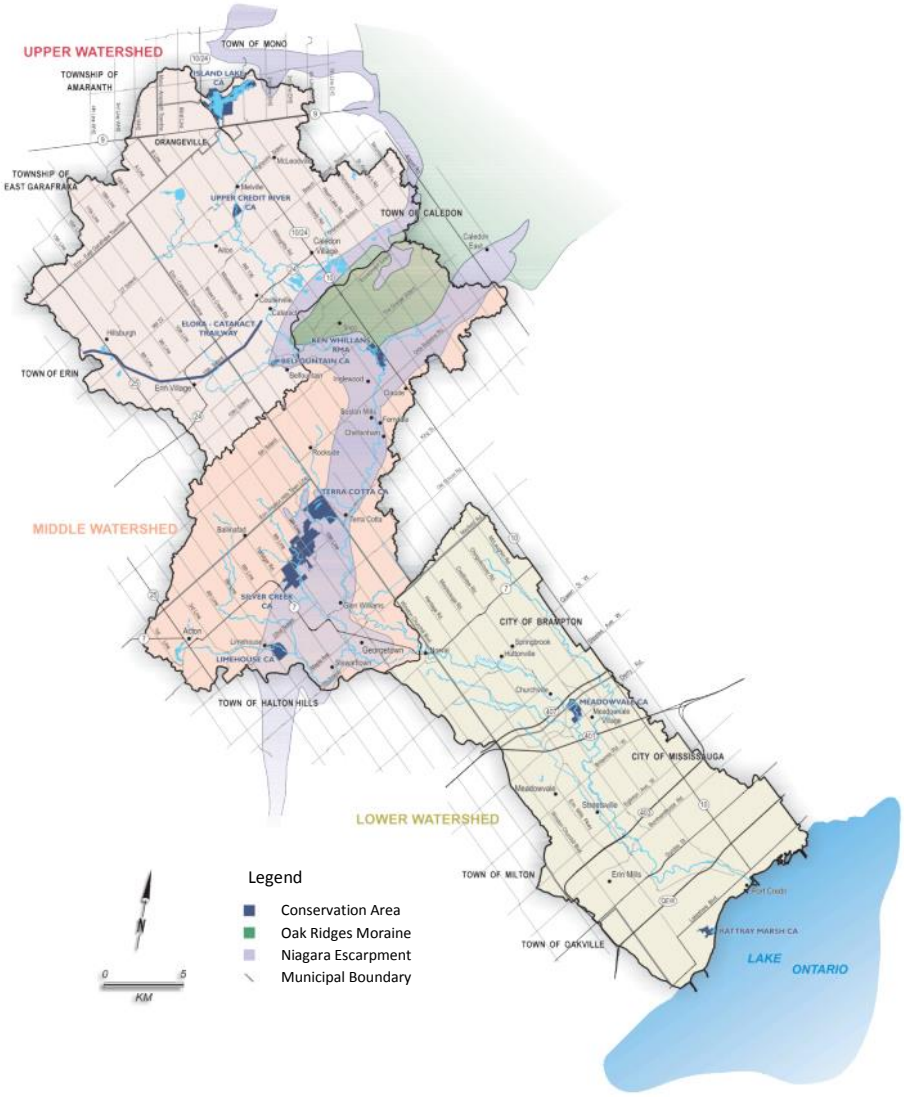


Figure 9: Map of Credit River Watershed (Green Analytics, 2011)

Credit Valley Conservation is in charge of managing the Credit River watershed and two, smaller adjoining watersheds, and extending to the centre of Lake Ontario (the extended geographic boundary into Lake Ontario ensures that the effects of the river systems are not viewed in isolation of the body of water the rivers flow into). The inland jurisdiction is split into three distinct physiographic areas- the upper, middle and lower watersheds. Information about these three parts of the watershed are visible above in Figure 9, and outlined below in Table 10.

Table 10: A table describing the characteristics of each of the physiographic zones of the Credit River Watershed (CVC, 2012a) (George Morris Centre, 2009) (CVC, 2012b)

	Upper watershed	Middle Watershed	Lower Watershed
Settlements	Orangeville, Erin, Alton, Caledon Village, Hillsborough	Inglewood, Cheltenham, Terra Cotta, Ballinafad, Acton, Georgetown, Norval	Mississauga, western Brampton, eastern Oakville
Geographic Area	Above the Niagara Escarpment	Niagara Escarpment and West Edge of Oak Ridges Moraine	Peel Clay Plain and Lake Iroquois Plain
Infiltration Capacity	High permeability; infiltration feeds groundwater stores	Topography lends itself to lots of run off but extensive natural cover of the region helps slow runoff velocities and allow for infiltration	Covered largely by impermeable surfaces, low permeability of natural land surfaces, high runoff
Primary Land Cover	Natural Cover, Agriculture and Open Space	Natural Cover, Agriculture and Open Space	Urban
Population Density	Low- 5.5% of watershed residents reside here	Low- 6.5% of watershed residents reside here	High- 88% of watershed residents reside here
Pressures	Development pressures as GTA population grows; decrease in large farms	High development pressures as GTA population grows	High percentage of impermeable surface cover. Pressures on this part of the watershed due to intensification.

At present, the land cover in the CRW is equally split between natural cover, agriculture and open space, and urban cover (CVC, 2012b). These land use types are not equally distributed in the different physiographic zones of the watershed, with the urban cover primarily being in the lower watershed. The natural cover in the watershed is being threatened by the rapid population growth in this region; between 1996 and 2006, the population of the watershed increased by 32% (George Morris Centre, 2009). These population pressures pose a difficult management problem- having to deal with increasing development, as well as ensuring the watershed is still able to retain ecosystem functionality.

3.2 Regional Context

There are four different regional stakeholders acting in the CRW, including: the Region of Peel, Halton Region, Durham County and Wellington County. Both of the study areas for this research (Meadowvale and Fletcher's Creek) are located within the Region of Peel (see Figure 11).

These regions are facing considerable development pressures as the populations continue to rise. For example, the Region of Peel is expected to rise to 1.97 million by 2041 (Ontario Ministry of Infrastructure, 2013a). This problem is widespread across the entire greater golden horseshoe area (see Figure 10). These issues were started to be addressed in the Places to Grow Act of 2005, and more specifically in the Growth Plan for the Greater Golden Horseshoe (i.e. GGH Growth Plan) released in 2006.

Figure 10: A map showing the regional boundaries of the Greater Golden Horseshoe. (Hemson Consulting Ltd., 2012)

The GGH Growth Plan *encourages* municipalities, conservation authorities, planning authorities and ENGOs to identify natural heritage features, develop protection policies, develop systems of accessible

parkland and trails and the establishment of green spaces in urban areas (Ontario Ministry of Infrastructure, 2013b). In addition, there are guidelines on how to develop greenfield areas, for example ensuring specific density targets are reached to ensure the land is being used optimally. The language used within this document does not require any of these activities to take place, however, and thus the extent to which natural heritage designation, maintenance and protection occurs in the face of increasing environmental pressures is left up to the discretion of each region. The current deadline for the incorporation of intensification and density targets into municipal official plans is June 2018 (Hemson Consulting Ltd., 2013).

3.3 Peel Public Health: Mental Health Promotion

Although health promotion is a key pillar of public health, it is viewed through a limited evidence-based lens. This means that goals, projects and programs are decided upon based upon evidence-based science providing solid cause and effect relationships, e.g. a decline in active transportation and increase in sedentary lifestyles makes someone more susceptible to obesity (Manson et al., 2004). While some factors related to mental well-being can be explained by these clinical trials, for example by looking at the physiological effects of stress, the subjective experience of mental well-being cannot be measured this way. This provides a barrier between being able to practice mental health and well-being promotion at the level of the public health authority.

Therefore, due to the reliance on evidence-based double-blind clinical trials to provide scientific evidence to inform programming and public health direction, mental health promotion is not a key priority of Peel Public Health. However, mental health is still being promoted indirectly through the actions of Peel Public Health's program priority of ensuring that the "residents of Peel live in an environment which supports physical activity and healthy eating," (Region of Peel Public Health, 2014: 31). This program emphasises the importance of urban design that promotes active living and healthy

communities, for example through having complete streets, which would encourage walking (Complete Streets for Canada, 2012). The programming has four key focus areas under the title "Eat and Move," two of which are relevant to mental well-being, namely- moving for the enjoyment of it, i.e. if you enjoy gardening, make that your physical activity, and having urban design that is supportive of physical well-being (Region of Peel Public Health, 2012).

Although the regional public health authorities often do not deal in mental health promotion, the Public Health Agency of Canada (PHAC) does. PHAC defines mental health as "the capacity for each of us to feel, think and act in ways that enhance our ability to enjoy life and deal with the challenges we face," and mental health promotion as, "the process of enhancing the capacity of individuals and communities to take control over their lives and improve their mental health," (Public Health Agency of Canada, 2012). The publications produced by PHAC focus on specific vulnerable populations, like youth or the homeless, and focus on alleviating mental illness burdens, such as depression (Public Health Agency of Canada, 2014). Therefore, it appears that the main focus of PHAC's mental health promotion strategies is from a diagnostic point of view.

This is also the focus of the Canadian Mental Health Association (CMHA), whose mental health promotion strategy focuses on developing and strengthening community supports; providing adequate mental health services; developing healthy public policy; improving housing, employment and social outcomes; and building the skills base of individuals (CMHA, 2008). Given that the three primary determinants of mental health include "social inclusion, freedom from discrimination and violence, and access to economic resources," (Keleher & Armstrong, 2006: 6), it makes sense that environmentally-based mental health promotion is not a key priority.

Although not a priority, the CMHA does recognise the importance of involving the natural environment in some of its programming. The CMHA has paired with Conservation Ontario to run the Mood Walks

program, which promotes spending time in nature to alleviate negative mental health symptoms. This provincial program is catered to adults with mental health issues who are aged 50 and above (CMHA Ontario, 2013). Mood Walks fulfils the mandates of both the CMHA, who deals largely with individuals who have already been diagnosed with mental health issues, and Conservation Ontario, who wants to promote the use of conservation areas.

Mood Walks is a step in the right direction toward promoting individuals to spend time in mentally healthy environments. However, the fact remains that the setting for environmentally-based mental health promotion is not in the public health realm at present, but lies in the abilities and prerogative of environmental managers, environmental designers and city planners to incorporate environmentally-based mental well-being into their work.

3.3 Special Purpose Bodies

Special purpose bodies (SPB) are local governmental organizations that cross political jurisdictional boundaries that are both connected to municipalities, and separate from them (Sancton, 2011). They are legislated by the provincial government, and often serve a single purpose, such as policing, transit or schooling (Sancton, 2011). The special purpose bodies of interest in this research include public health units and conservation authorities.

Both public health units and conservation authorities in Ontario are considered to be "inter-municipal special-purpose bodies," (Sancton, 2011). CAs are guided by a board of directors comprised of municipally appointed representatives from different municipalities within the participating watersheds (Sancton, 2011). CAs, such as CVC, are not reliant upon provincial funding, but instead derive their funding primarily from regional and municipal members (76%), secondarily from user fees (17%) and tertiary funding comes from the CVC Foundation (CVC, 2014b).

Similarly, public health units in Ontario are linked to the municipalities in which they work (Sancton, 2011). The board members and Medical Officer of Health are generally appointed by the province, while the funding for programs comes from both provincial and municipal sources (Sancton, 2011).

All of these local governance structures play a key role in contributing to the health of the environment and the populous. The special purpose bodies encourage inter-municipal communication, however it is not always an easy process.

3.4 Credit Valley Conservation

The Conservation Authorities Act was passed by the province in 1946, after pre-existing environmentally-concerned groups expressed concern over rapid degradation and failed management of the environment (Conservation Ontario, 2013). Conservation authorities (CAs) were designated as community-based advisory boards that were to act as conservators, managers and regulators of natural resources on the watershed level (Conservation Ontario, 2013). At present, there are 36 CAs in Ontario, the majority of which are located in southern Ontario.

Credit Valley Conservation (CVC) was formed in 1954 (CVC, 2014a), just a few months prior to the landing of extra-tropical storm Hazel, which reaped havoc on the infrastructure and lives of those living in and around the GTA (TRCA, nd). CVC is overseen by a board of directors (BoD) that is comprised of 12 appointed persons, who represent the different municipalities within the watershed as councillors or mayors. The distribution of seats on the BoD of a CA is dependent on the municipality's population, as defined in the Conservation Authorities Act (Ontario, 1990). Though the BoD for CVC previously held positions for community members, in recent years, the board has been reduced in size and now lacks community representation. This BoD is responsible for developing the CVC's strategic plan and vision, and ensuring that it is followed through (CVC, 2006).

CVC is legislated under the Conservation Authorities Act to study and manage the watershed in conjunction with other governmental agencies to prevent flooding and pollution, to acquire lands to fit that end and to be used for recreational purposes, and to research and evaluate their ability to manage the environment successfully (CVC, 2006).

Within this mandate, CVC has the following 5 goals:

- Water Quantity- to balance the needs of the watershed with the needs of those living in the watershed
- Water Quality- to ensure the quality of all water in the watershed does not deteriorate
- Terrestrial and Aquatic Species, Communities and Ecosystems- to protect and promote ecosystem service functionality
- Natural Hazards- to protect people from water-based hazards
- Social and Economic- to adequately manage the watershed with social and economic well-being in mind

This research falls primarily within the last category, which aims to: "demonstrate through research and identify and promote the community benefits of the watershed system; and protect human physical, social and economic health as they relate to the natural environment" (CVC, 2006: 23).

Explicit human-environment connections are discussed more in the principles and values of the CVC, highlighting how "healthy communities require a sustainable balance between economic, social, natural and human uses in the watershed," (CVC, 2006: 23). This value, in conjunction with promoting "ecologically sustainable lifestyles and behaviours through sustainable urban design approaches and conservation practices," provides the basis for why this research is taking place within the Credit River Watershed (CVC, 2006: 24).

3.5 Municipal Context

In addition to hosting complex geographies, the watershed also crosses municipal and regional boundaries, thus requiring intergovernmental cooperation for adequate management. The municipalities present within the Credit River Watershed include: the Town of Erin, the Town of Halton

Hills, the Town of Mono, Caledon, Brampton, and Mississauga. Figure 11 shows the regional boundary of Peel, the municipal boundaries of Erin, Mono, Halton Hills, Oakville, Caledon, Mississauga and Brampton, and how the watershed boundaries intersect these political boundaries. Other political and organizational boundaries within the watershed will be presented later in this chapter.

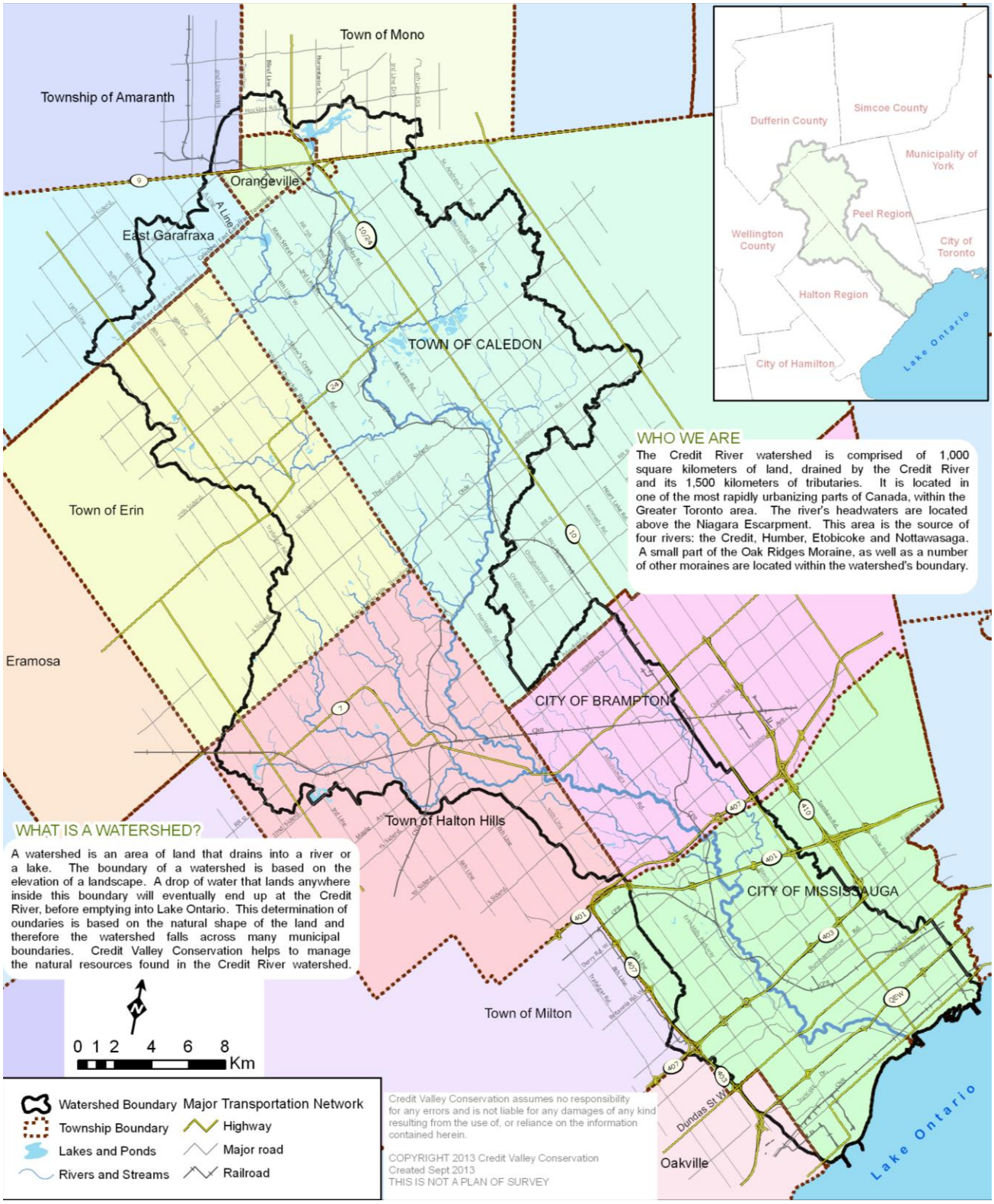


Figure 11: The municipal boundaries within the credit river watershed. Regional boundaries are visible in the top right corner of the map. Prepared by Paudel for the WSWB Survey (2014).

3.2.1 City of Mississauga

Mississauga is the sixth largest city in Canada, which is located on the northern shore of Lake Ontario (See Figure 11). It boasts over 713,000 people within its borders, hosting a wide variety of ethnicities and languages (Statistics Canada, 2011c). 47% of the population of Mississauga has a non-official language as their mother tongue, with 47.6% of the population speaking English as their mother tongue (Statistics Canada, 2012c). 66.4% of the population has achieved a postsecondary certificate, diploma or degree, with 11.6% of residents working in manufacturing industry and 11.5% working in retail (Statistics Canada, 2014d). The median after-tax income of residents is $75,141 (Statistics Canada, 2014d).

Originally a suburb of Toronto, Mississauga has since grown into its own distinctive urban area, which has fully developed the land within its borders. Mississauga is currently 292 square kilometers in area (Statistics Canada, 2011c), with an urban canopy that currently covers 15% of the city (City of Mississauga, 2011).

Mississauga's "Living Green Master Plan" (LGMP) encourages the continued development and maintenance of their natural heritage system, as "they are integral to clean air, land and water, support vital ecological functions and contribute to the health and spiritual well-being of Mississauga's residents" (City of Mississauga, 2012: 21). In addition, the LGMP encourages the development of regulations on how to protect and improve their natural heritage system in an effort to beautify the city, provide native habitat and ecological corridors, maintain genetic diversity and contribute to the well-being of residents and visitors (City of Mississauga, 2012).

3.2.2 City of Brampton

Brampton is located adjacent to Mississauga's northern border. The population of Brampton is approximately 524,000 people hosting a variety of cultures and languages, with just under 40% of the population speaking languages other than English at home (Statistics Canada, 2011a). The average pre-

tax household income for Brampton was just under $94,000 in 2010 (Brampton, 2013b). The average home value was $398,000 in 2010, with an 81.7% homeownership rate (Brampton, 2013b). Approximately 50.8% of the population of Brampton has gone beyond a high school education, e.g. has attended college or university or has done an apprenticeship or trades certificate (Brampton, 2013a). According to the 2011 census, residents of Brampton work most often in "sales and service" occupations, "business finance and administration" occupations, and "trades, transport and equipment operators and related" occupations (Brampton, 2013a).

Brampton contains 266.34 square kilometers of land (Statistics Canada, 2011a), 11% of which is covered by an urban canopy (City of Brampton, 2011). Not all of Brampton's land has been developed, and thus the city itself is still physically expanding through agricultural and natural lands. This provides Brampton with the opportunity to do many things in their new developments as it continues to grow, including:

- preserving pre-determined tracts of land to ensure large and small parks will be present with an appropriate distribution based upon perceived access and use
- putting pressures on developers to maintain some of the tree canopy that is lost during the building of residential neighbourhoods

3.2.2.1 Comparing Mississauga and Brampton

The cities of Mississauga and Brampton are facing considerable pressures. Between the 2006 and 2011 census, Brampton grew by 20.8% (Statistics Canada, 2011a) and Mississauga grew by 6.7% (Statistics Canada, 2011c), as compared with the national average growth rate of 5.9%. These increases in population size have put considerable pressure on Brampton and Mississauga to continue to develop land and intensify.

The growth pressures and development affect the ability of the natural environment to provide the same level of ecosystem services being previously provided. For example, in creating new neighbourhoods, previously permeable tracts of land are being compacted and paved, and existing trees

are being cut down. This results in a decreased ability for the area to deal with wet weather events, and reduces the carbon storage capacity of the area, respectively.

In addition, the challenge of designing, creating and maintaining natural features and spaces in Mississauga and Brampton are rather different. In Mississauga, the planning environment has changed into a "post-greenfield planning era," which means that the lack of remaining greenfield sites in Mississauga has shifted planning from greenfield development to intensification (Hemson Consulting Ltd, 2013). Therefore, new developments will come in the form of vertical developments like apartment and condo buildings, in an effort to absorb the increasing population and to increase density. However, with increased population density comes a different set of issues related to the environment. For example, locally available natural spaces can become overused, contributing to further environmental degradation, rather than enhancement.

3.2.3 Town of Caledon

Caledon is located along Brampton's northwestern border, covering a total of 688 square kilometers (Statistics Canada, 2012e). The town has a population just under 60,000 residents (Statistics Canada, 2012e) with an average income of over $88,000 per year after tax (Statistics Canada, 2014a). 61% of residents have achieved a postsecondary certificate, diploma or degree, with 13% of residents working in the manufacturing industry (Statistics Canada, 2014a).

3.2.4 Town of Erin

The Town of Erin is located to the West of Caledon, covering a total land area of just under 300 square kilometers (Statistics Canada, 2012a). The population of Erin was 10,700 residents in 2011 (Statistics Canada, 2012a). 60.2% of the population holds a postgraduate certificate, diploma or degree, with the primary industry being manufacturing at 13.8% (Statistics Canada, 2014b). The median post-tax income of residents of the region was $89,000 in 2011 (Statistics Canada, 2014b).

3.2.5 Town of Halton Hills

Halton Hills is located to the west of Brampton and Caledon and has a population of 59,000 people in 2011 (Statistics Canada, 2012b). The total land area of Halton Hills is 276 square kilometers (Statistics Canada, 2012b). The average income after tax in 2010 of households was approximately $90,400 (Statistics Canada, 2014c). 62% of adults hold a postsecondary certificate, diploma or degree (Statistics Canada, 2014c). Manufacturing (13.5%) and retail (11.2%) comprise the primary employment industries of residents in the area (Statistics Canada, 2014c).

3.2.6 Town of Mono

The town of Mono is located along the northwest border of Caledon, covering 277 square kilometers (Statistics Canada, 2012d). It had a population of 7,500 people in 2011 (Statistics Canada, 2012d). 61.3% of the population has achieved a postsecondary certificate, diploma or degree, with the major industries of employment in the area being manufacturing (12.9%) and retail (11.1%) (Statistics Canada, 2014e).The median after tax income of Mono residents was $95,000 in 2010 (Statistics Canada, 2014e).

3.6 Study Areas

The two study areas that were chosen for this project are located within Mississauga and Brampton. The methods for selecting these two study areas are discussed in section 5.1 of this paper.

Two study areas within the urbanised lower watershed were chosen for the pilot part of this project. These areas include Meadowvale, Mississauga and Fletcher's Creek, Brampton (the boundaries of which can be seen in Figure 12 and Figure 13 respectively, and their location within the watershed can be seen in Figure 11). The boundaries of these study areas (seen in Figure 12 and Figure 13) are based upon dissemination area boundaries from the 2006 census to align with the previous research done in the area by Conway and Shakeel (2012).

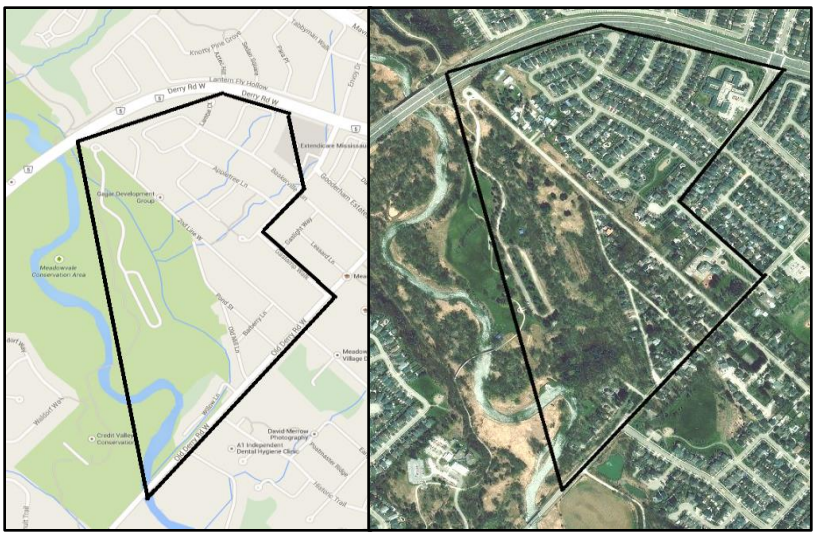


Figure 12: Two maps showing the boundaries of the Meadowvale, Mississauga study area. Left- Streets included in the study area, Right- satellite image of the study area.

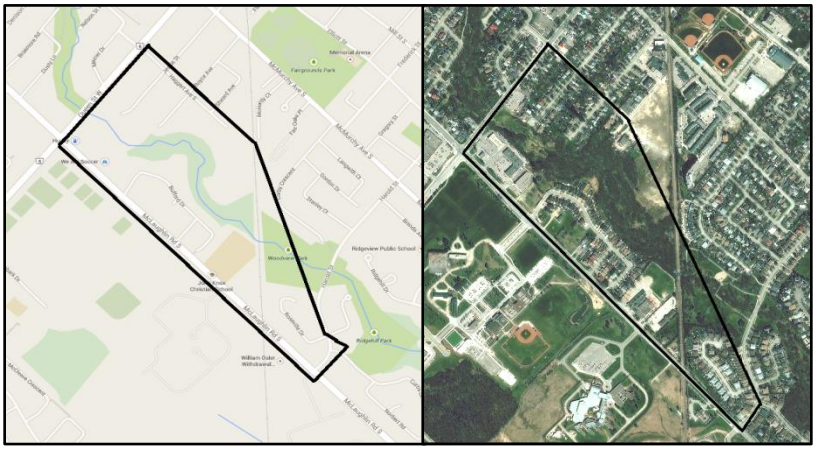


Figure 13: Two maps showing the boundaries of the Fletcher's Creek, Brampton study area. Left- Streets included in the study area, Right- satellite image of the study area

The two neighbourhoods are similar in the following ways: low-density housing, presence of a water feature in or adjacent to the dissemination areas, and being present in an urbanized part of the watershed. The differences between the two areas include: municipal designation (i.e. Brampton or Mississauga) and average household income. Some of the differences between the two study areas can be seen in Table 11, and further information can be found in appendices C and D.

Table 11: Characteristics of the two selected study areas

Characteristic	Meadowvale, Mississauga	Fletcher's Creek, Brampton
Dissemination Area (2006 Census Boundary)	1732	0231
Postal Codes in Area	L5W1A1, L5W1A5, L5W1W3, L5W1W4, L5W1W5, L5W1W6, L5W1Z1, L5W1Z2	L6Y1J7, L6Y1J8, L6Y1L7, L6Y1L8, L6Y2G2, L6Y2G7, L6Y2G8, L6Y3N3, L6Y3N4, L6Y4W1
Subwatershed	Credit River	Fletcher's Creek
Accessibility of Water Feature	High	Low
Average Household Income	$152,765 (Conway & Shakeel, 2012)	n/a
Household Types	Low-density residential	Low-density residential

Chapter 4: Research Context

The following chapter will discuss the work done prior to the commencement of this project and the overall research project within which this research is embedded.

4.1 Previous Research: CVC Human Well-Being Technical Report

CVC had previously conducted a study entitled the "The Importance of Ecosystem Services to Human Well-Being in the Credit River Watershed" (Green Analytics, 2011). This study had 4 goals:

- Discover how watershed resident's perceive the connection between parts of the environment and their well-being
- See how residents rank their satisfaction and importance of environmental attributes with ecosystem functions
- See whether there is a connection between demographics and what are the environmental priorities of the area
- Provide recommendations on how to move forward in evaluating relationships between the environment and well-being in the watershed (Green Analytics, 2011)

A survey was developed, and then conducted via an internet panel. A summary of results can be seen in Table 12.

Table 12: A table showing some of the results from the survey conducted as part of "The Importance of Ecosystem Services to Human Well-Being in the Credit River Watershed" report (Green Analytics, 2011)

Responses	
Yes, the environment is important to respondent's well-being	67.9%
Ecosystem services connection to well-being	
- Cleaning the air	91.2%
- Providing clean water	89.4%
- Scenic beauty	84.7%
- Wetlands and treed areas for regulating water flow	81.5%
- Protecting the environment for the future	84.2%
- Community belonging	71.5%
Willingness to contribute to bettering the watershed	
- Volunteer time for restoration projects	36.6%
- Restore a natural area on their private property	34.0%
- Donate money to conservation organizations	23.7%
- Other: pay taxes, keep park clean when visiting, vote for environmentally conscious politicians, use natural products, recycle, use the natural features of the watershed, educate others, lobby government officials	6.1%
Frequency of visits to natural areas	
- Parks and trails within walking distance	33.3%
- Parks and trails within driving distance	11.0%
- Other areas	negligible
Reasons for recreation	
- Scenic beauty	20.3%
- Hiking	13.3%
- Photography or birdwatching	7.6%
Health related recreation	
- Physical exercise	21.2%
- Stress relief	19.1%
- Restore concentration and productivity	11.3%

The study also compared the importance of and satisfaction with recreational opportunities, ecosystem services and natural areas for health purposes (see Figure 14). This shows how respondents were able to identify and relate to different activities, feelings or attributes of the environment, but does not show whether or how respondents connect natural features, ecosystem services and activities with relation to their well-being. Therefore, the results of this watershed-wide study prompted the development of the overall Watershed Well-Being Project, and subsequently, this research.

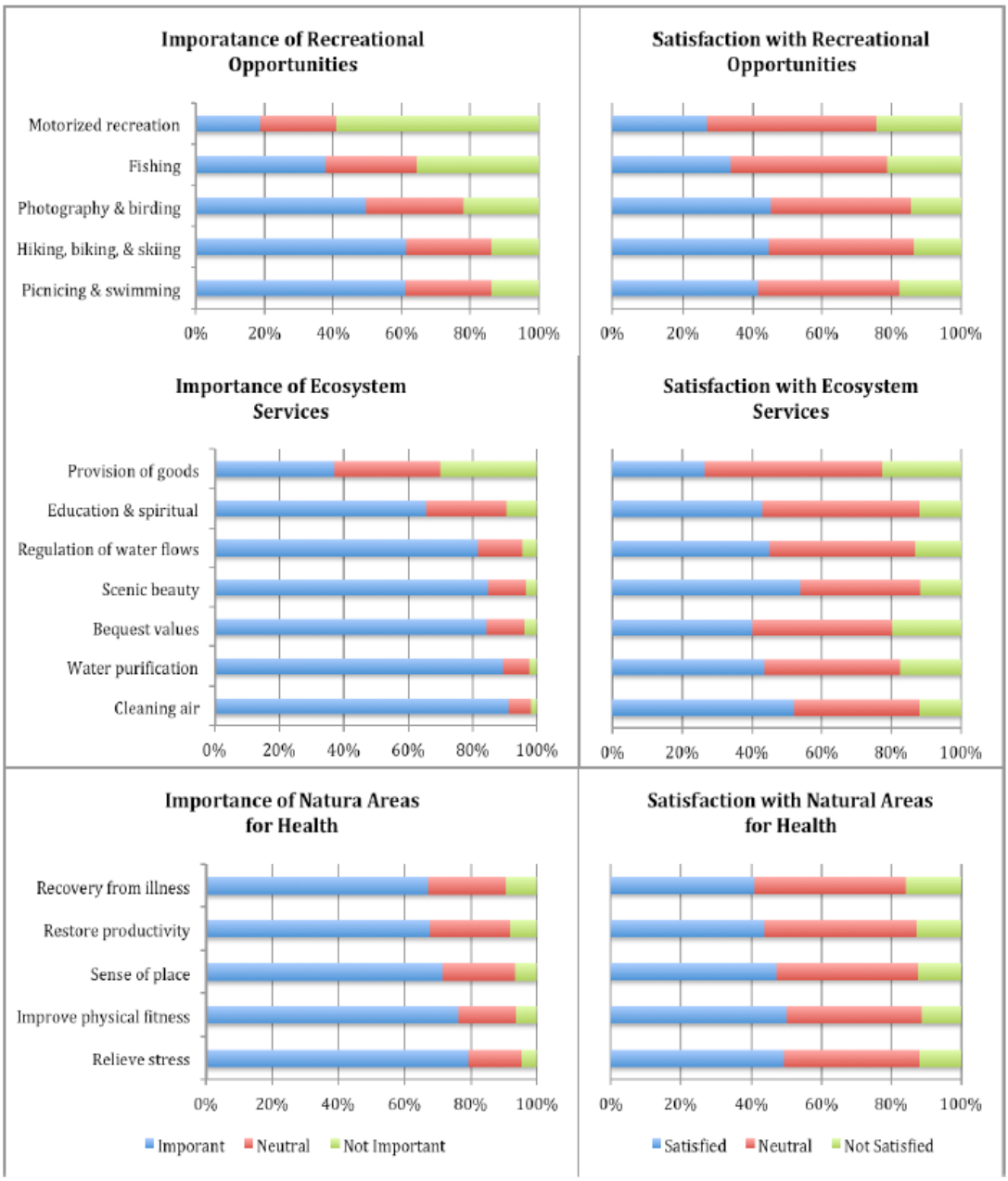


Figure 14: Comparing the importance of and satisfaction with environmental attributes for their contribution to well-being (Green Analytics, 2011: 18)

4.1.1 Recommendations

In order to further their understanding of the relationships between human-wellbeing and the natural environment, three recommendations about further research were made, including:

1. Explore how changes in the natural environment, e.g. deforestation of an area for building development, may affect the well-being of residents over time
2. Develop a way of monitoring and communicating human well-being and environment relationships
3. Conduct an institutional analysis of the watershed to determine which parties are in charge of which aspect of the environment and to what extent they are impact the environment

(Green Analytics, 2011)

This research, and the project within which it is embedded, is focussed on addressing point two- to develop a way of monitoring and communicating human well-being and environment relationships. The Green Analytics (2011) study provided a foundation for beginning this inquiry, by developing a preliminary conceptual framework that could be used to identify ecosystem-based indicators of well-being.

This indicator framework is based largely upon the Millennium Ecosystem Assessment's (2005) framework which was introduced in section 2.5.1 of this paper. The process involved in indicator selection and development is shown in Figure 15. This is the indicator development process upon which this overall research project is based, each of the stages of which will be described in turn.

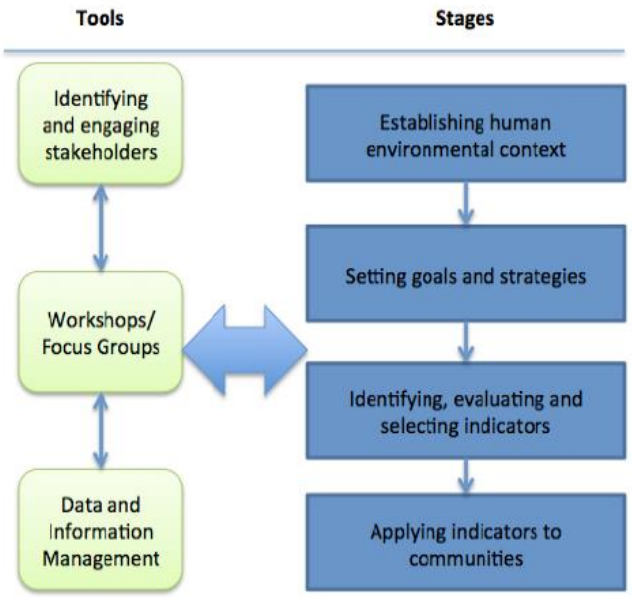


Figure 15: The tools and stages of an indicator framework development process (Green Analytics, 2011: 32).

4.1.1.1 Stage 1: Establishing the human-environmental context

In order to move forward with the different stages of indicator development, a general understanding of the relationships between people and the environment must be gained. The understanding of this relationship will be approached from two avenues: 1) look at pre-existing data that the CVC collects and how it can describe these relationships, and 2) discuss these relationships with other stakeholders that work in fields related to these relationships to ask how they interact with them (Green Analytics, 2011). This process will be dependent on how willing stakeholders will be to engage in this process, what scale the problems in the watershed are in comparison to the ability of the CVC to address them and how this inquiry could be tied into pre-existing or proposed projects within the watershed (Green Analytics, 2011).

4.1.1.2 Stage 2: Setting goals and strategies

In an effort to see how impactful these indicators could possibly be, it was proposed that the CVC should discuss the future of the watershed with stakeholders, specifically short and long term goals for the

management and care of the watershed (Green Analytics, 2011). This process could be undertaken from a top-down or a bottom-up approach, depending on what was the wanted outcome was (Green Analytics, 2011).

4.1.1.3 Stage 3: Identifying, evaluating and selecting indicators

After the goals and strategies have been decided upon, and the general human-environment relationships have been described, it is possible to decide upon a list of indicators that are equally relevant, viable and pertinent. Indicators can then be further refined based upon their ease of measurability and ease of use (Reed et al. 2006). In addition, indicators should be appropriate for the goal or strategy it addresses, it should be geographically relevant, and how the quantity and quality of the attribute the indicator describes may change over time should be understood (Green Analytics, 2011: 35).

4.1.1.4 Stage 4: Applying indicators to communities

After supporting the indicators with necessary data, it is then important to interpret and communicate what these indicators mean to other stakeholders and residents (Green Analytics, 2011). Guidelines about how each indicator will be interpreted should be established, for example through defining thresholds or using baselines or targets (Green Analytics, 2011). These guidelines will then be used in determining management action or inaction on things related to that indicator (Green Analytics, 2011). The status of these indicators in relation to their associated guidelines should then be shared with stakeholders and residents in an easy-to-understand fashion.

These stages guided this overall research project, which is introduced next in section 3.2.

4.2 Overall Project Context

This project is embedded within a larger project between York University and Credit Valley Conservation entitled “Human Well-Being, Ecosystem Services and Watershed Management in the Credit River Valley:

Web-Distributed Mechanisms and Indicators for Communication and Awareness." It has been partially funded and supported by the Water Economics, Policy and Governance Network (a SSHRC Partnership Grant), Credit Valley Conservation, the University of Guelph and York University.

The project team includes the following individuals:

Credit Valley Conservation:
- Mike Puddister, Director of Stewardship and Restoration
- Tatiana Koveshnikova, Ecological Goods and Services Project Coordinator

York University Faculty, Faculty of Environmental Studies:
- Dr. Martin Bunch, Professor
- Dr. Karen Morrison, Adjunct Professor

York University Graduate Students, Faculty of Environmental Studies:
- Alexandra Belaskie, MES Candidate 2015
- Julie Mallette, MES Candidate (Planning) 2014
- S. Mitchell Harrow, MES Candidate 2015
- Iftekhar Ahmed, MES Candidate (Planning) 2015

(This project is ongoing and thus is acquiring 2 new students per year for the foreseeable future.)

This project is designed to take the CVC's integrated watershed monitoring program to a new level. Since 1999, the objective of the integrated watershed monitoring program (IWMP) has been to *"promote the social and economic health of the community through effective watershed management"* (Strategic Plan, 2006: 22). This IWMP has focussed on collecting, interpreting and reporting on various attributes of the watershed's health, including water quality and invasive species, for example. This information is used to monitor the effect of CVC's actions within the watershed. At present, there is no active monitoring system set up to monitor the effects of watershed management on the health and well-being of residents living within the watershed. Therefore, this project aims to fill that gap by creating a way of monitoring how a) the watershed environment and b) CVC's management affects human well-being.

In order to achieve that goal, this project is working on identifying "ecosystem-based indicators of well-being" connecting human well-being parameters with biophysical measures. These indicators will then be displayed on an interactive web-based GIS map tool that will serve the dual purpose of management and forecasting, as well as public education.

Since the beginning of the project, our team has:

- Constructed a framework linking human well-being, watershed management and ecosystem services
- Established a few ecosystem-based indicators of well-being
- Designed, administered, and analysed a door-to-door survey in two pilot neighbourhoods
- Started developing the online map tool
- Shared project goals, present outcomes and projections with wider academic and non-academic audiences at conferences, meetings and through newsletters to residents

As this project continues into the next budgeting term, it will aim to:

- Complete the first draft of the website and test its approachability and content with residents and stakeholders
- Continue to develop, define and refine ecosystem-service based indicators of well-being (ongoing)
- Start to use the tool to evaluate current management practices as they relate to resident well-being
- Integrate findings into the annual Watershed Report Card

The role of my research in this project is to establish a locally-relevant connection between mental well-being and the environment that can be represented in part on the online tool, and provide narrative to the CVC about potential implications of management decisions on mental well-being.

4.2.1 Overall Research Project Progress

As the research in this paper has been progressing, so has the overall research project. This project has followed the indicator progression framework that was described in section 3.1.1 of this paper.

During meetings throughout the summer of 2013, Dr. Karen Morrison (of York University), presented an adaptation of the MEA Framework (as seen in Figure 6) that was catered to the "Adapting Mosaic"

scenario, which centres around the watershed context (MEA, 2005). The relationships she discussed are presented in Table 13. This presentation was used as a starting point to explore the relationships between ecosystem services and human well-being in the context of the Credit River Watershed (the study area for this project).

Table 13: Adaptation of MEA Framework to a watershed context (Morrison, 2013)

Component of Well-Being	Relationship to a Watershed Context	
Security	Changing Hydrology Flooding and Drought Water and Food Security	Sustainability and Adaptation to Climate Change Water Wars and Peace-Building
Basic Material for a Good Life	Drinking Water Industrial and Agricultural Water Virtual Water Food, Lumber, Aggregate	Fertile Soil Clean Air Rain
Health	Safe Drinking Water Swimmable, Fishable Water	Recreation Mental Health
Good Social Relations	Social Justice Equity (upstream vs. downstream, payments for environmental services, water allocation, canopy distribution)	Access Community-Building Inter-jurisdictional equity Intergenerational equity
Freedom of Choice and Action	Empowerment Access to Information	Watershed Governance

This framework was used to brainstorm preliminary indicators to guide subsequent inquiry in the project (see Table 14). Each indicator was then investigated to see what data already existed, what information is missing and how they could possibly visualised on the online map tool. As the existing data was determined insufficient for the proper development of the indicators, further data needed to be collected from stakeholders and residents to move forward. Thus, a small-scale pilot survey was developed (see section 5.3 for more information on survey development and administration).

Table 14: This table shows a list of preliminary indicators discussed amongst the research group and others at a meeting at the University of Northern British Columbia in June, 2013.

Water Quality Index	Pattern of Land-Use	Water Allocation
Water Security	Flood and Drought Risk	Canopy Distribution
Quantity and Quality of Water	Access to Green Space	Mental Well-Being
Park Connectivity	Stewardship	Recreation
Safe Drinking Water (Actual vs. Perceived)	Fish Consumption	Quantity and Quality of Green Space

During the months that the survey was being delivered, other team members started working on the online mapping tool, which can now be seen online at http://cvc.juturna.ca. The home screen of the website is visible in Figure 16, and a screen shot of the map tool can be seen in Figure 17.

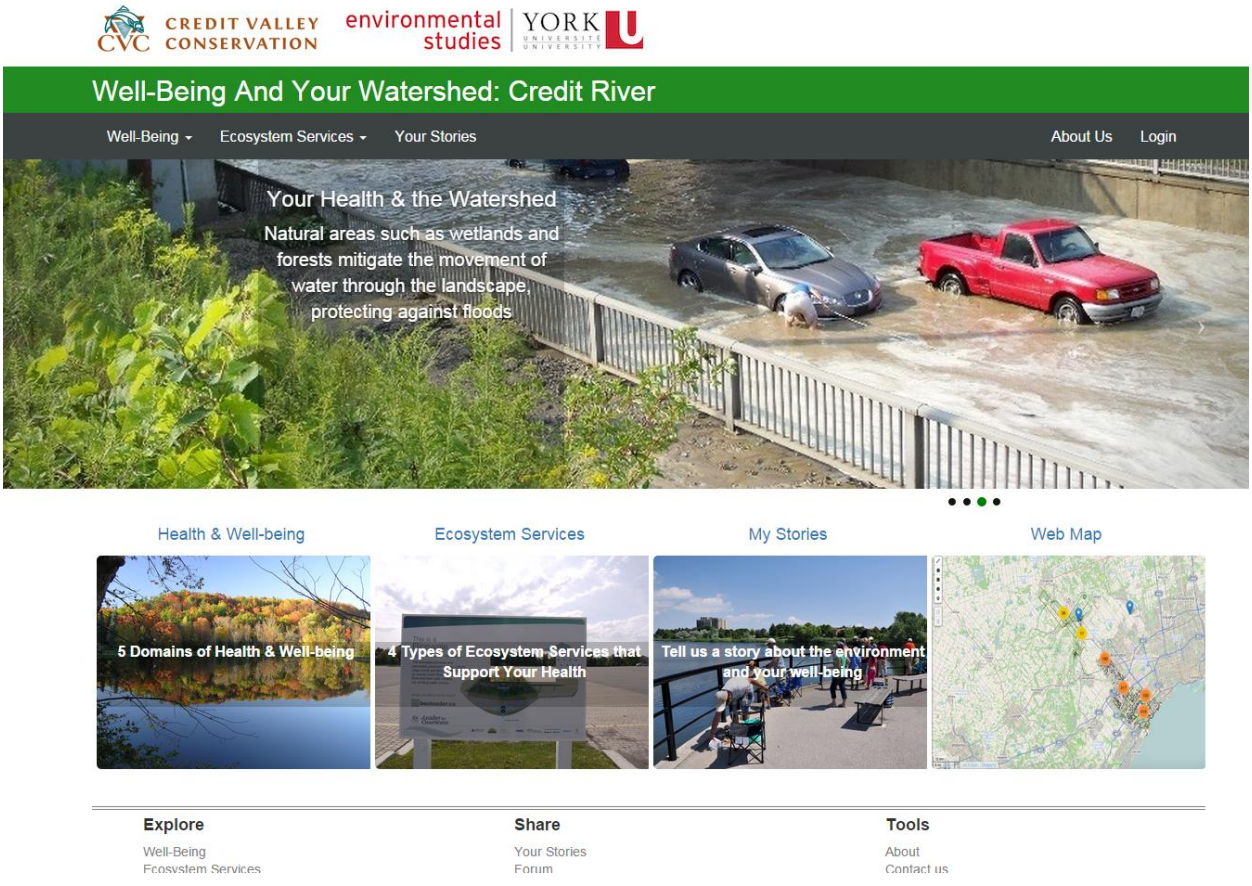


Figure 16: The home screen of the Watershed Well-being browser website.

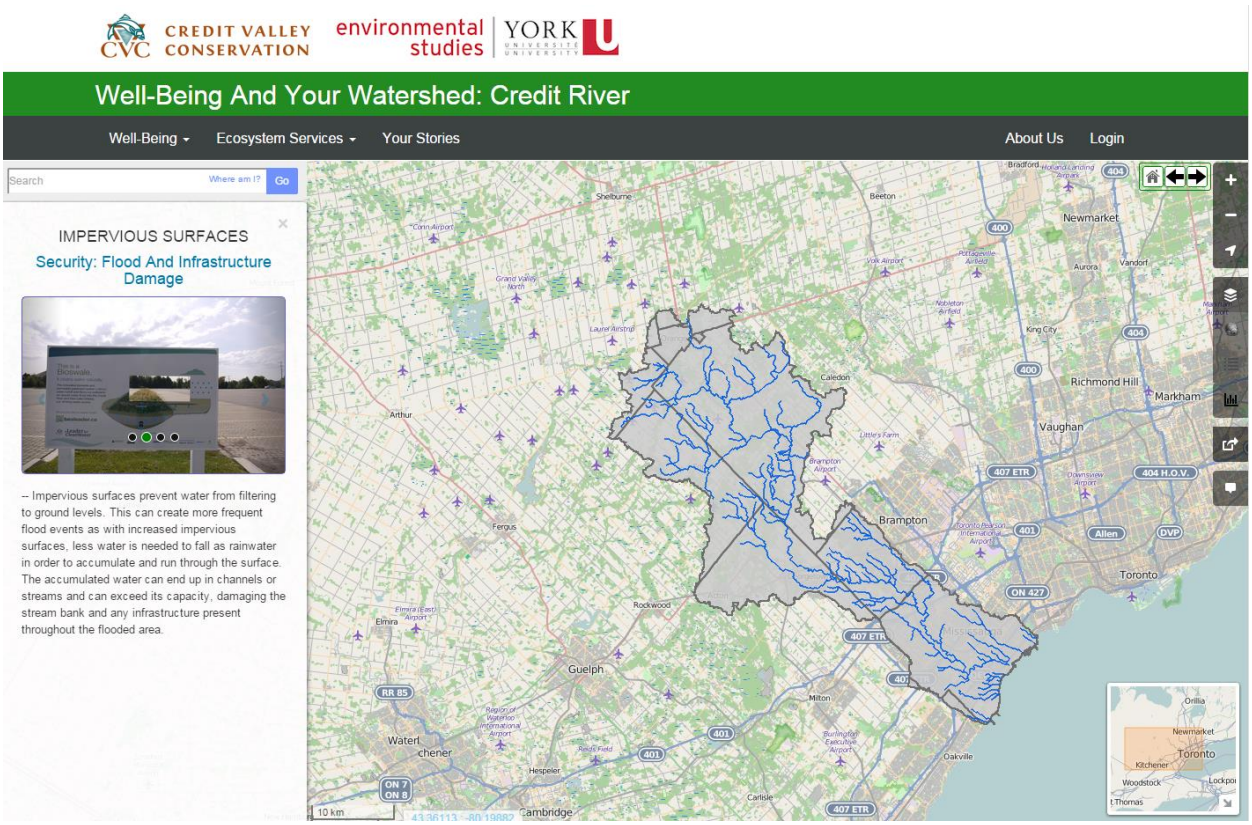


Figure 17: A screenshot of the map for the Watershed Well-Being browser.

The results from the watershed well-being survey (see Chapter 6) will inform what data is used in the map tool. This tool will be made available to the public and to stakeholders to explore the status of human well-being and natural environment connections within the watershed. As of May 2015, this browser can be considered to be a beta version.

This chapter has introduced the context for this research being conducted, including the previous work done by CVC and ongoing research being conducted jointly by CVC and York University. The following chapter will discuss the various methodologies used in this research.

Chapter 5: Methods

This chapter entitled “Methods” will showcase the various methods employed in conducting this research, starting with the neighbourhood selection; the design, implementation and analysis of the Watershed Well-Being Survey using R.

5.1 Neighbourhood Selection

The overall research project intended on using the survey as a pilot study in selected parts of the watershed. Therefore, the research group had to decide upon two small areas in which to administer the survey.

In anticipation of using the survey data on a map, it was decided that the geographic boundaries of the study areas should be based upon postal code and dissemination area boundaries. This also helps when wanting to compare survey data to census data.

In an effort to ensure the comparability and relatability between the two study areas in this study, it was decided that the land use of the two areas should be the same. Therefore, the prospective study areas were all in urban areas. This was not done in an effort to discount rural opinion in the watershed.

A list of five prospective study areas was aggregated. These five areas were selected based upon the following criteria: importance of the area to CVC and whether there are previous studies conducted in the area that can be drawn upon for comparison in the future. As resident opinion about the trees and tree canopy in Mississauga is of interest to the Region of Peel and CVC, Conway and Shakeel’s (2012) Trees and Residents report provided inspiration for four of the prospective study areas. In addition, CVC had expressed interest in conducting a Sustainable Neighbourhood Action Plan (SNAP) in the Fletcher’s Creek and Ridgehill area of Brampton, so that area was chosen as our fifth prospective study area.

A graduate student colleague and I attended each of the five prospective areas, and collected information on the physical neighbourhood, including the general size of the trees, the general home size to property front ratio, whether there were sidewalks and the type of water drainage infrastructure, for example. We combined this information with various demographic characteristics to produce the "Choosing a Target Neighbourhood" document which can be seen in Appendix B.

After collecting this information, it was decided that the project would be rolled out in two different dissemination areas with potential for expansion, depending on available time and resources. The two couplings of neighbourhoods included: Lakeview and Mineola, or Meadowvale and Fletcher's Creek. These areas were chosen based upon differences in average household income, whether there was a waterway running through the dissemination area, the state of the trees and whether there were nearby forest or water monitoring stations. This information can be seen in Appendix C.

Ultimately, Meadowvale and Fletcher's Creek were chosen as the study areas for the survey. One of the other study areas had previously undergone a flooding event that caused a strained relationship between residents and CVC. Therefore, it was deemed that Meadowvale and Fletcher's Creek would suit this study the best to prevent the survey administrators from interacting with potentially irate or unsettled residents.

5.2 Deciding on Methods

5.2.1 Deciding on the type of data collection

As more information was required for the study, the research group needed to decide on what format the survey would take, i.e. structured interviews or questionnaires.

5.2.1.1 Questionnaires

Questionnaires often take the form of a paper document that respondents fill out individually. They can contain both open-ended questions allowing free responses and close-ended questions with pre-

determined answer categories (Key, 1997). Oppenheim (1992) identified the following potential disadvantages to using a questionnaire:

- Faulty design
- Sampling and non-response errors
- Biased questionnaire design and wording
- Respondent misunderstanding the question
- Errors in coding, processing and statistical analysis
- Faulty interpretation of results

However, questionnaires have their advantages as well. Each question is asked in precisely the same way, allowing for maximum comparability between responses (Key, 1997). In addition, since an interviewer is not present at the time of the questionnaire being completed, i.e. respondents complete questionnaires individually in their own time, respondents may not fall into social desirability biases.

5.2.1.2 Structured Interviews

On the other hand, structured interviews provide an alternative method of data collection. There is a lot of control over how structured interviews are delivered to ensure as much comparability between respondent's answers as possible (Key, 1997). The advantages of using interviews include:

- Confusing or misinterpreted questions can be clarified by the interviewer present
- Can be used with illiterate individuals
- Respondents can respond to questions freely
- Interviewers can observe the behaviour of respondents (Key, 1997)

On the other hand, delivering structured interviews can prove costly, as interviewers need to be specifically trained and respondents need to be approached (Key, 1997). In addition, due to the amount of labour required for each interview, very large sample sizes are much more difficult to obtain (Bryman, 2008). Lastly, the interviewer presence could introduce social biases (Lakshear & Knobel, 2004), e.g. a respondent could respond in one way depending on what they think is the correct answer or one that will please the interviewer.

The survey that was developed for this study takes the form of a structured interview. This format was chosen to allow for the maximum amount of freedom in individual responses, whilst still retaining the ability to gather comparable results.

5.2.2 Deciding on a survey method

There are multiple different potential methods of survey delivery, including by mail, online, by telephone and in-person. Each of these different methods has their advantages and disadvantages (see Table 15).

Table 15: A table describing some of the advantages and disadvantages to different methods of survey delivery as described in Szolnoki and Hoffmann (2013)

Method of Delivery	Advantages	Disadvantages
Mail	Visual aids can be used Does not require interviewer to be present Can be completed at respondent's convenience Good geographical coverage Random sample achieved	Survey can occur in different order than intended Low response rate Longer time period
Online	Low cost High speed Visual, interactive and flexible Does not require interviewer to be present Can be completed at respondent's convenience	Requires initiative from respondent which may introduce a nonresponse bias Believed to be representative of subgroups only, not of general population Distortion of sample based on internet availability
Telephone	Low cost Good geographical coverage Personal interaction Random sample achieved	Interviewer bias Social desirability bias Low response rate Inability to use visual aids Distortion of sample based upon presence of land-line
In-Person	Based on personal interaction, so have a dynamic quality to them Clearly structured Flexible and adaptable Physical stimuli can be observed	Interviewer bias Social desirability bias High cost per respondent Geographical limitations Time pressure on respondents

Overall, online surveys are deemed to be the least representative style of survey delivery of the four methods mentioned, due to the fact that it cannot reach the entire adult population (Fricker et al.,

2005), often favouring the participation of young males (Terhanian, 2003) who are knowledgeable and opinionated (Duffy et al., 2005). In addition, respondents defer to 'don't know' responses and have a higher nonresponse rate with web surveys than other surveys (Heerwegh & Loosveldt, 2008). Online surveys also are inaccessible to individuals without computers or without the skill to use computers. Online surveys do, however, overcome the social desirability biases that are present in other methods that involve direct interaction (Duffy et al., 2005), and respondents are more likely to reveal sensitive information in this anonymous forum than face-to-face (Newman et al., 2002). The online method of survey delivery was not chosen, due to the fact that its advantages of use did not outweigh the disadvantages.

The research group aimed to complete the surveys within a short period of time. This eliminated the mail-out survey option, as it would likely take longer to mail out the survey, cost postage money for the delivery and return of surveys and the expected response rate would be low.

According to Groves (1979), people prefer face-to-face interviews over telephone interviews. In addition, it could also prove difficult to gain access to resident phone numbers in the watershed, as many numbers are not publicly listed, and others may not have a landline. Therefore, in an effort to reach as many residents as possible in the study areas, telephone-based interviews were eliminated.

In the end, the research team used an in-person delivery method as this worked best with the structured interview format. Due to the small geographic area of the study sites, the face-to-face method had the highest probability of producing a high response rate within a short period of time. It also provided an opportunity for the graduate students working on the project to gain valuable experience.

5.3 Watershed Well-Being Survey

5.3.1 Survey Instrument

The "Watershed Well-Being" survey was developed in response to the recommendations from a previous report entitled "The Importance of Ecosystem Services to Human Well-Being in the Credit River Watershed" (Green Analytics, 2011). The survey was developed to gather information from residents in the watershed about "environmental issues and priorities, community needs, preferences and misconceptions, effective ways to communicate information as well as possible indicator uses" (Koveshnikova, 2013). The survey was developed by another graduate student, Julie Mallette, and I over a 3-month period ending in October 2013. One of the final drafts of the survey was tested on a variety of friends, other graduate students and colleagues at Credit Valley Conservation who were not affiliated with the project. The survey and post-survey materials can be found in Appendix G: "Watershed Well-Being" Survey—Human well-being, ecosystem services and watershed management in the Credit River Watershed.

The final survey tool was comprised of a variety of questions under the following headings: Watershed IQ, Natural Environment, Understanding of Environment and Well-Being Relationships, Ecological Goods and Services, Social and Mental Well-Being, Values and Personal Characteristics, Demographics and Neighbourhood Characteristics. The questions were in a variety of formats, including open-ended questions, yes or no questions and likert scale questions. This research reports on the mental well-being component of the larger research project, the questions of which that are directly or indirectly related to mental well-being can be found in Table 16.

Table 16: Survey questions that illicit a response related to mental well-being (WSWB Survey, 2014)

II_1: We want to know about outdoor areas you may visit. a) Do you visit forested areas, wetlands and meadows? Why do you go there? How often? b) Do you visit city parks or public gardens? Why do you go there? How often? c) Do you visit green spaces at school grounds, cemeteries, golf courses and hospital grounds? Why do you go there? How often? d) Do you spend time in home gardens and yards? Why do you go there? How often? e) Do you visit rivers, streams, ponds and lakes? Why do you go there? How often?
II_2: Do you benefit from having street-side features such as trees and flower planters in your neighbourhood?
III_1: Do you think there is a link between your well-being and your local natural environment?
III_2: On a scale from 1-5, where 1 is "Not at all" and 5 is "Very Much", do you feel as if the following contribute to your well-being? If so, in what ways? a) Streams and rivers in your watershed b) Wetlands and forests in your watershed c) Open green spaces in your watershed
III_4: Do you actively take an interest in your neighbourhood environment, for example by planting trees, adopting-a-trail or attending organized events related to the environment? If so, what do you do?
V_1: Mental well-being relates to your productivity, concentration, stress and satisfaction with life. Is your mental well-being affected by your outdoor environment? Why?
V_2: On a scale from 1-5, where 1 is "Strongly Disagree" and 5 is "Strongly Agree," to what extent do you agree with the following statements about your mental well-being? a) I am satisfied with my life b) I feel like I lead a stressful life c) When stressed, I often seek out natural areas as a setting for relief, i.e. I go to a park d) I regularly go on walks through or sit in natural areas to relax e) I feel more relaxed about spending time in manicured green space including parks and public gardens f) I feel more relaxed about spending time in non-manicured green space including wetlands, forested areas and meadows g) I feel more relaxed after spending time in school grounds, cemeteries, golf courses and hospital grounds h) I feel more relaxed after spending time in private green spaces including home gardens and yards i) I feel more relaxed after spending time in spaces with street-side features including trees and flower planters j) I feel more relaxed after spending time near water features including rivers, streams, ponds and lakes k) I feel more relaxed when looking out of windows at green or natural areas

In an effort to encourage participation in the survey, an incentive was provided. Each respondent who completed the survey was given the opportunity to enter into a prize draw for one of ten $50 Visa gift

cards. At the conclusion of the study, a random number generator was used to select the winning participants. Six of the ten contacted winners claimed their prize.

5.3.2 Survey Delivery

The survey was administered orally via in-person door-to-door semi-structured interviews in the Meadowvale and Fletcher's Creek study areas. This study conducted surveys door-to-door based upon the higher response rate achieved in previous studies when using an in-person survey delivery method (see Table 17). The number of surveys required for each study area, i.e. the representative sample required, was calculated using a 90% confidence interval and a 10% margin of error for each area.

Table 17: Response rates using varying surveying methods

Name of Study	Who Conducted the Study	Type of Survey	Number Contacted: Number Completed	Response Rate	Participation Limitations
Lake Ontario Shoreline Survey: Uses, Attitudes and Perceptions of Restoration Options (Lura Consulting, 2012)	Lura Consulting	In-Person (approached at parks)	597: 305	51%	n/a
		In-Person (door-to-door in study area)	523: 175	33.5%	Difficulty accessing apartment buildings (underrepresented)
		Online	n/a: 110	n/a	Many incomplete (195 started, 110 completed)
The Importance of Ecosystem Services to Human Well-Being in the Credit River Watershed (Green Analytics, 2011)	Green Analytics in conjunction with Ipsos Reid	Online	n/a: 95	n/a	Households without computers may not be able to participate easily
Watershed Well-Being Survey (this study)	Graduate Students from York University	In-Person (door-to-door)	377: 107	28%	
		Written surveys	22: 6	27%	Some had incomplete answers

Prior to starting a day of surveying, each surveying team checked in with how each other were doing that day. In addition, at the end of each day when there was more than one surveying team working, the teams made an effort to share any interesting discussions or answers that had occurred that day. In this way, the whole surveying team was able to be supportive and encouraging of each other in our surveying work, develop friendships and improve surveying morale.

The survey was administered by a group of 6 graduate students. Each survey was given in groups of two, with one individual delivering the survey and the other transcribing what was said. On average, the surveys took between 15 and 25 minutes to administer (the longest being an hour) depending on who the respondent was, what kinds of answers they were giving and whether or not they remained on topic. For further information on survey etiquette, please see Appendix D.

Most of the demographic characteristics within the survey are self-explanatory, though some are not. The homeownership status of respondents refers to whether the respondent owns or rents their place of residence, and household composition refers to who all lives in their house, e.g. a couple with children.

After the completion of each survey, information about the person, property and its surroundings was recorded, including: the surveyed resident's gender, the number of trees present in a three-home span and their size based upon a visual assessment of how large they were; whether they had trees, shrubs or flowers in their front yard; if there was a sidewalk available on their street; whether their home was visually separated from the road (i.e. with a hedgerow or a fence), and the size of their front yard.

The initial surveying started in Meadowvale (Mississauga) in mid-October, and started in Fletcher's Creek (Brampton) in November. The initial survey response rate in Meadowvale was lower than expected, so a flyer (see Appendix H: Flyer) was distributed to each residence in Fletcher's Creek prior to surveying, which informed residents of our expected presence in the neighbourhood. This greatly

improved the initial response rate to our survey as compared with Meadowvale, as many residents told us they were expecting us.

Despite the initial spike in response rates, the surveying momentum died very quickly, and in the later weeks of surveying, it proved much more difficult to get responses. The teams went from getting five or six surveys in a six-hour weekend shift to getting two. To help boost numbers in Meadowvale, some paper copies of the survey were left with the resident to complete in their own time, and collected on a mutually agreed upon day later in the week.

5.3.3 Data Inconsistencies

In two cases, the data was altered slightly to ensure relevance. Some residents answered yes or no questions with "I Don't Know." In these cases, answers were changed to "No" as it was deemed more important to know whether respondents were confident in their answers about associations. The responses about how often people attended different kinds of natural spaces were standardised into a "days per year" format, which required changing subjective word-based frequencies into numerical frequencies (see Table 18). Frequencies with a definitive numerical value (i.e. every day) were given the appropriate value (i.e. 365), summer was assumed to be 4 months long and each month assumed to be 4 weeks long.

Table 18: A list of how frequency data was modified and standardized into the number of days per year format

Amount of Time	Assumed Frequency	Standardisation (# Days Per Year)
Rarely, Once in a Blue Moon, Not in a Long Time	2 times per year	2
Few Times in Summer	3 times per summer	3
Few Times	4 times per year	4
Occasionally, Once in a While, Sometimes, Not that Much, Not Often	1 time per 2 months	6
Several Times Per year	12 times per year	12
2-3 Weeks on the Lake Every Year	2 weeks per year	14
In Summer at Least Once on Weekends, Summer, Summertime, In Summer	1 time per week over 4 months	16
1-2 Times Per Month and 1 Time Per Week in Summer	1 time per month for 8 months, 1 time per week for 4 months	24
Weekends, Couple Hours Per Week	1 day per week	52
2 Times Per Week in Season, 2 Times Per Week When Weather is Good	2 times per week for 6 months	52
10 Hours Per Week	2 times per week	104
Few Times Per Week with More in Summer	2 times per week for 8 months, 3 times per week for 4 months	106
Frequently, Often, All the time, Always Outside	3 times per week	156
5 Times Per Week	5 times per week	260
Everyday	7 times per week	365

In addition, some respondents provided postal codes outside of the study area even though they were interviewed at home within the study area. In these cases, postal codes were altered according to the information in Table 19.

Table 19: A list of how mis-recorded or misidentified postal codes were modified

Mis-recorded or Misidentified Postal Code	Modification	Updated Postal Code
L5W1Z5	Assumed postal code to be the same as other surveys conducted that day	L5W1A5
L5W1G8	Unable to determine mistake	Marked postal code as a 'refused' answer and deleted entry
L6W1L7	Assumed typo- changed "W" to "Y"	L6Y1L7
L6Y1L6	Assumed typo- changed last "6" to "7"	L6Y1L7

Characteristics of the personal property and neighbourhood were also collected. Some of this information was lost. In instances where it was mis-recorded or lost, the respondent's postal code was looked up on google maps using the satellite view. The satellite view of the area was compared with the most common answers for neighbourhood features that were recorded for other respondents, and the best answer was then chosen to represent that respondent.

5.3.4 Limitations

In the past, Credit Valley Conservation has largely relied upon external consulting companies or full-time contract staff to conduct their surveys, including LURA Consulting, Green Analytics and the Pembina Institute, to name a few. These companies and individuals, collectively have more experience and expertise in designing and administering surveys than Julie Mallette and I. However, the experience of learning how to design and conduct surveys has proven invaluable, and the potential biases and inconsistencies produced by this novice practice are not thought to affect the overall outcomes of the survey.

The survey was conducted by a team of 6 graduate students. Each surveying team was composed of two people- one person who administered the survey, and one who wrote down the respondents' answers. Each individual was from a different cultural background, varying accents, varying demeanours and varying body language, which may have affected residents' responses. In addition, each individual had a different method of writing down responses, i.e. some wrote down answers verbatim, some synthesised answers, and some included side notes about stories being told by the respondent. These varying methods could introduce bias into answers provided by residents, and could result in some of the answers from open-ended questions being inaccurately grouped for analysis. These biases were not perceived to be large enough to greatly affect the interview responses.

The survey was administered between October 2013 and January 2014. Most surveys were delivered on the doorstep of the respondent's residence. As the seasons changed, the temperature dropped, the days got shorter and the local environment underwent various changes (i.e. the leaves on the trees dropped, and by the end of surveying, there was snow on the ground). This affected the study for both the interviewers and respondents. The interviewers experienced burnout faster as the temperature cooled and the amount of daylight shortened, as shifts were shorter. As the temperature dropped, respondents may have been less likely to donate their time to standing outside to complete the survey. In addition, the visible changes of one's local environment and the changes in activity as the seasons changed may have affected answers to questions related to the local outdoor environment. Had the surveys been conducted during warmer months, the response rate may have been higher with less call-backs.

At the beginning of our surveying process, it took a longer time to administer the survey. We initially asked respondents to donate between 25-30 minutes of their time to complete the survey. As the interviewers became more familiar with the survey, the time it took to deliver each survey was reduced to between 15 and 20 minutes. Some respondents who initially declined participation in the survey on the basis of time may have been more willing to participate had we been able to deliver the survey in 15 minutes at the start of surveying.

As our surveying continued, the response rate was declining, so the project team decided to hand out written surveys to respondents who requested a call-back, in an effort to gain our representative sample in each neighbourhood. These written surveys asked the same questions as the oral survey, but could be conducted by the resident at their leisure, and picked up from the front stoop of their home on days surveyors were back in the neighbourhood. Of the 22 surveys we handed out in Meadowvale, only 5 were returned. None of the written surveys were handed out in Brampton. There could be a difference

in responses based upon method of delivery. Some potential biases that could have occurred due to this mixed-method delivery are highlighted by Bowling (2005) outlined in Table 20: Potential biases by mode of questionnaire administration. Adapted from Bowling (2005: 284)

Table 20: Potential biases by mode of questionnaire administration. Adapted from Bowling (2005: 284)

Potential Biases	Face-to-Face Interviews	Self-Administered
Expected Survey Response	High	Low
Question order effects	Low	High
Social Desirability Bias	High	Low
"Yes-saying" Bias	High	Low
Willingness to disclose sensitive information	Low	High

The study areas were rather small (218 households in Mississauga and 159 households in Brampton). These numbers required an approximate 24%-30% response rate (approximately 1 response in every 3-4 households) to obtain our representative sample size for each area. As a result, the interviewing team had to go back to each area multiple times (up to 8 times) to get the sample required. This resulted in feelings of frustration and discomfort on the part of the interviewer in some areas where it seemed residents were no longer welcoming of our presence in the neighbourhood. In the future, it would be advised to have a larger geographic study area, which would require a proportionally smaller number of responses to obtain a representative sample size and reduce the number of call-backs required.

The cultural or familial background of some respondents affected the ability for us to conduct the surveys, as well. One participant did not speak English, so began the survey with her son translating for her, but then decided to quit the survey after a short time. In a few other cases, we had started the survey with a female member of the household, and then their male partner would come to stand with them part way through the survey process, causing a change in the dynamic between the researchers and respondent, resulting in altered answers.

5.3.5 Survey Analysis

After administering each survey, the data was inputted into an excel file that was shared confidentially between Julie Mallette and I. After being recorded, all paper response documents were stored at York University in a secure room. The results were coded, and then exported into R, an open-source statistical processing software.

Prior to full survey analysis, exploratory data analysis was conducted on the data. This approach to data analysis is largely visual, producing a variety of graphs to show potential trends, expose outliers, develop preliminary hypotheses about the data and test assumptions in ways that are not as clearly evident from statistical analysis (NIST/Sematech, 2013). In-depth statistical analysis of responses was then conducted on questions specifically pertaining to this paper.

To test for the strength of relationships and whether they were significant, a variety of statistical tests were conducted. The type of statistical test employed depends upon the type of variables being compared. Categorical variables contain two or more categories that contain mutually exclusive categories that are not continuous (UCLA Statistical Consulting Group, 2015). Ordinal variables contain two or more categories and have an intrinsic order, though the spacing between each value may not be consistent, i.e. likert scales (UCLA Statistical Consulting Group, 2015). Interval variables contain two or more equally spaced categories with an intrinsic order, i.e. 5, 10, 15, 20, and can either be normally or not normally distributed (UCLA Statistical Consulting Group, 2015). Table 21 outlines which tests are used depending on the type of variables being compared.

Table 21: Criteria for different statistical tests (Adapted from IDRE UCLA, 2014 and University of Sheffield, 2014)

Independent Variables	Dependent Variables	Test
None	Ordinal or Interval	Median
	Categorical	Chi-Squared Goodness of Fit
1 IV with 2 non-continuous groups (i.e. Mississauga or Brampton)	Interval and Normal (i.e. how many days per year someone attended a particular natural space)	T-Test
	Ordinal or Interval (i.e. likert scale answer)	Wilcoxon-Mann Whitney Test
	Categorical (i.e. ethnicity)	Chi-Squared Test
	Categorical (i.e. ethnicity)	Fisher's Exact Test
1 IV with 2 or more non-continuous groups (i.e. M/B or Postal Code)	Ordinal or Interval (i.e. likert scale answer)	Kruskal Wallis
	Categorical (i.e. ethnicity)	Chi-Squared Test
1 IV that is continuous or scalar (i.e. age)	Ordinal or Interval (i.e. likert scale answer)	Spearman's Correlation Co-Efficient
	Interval and Normal (i.e. how many days per year someone attended a particular natural space)	Pearson's Correlation Co-efficient
	Categorical (i.e. ethnicity)	One Way ANOVA
	Categorical (i.e. ethnicity)	Simple Logistic Regression
	Any	Simple Linear Regression

Each test tests for the validity of a null hypothesis that states the variables being compared are not related to each other. To determine if the null hypothesis is accurate or not, the p-value is determined. In cases where the p-value is greater than 0.05, the null hypothesis is accepted, which means that there is no relationship between the two variables being tested. In cases where the p-value is less than 0.05, the null hypothesis is rejected, which means that the relationship between the two variables is statistically significant and thus the variables are related.

5.3.5.1 Factor Analysis

The likert-scale questions explicitly related to mental well-being were selected for this analysis, including V_2_a through V_2_k. In an effort to discern whether there are underlying relationships between, or groupings of, these different questions and their answers, statistical tests can be utilized (Quick, 2011).

There are two possible methods of determining underlying covariance between different factors within the data, including principal components analysis and factor analysis. Principal components analysis (PCA) is a more simple method, which correlates different variables together without paying regard to the underlying structure of the variables (Costello & Osborne, 2005). Factor analysis is a more powerful tool that exposes covariance between factors by looking at the structure of the variables (Costello & Osborne, 2005). PCA exposes both shared and unique variance, whilst FA only exposes shared variance (Costello & Osborne, 2005). For the purposes of this research, FA was chosen as a method of determining factors due to its more specific nature.

Prior to conducting the factor analysis, the number of factors needed to be determined. If there were less than 2 factors, factor analysis is not viable. To determine the number of usable factors, a scree plot was produced. According to Easton and McColl (2012), a scree plot is "a graphical display of the variance of each [factor] in the dataset which is used to determine how many [factors] should be retained in order to explain a high percentage of the variation in the data." The number of potential factors is equal to the number of questions inputted, e.g. if 11 questions were inputted, then there are 11 possible factors.

The scree plot has the number of factors on the x-axis, and eigenvalues on the y-axis. An eigenvalue describes the amount of variance that is present between factors (Pennings, Keman & Jeinnijenhuis, 2006). The resultant scree plot is a hockey-stick shaped plot with a steep slope that breaks at some point to flatten out. There are two possible ways of interpreting the scree plot to determine which factors account for the greatest amount of variance in the data- either by counting the number of points prior to the break in the slope of the scree plot, or by counting the number of points that have an eigenvalue greater than 1, which is known as the eigenvalue-one criterion or Kaiser criterion (Costello & Osborne, 2005). In the case of this research, the latter option was chosen.

Prior to conducting the factor analysis function itself, the rotation of the plot must be determined. Orthogonal rotation functions assume there is no correlation between the different factors being represented, while oblique rotation functions assume there is a correlation between the different factors being represented. For this project, it is assumed there is a correlation between the various factors related to MWB, so an oblique rotation function (i.e. oblimin) was used.

After the number of factors is determined by the scree plot, factor analysis can be conducted. Factor analysis produces a standardized loadings pattern matrix, which is used to determine to what factor each question belongs. For the purposes of this project, loading values that are $\geq |0.3|$ are considered significant and contribute to that factor.

These factors were then amalgamated into individual scores, i.e. the likert-scale answers to questions related to each factor were added, then divided by the number of questions to determine factor scores. These factor scores were used in comparison with various demographic and other characteristics to determine relationships.

5.3.5.2 Environmental Index of Mental Well-Being

In an effort to determine a method of monitoring ongoing effects of CVC's management on resident mental well-being, an environmental index of mental well-being could be used. The term "environmental" refers to features of the natural landscape in and around each respondent's property. The design of this index was inspired by Mallette's (2014) work in creating an Environmental Social Well-Being Index.

The creation of this index is based upon the categories defined during factor analysis, including Wilderness and Personal Spaces, Relaxing Activities and Designed Spaces categories, in conjunction with whether respondents felt that outdoor spaces are important to mental well-being (see

Table 23). The Self-Reported State of Mental Well-Being factor was not included.

The Relaxing Activities component of the EIMWB combines the Relaxing Activities factor with the reasons why respondents went to particular natural spaces that were provided in questions II_1_a-e. The sum number of reasons respondents gave in questions II_1_a-e were recoded to be on a 1-5 scale based upon the distribution of responses (see Table 22).

Table 22: The number of qualitative answers respondents gave in questions II_1_a-e, and how they were recoded for use within the EMWBI

Number of MWB Reasons Listed	Categorical Scale	Score
0-1	Very Low (20%)	1
2	Low (40%)	2
3	Neutral (60%)	3
4	High (80%)	4
5-9	Very High (100%)	5

Table 23: Components of the environmental index of mental well-being (adapted from Mallette, 2014)

	Question Code	Survey Question	Operation	Combined
PA1 Wilderness and Personal Spaces	V_1_f (likert)	"I feel more relaxed after spending time in non-manicured green space"	As is	WPS= (V_1_f + V_1_h + V_1_j + V_1_k)/4
	V_1_h (likert)	"I feel more relaxed after spending time in private green space such as home gardens and yards"	As is	
	V_1_j (likert)	"I feel more relaxed after spending time near water features"	As is	
	V_1_k (likert)	"I feel more relaxed after spending time looking out of windows at green or natural areas"	As is	
Mental Well-Being Importance	V_1_a (yes or no)	"Do you feel that outdoor spaces are important to your mental well-being?"	V_1_a *5	MWBI=V_1_a*5
PA3 Relaxing Activities	V_1_c (likert)	"When stressed, I often seek out natural areas as a setting for relief"	As is	RA= (V_1_c + V_1_d + mental reasons)/3
	V_1_d (likert)	"I regularly go on walks through or sit in natural areas to relax"	As is	
	II_1_a,b,c,d,e (open-ended)	"We want to ask you about outdoor areas you may visit… why do you go there?"	Recoded mental well-being related reasons (see Table 36 for scoring)	
PA4 Designed Spaces	V_1_e (likert)	"I feel more relaxed after spending time in manicured green space such as parks and public gardens"	As is	DS= (V_1_e + V_1_g + V_1_i)/3
	V_1_g (likert)	"I feel more relaxed after spending time in school grounds, hospital grounds, cemeteries and/or golf courses"	As is	
	V_1_i (likert)	"I feel more relaxed after spending time in spaces with street-side features such as trees and flower planters"	As is	

The equation for the Environmental Index of Mental Well-Being (EIMWB) therefore is:

WPS+MWBI+RA+DS, and will be discussed further in section 6.6 and 7.4.

This chapter has described different methodologies employed in this research specifically related to neighbourhood selection and survey design, administration, analysis and interpretation. The subsequent chapter will present the results of the survey.

Chapter 6: Results

This chapter will explore some of the results obtained from the "Watershed Well-Being" survey (hereafter known as the "WSWB Survey (2014)") conducted by York University and Credit Valley Conservation. The components of the survey that will be focused on here include: demographic characteristics of respondents, values of respondents, neighbourhood characteristics and relationships between well-being and the natural environment with a specific focus on MWB.

Table 24: Representative sample size of areas where the survey was conducted (WSWB Survey, 2014)

	Meadowvale	Fletcher's Creek	Total
Number of postal codes in these areas	9	11	20
Number of single-family dwellings	218	159	377
Confidence Level	90%	90%	98%
Margin of Error	10%	10%	10%
Representative Sample Size	52	48	100
Actual Sample Size	57	50	107

In total, 107 household surveys were conducted (50 in Brampton and 57 in Mississauga) during the evenings and on weekends between October 2013 and January 2014 (see Table 24 for representative sample size requirements). In all statistical tests conducted, refused answers were removed, which affected the sample size. In instances where the sample size went below the representative threshold, it is noted. The reported results below that indicate a statistically significant relationship (i.e. $p<0.05$) are bolded.

6.1 Demographics

The demographic characteristics of the Fletcher's Creek, Brampton and Meadowvale, Mississauga study areas are outlined below (see Figure 18 and Table 25).

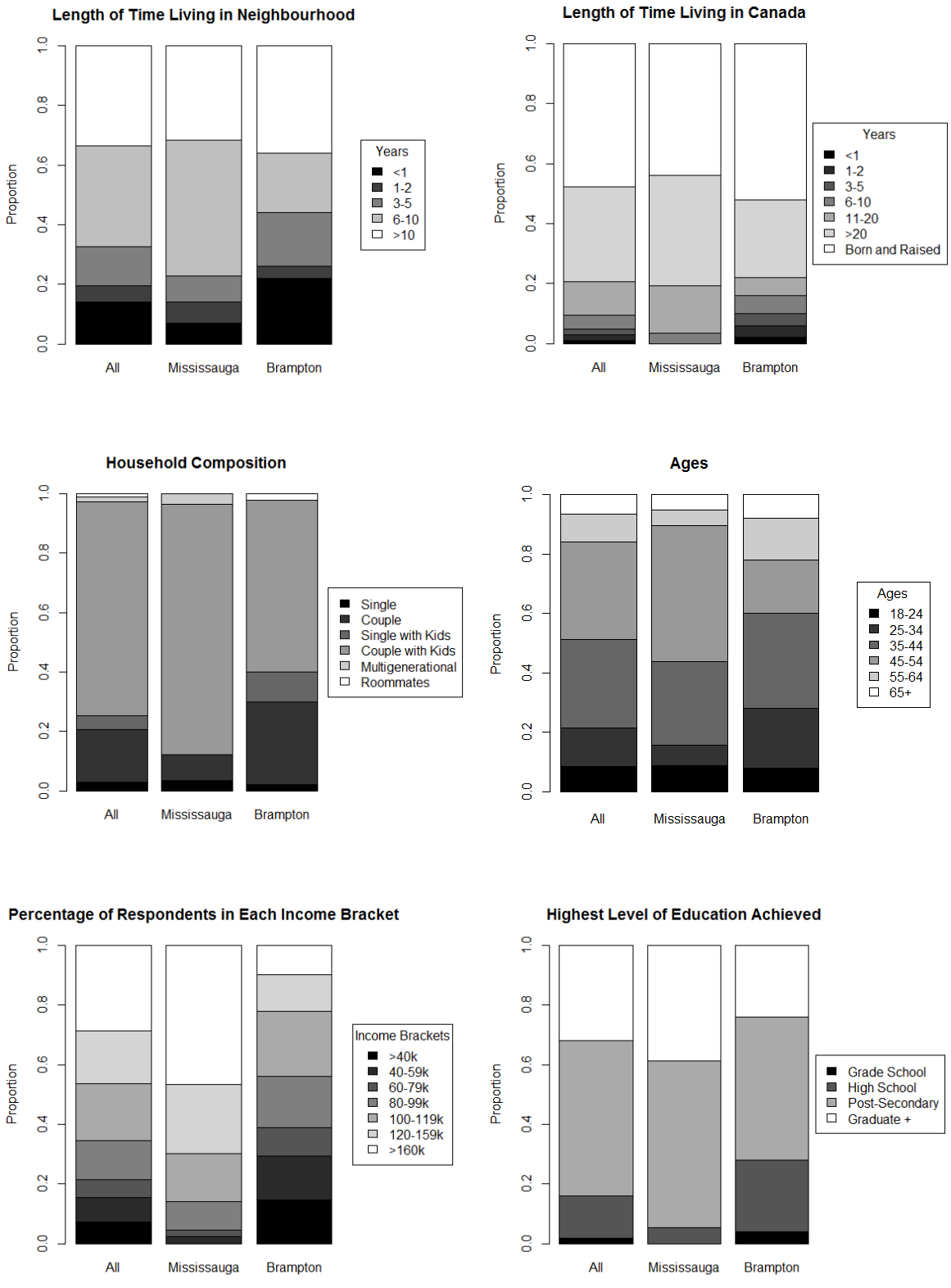


Figure 18: Comparison of respondents' demographic characteristics (WSWB Survey, 2014)

Table 25: Comparing demographic characteristics from WSWB Survey with other previously conducted studies (WSWB Survey, 2014; Green Analytics, 2011; Lura Consulting, 2012)

	Human Well-Being Report (Green Analytics, 2011)	LOISS Report (Lura Consulting, 2012)	Meadowvale, Mississauga (WSWB Survey, 2014)	Fletcher's Creek, Brampton (WSWB Survey, 2014)	Watershed Population (Green Analytics, 2011)
Mean Age	n/a	45-54	45-54	35-44	50% 34 and younger
Most Populous Ethnicities	European 55% S Asian 5% Canadian 24%	n/a	European 51% S Asian 19%	European 44% S Asian 14% Canadian 14%	European 51% S Asian 15% Canadian 10%
Years in Canada	Born and Raised	n/a	> 20 years	Born and Raised	n/a
Years in Neighbourhood	n/a	>15 years	6-10 years	6-10 years	n/a
Household Composition	Couple (Children not living at home)	n/a	Couple with Children	Couple with Children	n/a
Mode of Highest Level of Education	High School	Post-Secondary	Post-Secondary	Post-Secondary	Post-Secondary
Mean Income	>$80k	$60-149k	$120-149k	$80-99k	$90k

There were more male respondents in each area (Mississauga 53%, Brampton 61%) than female respondents. The average age of respondents in Mississauga was between the ages of 45-54, and 35-44 in Brampton. Respondents from both areas were likely to be either of European (51%) descent or South Asian (19%) descent (see Figure 18 for comparisons).

The distribution of the highest level of education in Meadowvale and Fletcher's Creek were significantly different (Wilcox p =0.006, W=1026; Kruskal p =0.006, χ^2= 7.552), even though the most frequent answer was 'post-secondary' (see Figure 18). Roughly half of the respondents from both areas were born and raised in Canada, with all respondents in Mississauga having been in Canada for at least 6 years, while Brampton primarily had respondents who had recently arrived in Canada less than a year prior to the survey. On average, Mississauga residents have lived in their neighbourhood for a longer period of time than those in Brampton.

There was a statistically significant difference between the two neighbourhoods with regard to income (Wilcox p =0.005, W=981.5; Kruskal p =0.005, χ^2=7.896). The Fletcher's Creek, Brampton neighbourhood had a large diversity of income levels, with the average falling in the $80-99,000 range, which is in line with the household average for the watershed, which is roughly $90,000 (Green Analytics, 2011). Meadowvale, Mississauga, however, has a much higher average household income than the watershed average, with almost half of its residents claiming household incomes greater than $160,000 per annum.

Table 26: Exploring differences in the demographic profile of Meadowvale, Mississauga and Fletcher's Creek, Brampton (WSWB Survey, 2014)

	Meadowvale, Mississauga (WSWB Survey, 2014)	**Fletcher's Creek, Brampton (WSWB Survey, 2014)**	**Comparison Tests**
Age	18-24: 9% 25-34: 7% 35-44: 28% 45-54: 46% 55-64: 5% 65+: 5%	18-24: 8% 25-34: 20% 35-44: 32% 45-54: 18% 55-64: 14% 65+: 8%	Wilcox p=0.362, W=1283.5 Kruskal p =0.361, χ^2=0.834
Ethnicity	S Asian: 19% E and SE Asian: 5% W Asian and Middle Eastern: 5% European: 51% African: 0% Central or S American: 4% Caribbean: 4% Australian and S Pacific: 2% Canadian: 2% Other/Mixed: 7%	S Asian: 14% E and SE Asian: 4% W Asian and Middle Eastern: 4% European: 44% African: 4% Central or S American: 2% Caribbean: 8% Australian and S Pacific: 2% Canadian: 14% Other/Mixed: 4%	Fisher p =0.361
Years in Canada	<1: 0% 1-2: 0% 3-5: 0% 6-10: 4% 11-20: 26% >20: 37% Born and Raised: 44%	<1: 2% 1-2: 4% 3-5: 4% 6-10: 6% 11-20: 6% >20: 26% Born and Raised: 52%	Wilcox p =0.821, W=1459 Kruskal p =0.819, χ^2=0.053
Years in Neighbourhood	<1: 7% 1-2: 7% 3-5: 9%	<1: 22% 1-2: 4% 3-5: 18%	Wilcox p =0.263, W=1252.5 Kruskal p =0.261, χ^2=1.263

	6-10: 46% 10+: 32%	6-10: 20% 10+: 36%	
Own or Rent Home	Own: 96% Rent: 4%	Own: 84% Rent: 16%	**Wilcox *p*=0.028, W=1603** **Kruskal *p* =0.027, χ^2=4.86**
Household Composition	Single: 4% Couple: 9% Single with Kids: 0% Couple with Kids: 84% Multigenerational: 4% Roommate: 0%	Single: 2% Couple: 28% Single with Kids: 10% Couple with Kids: 58% Multigenerational: 0% Roommate: 2%	**Fisher *p* =0.001**
Education	Grade School: 0% High School: 5% Post-Secondary: 56% Graduate +: 39%	Grade School: 4% High School: 24% Post-Secondary: 48% Graduate +: 24%	**Wilcox *p* =0.006, W=1026** **Kruskal *p* =0.006, χ^2=7.552**
Income	<$40,000: 0% $40-59,999: 2% $60-79,999:2% $80-99,999: 7% $100-119,999: 12% $120-149,999: 18% >$150,000: 35%	<$40,000: 12% $40-59,999: 12% $60-79,999:8% $80-99,999: 14% $100-119,999: 18% $120-149,999: 10% >$150,000: 8%	**Wilcox *p* =0.005, W=981.5** **Kruskal *p* =0.005, χ^2=7.896**
Gender	Male: 53% Female: 47%	Male: 61% Female: 39%	Wilcox *p* =0.333, W=1558.5 Kruskal *p* =0.331, χ^2=0.945

Error! Reference source not found. shows what demographic characteristics were statistically different between the two study areas. Age, ethnicity, years in Canada and the years in the neighbourhood were all not statistically different between the two neighbourhoods. In contrast, the home ownership status of the respondent, their household composition, highest level of education reached and income were all deemed statistically different between the two study areas (see **Error! Reference source not found.**).

6.2 Neighbourhood Differences

Characteristics related to the respondent's property and their neighbourhood were observed alongside survey responses. Overall, the two neighbourhoods were significantly different in the characteristics that were recorded (see Table 27).

Table 27: A table comparing the neighbourhood and property characteristics of respondents between the two study areas Meadowvale, Mississauga and Fletcher's Creek, Brampton, based upon answers from the WSWB Survey (2014).

	Meadowvale, Mississauga	Fletcher's Creek, Brampton	Tests
Sidewalks	91% no sidewalks 7% one sidewalk 2% one sidewalk on either side of the street	0% no sidewalks 66% one sidewalk 34% one sidewalk on either side of the street	**Wilcox *p*=0.000, W=2742.5** **Kruskal *p*=0.000, χ^2=80.641**
Size of Yard	21% small 49% medium 30% large	50% small 38% medium 12% large	**Wilcox *p*=0.001, W=935** **Kruskal *p*=0.001, χ^2=10.834**
Presence of Trees in Yard	88%	70%	**Wilcox *p*=0.025, W=1172.5** **Kruskal *p*=0.024, χ^2=5.072**
Presence of Flowers and Shrubs in Yard	75%	50%	**Wilcox *p*=0.007, W=1062.5** **Kruskal *p*= 0.007, χ^2=7.372**
Number of Trees in a Three Home Span	9% 1-2 trees 33% 3-4 trees 19% 5-6 trees 39% 7+ trees	32% 1-2 trees 44% 3-4 trees 19% 5-6 trees 8% 7+ trees	**Wilcox *p*=0.000, W= 779** **Kruskal *p*=0.000, χ^2=17.756**
Size of Trees on Property	70% Small	30% Small	**Wilcox *p*=0.000, W=852.5** **Kruskal *p*=0.000, χ^2=17.049**
	25% Medium	62% Medium	**Wilcox *p*=0.000, W=1958.5** **Kruskal *p*=0.000, χ^2=15.178**
	5% Large	8% Large	Wilcox *p*=0.575, W=1464 Kruskal *p*=0.570, χ^2=0.323

In addition to the recorded characteristics based upon each property, there were some observable differences within each study area. Meadowvale contained within it two distinct neighbourhoods. Some of the homes within the Meadowvale study area fell within the Meadowvale Village Heritage district. In this area, the tree canopy cover was much greater with more medium to large sized trees. This area had narrow streets that lacked sidewalks. Each property size was large and had large sized yards (see Methods chapter for specifications). The area outside of the heritage district had very different characteristics. The streets were wide and rarely had sidewalks. The properties sizes were smaller than in Meadowvale Village, with large two-storey homes on them. These properties typically had a medium-sized front yard with one to two small trees in a three home span.

The Fletcher's Creek study area contained three distinct neighbourhoods with differing characteristics. The first was comprised of Jessie and Royce streets. These streets were wide with sidewalks on either side of the street. The trees were generally of a medium to large size. Most properties had flowers and shrubs in front yards, which were typically medium to large in size. The homes were generally small bungalows. The second area was Bufford Drive and Corona Avenue. This area had sidewalks on one side of the street. It is characterised by large, similarly built two-storey homes on lots with small frontages. The back of many of the properties in this area was adjacent to Fletcher's Creek. The front yards were medium to small in size and had 2-3 trees in a three-home span. The last area was Harold Street and Roseville Drive. This area contained one-storey duplexes with reverse-slope driveways. There were sidewalks on either side of the street, which was lined with small to medium sized trees. The front yards were small. The sidewalks, roads and other infrastructure in this area seemed to be the most dilapidated out of the three different neighbourhoods in the Brampton study area.

6.3 General Well-Being and the Environment

All respondents in Meadowvale and 92% of respondents in Fletcher's Creek said they believed there was a relationship between their general well-being and the natural environment, with a significant difference between the two populations (Fisher's exact test p =0.045). Without being specifically prompted, 62% of responses to the question "Do you believe there is a relationship between your well-being and your natural environment? Why?" were related to mental well-being, including answers related to aesthetics and scenery, stress relief, relaxation, enjoyment, effect on mood and spirit, and connections to nature. In contrast, only 14% of answers were related to physical health and exercise benefits. 8% of responses were related to the negative effects of built environments on people, with specific complaints about the urban jungle, commuting, traffic congestion and car pollution. There was not a significant difference in the number of mental well-being related comments based on study area (Wilcox p =0.2187, W=1253.5; Kruskal p =0.2173, χ^2=1.522).

82% of residents in Meadowvale and 62% of residents in Fletcher's Creek answered either "Agree" or "Strongly Agree" that streams and rivers contribute to their general well-being. The distribution of responses is significantly different between these two areas (Wilcox p =0.001, W=924.5; Kruskal p =0.001, χ^2=10.4947). Similarly, 82% of respondents in Meadowvale and 57% of respondents in Fletcher's Creek answered either "Agree" or "Strongly Agree" that forests and wetlands contributed to their general well-being. The distribution of responses is also significantly different between these two areas (Wilcox p =0.001, W=900.5; Kruskal p =0.001, χ^2=10.6233). With regards to open green spaces, 77% of respondents in Meadowvale and 74% of respondents in Fletcher's Creek answered either "Agree" or "Strongly Agree" that this space contributed to their general well-being. The difference in distribution of responses from these two areas is not statistically significant (Wilcox p =0.449, W=1289.5; Kruskal p =0.447, χ^2=0.5786).

Table 28: This table compares the percentages of respondents who believe there is a relationship between the natural environment and their well-being. Responses from the WSWB Survey (2014) represent Meadowvale and Fletcher's Creek, while the Human Well-Being Report (Green Analytics, 2011) represents the watershed population as a whole.

	Meadowvale, Mississauga (WSWB Survey, 2014)	Fletcher's Creek, Brampton (WSWB Survey, 2014)	Human Well-Being Report (Green Analytics, 2011)
Well-Being Related to Natural Environment	100%	92%	67.9%

Respondents were also prompted to explain their perceived connection between their well-being and the environment and are summarized in

Table 29: Groupings of answers to question about connection between well-being and the outdoor environment (WSWB Survey, 2014). These answers were categorized based upon similarities. Some respondents gave more than one answer, totalling 151 discrete answers. The percentages represented in

Table 29 are related to this total rather than the total number of respondents. Refused or blank answers were omitted.

Table 29: Groupings of answers to question about connection between well-being and the outdoor environment (WSWB Survey, 2014)

Super-Category	Category	Example	Percentage of Responses
Mental Well-Being	Stress Relief and Relaxation	"I can feel it when I walk into natural areas- come down into relaxation, "palpable", noticeable anxiety melts away" "Green spaces and clean space helps to clean the mind and distress."	15.9%
	Effects of Smell	"When I was sick, I would go out on my balcony and the scent of the trees rejuvenated me and made me feel happy"	2.6%
	Connect with Nature	"Flowing water, fresh air, a place to decompress is very healthy in such a populated area" "Natural elements ground us and help us feel connected to nature; It keeps us mentally and physically balanced"	2.6%
	Landscape and Space Appreciation	"Stress free when seeing trees, slower pace, more space, all the green and the deer"	5.3%
	Affects Mood and/or Spirit	"Makes me happy to look outside and see all of the green" "It is a spiritual factor, want to escape man-made structures and get away" "Affects how you think, attitude, positivity, how you see things"	27%
	Escape from House	"Opportunity to relax and get out of the house"	2%
Physical Well-Being	Good for Recreation and Exercise	"Relax, exercise, stress relief" "To relieve stress, I go for a walk, exercise and biking"	9.3%
	Health and Quality of Life	"If there is a place to walk it will encourage you to stay healthier" "Getting outside increases serotonin"	5%
Environmental Well-Being	Overall Surroundings Nice and Likeable	"Where you live and surroundings area huge part" "If you like where you live, it makes a difference"	2.6%
	Well-Being of Environment Linked to Human Well-Being	"If the environment is poisonous, not too good for your health" "Human beings are created within nature"	4.6%
	Environmental Health	"Close to nature, feel better, air is fresher, water for swimming" "If there is a lot of smog, won't go jogging"	8%

Environmental Well-Being (continued)	Negative Effects of Built Environment	"Congestedness takes away from peacefulness of nature" "No green makes it feel like a concrete jungle; no life" "If polluted and can't open the windows, it affects me"	11%
Social Well-Being	Sense of Community and Socializing	"If you live in a place with stress, pollution, people infringing on my privacy, it would bother me. But here it's calming, the effect of a cottage. People know each other here. I know the name of everyone in this village and know their aches"	4%

The categories were further grouped into super-categories, including mental well-being, social well-being, physical well-being and environmental well-being. The social, physical and mental well-being super-categories are based upon the definitions of each of these types of well-being provided in the survey. The environmental well-being category focuses primarily on the respondent's interpretation of the physical environment.

The mental well-being super-category includes: stress relief and relaxation, effects of smell, landscape and space appreciation, affects mood and/or spirit, escape from house and connects with nature. Together, the answers related to mental well-being account for 54.4% of responses. The environmental well-being categories include: overall surroundings nice and likeable, well-being of environment linked to human well-being, environmental health, and negative effects of built environment, accounting for 26.2% of responses.

The physical well-being super-category includes: good for recreation and exercise, and health and quality of life. Together these categories account for only 14% of responses. There was only one category related to social well-being, which was sense of community and socializing, which accounted for a mere 4% of responses. There is no significant relationship between the number of responses related to any of these components of well-being given by respondents in Meadowvale and those in Fletcher's Creek.

6.3.1 Ecosystem Goods and Services

Respondents were asked a series of questions about their perceptions of environmental risks, such as their perceived risk of floods and flood damage in their area (see Table 30 and Figure 19). There was a significant difference in perceived risk of flooding between the two study areas (Wilcox p =0.022, W=1770; Kruskal p =0.022, χ2=5.272), with 30% of respondents in Fletcher's Creek and 12% of respondents in Meadowvale responding they were at a "Somewhat High Risk" or "High Risk." None of the other risk-oriented questions showed a significant difference in responses between study areas (see Table 30). The lowest perceived risk in both study areas was a risk of water shortages, with only 10% of respondents claiming they felt at a somewhat high or high level of risk. The greatest perceived risk was of the effects of rapid urbanization, with 61% of respondents claiming they felt they were at a somewhat high or high risk.

Table 30: Significance of difference in perceived risk between Meadowvale and Fletcher's Creek (WSWB Survey, 2014)

Perceived Risk	Meadowvale Mean	Fletcher's Creek Mean	Statistical Difference Between Study Areas-Tests	
Floods	1.930	2.580	**Wilcox p=0.022 W=1770**	**Kruskal p =0.022 χ^2=5.272**
Water Shortages	1.772	1.920	Wilcox p=0.981 W=1421	Kruskal p =0.978 χ^2=0.000
Effects of Climate Change	2.877	2.900	Wilcox p =0.792 W=1437.5	Kruskal p =0.789 χ^2=0.072
Effects of Introduced or Exotic Species	3.123	2.660	Wilcox p =0.174 W=1139.5	Kruskal p =0.173 χ^2=1.860
Effects of Rapid Urbanization	3.667	3.460	Wilcox p =0.575 W=1338	Kruskal p =0.573 χ^2=0.318
Risk of Water Quality	2.842	2.620	Wilcox p =0.428 W=1252.5	Kruskal p =0.426 χ^2=0.634

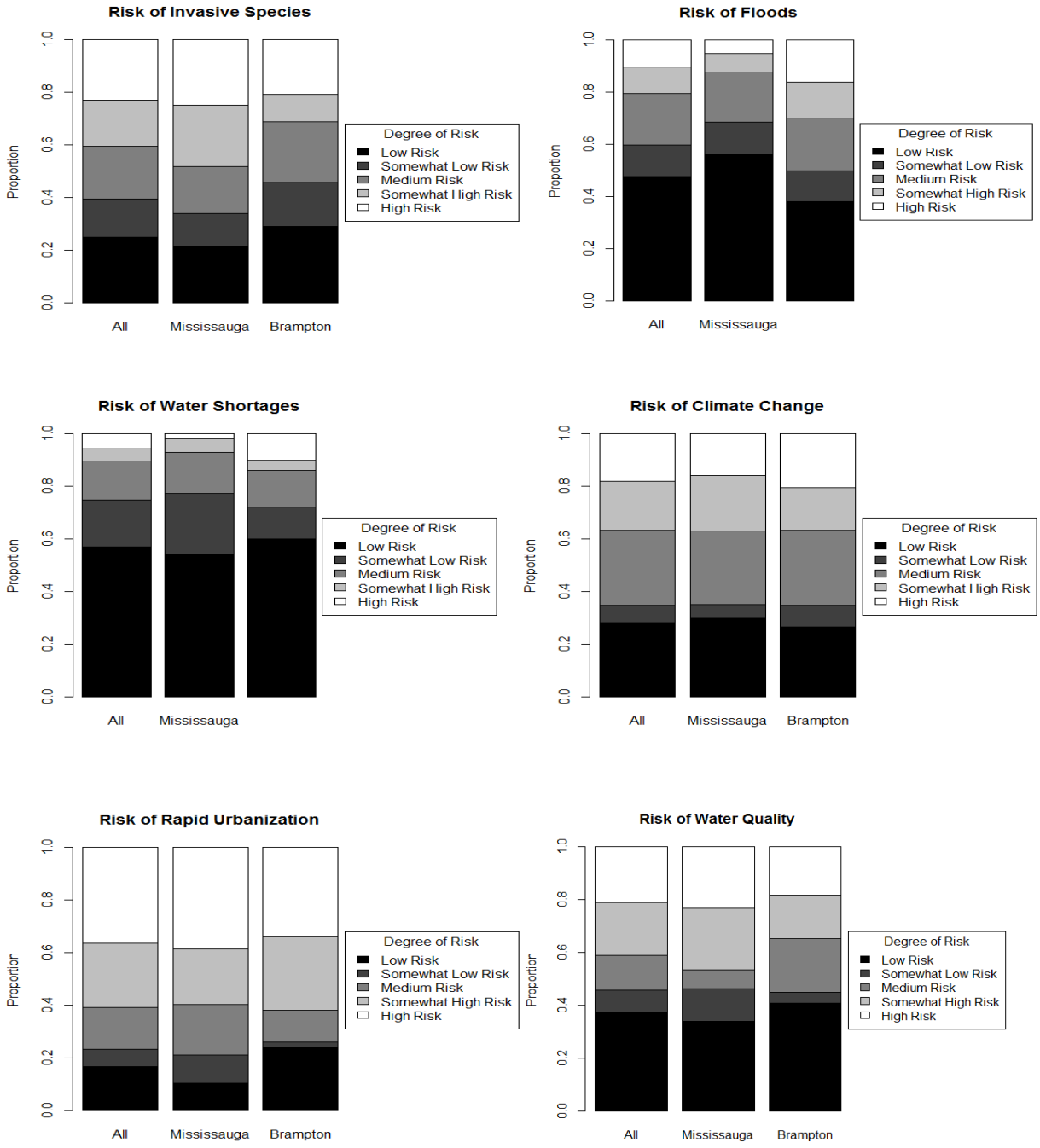


Figure 19: Graphs showing the perceived risk of various environmentally-oriented issues (WSWB Survey, 2014)

Respondents were then asked the following question "Do you rely on your local environment to provide you with any products or materials, including things such as firewood or fish?" 82% of respondents from Meadowvale, and 80% of respondents from Fletcher's Creek answered no to the aforementioned

question, with no significant difference in answers between the two study areas (Fisher's exact test p =0.806).

Respondents were subsequently asked a series of 5 questions about different outdoor activities they undertook that involve the environment, such as fishing or collecting firewood. 19% of respondents said that they relied upon their local environment for the provision of goods, such as firewood or fish. There was no significant difference between the answers from respondents from each of the two study areas (see Table 31).

Table 31: This table shows whether there was a significant difference between Meadowvale and Fletcher's Creek with regard to the importance of environmentally-reliant activities (WSWB Survey, 2014).

Activities	Meadowvale Means	Fletcher's Creek Means	Difference Between Study Areas- Tests	
Ability to Fish in Local Streams and Rivers	2.421	2.380	Wilcox p =0.914 W=1356	Kruskal p =0.912 χ^2=0.012
Ability to Grow and Gather food	2.930	3.380	Wilcox p =0.119 W=1634	Kruskal p =0.119 χ^2=2.436
Ability to Drink Tap Water	4.684	4.580	Wilcox p =0.322 W=1319	Kruskal p =0.320 χ^2=0.989
Ability to Swim in Local Rivers and Streams	3.737	3.360	Wilcox p =0.152 W=1180	Kruskal p =0.151 χ^2=2.060
Ability to Gather Firewood Nearby	2.281	2.260	Wilcox p =0.831 W=1429	Kruskal p =0.828 χ^2=0.047

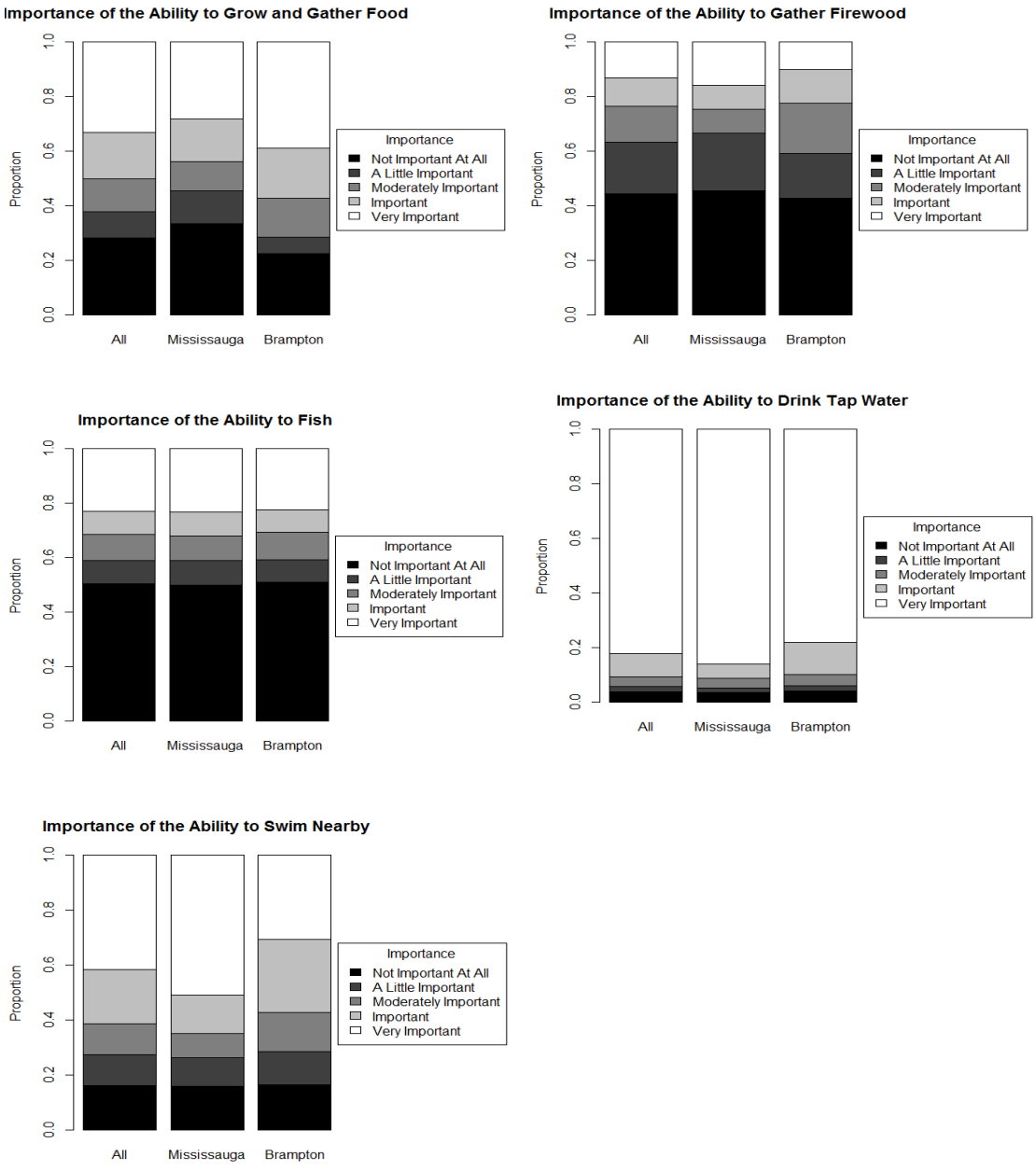


Figure 20: Graphs showing the importance of various environmentally-reliant activities (WSWB Survey, 2014)

6.4 Mental Well-Being and the Environment

The survey contained thirteen questions specifically pertaining to the relationship between the respondent's mental well-being and their natural environment. The first question asked, "Mental well-being relates to your productivity, concentration, stress and satisfaction with life. Is your mental well-being affected by your outdoor environment?" This question was asked to determine if the resident perceived a link between their mental well-being and the natural environment. Where the respondent lived significantly affected whether or not that link was perceived (Fisher Test p =0.005), with 98% of respondents in Meadowvale perceiving the link, as compared to 81% of respondents in Fletcher's Creek. The respondents' highest level of education was significantly related to their answers to this question, as well (Wilcox p =0.002, W=214.5; Kruskal p = 0.002, $\chi 2$= 9.861). There was no significant difference between respondents' answer to this question and any of the other neighbourhood or demographic characteristics.

When asked later about why individuals perceive a connection between their mental well-being and their natural environment, many different categories arose including positive and negative effects of the environment on mental well-being. In total, there were 118 discrete answers provided by respondents. The percentages in Table 32 are reflective of the total number of discrete answers, rather than the total number of respondents.

Table 32: Distribution of responses to how resident mental well-being is affected by the environment (WSWB Survey, 2014)

Category	Example	Percentage of Responses
Negatively affected	"Road rage affects me" "People get lots of headaches near cell towers" "If it is polluted outside, I cannot enjoy … and can be depressing"	10%
Not affected	"Not really"	1.7%
Decreases productivity	"It distracts me from work"	1.7%
Increases	"Relieves stress, makes me more productive"	3.4%

productivity		
Stress relief and relaxation	"Drive through neighbourhood to relax, calm down. Driving elsewhere is stressful" "Relieves stress by walking in the green neighbourhood" "Because of my son we have a lot of stress and need to take walks in forests. It makes me happy and makes my son happy."	15%
Therapeutic	"That's my therapy. It's calming, soothing, internal peace" "Smell of fresh trees, the forest, nature and wildlife. Not be in the hustle and bustle of a regular neighbourhood. To see a forest is mentally cleansing"	1.7%
Calming	"Calms me down" "In the summer- very calming. [provides] places for people to go other than shopping malls"	5.1%
Happiness and Enjoyment	" If it's a nice environment, you feel better and happier" "Greenery and nature makes me feel better" "Healthy outdoor environments create healthy happy moods"	11%
Aesthetics	"When things are ugly outside, I don't like it. That's why I live in an area with trees" "If you have a beautiful environment you think differently… your thoughts become more wholesome" "Surrounded by peace and beauty of nature. Not living in concrete. Looking out of the window every day is inspiring"	9.3%
Exercise	"Exercise is good for mental health" "After supper going on a walk to recharge" "Very active, therefore likes using and spending time in natural environment"	5.9%
Connection with nature	"You can sit outside here and feel connected with the environment. Definitely has an impact on my quality of life."	0.8%
Weather and Seasonal	"Weather and rhythms of the environment affect it" "Sit in the sun makes me happy; Sat where grey or dungy makes me bleh and depressed" "As a human our lives are basically tied with nature. For example, on a gloomy day, my day is basically ruined"	8.5%
Learning	"Very important to go out and explore the wilderness and learn from it"	0.8%
Cleanliness	"The cleaner the environment, the more advantageous it can be for our family"	2.5%
Retreat	"Nice retreat from being in the city"	0.8%
Mood and Feelings	"Greenery and nature makes me feel better" "Fresh air elevates your mood" "100% the health of mother nature directly reflects how I feel."	11%
Clear Mind	"Clear surroundings, clear mind"	1.7%
Possible Connection, Though Unsure	"In some ways, not really a direct link, sometimes you need a change of scenery which resets you"	3%
Acknowledged Connection Without Further Explanation	"Very important to well-being"	5%

There was a significant relationship between individuals who believe there is a relationship between their general well-being and their environment, and those that believe their mental well-being is related to their environment (Fisher's exact test p =0.044).

Currently, both neighbourhoods have high levels of life satisfaction, with 93% of respondents in Meadowvale and 80% of respondents in Fletcher's Creek indicating they were either "Satisfied" or "Very Satisfied" with their lives (Wilcox p=0.377, W=1296.5; Kruskal p=0.375, χ^2=0.787). Each area has a significantly different distribution of stress-responses, however, with 39% of respondents from Meadowvale and 24% of respondents from Fletcher's Creek indicating their lives were either "Stressed" or "Very Stressed" (Wilcox p=0.015, W=1043.5; Kruskal p=0.015, χ^2=5.958).

6.4.1 Natural Spaces and Features that Contribute to Mental Well-Being

The survey asked respondents general questions about spaces they may visit or pass by, why they go to those spaces and how often (see Table 33). Later in the survey, the various natural spaces and features were revisited, asking respondents to what degree those spaces or features were relaxing (see Figure 21).

Table 33: Paired questions relating the relaxing quality of space to individual habits within that space (WSWB Survey, 2014)

General Question about Spaces	Specific Question about Relaxing Quality of Spaces
Do you visit city parks or public gardens? Why do you go there? How often?	I feel more relaxed after spending time in manicured green space including parks and public gardens.
Do you visit forested areas, wetlands and meadows? Why do you go there? How often?	I feel more relaxed after spending time in non-manicured green space including wetlands, forested areas and meadows.
Do you visit green spaces at school grounds, cemeteries, golf courses and hospital grounds? Why do you go there? How often?	I feel more relaxed after spending time in school grounds, hospital grounds, cemeteries and golf courses.
Do you spend time in home gardens and yards? Why do you go there? How often?	I feel more relaxed after spending time in private green spaces including home gardens and yards.
Do you visit rivers, streams, ponds and/or lakes? Why do you go there? How often?	I feel more relaxed after spending time near water features including rivers, streams, ponds.
Do you benefit from having street-side features such as trees and flower planters in your neighbourhood? If so, in what ways?	I feel more relaxed after spending time in spaces with street-side features including trees and flower planters.

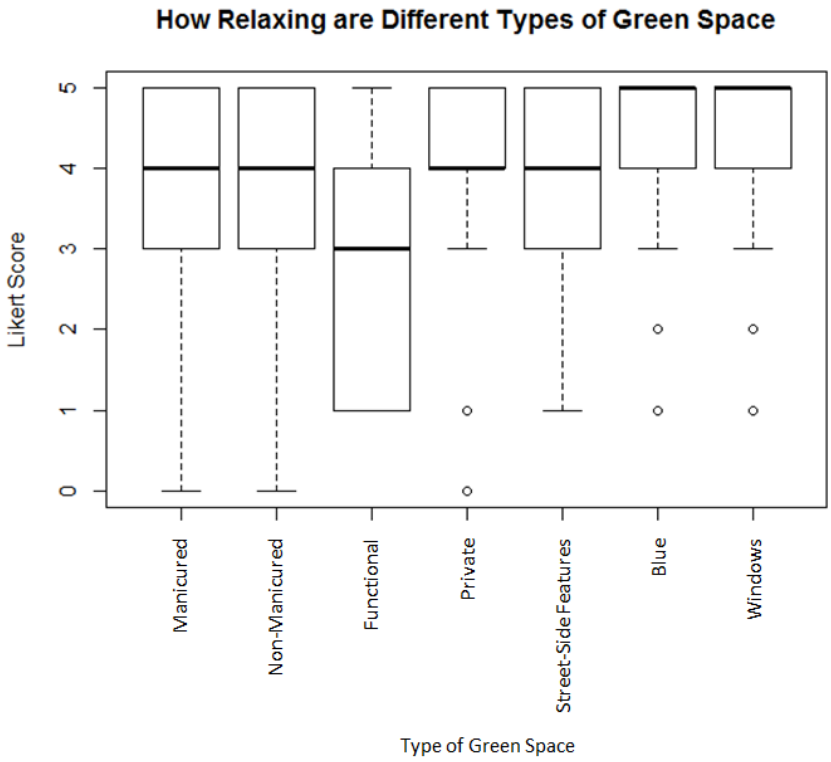


Figure 21: A box plot showing how relaxing respondents found different types of natural space (WSWB Survey, 2014)

6.4.1.1 Manicured Green Space and Mental Well-Being

Manicured green spaces include city parks and public gardens. 89% of residents in Meadowvale and 86% of residents in Fletcher's Creek said they went to these spaces in the past year. They attended these spaces on average 55 (median 12) and 52 (median 24) days per year, respectively (T test for mean *p* =0.869, t=-0.165). There was no significant difference between going to manicured green space based on the neighbourhood within which they lived (Chi squared *p* =0.801, x2= 0.064).

61% of respondents in Meadowvale and 78% of respondents in Fletcher's Creek responded "Agree" or "Strongly Agree" to the statement "I feel more relaxed after spending time in manicured green spaces including parks and public gardens." The differences in answers between the two study areas was not significant (Wilcox *p* =0.157, W=1641.5; Kruskal p=0.156, χ^2=2.017).

There was not a significant relationship between respondents going to manicured green space and whether or not they found those spaces relaxing (Wilcox p =0.406, W=522; Kruskal p=0.403, χ^2=0.699), nor was there a significant relationship between the reported amount of time spent in manicured green space and whether the respondent found it relaxing (Linear regression p =0.731, F=0.119).

6.4.1.2 Non-Manicured Green Space and Mental Well-Being

Non-manicured green space includes forests, wetlands and meadowland. 79% of respondents in Meadowvale and 46% of respondents in Fletcher's Creek said they went to non-manicured green space in the last year. There is a significant difference between responses in Meadowvale and Fletcher's Creek (Fisher's exact test p=0.001). On average respondents from Meadowvale went to these spaces 65 days (median 12 days) per year, while respondents from Fletcher's Creek went to these spaces 22 days (median 0 days) per year (T test for mean p =0.019).

74% of respondents in Meadowvale, and 50% of respondents in Fletcher's Creek responded "Agree" to "Strongly Agree" to the statement "I feel more relaxed after spending time in non-manicured green space, including forests, meadows and wetlands." There was a significant difference in responses between the two study areas (Wilcox p =0.005, W=994.5; Kruskal p =0.005, χ^2=7.796).

There was a very significant relationship between going to non-manicured green space and whether the respondent found those spaces relaxing (Wilcox p =0.000, W=647; Kruskal p =0.000, χ^2=20.188). In addition, the number of days each respondent spent in non-manicured green space was related to how relaxing they found those spaces (Linear regression p =0.008, F=7.227).

6.4.1.3 Functional Green Space and Mental Well-Being

Functional green space includes natural spaces at hospital grounds, school grounds, cemeteries or golf courses. 72% of respondents in Meadowvale and 64% of respondents in Fletcher's Creek went to functional green spaces in the last year. There is no significant difference between responses in Meadowvale and Fletcher's Creek (Chi squared p =0.502, x2=0.450). On average, respondents from

Meadowvale spent 58 days per year (median 6 days) and respondents from Fletcher's Creek spent 43 days per year (median 4 days) in these spaces (T test p =0.456, t=-0.748).

33% of respondents in Meadowvale, and 30% of respondents in Fletcher's Creek responded "Agree" to "Strongly Agree" to the statement "I feel more relaxed after spending time in functional green space, including hospital or school grounds, cemeteries or golf courses." The difference in responses between the two study areas was not significant (Wilcox p =0.954, W=1415.5; Kruskal p =0.952, χ^2=0.0037).

There was an overall significant relationship between going to functional green space and whether the respondent found that space relaxing (Wilcox p =0.030, W=922.5; Kruskal p =0.029, χ^2=4.754), specifically in Fletcher's Creek (Kruskal p =0.048, χ^2=3.921). There was not a significant relationship between functional space attendance and whether the respondent found it relaxing in Meadowvale (Kruskal p =0.229, χ^2=1.444). The number of days reportedly spent in functional green spaces was not related to how relaxing respondents found that space (Linear Regression p=0.151, F=2.100).

6.4.1.4 Private Green Space and Mental Well-Being

Private green space includes home gardens and yards on the person's personal residential property. 81% of respondents from Meadowvale and 84% of respondents from Fletcher's Creek answered that they spend time in their private green spaces in the last year (Chi squared p =0.848, x2=0.037). On average, respondents from Meadowvale spent 181 days (median 134 days) per year in their private space, and respondents from Brampton spent 171 days (median 104 days) per year in their private space (T test for mean p =0.747, t=-0.323).

75% of respondents in Meadowvale, and 86% of respondents in Fletcher's Creek responded "Agree" to "Strongly Agree" to the statement "I feel more relaxed after spending time in private green space, including home gardens and yards." The difference in responses between the two study areas was not significant (Wilcox p =0.249, W=1596.5; Kruskal p =0.248, χ^2=1.337).

There was a very significant relationship between spending time in private green space and whether the respondent found the space to be relaxing (Wilcox p =0.000, W=377; Kruskal p =0.000, χ^2=12.259). In addition, there was a very significant relationship between the amount of time spent in private green space and whether the respondent found that space to be relaxing (Linear regression p =0.000, F=15.15). This relationship was stronger in Meadowvale (Linear regression p =0.004, F=9.134) than in Fletcher's Creek (Linear regression p =0.015, F=6.403).

6.1.4.5 Blue Space and Mental Well-Being

Blue space refers to rivers, streams, ponds and lakes. 88% of respondents in Meadowvale and 62% of respondents in Fletcher's Creek said they spent time near blue space in the past year, which proves to be a statistically significant difference between the two populations (Chi squared p =0.004, x2=8.231). On average, respondents from Meadowvale spent 46 days (median 12 days) per year near blue space, and respondents from Brampton spent 21 days (median 2 days) per year near blue space (T test for mean p =0.074, t=-1.811).

91% of respondents in Meadowvale, and 84% of respondents in Fletcher's Creek responded "Agree" to "Strongly Agree" to the statement "I feel more relaxed after spending time near water features, including rivers, streams, ponds and lakes." The difference in responses between the two study areas was not significant (Wilcox p =0.103, W=1192.5; Kruskal p =0.103, χ^2=2.664).

There was a significant relationship between spending time near blue space and whether the respondent found that space to be relaxing (Wilcox p =0.002, W=677; Kruskal p =0.002, χ^2=9.427), with respondents in Fletcher's Creek perceiving this link to be greater (Kruskal p =0.010, χ^2=6.662) than in Meadowvale (Wilcox p = 0.318, W=139.5; Kruskal p =0.311, χ^2=1.026). In addition, there was a not significant relationship between the amount of time spent in blue space and whether that space was perceived to be relaxing (Linear regression p =0.260, F=1.286).

6.1.4.6 Street Side Features and Mental Well-Being

Street side features refer to trees and flower planters that are along the street side and generally are owned and/or maintained by the respective city. 98% of respondents in Meadowvale and all respondents in Fletcher's Creek said they benefitted from having street-side features in their neighbourhood, a difference which is not statistically significant (Wilcox p =0.879, W=1401; Kruskal p=0.876, χ^2=0.024). In addition, there was not a significant relationship between respondents stating they benefited from street-side features and whether that respondent felt more relaxed after spending time in spaces with said features (Wilcox p =0.924, W=100.5; Kruskal p =0.914, χ^2=0.012).

6.1.4.7 Looking Out of Windows and Mental Well-Being

Respondents were asked about how relaxed they felt after spending time looking out of a window at a natural area or feature. 86% of respondents from Meadowvale and 76% of respondents from Fletcher's Creek indicated that they felt "Relaxed" or "Very Relaxed" after looking out of windows at natural spaces or features, with no significant difference between the responses from both areas (Wilcox p =0.113, W=1195; Kruskal p =0.113, χ^2=2.518).

6.2.5 Qualitative Responses

In section 2 of the survey, respondents were asked about what activities they partake in within each different type of natural space. These qualitative responses were subsequently categorized for ease of analysis in the same fashion as was described in section 6.3 and 6.4. Though unprompted, many of the responses provided were related to mental well-being, see Table 34.

.

Table 34: This table shows examples of qualitative responses respondents provided that show why they went to different types of natural space, as they are related to mental well-being. It includes answers from the following questions from the Watershed Well-Being Survey (2014): II_1_a,b,c,d,e and II_2

Type of Natural Space	Category	Example Statements Within These Categories
Manicured Green Space	Enjoyment; Aesthetics and Scenery; Relaxation; Walking and Hiking	"Escape" "Good for soul and eyes" "Relax, enjoy the environment"
Non-Manicured Green Space	Enjoyment; Walking and Hiking; Scenery and Wildlife Viewing; Relaxation; Mystique; Change of Pace	"To get away from the city, change of pace" "For relaxation with a couple of friends"
Functional Green Space	Walking; Enjoyment and Appreciation; Passive Engagement	"Be outside and appreciate nature" "Wandering around paths"
Private Green Space	Gardening; Relaxing; Sitting; Enjoyment; Wildlife Viewing	"Grow plants, enjoy the habitat and trees" "Reconnecting with nature, making it look nice, connecting with the community"
Blue Space	Wildlife and Fish Viewing; Relaxation; Scenery; Aesthetics and Beauty; Walking; Enjoyment; Being with Nature	"Decompress, relaxation, interaction with nature" "Creek and river are beautiful" "Look for crayfish and salamanders"
Street-Side Features	Scenery and Aesthetics; Wildlife Viewing; Shade; Enjoyable, Pleasant and Inspiring; Relaxing; Connect with Nature	"Looks better, feels better" "Trees mostly, for animals, aesthetics" "Shows we take pride, it's gorgeous" "More calming"

Later in the survey, respondents were specifically asked to describe whether and how specific classifications of natural space had an effect on their well-being. These responses were similarly categorized as above and can be seen in Table 35.

Table 35: This table shows examples of how different respondents perceive their well-being is affected in different kinds of natural setting, as they relate to mental well-being. It includes qualitative answers from the following questions from the Watershed Well-Being Survey (2014): III_2_a,b,c

Type of Natural Space	Category	Example Statements Within These Categories
Streams and Rivers	Stress Relief and Relaxation Sound Appreciation; Scenery, Tree and Wildlife Appreciation; Enjoyable; Connect with Nature; Affects Mood; Makes This a Better Place	"The sound of moving water does wonders for me" "Pleasing for the senses, nature watching" "Kids throw rocks in the water, look at the fish go by and swim"
Forests, Meadows and Wetlands	Stress Relief and Relaxation; Sound Appreciation; Scenery, Tree and Wildlife Appreciation; Enjoyable; Connect with Nature; Affects Mood	"Great place to visit for wildlife, birds and squirrels" "Scared of wildlife and rodents" "Feel better with nice surroundings"
Open Green Space	Stress Relief and Relaxation; Sound Appreciation; Scenery and Wildlife Appreciation; Enjoyable; Affects Mood	"Allows for the sun and air to circulate while you play and relax in it" "Narrow spaces without green space cause stress" "Stress relieving, good to be out there"

After the responses were categorized, the percentage of mental well-being related answers to these questions was compared across both study areas. This was to see if there was a relationship between where someone lived and if they identified a mental well-being related activity. In general, there was no significant difference between the number of answers from Meadowvale and Fletcher's Creek. This is with the exception of manicured green space, whereby respondents from Meadowvale identified significantly more connections to mental well-being than respondents from Fletcher's Creek (see Table 36).

After the responses were categorized, each individual was given a mental well-being score for each type of outdoor space based upon whether their responses fell within the umbrella of mental well-being. These mental well-being scores were compared between Meadowvale and Fletcher's Creek.

Table 36: Relationship between the number of mental well-being related questions and what study area the respondent is from (WSWB Survey, 2014)

Type of Green Space	Percentage of responses related to MWB Meadowvale	Fletcher's Creek	Wilcox Test	Kruskal Test
Question: What do you do there?				
Manicured Green Space	31.0%	14.1%	***p*=0.041, W=1158.5**	***p*=0.035, χ^2=4.193**
Non-Manicured Green Spaces	34.8%	24.7%	*p*=0.101, W=1176	*p*=0.100, χ^2=2.701
Functional Green Space	8.9%	12.9%	*p*=0.561, W=1481.5	*p*=0.558, χ^2=0.344
Private Green Space	55.0%	53.2%	*p*=0.598, W=1500.5	*p*=0.596, χ^2=0.281
Blue Space	31.1%	16.5%	*p*=0.126, W=1226	*p*=0.125, χ^2=2.353
Question: Do you benefit from street-side features?				
Street-side Features	72.9%	74.7%	*p*=0.095, W=1667.5	*p*=0.094, χ^2=2.798
Question: Do you feel as if the following contribute to your well-being? In what way?				
Streams and Rivers	43.8%	46.8%	*p*=0.919, W=1440	*p*=0.916, χ^2=0.011
Forests and Wetlands	40.9%	29.8%	*p*=0.179, W=1243.5	*p*=0.178, χ^2=1.813
Open Green Space	23.5%	31.6%	*p*=0.397, W=1533.5	*p*=0.395, χ^2=0.724

6.5 Factor Analysis

Factor analysis was conducted on the likert-scale questions related to mental well-being, including questions V_2_a through V_2_k (see Appendix G: "Watershed Well-Being" Survey—Human well-being, ecosystem services and watershed management in the Credit River Watershed for the survey). The scree plot revealed there were four underlying factors (groups of variables) within this data, based upon the fact that there are four components with an eigenvalue greater than 1 (see Figure 22). These four components, thus, account for the greatest amount of variance found within the data.

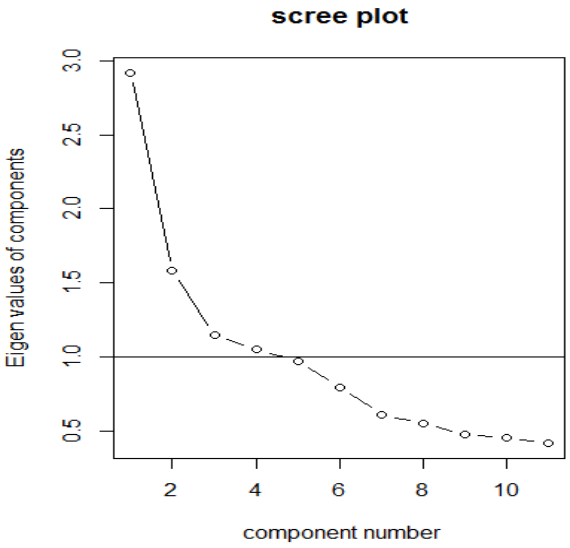


Figure 22: Scree plot revealing four factors within the mental well-being data.

The factor analysis produced a standardized loadings pattern matrix, which is used to determine to what factor each question belongs (see Figure 23). The communalities (h2) scores can also be found in Figure 23. These h2 scores represent the percentage variance each question accounts for. Each factor was paired to its question based on the absolute value of the factor loading, assuming that it was $\geq |0.3|$. In the case of V_2_i (relaxed after spending time near street-side features), there were multiple factors that this question could have fit into, so the factor with the highest factor loading value was selected.

```
Factor Analysis using method =  pa
Call: fa(r = corMat, nfactors = 4, rotate = "oblimin", fm = "pa")
Standardized loadings (pattern matrix) based upon correlation matrix
              PA1   PA2   PA4   PA3   h2   u2 com
data.V_2_a   0.17  0.45 -0.14  0.01 0.20 0.80 1.5
data.V_2_b   0.16 -0.74  0.02 -0.09 0.58 0.42 1.1
data.V_2_c   0.09 -0.06  0.11  0.51 0.35 0.65 1.2
data.V_2_d   0.04  0.10  0.04  0.76 0.63 0.37 1.0
data.V_2_e  -0.06 -0.12  0.71  0.17 0.54 0.46 1.2
data.V_2_f   0.58 -0.13 -0.17  0.20 0.43 0.57 1.5
data.V_2_g   0.18  0.28  0.25 -0.04 0.21 0.79 2.8
data.V_2_h   0.35  0.12  0.10  0.07 0.20 0.80 1.5
data.V_2_i   0.35  0.30  0.50 -0.08 0.60 0.40 2.5
data.V_2_j   0.70 -0.08  0.08  0.06 0.58 0.42 1.1
data.V_2_k   0.33 -0.04  0.24 -0.09 0.20 0.80 2.0
```

Figure 23: The standardized factor loadings for exploratory factor analysis of mental well-being related questions. PA1-PA4 are the factors, while h2 is the percentage variance each question accounts for. The questions pertaining to each factor are selected in a grey box.

In the case of V_2_g (relaxed after spending time in functional green space), there was no value that met the threshold of $\geq |0.3|$. The two possible factors for this question to fit into include PA1 and PA4. While the value of the factor loading for PA2 is slightly higher, the content of the question for V_2_g fit better within PA4. Therefore, this factor was included within the PA4 factor. The final components of each factor can be seen in Table 37.

Table 37: The components of each factor (WSWB Survey, 2014)

Factor	Name of Factor	Statements Pertaining to that Factor (Standardized Factor Loading)
PA1	Wilderness and Personal Spaces	I feel more relaxed after spending time: In non-manicured green space (0.58) In private green space (0.35) Near water features (0.70) Looking out of windows at green or natural areas (0.33)
PA2	Self-Reported State of Mental Well-Being	I am satisfied with my life (0.45) I feel like I lead a stressful life (-0.74)
PA3	Relaxing Activities	When stressed, I often seek out natural areas as a setting for relief (0.51) I regularly go on walks through or sit in natural areas to relax (0.76)
PA4	Designed Spaces	I feel more relaxed after spending time in: Manicured green space (0.78) School grounds, hospital grounds, cemeteries and golf courses (0.25) Spaces with street-side features (0.50)

The value of each factor was determined by adding together the likert scale answer to each corresponding question and dividing by the number of questions within that factor. To test whether or not these factors were also related to other components of the natural environment or other answers from the respondents, each factor was compared with responses from other parts of the survey.

6.5.1 PA1: Wilderness and Personal Spaces

The factor PA1 has been renamed "Wilderness and Personal Spaces." This category contains within it two distinguishable sub-categories, namely "Wilderness Spaces" which refers to experiences in non-

manicured green space and blue space, and “Personal Spaces” which refer to experiences within one’s private yard or garden and experiences of looking out windows at natural spaces.

The combined score of this factor is significantly related to the age of the respondent (linear regression p =0.018, F=5.748, R^2=0.043). In addition, this score is significantly related to the number of years the respondent has lived in Canada (linear regression p =0.003, F(105)=9.162, R^2=0.071), particularly in Fletcher’s Creek (linear regression p =0.032, F(48)=4.908, R^2=0.074) but not significantly in Meadowvale (linear regression p =0.053, F(55)=3.898, R^2=0.049). No other demographic characteristics had a significant relationship to this factor.

Table 38: Relationships between PA1 and respondent habits in different spaces. Please note "M" refers to Meadowvale study area, and "FC" refers to the Fletcher's Creek study area (WSWB Survey, 2014)

Type of Space	**Does the respondent go there?** Linear Regression			**Number of times per year** Pearson Correlation		
	All	M	FC	All	M	FC
Manicured	p=0.874 F(105)=0.025 R^2= -0.009	p=0.217 F(55)=1.559 R^2= 0.010	p=0.182 F(48)=1.833 R^2=0.017	**p=0.040 t(96)=2.084**	**p=0.033 t(51)=2.196**	p=0.600 t(43)=0.530
Non-Manicured	**p=0.000 F(105)=14.6 R^2=0.114**	**p=0.023 F(55)=5.451 R^2=0.074**	**p=0.018 F(48)=6.050 R^2=0.093**	**p=0.006 t(98)=2.810**	p=0.063 t(49)=1.899	p=0.125 t(47)=1.562
Functional	p=0.923 F(105)=0.009 R^2=-0.009	p=0.947 F(55)=0.004 R^2=-0.018	p=0.774 F(48)=0.084 R^2=-0.019	p=0.372 t(96)=0.898	p=0.382 t(49)=0.883	p=0.924 t(45)=0.096
Private	**p=0.000 F(105)=23.27 R^2=0.174**	**p= 0.009 F(55)=7.271 R^2=0.101**	**p=0.000 F(48)=23.100 R^2=0.311**	**p=0.004 t(102)=2.944**	p=0.080 t(52)=1.787	**p=0.022 t(48)=2.360**
Blue	p=0.054 F(105)=3.808 R^2=0.026	p=0.333 F(55)=0.955 R^2=-0.001	p=0.256 F(48)=1.3231 R^2=0.007	p=0.057 t(95)=1.930	p=0.073 t(50)=1.833	p=0.873 t(43)=0.160
Street-side Features	Wilcox p=0.917, W=100 Kruskal p=0.908, χ^2=0.014	Wilcox p=0.913, W=52 Kruskal p=0.895, χ^2=0.017	n/a	n/a	n/a	n/a

There is a significant relationship between the PA1 score and whether an individual goes to non-manicured or private spaces (see Table 38). The number of times per year the respondent attended manicured, non-manicured and private spaces is also significantly related to the PA1 scores (see Table 38).

The PA1 score was also compared to the number of qualitative answers each respondent gave that was related to mental well-being (i.e. the modified score mentioned earlier in the Qualitative section). The number of responses each individual gave that was related to mental well-being was significantly related to the PA1 score (see Table 39).

Table 39: Relationship between PA1 and qualitative answer score (WSWB Survey, 2014)

	All	Meadowvale	Fletcher's Creek
Qualitative Answer Score	**Linear regression** ***p*=0.000** **F (105)=14.74** **R^2=0.115**	**Linear regression** ***p*=0.022** **F(55)=5.519** **R^2=0.075**	**Linear regression** ***p*=0.003** **F(48)=9.483** **R^2=0.148**

6.5.2 PA2: Self-Reported State of Mental Well-Being

The factor PA2 has been renamed "Self-Reported State of Mental Well-Being" as it contains questions related to an individual's personal experience, including personal stress and satisfaction with life. The combined score for this factor is significantly related to the number of years the respondent lived in Canada (Linear regression p =0.009, F=7.041, R^2=0.054). In addition, the respondent's educational level was significantly related to their self-reported state of mental well-being (linear regression p =0.031, F=4.784, R^2=0.034). This factor was not significantly related to any other demographic characteristics.

The personal mental well-being of respondents did not affect whether or not people attended different kinds of green space, nor if they found it relaxing (see Table 40). However, the number of times people attended particular types of space per year was significantly correlated with their self-reported state of mental well-being scores (see Table 40).

Table 40: Relationships between PA2, environments, and activities. Please note "M" refers to Meadowvale study area, and "FC" refers to the Fletcher's Creek study area (WSWB Survey, 2014)

	Does the respondent go there? Linear Regression			**Number of times per year** Pearson Correlation			**Relaxing** Linear Regression		
	All	M	FC	All	M	FC	All	M	FC
Manicured	*p*= 0.821 F(105)= 0.051 R^2= -0.009	*p*= 0.536 F(55)= 0.388 R^2= -0.011	*p*= 0.645 F(48)= 0.214 R^2= -0.016	*p*= 0.430 t(96)= -0.793	*p*= 0.988 t(51)= 0.015	*p*= 0.141 t(43)= -1.500	*p*= 0.366 F(105)= 0.826 R^2= -0.002	*p*= 0.823 F(55)= 0.050 R^2= -0.017	*p*= 0.345 F(48)= 0.050 R^2= -0.017
Non-Manicured	*p*= 0.051 F(105)= 3.911 R^2= 0.027	*p*= 0.051 F(55)= 0.809 R^2= -0.003	*p*= 0.373 F(48)= 3.870 R^2= 0.055	***p*= 0.006 t(98)= 2.820**	***p*= 0.037 t(49)= 2.149**	*p*= 0.425 t(47)= 0.804	*p*= 0.054 F(105)= 3.805 R^2= 0.026	*p*= 0.930 F(55)= 0.008 R^2= -0.018	*p*= 0.100 F(48)= 2.807 R^2=0.036
Functional	*p*= 0.223 F(105)= 1.500 R^2= 0.005	*p*= 0.332 F(55)= 0.961 R^2= -0.001	*p*= 0.660 F(48)= 0.197 R^2= -0.017	*p*= 0.719 t(96)= -0.361	*p*= 0.449 t(49)= 0.763	***p*= 0.045 t(45)= -2.066**	*p*= 0.125 F(105)= 2.386 R^2= 0.013	*p*= 0.196 F(55)= 1.716 R^2= 0.013	*p*= 0.303 F(48)= 1.083 R^2= 0.002
Private	*p*= 0.223 F(105)= 1.463 R^2= 0.004	*p*= 0.601 F(55)=0. 277 R^2= -0.013	*p*= 0.134 F(48)= 2.321 R^2= 0.026	***p*= 0.036 t(102)= -2.126**	*p*= 0.233 t(52)=-1.207	***p*= 0.042 t(48)=-2.093**	*p*= 0.400 F(105)= 0.715 R^2= -0.003	*p*= 0.746 F(55)= 0.106 R^2= -0.016	*p*= 0.677 F(48)= 0.175 R^2= -0.017
Blue	*p*= 0.313 F(105)= 1.029 R^2= 0.000	*p*= 0.136 F(55)= 2.295 R^2= 0.023	*p*= 0.301 F(48)= 1.093 R^2= 0.002	*p*= 0.409 t(95)= 0.829	*p*= 0.851 t(50)= -0.188	*p*= 0.380 t(43)= 0.887	*p*= 0.720 F(105)= 3.308 R^2= 0.021	*p*= 0.713 F(55)= 0.136 R^2= -0.016	*p*= 0.018 F(48)= 6.026 R^2= 0.093
Street-side Features	Wilcox *p*= 0.704 W= 121.5 Kruskal *p*= 0.696 χ^2=0.153	Wilcox *p*= 0.894 W=51.5 Kruskal *p*= 0.876 χ^2=0.024	n/a	n/a	n/a	n/a	*p*= 0.667 F(105)= 0.186 R^2= -0.008	*p*= 0.688 F(55)= 0.164 R^2= -0.015	*p*= 0.816 F(48)= 0.055 R^2= -0.020

The self-reported state of mental well-being of each respondent was not significantly related to the qualitative answer score (see Table 41).

Table 41: Relationship between PA2 and Qualitative Answer Score (WSWB Survey, 2014)

	All	Meadowvale	Fletcher's Creek
Qualitative Answer Score	Linear regression p=0.264 F (105)=1.263 R^2=0.002	Linear regression p=0.842 F(55)=0.040 R^2=-0.017	Linear regression p=0.224 F(48)=1.515 R^2=0.010

6.5.3 PA3: Relaxing Activities

PA3 has been renamed "Relaxing Activities" as it contains within it statements about whether individuals seek out natural spaces to relax and if they find walking through those areas a relaxing activity. Overall, this factor is related to the years an individual has lived within their current neighbourhood (linear regression p =0.039, F(105)=4.366, R^2=0.031), but it is not deemed statistically significant in the individual neighbourhoods. The Relaxing Activities factor is not related to any other demographic characteristics.

There was an overall significant relationship between the number of times per year respondents went to non-manicured (Pearson p =0.030, t(98)=2.196) and private (Pearson p =0.009, t(102)=2.674) green spaces, and whether the respondent sought out relaxing activities in natural spaces.

Overall, there was a significant relationship between whether the respondent sought out relaxing activities and whether they thought the various types of natural spaces or features were relaxing (see Table 42). These relationships were much stronger overall for respondents in Meadowvale than in Fletcher's Creek (see Table 42).

Table 42: Relationship between PA3, environments, and activities. Please note "M" refers to the Meadowvale study area, and "FC" refers to the Fletcher's Creek study area (WSWB Survey, 2014)

	Does the respondent go there? Linear Regression			**Number of times per year** Pearson Correlation			**Relaxing** Linear Regression		
	All	M	FC	All	M	FC	All	M	FC
Manicured	*p*= 0.787 F(105)= 0.073 R^2= -0.009	*p*= 0.956 F(55)= 0.003 R^2= -0.018	*p*= 0.735 F(48)= 0.116 R^2= -0.018	*p*= 0.107 t(96)= 1.629	*p*= 0.053 t(51)= 1.986	*p*= 0.912 t(43)= 0.112	***p*= 0.001 F(105)= 12.400 R^2= 0.097**	***p*= 0.012 F(55)= 6.747 R^2= 0.093**	***p*= 0.017 F(48)= 6.155 R^2= 0.095**
Non-Manicured	***p*= 0.003 F(105)= 9.445 R^2= 0.074**	***p*= 0.013 F(55)= 6.65 R^2= 0.092**	*p*= 0.062 **F(48)= 3.674 R^2= 0.052**	***p*= 0.030 t(98)= 2.196**	*p*= 0.084 t(49)= 1.761	*p*= 0.156 t(47)= 1.443	***p*= 0.002 F(105)= 9.73 R^2= 0.076**	***p*= 0.003 F(55)= 9.785 R^2= 0.136**	*p*= 0.172 F(48)= 1.927 R^2= 0.019
Functional	*p*= 0.455 F(105)= 0.562 R^2= -0.004	*p*= 0.951 F(55)= 0.004 R^2= -0.018	*p*= 0.303 F(48)= 1.086 R^2= 0.002	*p*= 0.539 t(96)= 0.616	*p*= 0.614 t(49)= 0.508	*p*= 0.740 t(45)= 0.335	*p*= 0.235 F(105)= 1.425 R^2= 0.004	***p*= 0.048 F(55)= 4.107 R^2= 0.053**	*p*= 0.638 F(48)= 0.225 R^2= -0.016
Private	*p*= 0.458 F(105)= 0.554 R^2= -0.004	*p*= 0.486 F(55)= 0.491 R^2= -0.009	*p*= 0.737 F(48)= 0.114 R^2= -0.018	***p*= 0.009 t(102)= 2.674**	*p*= 0.074 t(52)= 1.825	*p*= 0.061 t(48)= 1.919	***p*= 0.034 F(105)= 4.590 R^2= 0.033**	***p*= 0.040 F(55)= 4.437 R^2= 0.058**	*p*= 0.380 F(48)= 0.786 R^2= -0.004
Blue	*p*= 0.144 F(105)= 2.162 R^2= 0.011	*p*= 0.747 F(55)= 0.105 R^2= -0.016	*p*= 0.125 F(48)= 2.433 R^2= 0.028	*p*= 0.078 t(95)= 1.784	*p*= 0.177 t(50)= 1.370	*p*= 0.224 t(43)= 1.233	***p*= 0.002 F(105)= 10.61 R^2= 0.083**	***p*= 0.000 F(55)= 14.030 R^2= 0.189**	*p*= 0.336 F(48)= 0.945 R^2= -0.001
Street-side Features	Wilcox *p*= 0.825 W=95 Kruskal *p*= 0.816 χ^2= 0.054	Wilcox *p*= 0.826 W=49.5 Kruskal *p*= 0.809 χ^2= 0.059	n/a	n/a	n/a	n/a	***p*= 0.007 F(105)= 7.642 R^2= 0.059**	***p*= 0.032 F(55)= 4.837 R^2= 0.064**	*p*= 0.107 F(48)= 2.704 R^2= 0.034

The relaxing activities factor is related to how many qualitative answers respondents gave that could be related to mental well-being (see Table 43). Therefore, individuals who were more likely to seek out natural areas for their relaxing activities were also acknowledging the fact that natural spaces have stress relieving qualities.

Table 43: Relationship between PA3 and Qualitative Answer Score (WSWB Survey, 2014)

	All	**Meadowvale**	**Fletcher's Creek**
Qualitative Answer Score	**Linear regression**	Linear regression	**Linear regression**
	***p*=0.041**	*p*=0.497	***p*=0.033**
	F (105)=4.272	F(55)=0.468	**F(48)=4.794**
	R^2=0.030	R^2=-0.010	**R^2=0.072**

6.5.4 PA4: Designed Spaces

PA4 contains within it statements about how relaxed respondents found manicured and functional spaces, as well as street-side features; this factor has been renamed "Designed Spaces." This factor is not significantly related to any demographic characteristics. There was a significant relationship between the number of times per year the respondent spent near streams, rivers, creeks or lakes and the designed spaces factor (Pearson correlation *p* =0.021, t(95)=-2.339), specifically in Meadowvale, but not in Brampton (see Table 44). The designed spaces factor was not significantly related to the qualitative answer score (see Table 45).

Table 44: Relationships between PA4 and respondent habits in different spaces. Please note "M" refers to Meadowvale study area, and "FC" refers to the Fletcher's Creek study area (WSWB Survey, 2014)

	Does the respondent go there? Linear Regression			**Number of times per year** Pearson Correlation		
	All	M	FC	All	M	FC
Manicured	*p*=0.896 F (105)= 0.017 R^2=-0.009	*p*=0.203 F (55)= 1.661 R^2=0.012	*p*=0.157 F (48)= 2.063 R^2=0.021	*p*=0.431 t(96)=-0.791	*p*=0.243 t(51)=-1.180	*p*=0.585 t(43)=0.551
Non-Manicured	*p*=0.756 F (105)= 0.097 R^2=-0.009	*p*=0.486 F (55)=0.491 R^2=-0.009	*p*=0.960 F (48)= 0.003 R^2=-0.021	*p*=0.432 t(98)=0.789	*p*=0.541 t(49)=0.616	*p*=0.305 t(47)=1.038
Functional	*p*=0.960 F(105)= 3.286 R^2=0.021	*p*= 0.073 F(55)=1.379 R^2=0.007	*p*=0.245 F(48)=2.423 R^2=0.028	*p*=0.112 t(96)=1.604	*p*=0.425 t(49)=0.804	*p*=0.082 t(45)=1.780
Private	*p*=0.338 F (105)= 0.926 R^2=-0.001	*p*=0.551 F (55)= 0.360 R^2=-0.012	*p*=0.450 F (48)= 0.581 R^2=-0.009	*p*=0.596 t(102)=0.532	*p*=0.870 t(52)=0.165	*p*=0.485 t(48)=0.704
Blue	*p*=0.837 F (105)= 0.042 R^2=-0.009	*p*=0.366 F (55)= 0.832 R^2=0.366	*p*=0.783 F (48)=0.077 R^2=-0.019	***p*=0.021** **t(95)=-2.339**	***p*=0.038** **t(50)=-2.132**	*p*=0.885 t(43)=-0.197
Street-side Features	Wilcox *p*= 0.853 W=96.5 Kruskal *p*= 0.844 χ^2=0.039	Wilcox *p*= 0.913 W=52 Kruskal *p*= 0.896 χ^2=0.017	n/a	n/a	n/a	n/a

Table 45: Relationship between PA4 and Qualitative Answer Score (WSWB Survey, 2014)

	All	**Meadowvale**	**Fletcher's Creek**
Qualitative Answer Score	Linear regression *p*=0.288 F (105)=1.141 R^2=0.001	Linear regression *p*=0.225 F(55)=1.508 R^2=0.009	Linear regression *p*=0.792 F(48)=0.070 R^2=-0.019

6.6 Environmental Index of Mental Well-Being

The Environmental Index of Mental Well-Being for each respondent was calculated, including the "Wilderness and Personal Spaces" factor, the "Designed Spaces" factor, the "Relaxing Activities" factor and Mental Well-Being Importance (from question V_1_a of the survey). To maintain the environmental

focus of this index, the "Personal Mental Well-Being" factor was removed from the calculation, as there could be many non-environmental confounding components affecting those scores.

Table 46: Environmental Index of Mental Well-Being compared to demographic and neighbourhood characteristics using linear regression (WSWB Survey, 2014). [1]

Characteristic	All	Meadowvale	Fletcher's Creek
Gender	***p*=0.022 F(105)=5.391 R^2=0.040**	***p* =0.016 F(55)=6.157 R^2=0.084**	*p*=0.456 F(48)=0.565 R^2=-0.009
Age	***p*=0.049 F(105)=3.966 R^2=0.027**	*p*=0.628 F(55)=0.238 R^2=-0.014	***p* =0.050 F(48)=4.047 R^2=0.059**
Ethnicity	*p*=0.503 F(105)=0.452 R^2=-0.005	*p*=0.297 F(55)=1.108 R^2=0.002	*p*=0.733 F(48)=0.118 R^2=-0.018
Income	*p*=0.627 F(105)=0.237 R^2=-0.007	*p*=0.853 F(55)=0.035 R^2=-0.018	*p*=0.758 F(48)=0.097 R^2=-0.019
Postal Code	***p* =0.021 F(84)=1.880 R^2=0.154**	***p* =0.010 F(47)=2.803 R^2=0.225**	*p*=0.275 F(36)=1.270 R^2=0.067
Presence of Sidewalks	*p*=0.130 F(105)=2.333 R^2=0.012	*p*=0.605 F(55)=0.271 R^2=-0.013	*p*=0.608 F(48)=0.267 R^2=-0.015
Size of Front Yard	*p*=0.821 F(105)=0.051 R^2=-0.009	*p*=0.322 F(55)=0.999 R^2=-0.000	*p*=0.659 F(48)=0.198 R^2=-0.017
Presence of Trees on Property	*p*=0.830 F(105)=0.0456 R^2=-0.009	*p*=0.330 F(55)=0.968 R^2=-0.001	*p*=0.930 F(48)=0.008 R^2=-0.021
Presence of Flowers and Shrubs on Property	*p*=0.405 F(105)=0.699 R^2=-0.003	*p*=0.545 F(55)=0.371 R^2=-0.011	*p*=0.347 F(48)=0.901 R^2=-0.002
Young Trees on Property	*p*=0.785 F(105)=0.075 R^2=-0.009	*p*=0.047 F(55)=4.112 R^2=0.053	*p*=0.275 F(48)=1.222 R^2=0.005
Middle Aged Trees on Property	*p*=0.842 F(105)=0.040 R^2=-0.009	*p*=0.053 F(55)=3.910 R^2=0.049	*p*=0.750 F(48)=0.103 R^2=-0.019
Old Trees on Property	*p*=0.341 F(105)=0.914 R^2=-0.001	*p*=0.669 F(55)=0.184 R^2=-0.015	*p*=0.176 F(48)=1.885 R^2=0.018

The index was compared to various demographic and neighbourhood characteristics to see if there was a correlation (see Table 46). The index value was significantly related to the gender of the respondent (linear regression *p*=0.022), particularly in Meadowvale (*p*=0.016), but not in Fletcher's Creek (*p*=0.456). The age of the respondent was significantly related to the index value across both study areas (*p*=0.049), and specifically in Fletcher's Creek (*p*=0.050), but not in Meadowvale (*p*=0.628). The postal code of

[1] It is acknowledged that some of the values within this table do not make sense (i.e. the *p* value for the entire population is not between the *p* values of each neighbourhood). The reasons for this are unknown.

respondents in was also related to the index score (p=0.021). This relationship was particularly significant in Meadowvale (*p*=0.01), but not in Fletcher's Creek (*p*=0.275). None of the remaining neighbourhood and household characteristics were significantly related to the index.

The index scores were also compared to the self-reported state of mental well-being factor, which yielded a significant relationship when all respondents were considered together, but not in the individual study areas (see Table 47).

Table 47: Environmental Index of Mental Well-Being compared to the self-reported state of mental well-being factor using linear regression (WSWB Survey, 2014).

	All	Meadowvale	Fletcher's Creek
Self-Reported State of Mental Well-Being Factor	***p*=0.049** **F(105)=3.96** **R^2=0.027**	*p*=0.682 F(55)=0.170 R^2=-0.015	*p*=0.115 F(48)=2.577 R^2=0.031

This chapter presented the results of the Watershed Well-Being Survey (2014) as they related to Mental Well-Being, looking at the demographic and neighbourhood differences. The factor analysis exposed four different underlying factors, including Self-Reported State of Mental Well-Being, Wilderness and Personal Spaces, Designed Spaces and Relaxing Activities. Each of these factors were analyzed individually before being aggregated, along with other data, into the Environmental Index of Mental Well-Being. This index was then compared to demographic and neighbourhood characteristics. The results that have been presented in this chapter will be discussed in detail in the following chapter.

Chapter 7: Discussion and Conclusion

This section will attempt to answer the question of how environmental management and design could be used as a mental health promotion strategy. It will begin with an interpretation of the survey results presented in the previous chapter. The discussion will conclude with recommendations on how to incorporate these ideas into a mental health promotion strategy, with proposed guidelines on how to manage and design spaces with mental well-being in mind.

7.1 The Natural Environment and Well-Being

In the survey, well-being was defined as "being happy, healthy and prosperous." When prompted about whether there was a relationship between their well-being and the local natural environment, 100% of respondents in Meadowvale and 92% of respondents in Fletcher's Creek agreed. The understanding of this relationship amongst residents of the watershed has seemingly increased since 2011, when the Green Analytics survey indicated that only 68% of respondents indicated there was a relationship between their well-being and their natural environment (Green Analytics, 2011). This difference could be attributed to the greater number of, and geographic distribution of, respondents in the Green Analytics report. Conversely, it could indicate an increasing awareness of the relationship between the environment and well-being within the watershed over the past few years.

Although there is a clear understanding of general relationships between well-being and the environment, when prompted about specific types of natural spaces, this understanding became more muddled (see Table 48). Overall, there was a stronger understanding of the relationship of well-being to various types of natural spaces and features in Meadowvale than in Fletcher's Creek. It is possible that respondents interpreted the questions to be if these spaces positively affected their well-being, rather than having an influence on well-being in general.

Table 48: Percentage of respondents who indicate they identify a relationship between their well-being and the type of natural space mentioned (WSWB Survey, 2014)

	Meadowvale, Mississauga	Fletcher's Creek, Brampton	Tests
Streams and Rivers	82%	62%	Wilcox p=0.003, W=973.5 Kruskal p=0.003, χ^2=9.0578
Forests and Wetlands	82%	57%	Wilcox p=0.001, W=900.5 Kruskal p=0.001, χ^2=11.548
Open Green Space	77%	74%	Wilcox p=0.565, W=1339.5 Kruskal p=0.563, χ^2=0.336

75% of respondents in both areas identified a link between the presence of open green space in the watershed and their personal well-being. Both Fletcher's Creek and Meadowvale residents have access to open green space adjacent to the study areas, though the size and accessibility of those spaces vary. However, there was no significant difference in answers to this question between the two study areas. In further research, it would be useful to see what degree proximity, size and accessibility each have on the perceived connection between open green space and well-being.

The degree to which streams and rivers in the respondent's area affected well-being was reportedly significantly different in Fletcher's Creek and Meadowvale. This could be related to the quality, accessibility, perception of risk and proximity of the nearby water features. These relationships will be elaborated in section 6.2.5. Again, it is possible that respondents could have interpreted the question as whether the streams and rivers positively affect their well-being rather than just affecting their well-being in general, which may account for some of the difference in responses.

There was a significant difference in how respondents from each area perceived their well-being was affected by forests and wetlands. The least understood relationship in Fletcher's Creek was between well-being and forests and wetlands. Again, this could be due to residents interpreting the question to mean positive effects of forests and wetlands on well-being, rather than just the presence of a relationship. The Fletcher's Creek area lacks formal access to the forest and wetland habitat adjacent to

the creek itself. In addition, there is an area at the end of Jessie Street which is posted as being a park, though is largely inaccessible due to the fact that it is constantly flooded (see Figure 24 for a map of the area). The lack of access, in the form of proper walking trails, to the forests and wetlands within the Fletcher's Creek study area may contribute the perceived lack of connection between those areas and resident well-being. In contrast, the residents of the Meadowvale area have pedestrian access to wetlands and forests in Meadowvale Conservation Area, which may contribute to their belief in a connection between these types of areas and their well-being. In future research, it would be useful to compare the accessibility and quality of wetlands and forests, and whether that affects how an individual understands the connection between wetlands and forests, and their well-being.

These results show that although a general understanding of the effect of the local natural environment on well-being is understood, the effects of specific environments on well-being is less well understood. Therefore, the public may benefit from being educated more on how specific natural spaces or features can contribute both positively and negatively to well-being. In future research, it would be useful to compare the differences in understanding of specific environments and well-being with neighbourhood and demographic characteristics to identify potential reasons why resident understanding is different.

7.1.1 Qualitative Responses to Well-Being

Each respondent was prompted to explain why they believed or did not believe in a relationship between their natural environment and their well-being. These answers were divided into categories. 54% of the responses to the question were related to mental well-being, 26% were related to negative effects of the environment, 14% were related to physical well-being and 8% were related to negative effects of the built environment on people. Immediately prior to this question, respondents were given the definition of well-being, which states "well-being refers to being happy, healthy and prosperous," which has a distinctive slant toward feelings of life satisfaction and success, rather than physicality. This could account for the large amount of well-being related answers.

When prompted to explain why respondents went to different kinds of natural space, children were mentioned 6% of the time. In these cases, children were often the sole driving force mentioned to bring the adult outside to spend time in natural areas, despite the fact that adults also receive benefits from being in those environments. Therefore, the importance of children spending time outdoors seemed to resonate more with these respondents than the benefits of spending time outdoors in nature to the adult. In future research, it would be useful to determine to what extent adults perceive the importance of spending time outdoors to their well-being in comparison to that of children of varying ages, and determine what factors affect this difference in perception.

7.1.2 Ecosystem Goods and Services

A series of six questions were asked about ecologically-related risks, i.e. flood risk, and five questions were asked about the importance of environmentally-reliant activities, i.e. the ability to fish in local streams and rivers.

As discussed in the previous section 7.1, there was a difference in the perceived risk of floods between Meadowvale and Fletcher's Creek. This is likely due to the proximity of households to the nearest watercourse, i.e. adjacent to some properties in Fletcher's Creek, and separated from the Credit River by parkland, and sometimes elevation, in Meadowvale.

In general, respondents did not feel at risk of water shortages. This could be due to the fact that all but one of the respondents are on municipal water from Lake Ontario, and thus have immediate access to water when they turn on their taps (Region of Peel, 2011). In future research, it would be useful to compare the perceived risk of water shortages on respondents on municipal water and those on well water in the rural parts of the watershed. In addition, it would be useful to educate the public about what could cause water shortages in their area in the future.

In both areas, just over one third (37%) of respondents said they felt at risk of the effects of climate change, with no significant difference between areas. Given the rise in extreme weather events, such as the July 8th, 2013 flood in the Toronto region, and the increasing urbanization of both study areas, it would be useful to educate the public more on the effects of climate change happening locally and how it can come to affect them.

In Meadowvale, approximately half of respondents (48%) felt at risk of the effects of exotic or introduced species, while under a third of respondents (31%) in Fletcher's Creek felt at risk of the effects of exotic or introduced species. The difference in responses, although not significant, may be due to the potential contact individuals may have with that species. The Meadowvale Conservation Area has some areas within it with biologically harmful invasive species that are pointed out by signage. Therefore, residents living nearby may be more aware of them. In Fletcher's Creek, the forest habitat nearby that could host some of the biologically harmful invasive species is largely inaccessible, therefore residents may not have has as much cause to be knowledgeable about them. In addition, the effects of invasive or introduced species on local habitats may not be well known among residents, though Credit Valley Conservation provides a large amount of information online for residents about invasive species, should they seek it out (CVC, 2012c).

Just under two-thirds of respondents in both Meadowvale and Fletcher's Creek felt at risk of rapid urbanization. This may be due to the rapid rise in population of the watershed, i.e. 32% between 1996 and 2006 (George Morris Centre, 2009), that has put considerable development pressures on the region. Therefore, many of the respondents who have been living in the respective cities for longer than 10 years would have seen a large change to the built and natural landscape in that time.

Respondents from both areas indicated that their perceived risk related to water quality was variable, with responses all across the risk spectrum. Some respondents indicated mistrust in the municipal water

supply, stating that they used reverse osmosis systems or wanted the fluoride removed from the water. Although the perceived risk related to water quality is inconclusive, 91% of respondents indicated that the ability to drink their tap water was either “Important” or “Very Important.” In future research, it would be useful to educate the public on water security in their area, and on the linkages between access to water and water quality.

To further understand how residents perceive different environmental risks or hazards, it would be useful to ask why each respondent felt at a high, medium, or low risk of these different factors, as well as identify the extent to which respondents understand what each of these risks are, i.e. risks related to the spread of invasive species. It would also be useful to compare these different perceived risks with neighbourhood and demographic characteristics to determine if there are particular populations or areas which may benefit from understanding these risks better. In addition, all of the risks discussed have the ability to affect well-being, so it would be useful in the future to ask how these specific environmental risks affect the respondent’s well-being.

7.2 Perspectives of Mental Well-Being and the Environment

The perceived link between mental well-being and the environment was significantly different in Meadowvale (98%) and Fletcher’s Creek (81%). Most individuals listed how their mental well-being was positively affected by their natural environment (e.g. it increases productivity, is relaxing, therapeutic, provides aromatherapy, and makes people happy), with only a few individuals who commented on negative connections (e.g. if the weather is bad, if it isn’t clean, or it decreases productivity).

Table 49: Ranking of natural spaces based on how relaxing respondents found them to be (WSWB Survey, 2014)

Least----------Relaxing----------Most	All	Meadowvale	Fletcher's Creek
	Blue	Blue	Private
	Looking from windows at nature	Looking from windows at nature	Blue
	Private	Private	Manicured
	Manicured	Non-manicured	Looking from windows at nature
	Non-manicured	Manicured (tied)	Street-side features
	Street-side features	Street-side features (tied)	Non-manicured
	Functional	Functional	Functional

The types of space are listed in order from most relaxing to least relaxing can be seen in Table 49. The following section will discuss the responses of individuals by type of natural space.

7.2.1 Manicured Green Space

On average, residents of both neighbourhoods attended city parks and public gardens, i.e. manicured green space, at least once in the past year. Individual residents in Fletcher's Creek went to these spaces more often per year than in Meadowvale, though the average number of days per year between all residents was higher in Meadowvale than Brampton. This could be due to the presence of a large manicured green space adjacent to the Fletcher's Creek study area, while although Meadowvale has a large manicured space nearby, it is within the Conservation Area, and therefore may not have been thought of in isolation of the rest of the conservation area, which is largely non-manicured green space.

7.2.2 Non-Manicured Green Space

In general, respondents who went to non-manicured green spaces more often were more likely to find that space to be relaxing. However, there were marked differences between how Meadowvale and Fletcher's Creek residents interacted with non-manicured spaces, for example 79% of Meadowvale respondents said they go to non-manicured spaces, while only 49% of respondents in Fletcher's Creek claimed they go to non-manicured spaces. This may be due to differences in proximity and accessibility (see Figure 24and Figure 25 for maps of the two areas). The Meadowvale study area is adjacent to

Meadowvale Conservation Area, which is a large non-manicured space with paved and maintained trails. The physical proximity of this space, and the fact that it is accessible, likely contribute to how often respondents go to the area, and therefore how relaxing they find the area. In Fletcher's Creek, there is non-manicured space along the creek itself, which bisects the study area. However, the creek and the forested areas are not accessible by paths, which could reduce the likelihood of individuals attending the space and therefore reduce the ability of the individual to receive the relaxing benefits of that space.

7.2.3 Functional Green Space

The category "functional spaces, including hospital grounds, school grounds, golf courses and cemeteries" was a bit of a mixed bag, with highly variable answers from respondents. Each space allows for different activities, which may invoke different feelings, thus exposing a fundamental flaw to this survey question. For example, respondents who went to hospital grounds could view them in different lights, i.e. the hospital grounds may remind them of a sick loved one, and therefore invoke negative, sad or anxious feelings, while another person may view hospital grounds as a positive space to bring a sick loved one out for a walk, therefore invoking more positive feelings. The way individuals interact with these functional green spaces could also vary. For example, someone could attend a cemetery to visit a grave which may be a sad event, whilst someone else could use the cemetery as a recreational space for a run, and therefore view the space very differently. These sorts of differences could account for the wide distribution of responses as to how relaxed the respondent felt after spending time in functional spaces. The majority of respondents (49%) answered "Not relaxed at all" or "A little relaxed." In future research, it would be useful to separate out these different kinds of functional green space, e.g. ask separate questions about different kinds of functional green spaces, to understand more fully the types of activities people do in these spaces and therefore figure out how to make these spaces more relaxing.

7.2.4 Private Green Space

Respondents in both areas spent time in their private green space more than in any other kind of natural space, with 81% of Meadowvale respondents and 84% of Fletcher's Creek respondents stating they spent time in their private green space. On average, respondents spent between 2 to 3 days per week in their private green spaces. The individuals who spent time in private green space were more likely to find it relaxing than those who did not spend time in their private green space.

The activities being undertaken in private green spaces were varied. Some individuals expressed they mainly spend time in their private green space doing maintenance activities, such as raking leaves, mowing the lawn or gardening, whilst others talked of having people over for social activities, or to go sit outside to relax. These experiences in private green space are unique in that they can be both passive and interactive, e.g. an individual can look at or be active in the space, and can also shape the natural space they are in through gardening and landscape design, respectively (Sempik, Hine & Wilcox, 2010). The mingling of both types of activity allows for a more restorative experience than merely viewing a space.

In future research, it would be useful to learn about different attitudes individuals have about the activities being undertaken in private green space. These spaces are unique as it is the individual homeowner's imperative to design and maintain their private yard, in contrast with the other spaces which are designed and maintained by others, including governmental organizations and private groups.

7.2.5 Blue Space

There was a large difference in attitudes toward blue space between Meadowvale and Fletcher's Creek. 88% of Meadowvale residents responded that they went to blue space within the last year, going approximately once per month. In contrast, only 62% of respondents from Fletcher's creek responded they went to blue space within the last year, going approximately once every six months. In addition, when the respondent specified the blue spaces they attended, Meadowvale respondents indicated they

went to the Credit River the most often, while respondents from Fletcher's Creek went to other water features the most often. This response is surprising considering the proximity of both neighbourhoods to blue space, i.e. the Credit River adjacent to the Meadowvale study area, and Fletcher's Creek which bisects the Fletcher's Creek study area (see Figure 24). Therefore, the difference in attendance must be due to a factor other than proximity, most likely accessibility.

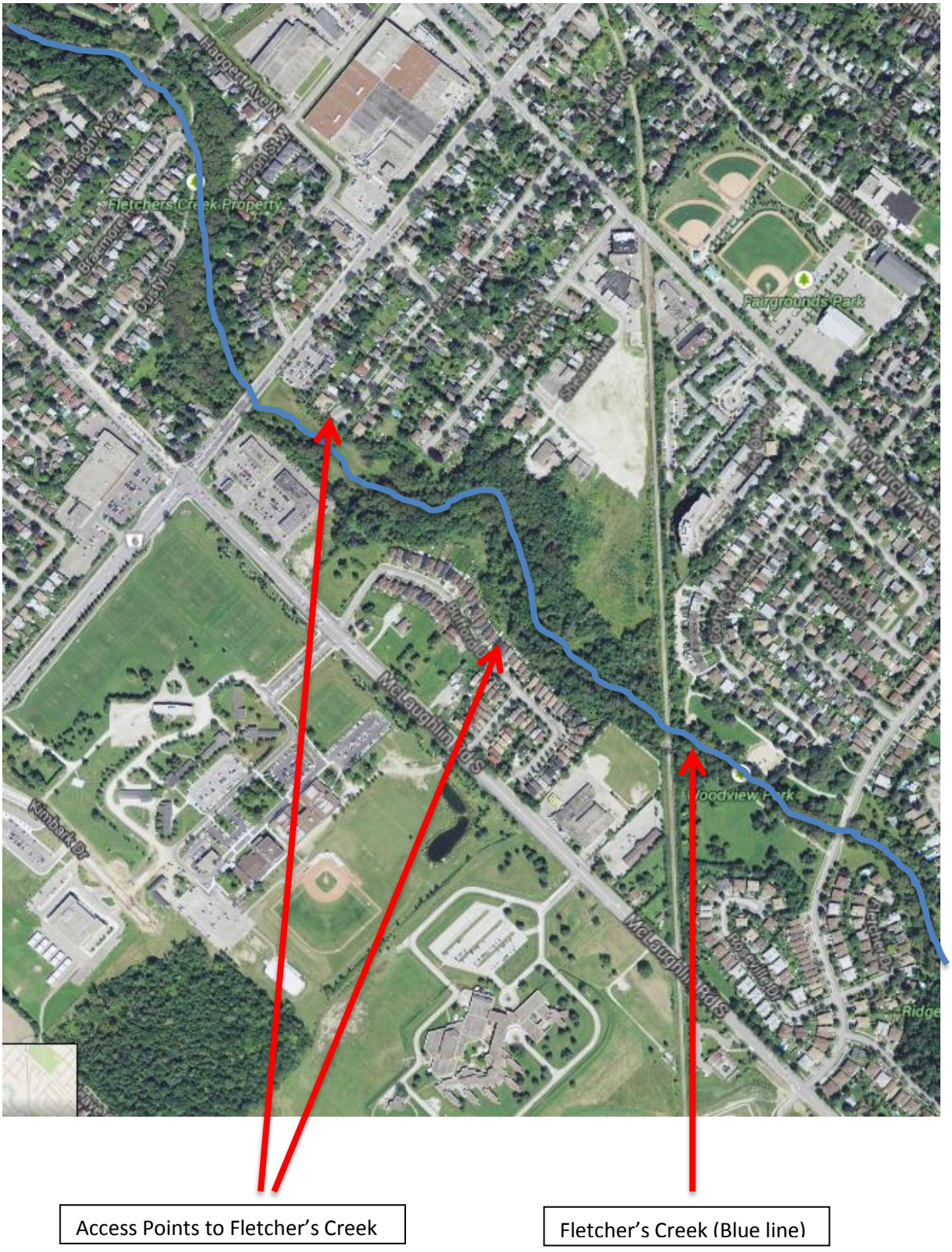


Figure 24: A satellite image of the Fletcher's Creek study area, depicting where Fletcher's Creek is located, where the access points are to Fletcher's Creek, and the dense riparian zone adjacent to the creek. (Image from Google Maps).

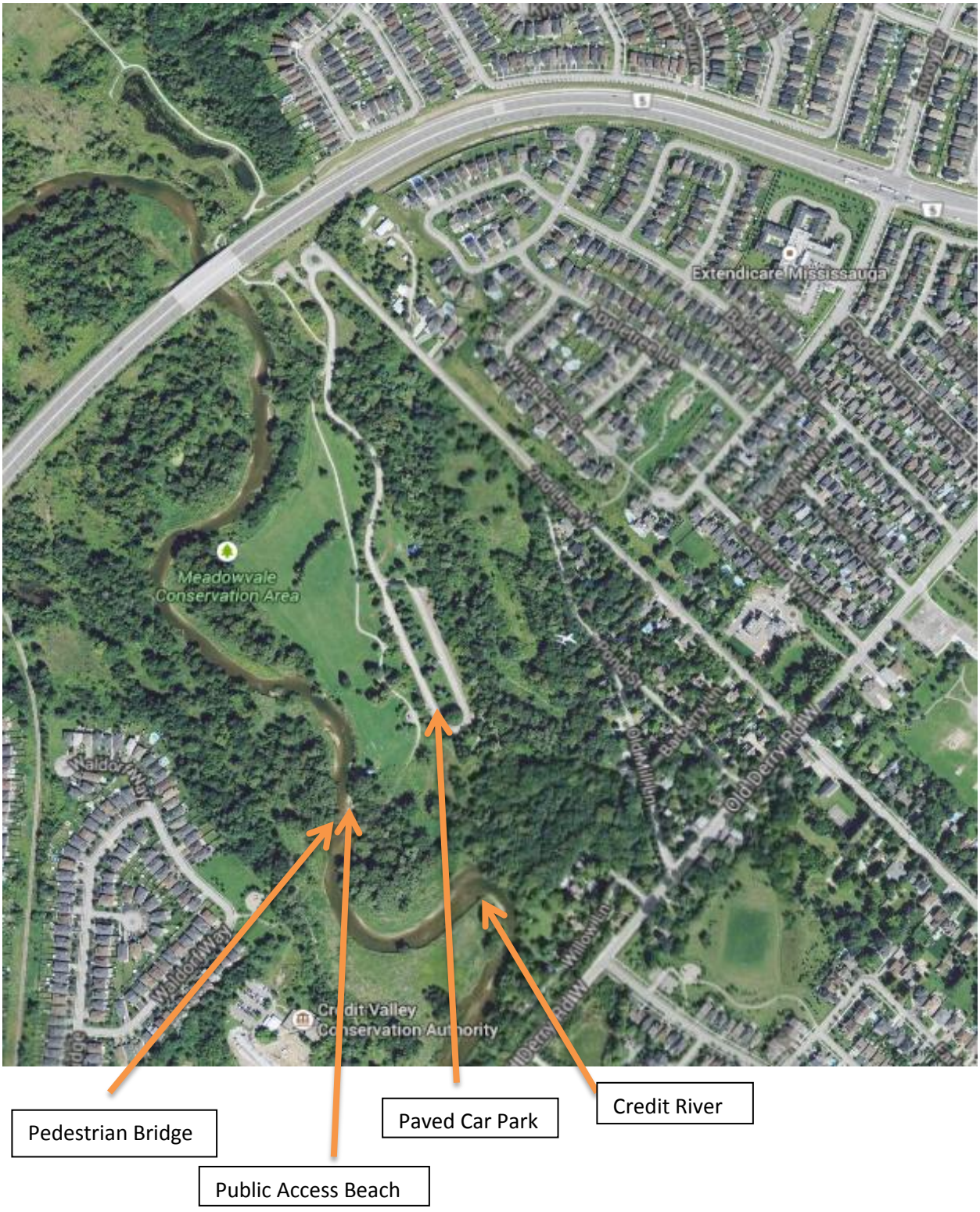


Figure 25: A satellite view of the Meadowvale study area, showing the different access points to the Credit River within the Meadowvale Conservation Area (map courtesy of Google Maps)

In Meadowvale, the nearby water feature is the Credit River (see Figure 25). This space is embedded within Meadowvale Conservation Area, and therefore is made accessible to the public by beach, bridge and grassy areas nearby. In addition, there are many benches and picnic tables for people to sit and enjoy a view of the river. These different features allow for easy access to the blue space. In addition, the majority of homes within the study area were separated from the river by part of the conservation area, and over half of the homes were atop a hill, thus reducing risk of flooding in those residences.

In contrast, Fletcher's Creek is not easily accessible. There are currently two access points to the creek within the study area, including through the park at the end of Jessie Street (left arrow of Fletcher's Creek area in Figure 24), and a paved walkway between two properties along Bufford (right arrow in Figure 24). The Jessie Street access point lacks a paved walkway to bring people through the park to the creek. The Bufford access point has a paved walkway that ends abruptly at the level of the back property lines, and does not offer a formal walkway or path along the creek behind the properties. Neither access point has benches or picnic tables nearby for people to sit and enjoy a view of the creek. In addition, the riparian zones of the creek are densely vegetated, preventing sight lines to the water. Lastly, the creek habitat is not seen as an ideal space to go to as it often has litter in and around the creek. All of these factors together prevent residents of these two sub-neighbourhoods to gain access to the creek, and therefore access to the restorative potential of that space. Just south of the train tracks along Fletcher's Creek, there is a park that does allow access to the creek. However, the train tracks prevent walking access to this area from the Jessie/Royce and Bufford neighbourhoods.

As there was a significant relationship between going to blue space and how relaxing an individual finds that space, it would be useful to make accessible this stretch of Fletcher's Creek to allow individuals to have access to that restorative space.

7.2.6 Street-Side Features

Street-side features, including trees and flower planters, were considered a benefit to the well-being of 98% of respondents, though only 62% of respondents "Agreed" or "Strongly Agreed" that the presence of street-side features made them feel relaxed. The individual environmental features of respondent's residences, e.g. the presence, age and size of trees in their front yard, did not have an effect on whether these features were relaxing or whether these features were beneficial to well-being.

Respondents were given a very broad definition of street-side features to include trees and flower planters, but not told where these features may occur, i.e. along residential or commercial streets, or given a particular example upon which to base their answers. This could account for the wide range of answers respondents gave to the question.

The presence and diversity of street trees within residential neighbourhoods can be used as an indicator of socioeconomic inequalities in some areas. Pedlowski, Adell & Heynen (2002) shows how higher income neighbourhoods are usually privy to having more street trees with greater biodiversity than lower income neighbourhoods regardless of the age of those neighbourhoods. This conclusion was reinforced in this study, as the higher income neighbourhood (Meadowvale) had more trees on respondent properties and adjacent properties than in Fletcher's Creek, though the average size of trees were smaller in Meadowvale than in Fletcher's Creek. This reinforces the idea that there generally is an "uneven geographical relationship between the existing distribution pattern of trees and income" (Landry, 2009: 2653).

The WSWB Survey did not ask specifically about the maintenance, quality and quality of street-side features, though that could play a part in whether an individual deemed these features to be relaxing. For example, an area where the street-trees are damaged or sick may be less aesthetically pleasing to residents than an area where the street-trees are healthy and well-maintained. One particular

respondent complained about the inadequate maintenance of the trees on the margins of their property, claiming that the city was responsible for dealing with the autumn leaves (WSWB Survey, 2014). This reveals the question of who is accountable for the maintenance of different kinds of street-side features, for example property owners may be responsible for street-trees adjacent their property, while the city may take a central role in the maintenance of street-trees in front of commercial spaces. In future research, it may prove useful to ask more specifically who is responsible for the maintenance of street-side features, as well as if the quality and quantity of these features contributes differently to well-being.

7.2.7 Looking Out of Windows

Looking out of windows at natural spaces or features was believed to be "Relaxing" or "Very Relaxing" to 86% of respondents from Meadowvale and 76% of respondents from Fletcher's Creek. This falls in line with existing literature, which shows how views of nature from windows can influence stress, for example by improving post-operative recovery time (Ulrich, 1984), or improving employee performance in the workplace (Dravigne et al., 2008) or in schools (Matsuoka, 2010; Heschong Mahone Group, 2003).

7.3 Factor Analysis

The factor analysis revealed four underlying factors affecting mental well-being. These included "Self-Reported State of Mental Well-Being," "Relaxing Activities," "Wilderness and Personal Spaces," and "Designed Spaces." Each of these four factors will be discussed in turn.

7.3.1 Self-Reported State of Mental Well-Being Factor

This factor contained within it the seemingly juxtaposed concepts of the amount of stress and satisfaction in one's life. Within this factor, stress and satisfaction scores were significantly inversely related (linear regression p=0.001, F(105)=10.9, R^2=0.094) in both areas.

The statements about stress and satisfaction in life were supposed to illicit responses about their long-term self-reported mental well-being. However, the statements were not specific, so some respondents

may have responded with their current mood rather than longer term well-being, which could have implications for the usefulness of this measure.

This factor was excluded when calculating the individual environmental indices of mental well-being for each respondent. This is due to the fact that one's personal state of mental well-being can be affected by many different confounding factors, not all of which are the environment within which they live. Therefore, to maintain the rigorousness of the index, this factor was excluded. The value of this score was, however, compared to the environmental index of mental well-being, showing that the amount of stress and satisfaction an individual experiences in their life is significantly related to the environmental index of mental well-being.

7.3.2 Relaxing Activities Factor

The relaxing activities category contains two statements, including "I regularly go on walks through or sit in natural areas to relax," and "When stressed, I often seek out natural areas as a setting for relief i.e. I go to a park." Respondents who scored highly for this factor also "agreed" or "strongly agreed" that natural settings and features made them feel relaxed. Therefore, individuals who recognised or experienced the relaxing effects of different natural settings were more likely to undertake relaxing activities in natural settings.

There was a significant relationship between this factor and the number of times per year respondents went to non-manicured or private green spaces. This may be related to the experiences one could expect to have in those spaces, i.e. going to these spaces specifically to relax.

Earlier in this paper, it was discussed that respondents were more likely to find a space relaxing the more often they went to that space. However, there was not a significant relationship between the number of days respondents went to different types of natural space, and whether they seek out natural settings for relaxing activities. Therefore, it is possible that the relaxing experience of being in a

space is not the primary reason for going to that space, but a secondary outcome of spending time in these spaces. This concept will be discussed further later in this chapter.

In retrospect, it would have proven useful to ask respondents specifically if they sought out relaxing activities in each of the types of natural space to see if some types of natural space were relaxing but not used for relaxing activities, or vice versa.

7.3.3 Wilderness and Personal Spaces Factor

The wilderness and personal spaces factor includes statements about feeling relaxed after spending time in non-manicured green space, near blue space, in private green space or looking out of windows at natural spaces or features. These spaces are similar in that the purpose of being in that space is not primarily for an activity that occurs there, but for the appreciation of the space itself.

Sempik, Hine & Wilcox (2010) described experiences in natural spaces as being either passive, i.e. the intention of being in that space is not for the space itself but for the activity, or interactive, i.e. the intention of being in that space is for the space itself. The kinds of spaces in this category fit into both experiential categories.

Table 50: The types of natural space and the experiences each natural space may invoke using examples from the WSWB Survey (2014)

Type of Space	Types of Experience	Examples of activities from the WSWB Survey (2014)
Non-manicured green space	Passive	"To take pictures" "Walk or bike through"
	Interactive	"Mushroom picking"
Near blue space	Passive	"Fall colour appreciation" "To enjoy nature" "Hiking"
	Interactive	"Fishing" "Swimming"
Private green space	Passive	"Watch deer and rabbits" "We have company in the yard for BBQs"
	Interactive	"I have my garden where I grow tomatoes, peas, celery, cucumbers and basil" "Mow the lawn"
Looking out of windows at natural spaces	Passive	n/a

Table 50 shows how these different kinds of spaces could host different types of activity. All spaces, except for looking out of windows, can host both passive and interactive experiences. Looking out of windows implies a barrier between the respondent and the natural environment, thus interactive experiences are not possible.

Respondents were not asked about the degree to which different activities they undertook in each natural setting were relaxing, so it is not possible to know the extent to which passive and interactive experiences shape the restorative experience in this paper. Future research could explore the how relaxing passive and interactive experiences in these different spaces, and how they are related to the function of those spaces.

The physical attributes and experiences of these spaces are all very different, which makes understanding their aggregation into a factor more confusing. One common element between these different spaces, therefore, could be related to the intention or purpose of attending that particular space. This implies that the setting of their activities could be as important as the activity itself. For

example, when going on a hike, the fact that it is overlooking a blue space may be equally as important as the hike itself. However, this is just one possibility of how the experiences in these different spaces could be united, and more research needs to be conducted to understand the nuance.

7.3.4 Designed Spaces Factor

The "designed spaces" factor includes the statements about feeling relaxed after spending time in functional green spaces, in manicured green spaces and near street-side features. In contrast with the wilderness and personal spaces, the experiences in the designed spaces lean more toward passive experiences rather than interactive ones. Passive experiences can range from simply viewing a natural space as you drive by to sitting in a garden for a prolonged period of time. Thus, the intended function or reason for using these natural features or spaces becomes important in determining the types of restorative experiences that can occur in those spaces.

7.4 Towards an Environmental Index of Mental Well-Being

This index was included the following information: Relaxing Activities factor score, Designed Spaces factor score, Wilderness and Personal Spaces factor score and the Mental Well-Being Importance score.

When conducting analysis, the index was compared with demographic and neighbourhood characteristics. There was a significant difference between the index scores for men and women. This aligns with Zelenzny, Chua & Aldrich (2000), who show how women tend to be more ecocentric, e.g. have a greater concern for the environment and all living things, than men. This could have affected whether the mental well-being link was perceived, and the extent to which each individual felt relaxed after spending time in or amongst different natural areas or features, respectively.

The purpose of creating this index was to determine if there was a way to describe the mental well-being benefits one may receive from being in a particular place. Therefore, based upon where an individual lives, the index could provide information on how restorative the local environment is to that

individual. As it is presented in this paper, the index is not yet adequate to provide this kind of information. In order to create an environmental index of mental well-being that is useful, the metric should include the proximity of the residence to each type of natural space or feature described by the relaxation questions making up the designed spaces factor and wilderness and personal spaces factor. This is supported by the fact that the resident's postal code was significantly related to the index score. By including this information, it would be possible to determine on a residence-by-residence basis what possible interventions could take place to improve the mental well-being of that area, e.g. by increasing the quality and quantity of street-side features, or by improving access to a nearby non-manicured space.

The EIMWB could also be used in identifying differences in preference for natural features and settings based upon demographic characteristics, like ethnicity, immigration status or age. The two neighbourhoods in this study were rather multicultural, representing the overall distribution of ethnicities present in the Credit River Watershed (see Table 25: Comparing demographic characteristics from WSWB Survey with other previously conducted studies (WSWB Survey, 2014; Green Analytics, 2011; Lura Consulting, 2012)). However, there are many geographic pockets in Mississauga and Brampton that are not as diverse, hosting individuals primarily from one or two specific ethnic or cultural groups, and these different groups of individuals may have different preferences for the types of natural features and spaces accessible in their neighbourhoods (Buijs, A., Elands, B. & Langers, F., 2009). Given this difference in preference, the EMWBI could be used to indicate where the design of natural spaces and features could be better suited within its wider social and ecological context to provide the most restorative experience.

Lastly, the EIMWB could be used to identify differences in need for natural features and spaces depending on the type of land use and population density, i.e. do residents of a low-density single family

home neighbourhood have different preferences for natural spaces and features than individuals living in apartment buildings, or along commercial streetscapes. In addition, one could determine if there was a difference between the EIMWB scores of homeowners versus renters.

The overall research project aimed to develop methods of monitoring and evaluating the effects of CVC's management activities on the well-being of residents. The EIMWB provides an opportunity to start assessing how mental well-being is affected by the local natural environment. As it stands, the EIMWB could be used as a preliminary tool for investigation, but should be looked at more critically to see if it is possible to improve the metric prior to its use as a monitoring tool.

7.5 Environmentally-Based Mental Health Promotion

As was introduced in the section 2.4.1, health promotion can be split into three categories: prevention (primary, secondary and tertiary), health education and health protection (Downie, Tannahill &Tannahill, 2000; Kauhanan et al., 1998). Environmentally-based mental health promotion strategies fall primarily into the education and protection categories.

7.5.1 Education

In an environmental context, health education aims to empower individuals with knowledge about how the environment affects their health and well-being. The results of the WSWB survey (2014) have exposed some potential gaps in resident knowledge about the relationships between mental well-being and the environment, which should be addressed.

The following points were identified by the watershed well-being survey as requiring more education:

- Although respondents understood that their general well-being was connected to their environment, they were less aware of how specific environments, like forests and wetlands, affect their well-being.

- Some respondents indicated the importance of going to various natural spaces for their children. It would be useful to educate the public more about how the natural environment can act as a restorative space for people across the age spectrum.

After the conclusion of this research, two modes of health education will take place. Firstly, a short pamphlet will be produced and provided to respondents of the survey about the relationships between their mental well-being and their local natural environment, which will address the gaps above as well as provide more general information on the outcomes of the survey. This information will be made available online on the overall project's webpage.

A more in-depth version of the pamphlet will include information on the benefits of specific natural features and spaces to mental well-being that have started to be developed in this paper. This version of the pamphlet will be made available to appropriate stakeholders, i.e. in municipalities, conservation authorities, regions, and public health authorities, in an effort to share more knowledge about the relationship between mental well-being and the natural environment with individuals who can enact change in policy. Therefore, the educational goal will be realised on a small scale through providing information to the public and stakeholders on connections between mental well-being and the local natural environment.

7.5.2 Protection

Health protection focusses on providing healthy supportive environments for healthy lives. Within this pillar, many public health departments focus on water and food safety, protection from environmental threats and mitigating infectious disease outbreaks, for example (Association of Faculties of Medicine of Canada, 2011). It is primarily within this pillar of health promotion that one would find environmentally-based mental health promotion strategies.

Recently, public health and land use planning came together in the document “Improving Health by Design in the Greater Toronto-Hamilton Area” (Mowat et al., 2014). This document briefly touches on the implications of urban design on mental health, focussing primarily on the ability of urban environments supportive of physical activity will have cascading effects on mental well-being (Mowat et al., 2014). The direct relationships between urban design and mental health are not discussed in that paper, however. This follows the fact that public health agencies focus their efforts and programming on relationships that can be backed up with hard, scientifically rigorous data. However, many studies connecting experiences in or near nature on mental well-being are of a subjective nature. Therefore, although most health promotion strategies are funnelled through public health authorities, they do not provide the optimal setting for environmentally-based mental health promotion to take place. Instead, the best setting for these health promotion considerations at this time are by environmental managers within municipalities and conservation authorities, where incorporating mental well-being considerations into pre-existing design and management considerations would prove relatively simple. Therefore, this can act as a starting-off point for environmentally-based mental health promotion, which eventually, with more scientifically rigorous research coming out, could be approached collaboratively between both the environmental and public health sectors.

However, the consideration of mental health into environmental management and design may not be intuitive. Therefore, it is important to educate current environmental managers about how the same natural features and settings that are currently being managed to be recreational spaces and provide ecosystem services to communities can also provide the context for restorative experiences. For example, a large maple tree in a park can provide shade and aesthetic benefits that contribute to restorative experiences, as well as water and carbon sequestration. After these relationships are able to be made more explicit, incorporating mental well-being into the management of natural features and settings is not a far stretch.

7.6 Conclusions

As the stress-burden on individuals continues to rise in urban areas, it is imperative that action be taken to try to mitigate and prevent these stressors, not only for the health and well-being of the individual, but also for the complex burdens placed on society. This study investigated resident relationships with and perceptions of their local natural environments as it relates to their well-being.

The respondents in both Meadowvale and Fletcher's Creek generally understand that there is a link between their individual well-being and their natural environment, though the specific attributes of these environments that contribute to that connection are not well understood. However, when specifically prompted, respondents acknowledged the link between mental well-being and the natural environment, highlighting various features of the environment, such as trees or wildlife, which contribute to that connection.

Although respondents acknowledged that all natural environments and settings (with the exception of functional spaces) make them feel relaxed after spending time in or near them, the current behaviours of respondents indicate that spending time in natural settings are not a high priority. This could be due to spending time in natural spaces is secondary to other activities that take up their time, though that was not investigated in this paper.

Through comparing how often respondents go to various natural spaces with how relaxing those spaces are it is possible to expose some issues in the design or maintenance of natural features and spaces. For example, Meadowvale and Fletcher's Creek residents both said that they felt more relaxed after spending time near blue space, but there was a large difference in the number of days the residents spent there. These differences could be attributed to the accessibility of the nearby blue spaces and how those spaces are perceived, i.e. clean and maintained or dirty and not maintained. Therefore, it is

possible to use questions about mental well-being in conjunction with other questions about the use and function of spaces to identify moments of design and/or management interventions.

In addition, the Environmental Index of Mental Well-being discussed in this paper could be used in conjunction with other data, such as proximity to natural spaces, functional use of spaces or Mallette's (2014) Environmental Index of Social Well-Being, monitor the effects of environmental management over time on mental well-being.

As more people move into urban areas, the mental health burden will continue to rise unless steps to mitigate the stressfulness of urban environments are taken. One potential intervention is through environmentally-based mental health promotion, which would focus upon using the form and function of urban natural areas as a means to prevent and mitigate urban stressors, such as excessive noise or harsh visual streetscapes that contribute to the background stress levels of urbanites. A mental health promotion strategy like this one should be approached, but not lost, within a larger environmentally-oriented health promotion strategy, which also incorporates both social (Mallette, 2014) and physical health.

This sort of environmentally-based health promotion is best suited to take place within conservation authorities and environmentally-oriented departments of municipalities. In these settings, current management practices are already addressing ecological health in relation to human health and well-being, so it is not a far stretch to incorporate mental health and well-being into their work as an upstream mental health promotion strategy.

Bibliography

Antibiotic Awareness. (2012). *Antibiotic Use & Resistance*. Retrieved November 2014, from http://antibioticawareness.ca/?page_id=14

Argyle, M. (2001). *The Psychology of Happiness.* Routledge.

Association of Faculties of Medicine of Canada. (2011). *Implementing prevention, health protection and health promotion*. Retrieved December 2014, from http://phprimer.afmc.ca/Part1-TheoryThinkingAboutHealth/Chapter4BasicConceptsInPreventionSurveillanceAndHealthPromotion/Implementingpreventionhealthprotectionandhealthpromotion

Babyak, M., Blumenthal, J., Herman, S., Khatri, P., Doraiswamy, M., Moore, K., Craighead, W., Baldewicz, T. & Krishnan, K. (2000). Exercise treatment for major depression: Maintenance of therapuetic benefits at 10 months. *Psychosomatic Medicine, 62*, 622-628.

Bio-Medicine. (2012). *Directed Attention Fatigue*. Retrieved February 2015, from http://www.bio-medicine.org/medicine-definition/Directed_attention_fatigue/

Blumenthal, J., Babyak, M., Moore, K., Craighead, W., Herman, S., Khatri, P., Waugh, R., Napolitano, M., Forman, L., Appelbaum, M., Doraiswamy, M. & Krishnan, R. (1999). Effects of exercise training on older patients with major depression. *Archives of Internal Medicine, 159*, 2349-2356.

Bonnell, J. (2010). Imagined Futures and Unintended Consequences: An Environmental History of Toronto's Don River Valley. Toronto: OISE (Unpublished Doctoral Dissertation).

Bowling, A. (2005). Mode of questionnaire administration can have serious effects on data quality. *Journal of Public Health, 27*(3), 281-291.

Boyd, K. (2000). Disease, illness, sickness, health, healing and wholeness: exploring some elusive concepts. *Journal of Medical Ethics: Medical Humanities, 26*, 9-17.

Brampton. (2013a). *National Household Survey Bulletin #2*. Retrieved February 2015, from http://www.brampton.ca/EN/Business/edo/business-knowledge/Economic-Reports-Papers-Statistics/Documents/Census%20Bulletin/2011%20NHS%20%Bulletin%20%20-%20Labour,%20Education,%20Place%20of%20work,%Commuting%20to%220work,%20Mobility%20etc.pdf

Brampton. (2013b). *National Household Survey Bulletin #3*. Retrieved February 2015, from http://www.brampton.ca/EN/Business/edo/business-knowledge/Economic-Reports-Papers-Statistics/Documents/Census%20Bulletins/2011%20National%20Household%20Survey%20Bulletin%203%20-%20Income,%20Earnings,%20Housing%20and%20Shelter%20Cost.pdf

Bryman, A. (2008). *Social research methods.* Oxford: Oxford University Press.

Buijs, A., Elands, B. & Langers, F. (2009). No wilderness for immigrants: Cultural differences in images of nature and landscape preferences. *Landscape and Urban Planning, 91*(3), 113-123.

Bunch, M., Morrison, K., Parkes, M., & Venema, H. (2011). Promoting Health and Well-Being by Managing for Social-Ecological Resilience: the Potential of Integrating Ecohealth and Water Resources Management Approaches. *Ecology and Society, 16*(1), 1-18.

Carlson, N. (2004). *Physiology of Behaviour* (8 ed.). New York: Allyn & Bacon.

Carneiro, F., Oliveira, M., Netto, G., & Corvalan, C. (2006). Meeting report: Development of environmental health indicators in Brazil and other countries in the Americas. *Environmental Health Perspectives, 114*, 1407-1408.

Carrera-Bastos, P., Fontes-Villalba, M., O'Keefe, J., Lindeberg, S. & Cordain, L. (2011). The western diet and lifestyle and disease of civilization. *Research Reports in Clinical Cardiology, 2*, 15-35.

CDC. (2001). *Achievements in Public Health, 1900-1999: Control of Infectious Diseases*. Retrieved June 2014, from Morbidity and Mortality Weekly Report: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4829a1.htm

Charron, D. (2012). Ecohealth: Origins and Approach. In D. Charron, *Ecohealth Research in Practice: Innovative Applications of an Ecosystem Approach to Health* (pp. 1-30). New York: Springer.

City of Brampton. (2011). *Regional Municipality of Peel.* Retrieved February 2015, from City of Brampton Urban Forest Study: Technical Report: https://www.peelregion.ca/planning/climatechange/reports/pdf/bramp-urb-forest-study-july14-2011.pdf

City of Mississauga. (2011). *Regional Municipality of Peel.* Retrieved February 2015, from City of Mississauga Urban Forest Study: Technical Report: https://www.peelregion.ca/planning/climatechange/reports/pdf/mississ-urb-forest-study-july15-2011.pdf

City of Mississauga. (2012). *Living Green Master Plan.* Retrieved January 2015, from http://www5.mississauga.ca/marketing/websites/livinggreen/downloads/LGMP2012_Final.pdf

CMHA. (2008). *Mental Health Promotion: A Framework for Action by the CMHA.* Ottawa: Canadian Mental Health Association.

CMHA. (2015). *Mental Health Promotion*. Retrieved March 2015, from http://www.cmha.ca/public-policy/mental-health-promotion/

CMHA Ontario. (2008). *Mental Health Promotion in Ontario: A Call to Action.* Retrieved December 2014, from CMHA Ontario: http://ontario.cmha.ca/public_policy/mental-health-promotion-in-ontario-a-call-to-action/#.VFbl3vldUnU

CMHA Ontario. (2013). *About Mood Walks*. Retrieved December 2014, from Mood Walks: http://www.moodwalks.ca/about-mood-walks/

Colligan, T. & Higgins, E. (2006). Workplace Stress. *Journal of Workplace Behavioural Health, 21*(2), 89-97.

Complete Streets for Canada. (2012). *What are Complete Streets?* Retrieved November 2014, from http://completestreetsforcanada.ca/what-are-complete-streets

Conservation Ontario. (2013). *History of Conservation Authorities*. Retrieved June 2014, from Conservation Ontario: http://www.conservation-ontario.on.ca/about-us/conservation-authorities/history

Costello, A. & Osborne, J. (2005). Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most From Your Analysis. *Research & Evaluation, 10*(7), 1-9.

Cummins, R. (1996). The domains of life satisfaction: An attempt to order chaos. *Social Indicators Research, 38*, 303-332.

CVC. (2003). *Watershed Report Card.* Retrieved June 2014, from Credit Valley Conservation: http://www.creditvalleyca.ca/wp-content/uploads/2011/02/wsreportcardexecsum.pdf

CVC. (2006). *Strategic Plan 2006.* Mississagua: Credit Valley Conservation.

CVC. (2011). *Technical Report: The Importance of Ecosystem Services to Human Well-Being in the Credit River Watershed.* Mississauga: Credit Valley Conservation.

CVC. (2012a). *Chapter 2: Integrated Watershed Monitoring Program.* Retrieved June 2014, from Credit Valley Conservation: http://www.creditvalleyca.ca/watershed-science/watershed-monitoring/credit-river-watershed-health-report/chapter-2-integrated-watershed-monitoring-program/

CVC. (2012b). *Chapter 3: Land Use Change*. Retrieved June 2014, from CVC: http://www.creditvalleyca.ca/watershed-science/watershed-monitoring/credit-river-watershed-health-report/chapter-3-land-use-change/

CVC. (2012c). *Invasive Species 101*. Retrieved June 2014, from http://www.creditvalleyca.ca/watershed-science/plants-animals-communities/invasive-species/invasive-species-101/

CVC. (2013). *Your Green Yard*. Retrieved June 2014, from http://www.creditvalleyca.ca/your-land-water/green-cities/your-green-yard/

CVC. (2014a). *About the Organization*. Retrieved June 2014, from Credit Valley Conservation: http://www.creditvalleyca.ca/about-cvc/about-the-organization

CVC. (2014b). *Funding.* Retrieved June 2014, from Credit Valley Conservation: http://www.creditvalleyca.ca/about-cvc/about-the-organization/funding/

Day, R. (1987). Relationships between life satisfaction and consumer satisfaction. In A. Coskun Samli, *Marketing and the Quality of Life Interface.* New York: Quorum Books.

Downie, R., Tannahill, C. & Tannahill, A. (2000). *Health Promotion Models and Values.* Oxford: Oxford University Press.

Dravigne, A., Waliczek, R., Lineberger, R. & Zajicek, J. (2008). The effect of live plants and window views of green spaces on employee perceptions of job satisfaction. *Hort Science, 43*, 183-187.

Duffy, B., Smith, K., Terhanian, G. & Bremer, J. (2005). Comparing data from online and face-to-face surveys. *International Journal of Market Research, 47*(6), 615-639.

Easton, V. & McColl, J. (2012). *The Statistics Glossary*. Retrieved June 2014, from Scree Plot: http://www.stats.gla.ac.uk/glossary/?q=node/451

Environment Canada. (2010). *Integrated Watershed Management*. Retrieved June 2014, from https://ec.gc.ca/eau-water/default.asp?lang=En&n=13D23813-1

Flanagan, J. (1978). A research approach to improving our quality of life. *American Psychologyst, 33*, 138-147.

Fricker, S., Galesic, M., Tourangeau, R. & Yan, T. (2005). An experimental comparison of web and telephone surveys. *Public Opinion Quarterly, 69*(3), 370-392.

Gatersleben, B., & Andrews, M. (2013). When walking in nature is not restorative- the role of prospect and refuge. *Health and Place, 20*, 91-101.

George Morris Centre. (2009). *Demographic Profile of the Credit River Watershed.* Retrieved May 2014, from Credit Valley Conservation: http://www.creditvalleyca.ca/wp-content/uploads/2014/04/Demographic-Profile-of-the-CRW-Final-Report.pdf

Global Water Partnership. (2010). *What is IWRM?* Retrieved June 2014, from Global Water Parnership: http://www.gwp.org/en/The-Challenge/What-is-IWRM/

Green Analytics. (2011). *CVC Technical Report: The Importance of Ecosystem Services to Human Well-Being in the Credit River Watershed.* Mississauga: Credit Valley Conservation.

Groves, R. (1979). Actors and questions in telephone and personal interview surveys. *Public Opinion Quarterly*, 190-205.

Headey, B. & Wearing, A. (1992). *Understanding happiness: A theory of subjective well-being.* Melbourne, Australia: Longman Cheshire.

Heerwegh, D. & Loosveldt, G. (2008). Face-to-face versus web surveying in high-internet-coverage population. *Public Opinion Quarterly, 72*(5), 836-846.

Hemson Consulting Ltd. (2012). *Greater Golden Horseshoe Growth Forecasts to 2041: Technical Report.* Toronto: Hemson Consulting Ltd.

Hemson Consulting Ltd. (2013). *Long-Range Forecasts City of Mississauga 2011-2051.* Toronto: City of Mississauga.

Heschong Mahone Group. (2003). *Windows and classrooms: A study of student performance and the indoor environment.* Sacramento, CA: California Energy Commission.

IDRE UCLA. (2014). *Institute for Digital Research and Education.* Retrieved March 2014, from What Statistical Analysis Should I Use?: http://www.ats.ucla.edu/stat/mult_pkg/whatstat/

James, W. (1892). *Psychology: The Briefer Course.* New York: Holt.

Kalia, M. (2002). Assessing the econoimc impact of stress- the modern day hidden epidemic. *Metabolism, 51*(6), 49-53.

Kaplan, S. (1995). The Restorative Benefits of Nature: Toward an Integrative Framework. *Journal of Environmental Psychology, 15*, 169-182.

Kauhanen, J., Myllykangas, M., Salonen, J. & Nissinen, A. (1998). *Kansanterveystiede (Public Health)* (2 ed.). Porvoo: WSOY.

Keleher, H. & Armstrong, R. (2006). *Evidence-based mental health promotion resource.* Melbourne: Department of Human Services and VicHeath.

Key, J. (1997). *Questionnaire and Interview as Data-Gathering Tools*. Retrieved March 2015, from Data Tools: http://www.okstate.edu/ag/agedcm4h/academic/aged5980a/5980/newpage16.htm

Kim, Y., Park, Y., Allegrante, J., Marks, R., Ok, H., Cho, K., & Garber, C. (2012). Relationship between physical activity and general mental health. *Preventative Medicine, 55*, 458-463.

Koveshnikova, T. (2013). *Human well-being, ecosystem services and watershed management in the Credit River Valley: Concept paper for review and discussion.* Credit Valley Conservation.

Krabbendam, L. & van Os, J. (2005). Schizophrenia and urbanicity: a major environmental influence-conditional on genetic risk. *Schizophrenia Bulletin, 31*, 795-799.

Landry, S. & Chakraborty, J. (2009). Street trees and equity: evaluating the spatial distribution of an urban amenity. *Environment and Planning, 41*, 2651-2670.

Lederbogen, F., Haddad, L., & Meyer-Lindenberg, A. (2013). Urban social stress- Risk factor for mental disorders. The case of schizophrenia. *Environmental Pollution, 183*, 2-6.

Louv, R. (2008). *Last Child in the Woods: Saving our Children from Nature-Deficit Disorder.* Chapel Hill: Algonquin Books of Chapel Hill.

Lura Consulting. (2012). *Lake Ontario Shoreline Survey: Uses, Attitudes and Perceptions of Restoration Options.* Mississauga: Credit Valley Conservation.

Mallette, J. (2014). Planning for ecological health and human well-being in the Credit River Watershed: Social well-being benefits of urban natural features and areas. York University.

Manson, J., Skerrett, P., Greenland, P & Vanltallie, T. (2004). The escalating pandemics of obesity and sedentary lifestyle. *Archives of Internal Medicine, 164*(3), 249-258.

Marmot, M. (2007). Achieving health equity: from root causes to fair outcomes. *The Lancet, 370*(9593), 1153-1163.

Matsuoka, R. (2010). Student performance and high school landscapes: Examining the links. *Landscape and Urban Planning, 97*(4), 273-282.

Mayo Clinic. (2013). *Stress Management*. Retrieved October 2014, from http://www.mayoclinic.org/healthy-living/stress-management/in-depth/stress/art-20046037

McMichael, A. (2006). Population health as the 'bottom line' of sustainability: a contemporary challenge for public health researchers. *The European Journal of Public Health, 16*(6), 579-581.

McMichael, A., Friel, S., Nyong, A. & Corvalan, C. (2008). Global environmental change and health: impacts, inequalities and the health sector. *British Medical Journal, 336*(7637), 191-194.

McPherson, E. (2006). Urban forestry in North America. *Renewable Resources Journal, 24*(3), 8-12.

MEA. (2005). *Ecosystems and Human Well-Being: A Framework for Assessment.* Washington, DC: United Nations.

MedicineNet Inc. (2014). *Definition of Stress*. Retrieved October 2014, from MedicineNet: http://www.medicinenet.com/script/main/art.asp?articlekey=20104

Merriam-Webster Inc. (2014). *Attention*. Retrieved January 2015, from Merriam Webster: http://www.merriam-webster.com/dictionary/attention

Morrison, K. (2013, June 18). Watersheds and Public Health. Prince George, B.C.

Mowat, D., Gardner, C., McKeown, D., Tran, N., Moloughney, B. & Bursey, G. (2014). *Improving Health by Design in the Greater Toront-Hamilton Area.* Retrieved from http://www.peelregion.ca/health/resources/healthbydesign/pdf/moh-report.pdf

Newman, C., Des Jarlais, D., Turner, C., Gribble, J., Cooley, P. & Paone, D. (2002). The differential effects of face-to-face and computer interview modes. *American Journal of Public Health, 92*(2), 294-297.

NIST/Sematech. (2013). *1.1.1 What is EDA?* Retrieved May 2014, from Engineering Statistics Handbook: http://www.itl.nist.gov/div898/handbook/eda/section1/eda11.htm

Nordh, H., Hartig, T., Hagerhall, C. & Fry, G. (2009). Components of small urban parks that predict the possibility for restoration. *Urban Forestry & Urban Greening, 8*, 225-235.

OECD. (2015). *Life Satisfaction*. Retrieved March 2015, from OECD Better Life Index: http://www.oecdbetterlifeindex.org/topics/life-satisfaction/

Ontario. (1990). *Conservation Authorities Act.* Government of Ontario.

Ontario Ministry of Infrastructure. (2013a). *Amendment 2 (2013) to the growth plan for the greater golden horseshoe*. Retrieved January 2015, from https://www.placestogrow.ca/index.php?option=com_content&task=view&id=398&Itemid=14

Ontario Ministry of Infrastructure. (2013b). Growth Plan for the Greater Golden Horseshoe: Office Consolidation. Ontario.

Oppenheim, A. (1992). *Questionnaire design, interviewing and attitude measurement.* New York City: St. Martin's Press.

Parkes, M., & Horowitz, P. (2009). Water, ecology and health: Ecosystems as settings for promoting health and sustainability. *Health Promotion International, 24*(1), 94-102.

Parkes, M., Morrison, K., Bunch, M. & Venema, H. (2008). *Ecohealth and Watersheds: Ecosystem approaches to re-integrate water resources mangement with health and well-being.* Winnipeg: Network for Ecosystem Sustainability and Health, and IISD.

Parkes, M., Morrison, K., Bunch, M., Hallstom, L., Neudoerffer, C., Venema, H. & Waltner-Toews, D. (2010). Towards integrated governance for water, health and social-ecologcial systems: The watershed governance prism. *Global Enviornmenal Change, 20*, 693-704.

Parkes, M., Panelli, R., & Weinstein, P. (2003). Converging paradigms for environmental health theory and practice. *Environmental Health Perspectives, 111*, 669-675.

Pedersen, C. & Mortensen, P. (2001). Evidence of a dose-response relationship between urbanicity during upbringing and schizophrenia risk. *Archives of General Psychiatry, 58*, 1039-1046.

Pedlowski, M., Adell, J. & Heynen, N. (2002). Urban forest and environmental inequality in Campos dos Goytacazes, Rio de Janeiro, Brazil. *Urban Ecosystems, 6*, 9-20.

Peen, J., Schoevers, R., Beekman, A. & Dekker, J. (2009). Teh current status of urban-rural differences in psychiatric disorders. *Act Psychiatrica Scandinavica, 121*(2), 84-93.

Pennings, P., Keman, H., & Jeinnijenhuis, J. (2006). *Doing Research in Poliitcal Science: An Introduction to Comparative Methods and Statistics.* London: SAGE Publications, Ltd.

Praag, B., Frijtersvan, P. & Ferreri-Carbonell, A. (2003). The anatomy of subjective well-being. *Journal of Economic Behaviour & Organization, 51*, 29-49.

Public Health Agency of Canada. (2012). *Frequently Asked Questions*. Retrieved March 2015, from http://www.phac-aspc.gc.ca/mh-sm/mhp-psm/faq-eng.php

Public Health Agency of Canada. (2014). *Publications*. Retrieved January 2015, from http://www.phac-aspc.gc.ca/mh-sm/mhp-psm/pubs_hc-sc-eng.php

Public Health Ontario. (2014). *Health Promotion*. Retrieved January 2015, from Public Health Ontario: http://www.publichealthontario.ca/en/BrowseByTopic/HealthPromotion/Pages/Health-Promotion.aspx#.VFZs9PldUnU

Quick, J. (2011). *R Tutorial Series*. Retrieved March 2014, from Exploratory Factor Analysis: http://rtutorialseries.blogspot.ca/2011/10/r-tutorial-series-exploratory-factor.html

Reading, C. & Wien, F. (2009). *Health Inequalities and Social Determinants of Aboriginal People's Health.* Prince George: National Collaborating Centre for Aboriginal Health.

Region of Peel. (2011). *Public Works*. Retrieved July 2014, from About Tap Water in Peel: http://www.peelregion.ca/pw/water/tapwater/about/

Region of Peel Public Health. (2012). *Changing Course: Creating Supportive Environments for Healthy Living in Peel.* Mississauga: Region of Peel.

Region of Peel Public Health. (2014). *2014-19 Setting the Pace: A Revision to Peel Public Health's 10-Year Strategic Plan 2009-2019.* Mississauga: Region of Peel Public Health.

Risk Analytica. (2011). *The Life and Economic Impact of Major Mental Illnesses in Canada.* Retrieved May 2014, from https://www.mentalhealthcommission.ca/English/system/files/private/document/MHCC_Report_Base_Case_FINAL_ENG_0.pdf

Roe, J. & Aspinall, P. (2011). The resorative benefits of walking in urban and rural settings in adults with good and poor mental health. *Health & Place, 17*(1), 103-113.

Rojas, M. (2006). Life satisfaction and satisfaction in domains of life: Is it a simple relationship? *Journal of Happiness Studies, 7*, 467-497.

Sancton, A. (2011). *Canadian Local Government: An Urban Perspective.* Toronto: Oxford University Press.

Segerstrom, S. & Miller, G. (2004). Psychological Stress and the Human Immune System: A Meta-Analytic Study of 30 Years of Inquiry. *Psychological Bulletin, 130*(4), 601-630.

Sempik, J., Hine, R., & Wilcox, D. (2010). *Green Care: A Conceptual Framework.* Loughborough: Loughborough University.

Shibata, S. & Suzuki, N. (2001). Effects of indor foliage plants on subjects' recovery from mental fatigue. *North American Journal of Psychology, 3*, 358-396.

Srivastava, K. (2009). Urbanization and mental health. *Industrial Psychiatry Journal, 18*(2), 75-76.

Stansfeld, S. (2006). Social support and social cohesion. In M. &. Marmot, *Social Determinants of Health* (2 ed.). Oxford: Oxford University Press.

Statistics Canada. (2011a). *Brampton.* Retrieved February 2015, from Statistics Canada: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3521010

Statistics Canada. (2011c). *Mississauga.* Retrieved February 2015, from Statistics Canada: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3521005

Statistics Canada. (2012a). *Census subdivision of Erin, T-Ontario*. Retrieved February 2015, from Focus on Geography Series, 2011 Census: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3523017

Statistics Canada. (2012b). *Census subdivision of Halton Hills, T-Ontario*. Retrieved February 2015, from Focus on Geography Series, 2011: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3524015

Statistics Canada. (2012c). *Census subdivision of Mississauga, CY- Ontario*. Retrieved February 2015, from Focus on Geography Series, 2011 Census: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3521005

Statistics Canada. (2012d). *Census subdivision of Mono, T-Ontario*. Retrieved February 2015, from Focus on Geography Series, 2011 Census: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3522012

Statistics Canada. (2012e). *Town of Caledon*. Retrieved February 2015, from http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-csd-eng.cfm?LANG=Eng&GK=CSD&GC=3521024

Statistics Canada. (2013). *Canadian Community Health Survey- Mental Health*. Retrieved October 2014, from Statistics Canada: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5015#a1

Statistics Canada. (2014a). *NHS Focus on Geography Series- Caledon*. Retrieved February 2015, from http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/fogs-spg/Pages/FOG.cfm?lang=E&level=4&GeoCode=3521024

Statistics Canada. (2014b). *NHS Focus on Geography Series- Erin*. Retrieved February 2015, from http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/fogs-spg/Pages/FOG.cfm?lang=E&level=4&GeoCode=3523017

Statistics Canada. (2014c). *NHS Focus on Geography Series- Halton Hills*. Retrieved February 2015, from http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/fogs-spg/Pages/FOG.cfm?lang=E&level=4&GeoCode=3524015

Statistics Canada. (2014d). *NHS Focus on Geography Series- Mississauga*. Retrieved February 2015, from http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/fogs-spg/Pages/FOG.cfm?lang=E&level=4&GeoCode=3521005

Statistics Canada. (2014e). *NHS Focus on Geography Series- Mono*. Retrieved February 2015, from http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/fogs-spg/Pages/FOG.cfm?lang=E&lefel=4&GeoCode=3522012

Szolnoki, G. & Hoffmann, D. (2013). Online, face-to-face and telephone surveys- Comparing different sampling methods in wine consumer resarch. *Wine, Economics and Policy, 2*(2), 57-66.

Tennessen, T. & Cimprich, B. (1995). Views to nature: effects on attention. *Journal of Environmental Psychology, 15*, 77-85.

Terhanian, G. (2003). The unfulfilled promise of internet research. *MRS Conference Paper 37.*

The American Institute of Stress. (2015). *What is Stress*. Retrieved October 2014, from The American Institute of Stress: http://www.stress.org/what-is-stress/

TRCA. (2014). *TRCA.* Retrieved January 2015, from Peel Rural Water Quality Program: http://www.trca.on.ca/dotAsset/15840.gif

TRCA. (nd). *Hurricane Hazel*. Retrieved from Hurricane Hazel: http://www.hurricanehazel.ca

UCLA Statistical Consulting Group. (2015). *What is the difference between categorical, ordinal and interval variables?* Retrieved March 2014, from http://www.ats.ucla.edu/stat/mult_pkg/whatstat/nominal_ordinal_interval.htm

Ulrich, R. (1984). View through a window may influence recovery from surgery. *Science, 224*(4647), 420-421.

United Way Peel Region. (2014). *Mapping the Mental Health System in Peel Region: Challenges and Opportunities.* Retrieved January 2015, from http://unitedwaypeel.org/research/pics/Mapping_the_Mental_Health_System_in_Peel_Region_challenges_opportunities_2014-01-20.pdf

University of Sheffield. (2014). *Mathematics and Statistics Help.* Retrieved July 2014, from Which Statistical Test Should I Use?: http://www.sheffield.ac.uk/mash/what_test

US EPA. (2013). *Eco-Health Relationship Browser Introduction*. Retrieved October 2014, from EPA: http://www.epa.gov/research/healthscience/browser/introduction.html

VanLeeuwen, J. (1998). Describing, applying and testing models and indicators of human health in agroecosystems: Finding the balance. Ottawa: National Library of Canada.

Ware, J. (2000). *SF-36 Health Survey Update*. Retrieved from SF-36: http://www.sf-36/tools/sf36.shtml

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D. & Depledge, M. (2010). Blue space: The importance of water for preference, affect and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology, 30*, 482-493.

WHO. (1986). The Ottawa Charter for Health Promotion. Ottawa: World Health Organization.

WHO. (2013). *What are the Social Determinants of Health?* Retrieved May 2014, from WHO: http://www.who.int/social_determinants/sdh_definition/en/

WHO. (2014). *Mental Health: a state of well-being*. Retrieved December 2014, from World Health Organization: http://www.who.int/features/factfiles/mental_health/en

WHO. (2015a). *Media Centre: Cholera*. Retrieved February 2015, from http://www.who.int/mediacentre/factsheets/fs107/en/

WHO. (2015b). *Water-related diseases: Malaria*. Retrieved March 2015, from http://www.who.int/water_sanitation_health/diseases/malaria/en/

Zelenzny, L., Chua, P. & Aldrich, C. (2000). New Ways of Thinking about Environmentalism: Elaborating on Gender Differences in Environmentalism. *Journal of Social Issues, 56*(3), 443-457.

Appendix A: Sample Questions from Mental Health Surveys

This appendix contains within it sample questions from both the SF-36 and CCHS-MH surveys.

Table A1: Sample SF-36 questions

Sample questions from the SF-36 Test Related to Mental Well-Being (Quality Metric, Inc. 2000)
During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Answer from 1 to 5, where 1 is "All of the Time" and 5 is "None of the Time" a) Cut down on the amount of time you spent on work or other activities b) Accomplished less than you would like c) Did work or other activities less carefully than usual
During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors or groups? Answer from 1 to 5, where 1 is "None" and 5 is "Extremely"
These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks… Answer from 1 to 5, where 1 is "All of the Time" and 5 is "None of the Time" a) Did you feel full of life? b) Have you been very nervous? c) Have you felt so down in the dumps that nothing could cheer you up? d) Have you felt calm and peaceful? e) Did you have a lot of energy? f) Have you felt downhearted and depressed? g) Did you feel worn out? h) Have you been happy? i) Did you feel tired?
During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)? Answer from 1 to 5, where 1 is "All of the Time" and 5 is "None of the Time"

Table A3: Sample CCHS-MH questions

Sample Questions from CCHS-MH Related to Mental Well-Being (Statistics Canada, 2013)
In the past month, how often did you feel: Answer from 1 to 6, where 1 is "Every Day" and 6 is "Never" a) Happy? b) Interested in life? c) Satisfied with your life? d) That you had something important to contribute to society? e) That you belonged to a community (like a social group, your neighbourhood, your city, your school)? f) That our society is becoming a better place for people like you? g) That people are basically good? h) That the way our society works makes sense to you? i) That you liked most parts of your personality? j) Good at managing the responsibilities of your daily life?

k) That you had warm and trusting relationships with others?
l) That you had experiences that challenge you to grow and become a better person?
m) Confident to think or express your own ideas and opinions?
n) That your life has a sense of direction or meaning to it?

In general, how would you rate your ability to handle unexpected and difficult problems, for example, a family or personal crisis? Would you say your ability is…? Answer from 1 to 5, where 1 is "Excellent" and 5 is "Poor"

Thinking about stress in your day-to-day life, what would you say is the most important thing contributing to feelings of stress you have?

a) Time pressures/ not enough time
b) Own physical health problem or condition
c) Own emotional or mental health problem or condition
d) Financial situation (e.g. Not enough money, debt)
e) Own work situation (e.g. hours of work, working conditions)
f) School
g) Employment status (e.g. unemployment)
h) Caring for- own children
i) Caring for- others
j) Other personal or family responsibilities
k) Personal relationships
l) Discrimination
m) Personal and family's safety
n) Health of family members
o) Other- Specify
p) Nothing
q) Refused
r) Don't know

During the past month, about how often did you feel: Answer from 1 to 5, where 1 is "All of the Time" and 5 is "None of the Time"

a) Tired out for no good reason
b) Nervous
c) So nervous that nothing could calm you down
d) Hopeless
e) Restless or fidgety
f) So restless you could not sit still
g) Sad or depressed
h) So depressed that nothing could cheer you up
i) That everything was an effort
j) Worthless

Table A3: Categories of questions present in the CCHS-MH Survey (Statistics Canada, 2013)

Type of Question Section	Question Section Title
Administrative Questions	Survey Introduction
Socio-Demographic Question	Age of Respondent
General Health	General Health Height and Weight (self-reported) Chronic Conditions Pain and Discomfort Physical Activity- short form
Mental Health Status	Positive Mental Health Stress- Sources Distress Depression Suicide Mania Generalized Anxiety Disorder Smoking Alcohol Use, Abuse and Dependence Substance Use, Abuse and Dependence
Disability	WHO Disability Assessment Schedule Two-Week Disability
Mental Health Services, Treatment and Experience	Mental Health Services Medication Use Drug Identification Numbers Perceived Need for Care Help Needed Mental Health Experiences
Life Experiences	Family Mental Health Impact Social Provisions Scale 10 Items Negative Social Interactions Contact with Police Childhood Experiences Spirituality Labour Force Work Stress
Socio-Demographics	Income Socio-Demographic Characteristics Education Education of the Respondent Education of Other Household Members
Administrative Questions	Administration Information Health Number

Appendix B: Choosing a Target Neighbourhood

Purpose: To explore criteria that may help determine a given area's potential for study. This information will help identify target neighbourhoods for the administration of our well-being attitudes survey and to be used as pilots for the web-based public education tool. The Trees and Residents report (Conway & Shakeel, 2012) has used four study areas, the choice of which we could replicate, with contrasting neighbourhood ages and levels of income: Lakeview (old, low income), Meadowvale (new, high income), Mineola (old, high income), and Lakeview (old, low income).

		Lakeview, Mississauga / Sheridan's Creek (LOISS)	**Meadowvale, Mississauga**	**Rathwood, Mississauga (Burnhamthorpe and Cawthra)**	**Mineola, Mississauga**	**Ridgehill, Brampton (Fletcher's Creek Option 1)**
LAND USE	Residential Zoning Type (e.g. R1C)	Fully detached homes primarily	Semi-detached homes primarily	Townhouses primarily	Fully detached homes primarily	Primarily: R1B Secondarily: R1C, R1D, R3B, R2A
	Age of Neighbourhood	Before 1970 (mostly)	95% after 1970	Post-1971	Before 1970	1963-1971
	Flood Issues					Yes
	Other Characteristics (i.e. downspouts connected, % impervious)					Generally 80% impervious ratio Connected downspouts Generally no sidewalks on one side of Fletchers Pools
	Transportation or utility corridor within boundaries	Near Long Branch GO Station	Railway	Near Mississauga Valley CC		N/a
	Religious or other non-school institution within boundaries	n/a	n/a	n/a	St. Mary's Syrian Orthodox Church, Kenmuir Baptist Church	

		Lakeview, Mississauga / Sheridan's Creek (LOISS)	Meadowvale, Mississauga	Rathwood, Mississauga (Burnhamthorpe and Cawthra)	Mineola, Mississauga	Ridgehill, Brampton (Fletcher's Creek Option 1)
	School within boundaries	Allan A. Martin Senior PS, Gordon Graydon Memorial Secondary School, Toronto French School	Meadowvale Village PS, Rotherglen School	Eec Rene-Lamoureux, St. Charles Garnier,	Lyndwood Public School	Beatty-Fleming Sr. PS, Northwood PS, St Joseph School (all 3 located on the W side of McLaughlin Rd.)
	Community Centre or meeting place within boundaries	Near Cawthra CC	No	Near Mississauga Valley CC	Near Cawthra CC	Chris Gibson Community
	Stormwater management	Lakeview Green Street LID	CVC LID	Close to Elm Dr. LID	n/a	1 Stormwater Pond (SW3/PO532)
NATURAL HERITAGE	Businesses/Institutions with large patch/strip of land (terrestrial or LID opportunities), Municipal buildings		Extendicare Mississauga; Credit Valley Conservation		Dufferin-Peel Catholic District School Board	Georgia-Pacific (tissue, packaging, paper, pulp, building products and related chemicals), Senior Flexonics (manufacturing of expansion joints, metal hoses, PTFE hoses, HVAC piping products)
	Creek within boundaries	Sheridan Creek?	Credit River	Yes	Yes	Fletcher's creek
	Natural Area within boundaries	No	Meadowvale CA		Yes, along creek	Yes, along creek
	Park or public land within boundaries	Serson Park	CA	Meadow Glen Park, Parkway Green, Woodington Green	Dellwood park, Lyndwood Park, Spruce Park	Fletcher's Creek Property; Chris Gibson Park
	Stream connectivity			n/a		Stream reach is disconnected from existing floodplain
	Erosion issues					Yes

		Lakeview, Mississauga / Sheridan's Creek (LOISS)	**Meadowvale, Mississauga**	**Rathwood, Mississauga (Burnhamthorpe and Cawthra)**	**Mineola, Mississauga**	**Ridgehill, Brampton (Fletcher's Creek Option 1)**
	Water quality		Water chemistry marginal, water temperature warmer than target			Stormwater outlet WQ is Poor to fair dry (represents dry weather); PSQMN Site d/s; Poor WQI since 1997
	Fisheries		Fish status poor, trend increasing			Poor IBI; Creek chub, white sucker, common shier – tolerant species reflective of disturbed conditions
OTHER	Pre-existing relationship or project within boundaries					CYC and Branch Out plantings along Creek; YGY at Chris Gibson CC
	Ward/councillor	M031 (approximately)	M005	M024	M030	SDA B025; Elaine Moore & Grant Gibson
	Additional opportunities					Close to downtown – potential for foot traffic and demonstration projects?
DEMOGRAPHICS	Education	University certificate, diploma or degree: 13%	University certificate, diploma or degree: 40%	University certificate, diploma or degree: 16%	University certificate, diploma or degree: 28%	University certificate, diploma or degree: 19%
	Income	~~Median: 29,846~~ Average: 66,447 15% of families are	~~Median: 32, 746~~ Average: 152,765 9% of families are low	~~Median: 27,304~~ Average: 63,520 12% of families are	~~Median: 35,047~~ Average: 138,103 7% of families are low	Median: 29,987 Average: 33,624 11% of families are

		Lakeview, Mississauga / Sheridan's Creek (LOISS)	**Meadowvale, Mississauga**	**Rathwood, Mississauga (Burnhamthorpe and Cawthra)**	**Mineola, Mississauga**	**Ridgehill, Brampton (Fletcher's Creek Option 1)**
		low income	income	low income	income	low income
	Mode of transportation to work	Automobile (driver): 67% Public transit: 20% Walked: 5%	Automobile (driver): 80% Public transit: 10% Walked: 1%	Automobile (driver): 72% Public transit: 17% Walked: 3%	Automobile (driver): 77% Public transit: 13% Walked: 2%	Automobile (driver): 78% Public transit: 11% Walked: 1%
	Percentage of population with a usual place of work in their city or town of residence	44%	43%	41%	37%	37%
	Rate of Employment (overall)	62%	77%	92%	67%	
	House Value (Average)	$350,366	$433,798	$303,707	$581,419	

Map from “Trees and Residents: An exploration of residents’ role in growing Mississauga’s urban forest” (Conway & Shakeel, 2012)

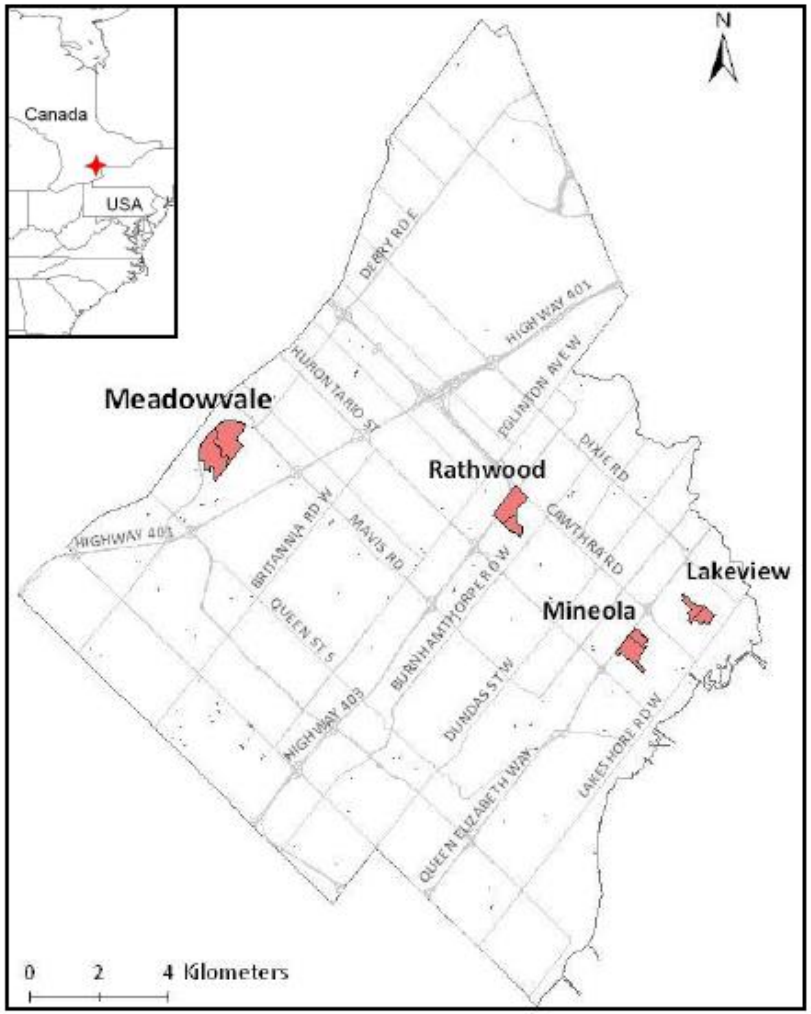


Figure 3.1: Map of the four study neighbourhoods in City of Mississauga.

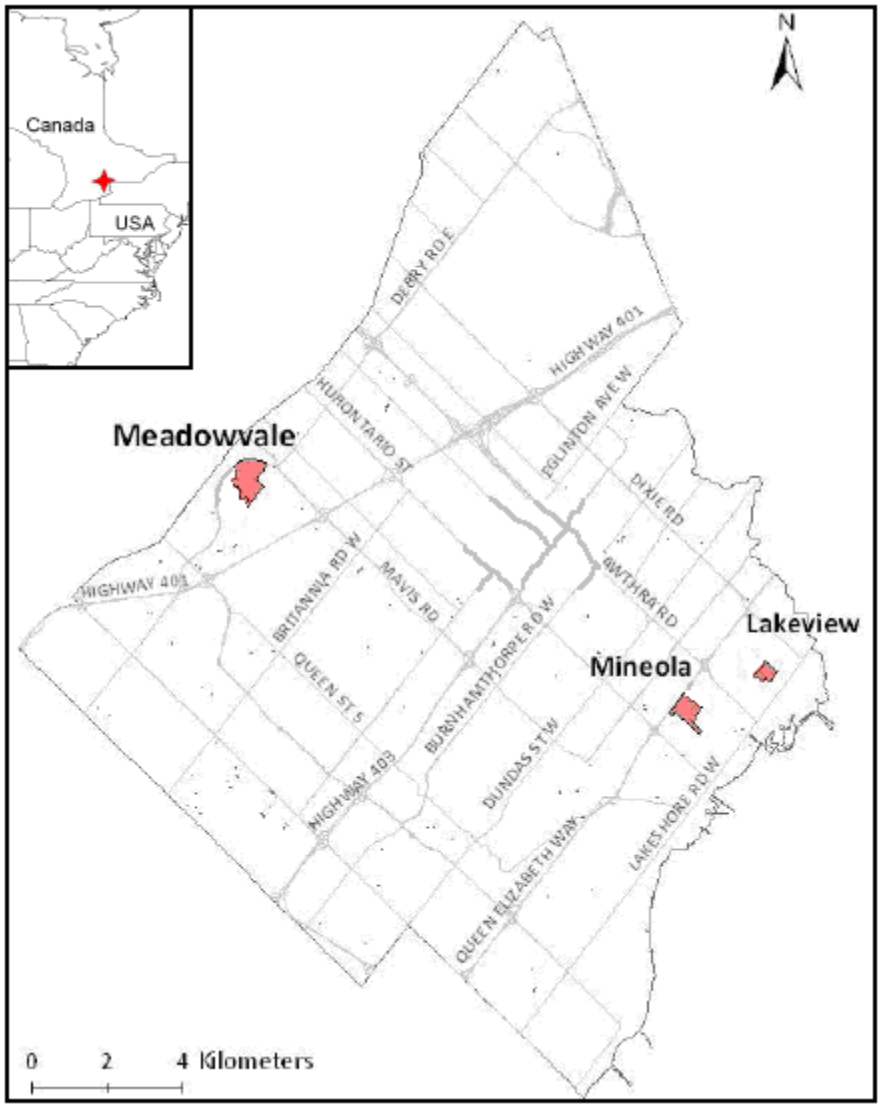
Appendix C: Options for Neighbourhoods

Purpose: To determine which two dissemination areas will be selected for the administration of our well-being attitudes survey and to be used as pilots for the web-based public education tool. This chart explores various criteria that are relevant in selecting neighbourhoods for the pilot study. Maps of the location of these areas are provided on page 2.

Action: Decide whether option 1 (Lakeview and Mineola) or option 2 (Meadowvale and Fletcher's Creek) will be the study areas used in the pilot study.

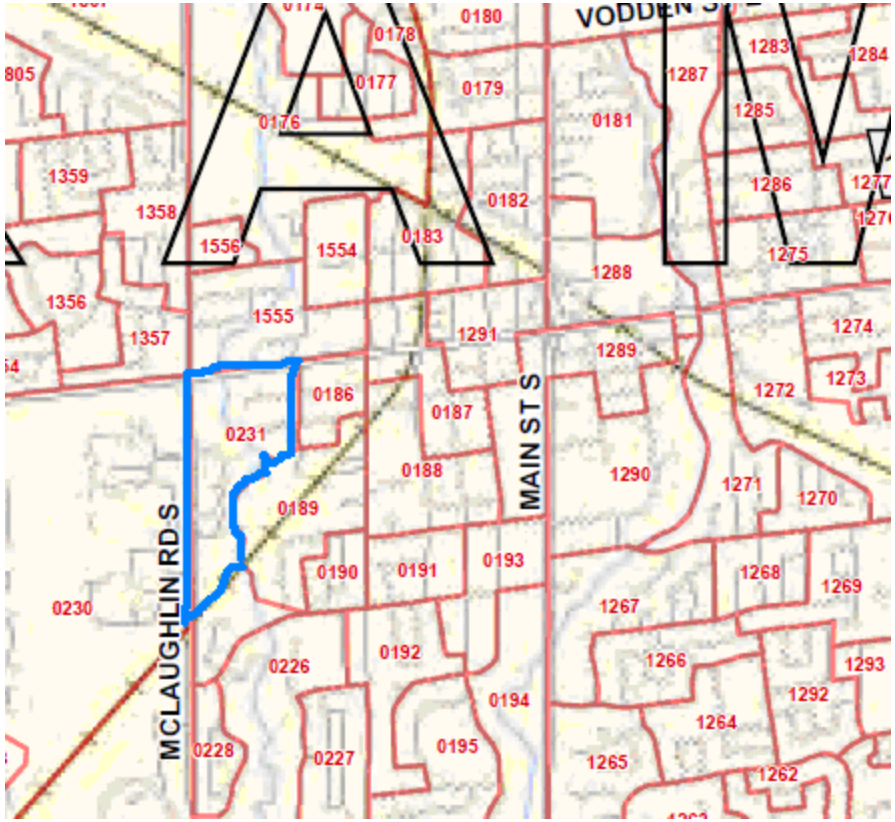
		Option 1: Lakeview and Mineola		**Option 2: Meadowvale and Fletcher's Creek**	
LAND USE	Dissemination Area	0953 (L)	0758 (M)	1732 (M)	0231 (FC)
	Primary Housing Type	Fully detached homes	Fully detached homes	Semi-detached homes	Fully detached homes
	Age of Neighbourhood	Before 1970 (mostly)	Before 1970	95% after 1970	1963-1971
	Homes within Floodplain	Yes	Yes	No	Yes
	Water Features Within Boundaries	Sheridan Creek	Cooksville Creek	Credit River	Fletcher's creek
	Natural areas, parks or public lands within boundaries	Serson Park	Along creek	Meadowvale CA	Along creek
	Nearby Monitoring Sites (Forest or Water)	No	No	Yes (Water and Forest)	Yes (Water)
	Sidewalk Presence	Generally, Y	Generally, N	Generally, N	Generally, Y
	Average Front Yard Size	Large	Medium	Medium	Medium
	State of Trees	Mix of medium/young trees and very large/very old trees (shows tree replacement within past 5-10 years)	Large trees; less in front yard than back yard	Small, young trees in newer development; in Meadowvale Village, older, large trees	Mix of Larger/old trees on east side of creek and smaller, younger trees on west side
DEM	Percentage of residents with University certificate, diploma or degree	13%	28%	40%	19%

	Average Household Income ($)	66,447	138,103	152,765	(Unknown)
	Mode of transportation to work	Automobile (driver): 67% Public transit: 20% Walked: 5%	Automobile (driver): 77% Public transit: 13% Walked: 2%	Automobile (driver): 80% Public transit: 10% Walked: 1%	Automobile (driver): 78% Public transit: 11% Walked: 1%



(Left) Modified map of three dissemination areas (Meadowvale- 1732, Lakeview- 0953 and Mineola- 0758)

Adapted from "Trees and Residents" Paper by Shakeel and Conway (2012)



(Above) Fletcher's Creek: Dissemination Area 0231

Brampton, ON

Appendix D: Etiquette for Surveyors

For anyone participating in the administration of this survey, please read over the following points about your presentation and etiquette. It is highly important that all of us follow these parameters not only for consistency's sake, but also to ensure that we are representing both York and the CVC in a positive and engaging way.

Teams:

- Always work in pairs!

Appearance:

- Clean and presentable
- Smiles!
- Wear comfortable shoes as we'll be walking around a lot.
- Preferably jeans or other pants (no rips/tears/fades etc.). Please, no skirts or shorts.

Visible Identification:

- Wear York hoodies (clean) and York lanyards with student card inside.

Before Starting the Day:

- Make sure you have the following on your person:
    - Binders
    - Cell phone (on silent, not vibrate or with volume)
    - Water
- Make sure you have the following in the car:
    - Mini first aid kit
    - Car folder (Directions on how to get to each DA from CVC and Directions on how to get from each DA to the nearest hospital)
- Make sure you have the following in each binder:
    - Speaker Binder
        - 1 protected informed consent form
        - 1 survey script
        - 1 copy of survey for respondent
        - 20 (ish) informed consent forms
        - 1 live incident report log
        - 1 protected pack of extra incident report log pages
    - Recording Binder
        - 1 protected map of dissemination area
        - 1 live Neighbourhood log
        - 1 protected pack of extra neighbourhood logs (make sure there are blank ones)
        - 1 live contact info form
        - 1 protected pack of extra contact info forms
        - 1 live post-survey questions form
        - 1 protected pack of extra post-survey question forms
        - 1 red folder with 20 blank survey response forms (numbered!)

        - 1 CVC envelope for completed surveys (please label this folder with the date and initials of surveyors)
- Have a good idea of what ground you want to cover that day and clearly communicate it with other team (if there). Also, make sure to only survey households within each dissemination area. (i.e. if a street is on the border of a dissemination area, only survey the side of the street adjacent to the rest of the dissemination area and not the opposite side).

Presentation of the Survey:
- Eye contact
- Relaxed stance- don't block the doorway; stand under light that makes you clearly visible to the person being surveyed; smile

Survey Recording:
- If you are the person writing survey answers during the survey process, make sure you aren't looking down at your page the entire time. It is important for you also to appear friendly and receptive to what they're saying
- Try to refrain from showing contact information page to respondents to preserve the identity of other respondents whose information is on that page
- **MAKE SURE THE SURVEYS ARE NUMBERED!**

Leaving Each Home (to do at sidewalk level before moving on to next house):
- Clearly mark on the survey calendar page which houses you attended and what their responses were
- If survey was completed, fill out the post-survey questions page. Make sure the survey number matches that of the survey just completed.

End of Day Information:
- After having completed surveying an area, put completed surveys into a folder and label the front of it with the date and surveyors initials
- Debrief with group- any issues with residents that we should know about, any questions that repeatedly were difficult for the respondent and how you worked around that…
- Highlight on dissemination area map where you went that day, labelling both the start and ending house number on the map itself. Please do this for both binders.

End of Week Information:
- Make sure that each Sunday evening, Mitch or I receive the folders with completed surveys so that we can input them into the computer the following week.

Breaks and Fatigue:
- Please be attentive to how you are feeling when conducting the surveys. If you get to a point where you are fatigued, please take a break and recharge. We do not ever want to come off as disinterested or rushed when administering the survey.
- When taking a break as a pair, let the other pair know so that everyone can take one together.

Incidents Log:
- If anyone being surveyed has any complaints about an interaction, or if you felt as if the survey did not go well, please record this down in the Survey Incidents log. We will make these

incidents known to Tatiana and Martin in case anyone contacts us in the future about these events.
- In the case of an emergency or injury, attend to the injury/emergency first (call 911, use the first aid kit, etc.) and then afterward, make sure you fill out the incidents log as well.

Re-Surveying the Area (if needed):
- Ensure that at least one member of the returning team is re-surveying the same area. That way, if we are coming back to a house that asked you to return another time, we will be recognizable
- Prepare a list of houses beforehand- only go back to houses where at least one of the following conditions existed
    - No one was home
    - Call-back offer was accepted
- If the household indicated that they did not want a call-back or they refused to participate in the survey, do not go back to that household.

Appendix E: Survey Script for Surveyors

Hello, my name is _____ and I am a graduate student at York University. I'm doing a survey in your area on behalf of York University, the University of Guelph and Credit Valley Conservation (CVC). This is my colleague _____, also a graduate student at York University.

We want to know your opinion on the natural environment and how it impacts your well-being. If you participate, you will be entered automatically into a prize draw for one of ten $50 Visa gift cards.

(If the interviewee appears to be under the age of 18, ask if you can speak to an adult living in the household. If an adult is available, restart the Introduction section. If an adult is unavailable, thank them and end the interview)

To see if you qualify, I need to confirm your place of residence, do you live in this house?

- Yes *(Proceed with interview)*
- No/Just Visiting/ Other Family Member or Friend Lives Here *(Ask if you can speak to an adult living in the household. If an adult is available, restart the Introduction section. If an adult is unavailable, thank them and end the interview.)*

Do you have about 15-20 minutes to answer some questions?

- Yes *(Ask participant to initial that they read the informed consent form. Proceed with screening questions)*
- No: We intend on being in the area again on _____

Will you be available for an interview then?

_____

(Hand participant the informed consent form and go through it)

This page has information on our research project and the survey. Please take a moment to look through it. There are three main points. First, if at any time you want to stop the survey, please let me know. Second, all information you provide is confidential and third, information will only be seen by researchers on this project.

I: WATERSHED IQ

Ok, let's proceed. I am first going to ask some general questions about watersheds and conservation authorities. Can you tell me…

[Read each question 1-5 verbatim to respondent]

[Show participants the picture of the watershed provided on the back of the handout given to them earlier]

A watershed is an area of land that drains into a river or lake. The Credit River watershed, which we are in right now, stretches from north of Caledon to the shores of Lake Ontario.

[Read question 6 verbatim to respondent]

II: NATURAL ENVIRONMENT

We want to ask you about outdoor areas you may visit.
[Read each question 1-5 verbatim to respondent]

III: UNDERSTANDING OF ENV/WB RELATIONSHIP AND ACTION

We are going to ask you some questions about your well-being. Well-being refers to being happy, healthy and prosperous.
[Read each question 1-4 verbatim to respondent]

IV: ECOLOGICAL GOODS AND SERVICES

Our watershed environment has the capacity to provide benefits such as drinkable water and flood protection, many of which are affected by human actions.
[Read each question 1-3 verbatim to respondent]

For the purposes of this next question, assume that 'local' refers to places within the Credit River Watershed *(point to handout you gave them earlier)*.
[Read question 4 verbatim to respondent]

V: SOCIAL AND MENTAL WELL-BEING

Overall well-being can be split into three different categories: physical well-being, mental well-being and social well-being. The next few questions deal with mental and social well-being.
[Read each question 1-4 verbatim to respondent]

VI: VALUES

The following statements represent guiding principles that may or may not matter to you. On a scale from 1-5, where 1 is "Not Important At All" and 5 is "Very Important," please indicate how **important** each principle is to you. *[Read each question verbatim to respondent]*

VII: DEMOGRAPHIC DATA

Finally, for the purposes of analysis, we would like to know more about you and members of your household. Please remember that all answers will remain confidential, and you may refuse answering any questions that may be asked.
[Read each question 1-9 verbatim to respondent]
(For question 9 about income- point to survey for them to non-verbally indicate their answer)

VIII: CONCLUSION

Thank you very much for your time and feedback. Would you like to receive further information about the survey results? *(If 'Yes')* Please provide your contact information (e-mail). Please note that any contact information you do provide to us will not be made available to any third party actors.

CVC collaborates with many organizations, industries and communities. Would you be interested in learning about stewardship activities, greening programs, education and outreach events, and other partnership projects? *(In case they have not yet provided their contact information before)* Please provide your contact information.

Lastly, all completed questionnaires will be entered into a prize draw. The winners will be drawn in late November and will be notified by e-mail or telephone. *(In case they have not provided their contact information before)* Please provide your contact information (e-mail or phone number) if you want to participate in a prize draw.

If you have any further questions, our contact information is on the back of the hand-out we gave you at the start of the survey.

Thanks again and have a great day!

Appendix F: Informed Consent and Watershed Infographic

Study Name: Human well-being, ecosystem services and watershed management in the Credit River Valley: Web-distributed mechanisms and indicators for communication and awareness

Researchers: This project is led by Dr. Martin Bunch, Faculty of Environmental Studies at York University in collaboration with Dr. Karen Morrison, University of Guelph, staff at the Credit Valley Conservation Authority and Master's candidates at York University.

Purpose of the Research:
The goal of this project is to identify indicators of human well-being associated with ecosystem services, including economic valuations, develop an internet-based tool to communicate these indicators, and assess the efficacy of this tool in an application to the Credit River Watershed.

What You Will Be Asked to do in the Research: You will be asked to respond to a series of questions in a survey. This should take no more than 30 minutes of your time.

Risks and Discomforts: We do not foresee any risks or discomfort from your participation in the research.

Benefits of the Research and Benefits to You: Through your participation you may have increasted knowledge of conservation activities in your area, and of relationships between your local environment and human health and well-being. At the conclusion of the survey, you will have the option to enter into a draw for one of ten $50 Visa gift cards that can be used for any purchase as a reward for participating in this survey.

Voluntary Participation: Your participation in the study is completely voluntary and you may choose to stop participating at any time. Your decision not to volunteer will not influence the nature of your relationship with the researchers, York University, or any other group associated with this project, now or in the future.

Withdrawal from the Study: You can stop participating in the study at any time, for any reason, if you so decide. Your decision to stop participating, or to refuse to answer particular questions, will not affect your relationship with the researchers, York University, or any other group associated with this project. In the event you withdraw from the study, all associated data collected will be immediately destroyed wherever possible.

Confidentiality: Information generated by your participation in this project will be accessible only to the researchers on this project. Your data will be safely stored in a locked facility and only research staff will have access to this information. Data may be retained indefinitely and could be used for future research studies. Confidentiality will be provided to the fullest extent possible by law.

Questions About the Research? If you have questions about the research in general or about your role in the study, please feel free to contact either of the following:
Dr. Bunch, Faculty of Environmental Studies, York University
Phone: (416) 736-2100, extension 22630 E-mail: bunchmj@yorku.ca

Tatiana Koveshnikova, Credit Valley Conservation
Phone: (905) 670-1615, extension 443 E-mail (tkoveshnikova@creditvalleyca.ca).

This research has been reviewed and approved by the Human Participants Review Sub-committee, York University's Ethics Review Board, and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process, or about your rights as a participant in the study, please contact the Sr. Manager & Policy Advisor for the Office of Research Ethics, 5th Floor, York Research Tower, York University (telephone 416-736-5914 or e-mail ore@yorku.ca).

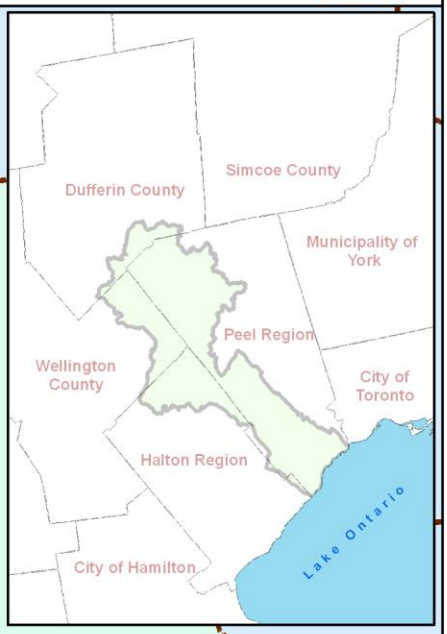
Legal Rights and Signatures:

If you consent to participating in “Human well-being, ecosystem services and watershed management in the Credit River Valley: Web-distributed mechanisms and indicators for communication and awareness,” please initial the front page of the survey. I am not waiving any of my legal rights by initialing the survey. My initials on the survey cover indicate my consent.

_____ _____

Signature of Surveyor and Affiliation Date

Credit Valley Conservation Watershed



WHO WE ARE

The Credit River watershed is comprised of 1,000 square kilometers of land, drained by the Credit River and its 1,500 kilometers of tributaries. It is located in one of the most rapidly urbanizing parts of Canada, within the Greater Toronto area. The river's headwaters are located above the Niagara Escarpment. This area is the source of four rivers: the Credit, Humber, Etobicoke and Nottawasaga. A small part of the Oak Ridges Moraine, as well as a number of other moraines are located within the watershed's boundary.

WHAT IS A WATERSHED?

A watershed is an area of land that drains into a river or a lake. The boundary of a watershed is based on the elevation of a landscape. A drop of water that lands anywhere inside this boundary will eventually end up at the Credit River, before emptying into Lake Ontario. This determination of oundaries is based on the natural shape of the land and therefore the watershed falls across many municipal boundaries. Credit Valley Conservation helps to manage the natural resources found in the Credit River watershed.

Township of Amaranth
Town of Mono
Orangeville
East Garafraxa
TOWN OF CALEDON
Town of Erin
Eramosa
CITY OF BRAMPTON
Town of Halton Hills
CITY OF MISSISSAUGA
Town of Milton
Oakville
Lake Ontario

0 1 2 4 6 8 Km

- Watershed Boundary
- Township Boundary
- Lakes and Ponds
- Rivers and Streams

Major Transportation Network
- Highway
- Major road
- Railroad

Appendix G: "Watershed Well-Being" Survey—Human well-being, ecosystem services and watershed management in the Credit River Watershed

Please note- questions marked "OE" were open ended, "L" were likert-scale questions, "Y/N" were yes/no questions and "#" were questions requiring a numerical answer

Part I: Watershed IQ

1) What does the term watershed mean to you? *(OE)*
2) What is the name of the watershed you live in? *(OE)*
3) What is the name of the river, stream or creek nearest to your home? *(OE)*
4) Have you heard of Credit Valley Conservation before today? *(Y/N)*
   If so, do you remember how you came to know about them? *(OE)*
5) What is your understanding of the role of Conservation Authorities in Ontario? *(OE)*
6) Are you aware of any current or recent issues related to the environment in your neighbourhood, municipality or watershed? *(OE)*

Part II: Natural Environment

1) We want to know about outdoor areas you may visit.
   a. Do you visit forested areas, wetlands and meadows? *(Y/N)*
      Why do you go there? *(OE)*
      And how often? *(#)*
   b. Do you visit city parks or public gardens? *(Y/N)*
      Why do you go there? *(OE)*
      And how often? *(#)*
   c. Do you visit green spaces such as school grounds, cemeteries, golf courses and hospital grounds? *(Y/N)*
      Why do you go there? *(OE)*
      And how often? *(#)*
   d. Do you spend time in home gardens and yards? *(Y/N)*
      Why do you go there? *(OE)*
      And how often? *(#)*
   e. Do you visit rivers, streams, ponds and lakes? *(Y/N)*
      Why do you go there? *(OE)*
      And how often? *(#)*
2) Do you benefit from having street-side features such as trees and flower planters in your neighbourhood? *(Y/N)*
   If so, in what ways? *(OE)*
3) When you decide to go to a natural area or park, what factors or features do you look for when deciding which place to go to? *(OE)*
4) When you decide to go to a natural area or park, what factors or features prevent you from wanting to go to these places? *(OE)*
5) Please name your favourite local green space or natural feature. *(OE)*

Part III: Understanding of environment and well-being relationship

1) Do you think there is a link between your well-being and your local natural environment? *(Y/N)*
   If so, how are you affected? *(OE)*

2) On a scale from 1-5, where 1 is “Not at all” and 5 is “Very Much”, do you feel as if the following contribute to your well-being? If so, in what ways?
    a. Streams and rivers in your watershed *(L)*
    b. Wetlands and forests in your watershed *(L)*
    c. Open green spaces in your watershed *(L)*
3) Are you aware of any programs in place to improve these areas? *(OE)*
4) Do you actively take an interest in your neighbourhood environment, for example, by planting trees, adopting-a-trail or attending organized events related to the environment? *(Y/N)*
   If so, what do you do? *(OE)*

Part IV: Ecological goods and services

1) On a scale from 1-5, where 1 is “Not at Risk At All” and 5 is “At a High Risk”, to what extent do you feel at risk from the following?
    a. Floods and/or flood damage due to extreme weather events *(L)*
    b. Water shortages *(L)*
    c. The effects of climate change *(L)*
    d. The effects of introduced exotic species that quickly spread *(L)*
    e. The effects of rapid urbanization and changing land use over time *(L)*
    f. Water quality *(L)*
2) If you could change up to three things in your local environment to improve your well-being, what would they be? *(OE)*
   Why? *(OE)*
3) Do you rely on your local environment to provide you with any products or materials, including things such as firewood or fish? *(Y/N)*
   If so, please tell us which products or materials. *(OE)*
4) On a scale from 1-5, where 1 is “Not Important at All” and 5 is “Very Important,” how important are the following to you?
    a. Ability to fish *(L)*
    b. Ability to grow and gather food *(L)*
    c. Ability to drink tap water *(L)*
    d. Ability to swim in local streams, rivers and lakes *(L)*
    e. Ability to gather firewood *(L)*

Part V: Social and mental well-being

1) Mental well-being relates to your productivity, concentration, stress and satisfaction with life. Is your mental well-being affected by your outdoor environment? *(Y/N)*
   Why? *(OE)*
2) On a scale from 1-5, where 1 is “Strongly Disagree” and 5 is “Strongly Agree,” to what extent do you agree with the following statements about your mental well-being?
    a. I am satisfied with my life *(L)*
    b. I feel like I lead a stressful life *(L)*
    c. When stressed, I often seek out natural areas as a setting for relief, i.e. I go to a park *(L)*
    d. I regularly go on walks through or sit in natural areas to relax *(L)*
    e. I feel more relaxed after spending time in manicured green space including parks and public gardens *(L)*

f. I feel more relaxed after spending time in non-manicured green space including wetlands, forested areas, and meadows *(L)*
g. I feel more relaxed after spending time in school grounds, cemeteries, golf courses, and hospital grounds *(L)*
h. I feel more relaxed after spending time in private green spaces including home gardens and yards *(L)*
i. I feel more relaxed after spending time in spaces with street-side features including trees and flower planters *(L)*
j. I feel more relaxed after spending time near water features including rivers, streams, ponds and lakes *(L)*
k. I feel more relaxed when looking out of windows at green or natural areas *(L)*

3) Social well-being relates to your relationships, sense of safety, and community bonds. Do you feel that outdoor spaces, like parks and gardens, are important to your social well-being? *(Y/N)*
Why? *(OE)*
4) On a scale from 1-5, where 1 is "Strongly Disagree" and 5 is "Strongly Agree," to what extent do you agree with the following statements about your well-being as it relates to your neighbourhood environment?
a. Trees, shrubs, flowers and green space make this a better place *(L)*
b. I am more sociable in places with trees, shrubs, flowers and green space *(L)*
c. I feel safe in places with trees, shrubs, flowers and green space *(L)*
d. I would be willing to take action to ensure that trees, shrubs, flowers and green space in my neighbourhood are protected *(L)*
e. Diverse, mature, healthy trees and green space make this a better place *(L)*
f. I prefer to undertake leisure and/or recreational activities in places with trees, shrubs, flowers and green space *(L)*

Part VI: Values and Personal Characteristics

1) The following statements are principles that may or may not matter to you. On a scale from 1-5, where 1 is "Not Important At All" and 5 is "Very Important," please indicate how important each principle is to you.
a. Leading an exciting life filled with stimulating experiences *(L)*
b. Trusting the people in my community *(L)*
c. Existing in harmony with other species *(L)*
d. Being proud of living in my community *(L)*
e. Showing self-discipline, self-restraint and resistance to temptations *(L)*
f. Protecting the environment and preserving nature *(L)*
g. Having the right to lead or command *(L)*
h. Feeling a sense of belonging in my community *(L)*
i. Having material possessions and money *(L)*
j. Social justice, and caring for the weak *(L)*
k. Unity with nature and fitting into nature *(L)*
l. Being curious, interested in everything and exploring *(L)*

Part VII: Demographics

1) How old are you? *(OE)*

2) We all live in Canada, but our ancestors come from many different ethnic backgrounds. What is the **main** ethnic background of your ancestors? *(OE)*
3) How long have you lived in Canada? *(#)*
4) How long have you lived in your current neighbourhood? *(#)*
5) Do you own or rent your place of residence? *(OE)*
6) Which of the following best describes your household composition? *(Respondent chose one option from list)*
    a. Single person
    b. Couple
    c. Single person with one or more children
    d. Couple with one or more children
    e. Roommates
    f. Intergenerational
7) Which is the highest level of education you have completed? *(OE)*
8) What is your postal code? *(OE)*
9) Which category best describes your total household income (before taxes) in 2012? *(Respondent chose one option from list)*
    a. Less than $40,000
    b. $40,000 to $59,999
    c. $60,000 to $79,999
    d. $80,000 to $99,999
    e. $100,000 to $119,999
    f. $120,000 to $159,999
    g. $160,000 or more
    h. Refused

Part VIII: Post-Survey Questions: Surveyor Observations

1) Gender
    a. Male
    b. Female
2) Sidewalk presence
    a. None
    b. One
    c. Two
3) Sidewalk separated from road?
    a. Yes
    b. No
4) Size of front yard
    a. Small
    b. Medium
    c. Large
5) Fenced in front yard?
    a. Yes
    b. No
6) Presence of trees
    a. Yes
    b. No

7) Presence of flowers or shrubs
    a. Yes
    b. No
8) Number of trees in three home span (respondent + immediate neighbours)
    a. 1-2 trees
    b. 3-4 trees
    c. 5-6 trees
    d. 7+ trees
9) Size of trees (based on estimated height and girth)
    a. Small
    b. Medium
    c. Large

Appendix H: Flyer

ATTENTION RESIDENTS

Credit Valley Conservation and York University will be conducting a door-to-door survey in your neighbourhood throughout the month of November 2013.

We want to know your opinions about how your well-being relates to your natural environment. The results of this survey will be used to inform the management of your local parks and green space.

If you participate, you will be automatically entered into a **PRIZE DRAW** for one of ten **$50 VISA GIFT CARDS**.

We look forward to hearing what you have to say!

If you have any questions or comments, feel free to contact us at:

abelaskie@creditvalleyca.ca or jmallett@creditvalleyca.ca