Walkability of Three Southern Ontario Inner City University Campus Thoroughfare Streets.
Assessing the Physical and Perceptual Qualities of the Built Environment

A Master’s Report submitted to the School of Urban and Regional Planning

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Executive Summary

Background and Objectives
In recent years, the quality of the pedestrian environment, and the importance of planning and designing streets for all users, has gained considerable traction among planning professionals. There is growing recognition that streets should provide environments for pedestrians that are inviting, safe, aesthetically pleasing, and equipped with sufficient pedestrian amenities. This is even more important when considering pedestrian environments on university campuses because of the volume of pedestrian traffic they see.

The objective of this report is to evaluate the walkability of three Southern Ontario inner city university campus thoroughfare streets: Union Street at Queen’s University, Laurier Avenue at the University of Ottawa, and St. George Street at the University of Toronto. Through a walkability audit and direct observations, along with the analyses of relevant policies and plans for improvements of these thoroughfares, this report presents assessments of the overall quality of each pedestrian environment and presents recommendations for improvements.

Research Methods
The research involved two primary methods for each campus thoroughfare street: a walkability audit tool and direct observations. Use of the PEDS audit tool provided a systematic approach to easily compare and evaluate the presence and quality of pedestrian features on each street based on 36 criteria. Two secondary methods - a literature review and policy analysis - provided contextual information for the three study sites, supplementary information to the audits and observations, and insights into the planned improvements of the three streets.

Key Findings and Recommendations
The information gained from the PEDS audit and direct observations showed varying levels in the pedestrian quality and walkability of the three campus thoroughfare streets. Each street both excelled and lacked in different areas. Overall, St. George Street was the strongest in terms of providing an environment that is inviting, accommodating, and safe for pedestrians, which is likely attributable to its recent revitalization. Specifically, St. George had the highest quality pedestrian environment because of the buffers between the sidewalk and street, the variation in...
sidewalk width, its high level of connectivity, the high degree of enclosure, aesthetics and building articulation, pedestrian and street lighting, and the walking amenities it provides. Meanwhile, the analysis suggested that Laurier Avenue has the lowest quality pedestrian environment, most notably because of the conditions of the sidewalks, lack of pedestrian lighting, and unsheltered bus stops. Through an analysis of the audit results and direct observations, recommendations were created for each of the streets.

**Union Street**

*Union Street Recommendation #1:*
*Add pedestrian friendly landscape architecture and buffers between the road and sidewalk.*

*Union Street Recommendation #2:*
*Apply traffic calming measures at numerous points on the street to enhance safety.*

*Union Street Recommendation #3:*
*Repair unsafe bike lanes along the segment and make them more visible.*

**Laurier Avenue**

*Laurier Avenue Recommendation #1:*
*Add more pedestrian level lights to the street.*

*Laurier Avenue Recommendation #2:*
*Improve transit comfort through the introduction of sheltered bus stops.*

*Laurier Avenue Recommendation #3:*
*Widen the sidewalk along the segment.*

**St. George Street**

*St. George Street Recommendation #1:*
*Incorporate more crossing aids.*

*St. George Street Recommendation #2:*
*Introduce wayfinding aids to nearby points of interest and transit options.*
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Chapter 1: 
Introduction

1.1 Overview
The purpose of this report is to evaluate the walkability of three Southern Ontario inner city university campus thoroughfare streets. More specifically, the objective is to assess the physical qualities of the built environments of one major thoroughfare street at each of the three university campuses (St. George Street at the University of Toronto; Union Street at Queen’s University; and Laurier Street at the University of Ottawa). The streets were evaluated using a walkability audit, observations, interviews, and campus policy analysis, and these evaluations were guided by the following questions:

1) What pedestrian oriented physical qualities and streetscape elements are present or lacking on major streets situated within three inner city university campuses in Ontario?

2) How can these major streets become more walkable and pedestrian friendly through physical design?

1.2 General Problem
Although walking is the cornerstone of human movement and mobility, it has been neglected within recent urban developments (Tier, 2014), by placing more importance on the personal automobile. According to Southworth and Forsyth (2008), historically, almost all developments in transportation aspects seem to have degraded the pedestrian environment. More importance has been placed on roads serving higher and higher-volumes of traffic. As a result, pedestrian interaction has been neglected and roads have lost their human scale.

This trend is extremely important when it comes to university campuses, as they generate considerable volumes of traffic in a variety of modes. While some trips involve private vehicles or public transit originating from a distance, the majority begin from nearby locations, which are better suited for walking. The result of this is a multimodal environment with high levels of walking in conjunction with high levels of vehicle volume on the thoroughfare streets that run through university campuses. This is a particularly salient issue for inner city universities where
the major thoroughfares that bisect the campuses also serve as critical transportation corridors for the city as a whole. Because of the high volume of pedestrians on these major streets, evaluations should be undertaken to measure how walkable they truly are.

1.3 Evaluating Walkability of University Campuses

There have been extensive studies done by researchers on defining, measuring, and understanding walkability. Consequently a significant body of academic literature has arisen in recent years. Through this research, much of the emerging literature has focused on “how deficits in the environment make walking unpleasant, inconvenient or scary” (Brown, 2007, P.35). The majority of walkability studies have focussed on a specific factor or issue and its correlation with walkability (most specifically being health issues). Yet, the literature review performed for this research encountered only two published scholarly studies that have examined walkability specifically on university campuses.

One recent study from Dalhousie University (Tier, 2014) examined walkability on a particularly busy thoroughfare street on the campus, while the other study undertaken by Horacek (2012) evaluated the walkability of 15 US post-secondary campuses and scored them based on an audit.

In addition to these two particular studies, master’s reports produced by students from Queen’s School of Urban and Regional Planning evaluated the walkability of areas in Vancouver, BC, and offer useful precedents for measuring walkability. The results of the review of the literature will be discussed in more detail in Chapter 2.

1.4 Scope

This report investigated and evaluated the walkability of the major street running through three Southern Ontario inner city campuses. While most Canadian universities are located on the periphery of the city and not in the urban centre, the study of walkability on inner city campuses is critical because of the high volumes of vehicular and foot traffic they encounter. In choosing which campuses to use as case studies, three criteria were considered. Firstly, all of the campuses chosen must be located in or very close to the downtown of the city. Secondly, there must be a major thoroughfare road that runs through the campus, which would be the main
aspect of the study. Lastly, all three schools must be in the same relative geographic location of Southern Ontario.

Taking these three criteria into consideration, the Southern Ontario campuses chosen as case studies (Table 1) for this research project were Laurier Street at the University of Ottawa, Union Street at Queen’s University, and St. George Street at the University of Toronto.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Number of Students</th>
<th>Population of City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queen’s University</td>
<td>24,582</td>
<td>123,363 (2011)</td>
</tr>
<tr>
<td>University of Toronto (St. George)</td>
<td>47,295</td>
<td>2,791,140 (2013)</td>
</tr>
<tr>
<td>University of Ottawa</td>
<td>42,207</td>
<td>883,391 (2011)</td>
</tr>
</tbody>
</table>

1.5 Methods

This report evaluates the walkability of three different university campus thoroughfare streets in Toronto, Kingston, and Ottawa, as they experience high volumes of pedestrian traffic. After considering the best possible way to approach this study, it became clear that a comparative case study (Hay, 2010) with qualitative data collection methods would best suit this specific study. For each campus, four methods were used in each site to evaluate the quality of the walking environment: walkability audits, observational analyses of each street, and three key informant interviews with planning professionals who have extensive knowledge of each campus. A literature review and analyses of campus master plans and other relevant documents were also considered to generate supplementary background information and to strengthen the validity of the results.

Following this introductory section and literature review in Chapter 2, the report will describe the methods in Chapter 3. Next, the case study campuses will be introduced and the document analysis will be articulated in Chapter 4. Chapter 5 will present the results and analysis of the walkability survey, observations, and interviews for each campus, before entering into the closing discussion of the recommendations in Chapter 6.

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1 Population numbers obtained from each institutional website. Full citations located in the reference section.
Chapter 2: Literature Review

2.1 Introduction

One of the most significant problems planners face in Canada is attempting to make the transition from cars to active transportation methods. Dependency on cars places considerable stress on not only the environment and urban infrastructure, but also on personal health. One of the most suitable ways of reducing this dependency is by promoting more active transportation. The challenge for urban planners, urban designers, and municipal decision makers, however, is to design our communities and streetscapes in such a way as to encourage alternative modes of travel, such as walking. Additionally, large institutions, such as universities, play key roles in promoting active transportation within the cities they are situated, through their policies, plans, and design. Because of the high volume of pedestrians that universities attract, they offer useful case studies and insights into what a walkable area could resemble.

This literature review begins by defining the term “walkability”, and identifying the factors that make a place walkable. Next, the main methodologies used by academics in assessing walkability are discussed. Finally, previous work done on measuring walkability on campuses will be discussed.

2.2 Defining the Term Walkability

Until fairly recently, the notion of “walkability” was not even taken into consideration and the idea of pedestrian space automatically took a back seat to the more overshadowing goal of facilitating vehicle flow and accommodating automobiles. In the past decade, the attention paid to walkability among scholars and policy-makers has grown considerably. And yet, there is little consensus on the definition of walkability. In the eyes of William Whyte (1988), defining walkability extends beyond pedestrian concerns, as the ability to walk in a neighborhood indicates not only a type of mobility and means of travel, but also a type of sociability between neighbors, which, together, likely affect the physical, mental, and spiritual health of people in the community. Lo (2009) asserts that “to understand walkability, it is important to consider how pedestrians are defined and the discourses that shape the development of pedestrian space”
(P.145). This means understanding how to optimize space for pedestrians, rather than focusing all efforts on improving the motorized transportation.

Alternatively, Lenthe (2011) believes that walkability lies solely with resident perception, inasmuch as each resident has their own ideas of what makes their neighbourhood walkable. Lenthe (2011) argues that differences in awareness of the environmental determinants of walkability account for these varied perceptions, and that these mismatched perceptions would benefit from improved education and understanding of the mechanisms of the term. Lo concurs with Lenthe’s notion when she argues that “walking is a multidisciplinary activity, and therefore requires multidisciplinary metrics to measure the walkability of places” (Lo, 2009, P.164).

Rather than the walkability of a particular place hinging on a single element such as the volume of pedestrians or the look of the neighbourhood, a range of influences must be taken into consideration. Notwithstanding the lack of convergence on a universal meaning of the term, there appears to be a breadth of literature that describes factors that make a place walkable. Based on the literature, walkability was defined as being the level in which the street and built environment affect a pedestrian’s sense of safety and comfort when using the street. Additionally, how inviting a street is plays a key role in the level of walkability.

2.3 Walkability Factors

Understanding how the walkability of a certain place encourages or discourages pedestrians has become a very important priority for planners. Despite the fact that walking presents multiple societal and personal benefits, many people walk too little to realize these potential benefits. According to Brown (2007) “recent research has focused on lifestyle activities, such as walking, and noted how deficits in the environment make walking unpleasant, inconvenient or scary” (P.35). Both Brown (2007) and Leslie (2007) agree that one of the largest barriers to enticing people to walk is deficits with the environment, such as the overall look or physical quality, as this influences physical activity greatly. Research has shown that people tend to walk more when they perceive that the walking environment in their neighbourhood is of higher quality, referring to the overall look or aesthetic (Brown, 2007). These types of studies allow researchers to make assumptions regarding the correlations between environmental aspects and walkability.
Recently, researchers have identified numerous neighbourhood characteristics that seem to be more conducive to high rates of walking within communities, such as higher densities, closer proximity of activities, smaller block sizes, universal access characteristics, absence of heavy traffic, landscaping, land-use mix, and more sidewalks (Lo, 2009; Moudon et al., 2006).

These factors can be categorized into one of four overarching sections: Environment, Pedestrian Facilities, Road Attributes, and Walking/Cycling Environment. Each of the sections are based upon extensive research and literature to reflect environmental features that are considered to be key attributes of pedestrian environments that could affect walkability (Active Living Research, 2004). Sections 2.3.1 to 2.3.4 below present evidence based on the categories in the PEDS audit tool and offer a brief explanation of what each of the general themes mean.

2.3.1 Environment

The scope of land uses that are present along a street often provides a good indicator of the quality of the pedestrian environment. In recent years, more emphasis has been placed upon promoting mixed uses as a means to strengthen the pedestrian environment. Having a variety of land uses spurs different kinds of activities (Moughtin, 2003), offering people opportunities to interact and activities to occur throughout the day (Jacobs, 1961). Creating and facilitating an environment that allows people to interact with others and the built environment in the same area fosters social diversity and economic stimulus to the area. This, in most cases, will have a profoundly positive effect on the pedestrian environment (Jacobs, 1961).

Slope is an important aspect that can have a profound effect on the walkability of a particular street. Generally, a street that has very little to no slope is much more accessible and inviting than a street with a steeper slope. A gradual slope can add a layer of interest to a street, as it can provide pedestrians with a view and can add interest and appeal to a street that is lacking in substance. The slope in San Francisco, for instance, has made the pedestrian environment of the street more popular (Jacobs, 1993). However, slope can become a problem in colder climates where ice build-up can occur. In these settings, it is critical that sidewalks are designed to have an even and non-slip surface that is comfortable and safe for all people to walk on year round.
Intersection density and street connectivity are also very important when evaluating the pedestrian environment. According to Jacobs (1961), not only do intersections facilitate vehicle traffic, they also break roads into smaller segments or blocks, making it easier for pedestrians to access several parts of the city. Streets that do not allow for this (dead ends, very long segments, cul-de-sacs etc.) subliminally discourage pedestrian use of the street and forces pedestrians to find alternative and longer routes to get to their destination (Jacobs, 1961).

2.3.2 Pedestrian Facility
Sidewalks are designed and intended to accommodate high levels of pedestrian traffic and are traditionally provided parallel or adjacent to a roadway. Sidewalks are often the busiest and most prominent public spaces that a city can offer. Given their prominence, sidewalks are a key attribute when considering the pedestrian friendliness of streets. Successful sidewalks should allow for the experience of comfort, safety, accessibility, and efficiency when walking along them and should provide an environment that both facilitates and encourages efficient mobility and public interaction (Jacobs, 1961). While paved and dirt paths are typically more prevalent in natural settings, and less commonly aligned with streets, these types of pedestrian facilities are often prominent on university campuses, as they provide ease of access from the major roadway to destinations within the campus.

Another significant influence on pedestrian comfort, which can affect the overall walkability of a street, is the material of pedestrian facility (Gehl, 2010). Depending on the location and geography, sidewalks can be designed with practicality in mind; in most instances emphasis is places upon sidewalks having an even and non-slip surface that is comfortable and safe for all people to walk on. In other instances, weight is placed on the aesthetics and visual appearance of the sidewalks; therefore materials are chosen to facilitate this preference. In all cases, durability and accessibility are the most important factors when determining which path materials should and will be used.

The size and width of the pedestrian facility is a contributor to the overall walkability of a street. The key to creating a successful and inviting pedestrian environment is making sure that the
sidewalk is sufficiently wide to provide enough room so pedestrians are not bumping into each other or being pushed off the sidewalk onto the road. According to Gehl (2010), when the priority on the street is given to cars, sidewalks become an afterthought and are often too narrow and overcrowded (Gehl, 2010). The volume of foot traffic should be an essential consideration when determining what level of separation is needed between cars and pedestrians (Moughtin, 2003).

The main purpose for sidewalks is to facilitate and accommodate pedestrian use. Despite this, there are often instances where pedestrians are forced to share sidewalk spaces with amenities and utility hardware. Objects such as planters, bus shelters, lamps, traffic signs, parking equipment, and utility hardware are located within the pedestrian right-of-way, which obstructs and reduces the efficiency of the pedestrian flow (Gehl, 2010), and can greatly affect the quality of the pedestrian environment (Fruin, 1971). Thus, to combat this and create a comfortable and enjoyable walking experience, sidewalks should be clear of any unnecessary barriers that cause an interruption for pedestrians. Careful consideration should be taken when deciding where to place these amenities.

The level of accessibility of sidewalks greatly affects pedestrian use. This means that people of all ages and abilities should have access to the use of a sidewalk. The ways to ensure this level of accessibility are curb ramps and curb cuts, which facilitate a transition between the surface of the sidewalk and the road.

The connectivity of sidewalks and paths to the surrounding facilities is an important aspect to a successful pedestrian environment. Sidewalks and paths that are clearly connected to crosswalks and other sidewalks successfully encourage usage and promote walkability. In addition to this, highly connected streets and sidewalks offer direct routes to destinations and make walking more feasible and efficient. In the end, the goal is to provide pedestrians safe and convenient access to facilities on both sides of the streets.
2.3.3 Road Attributes

For a pedestrian, safety is often paramount in their decision of whether or not to walk to their destination. Perceived safety is greatly influenced by the size of roadway, the condition of the road, and presence of crosswalks and safe crossings. However, the primary factors that influence a pedestrian’s decision to walk or not is the speed and volume of traffic. According to Whyte (1988), an ongoing issue in the planning field is the separation of vehicle and pedestrian traffic, and is something that warrants consideration as a means to create an inviting and safe pedestrian environment. A practical means of providing a buffer between pedestrians and traffic flow is on-street parking. The presence of parked vehicles on the street not only helps to create a safe environment for pedestrians, but is also an effective approach to slowing down traffic.

Other traffic and speed control devices act as means to reduce traffic speed on streets. Examples of this include speed bumps, roundabouts, and curb extensions, which are all designed to enhance the safety of the pedestrian environment. Curb extensions occur when the width of the sidewalk widens at intersections, which reduces the distance that the pedestrian has to cross to travel to the other side of the road. This traffic control measure not only significantly reduces the time that pedestrians are exposed to traffic, it also provides space for amenities that could improve the overall walkability of the street (National Centre for Bicycling and Walking, 2002).

Signalized and non-signalized crosswalks provide designated areas where pedestrians can safely cross the road, and are a common occurrence at most street intersections. Roads that contain higher frequencies of crosswalks and provide stronger sidewalk connectivity usually foster a more walkable environment (Gehl, 2010). Other forms of crossing aids for both pedestrians and cyclists include: over and underpasses, pedestrian signals, and pedestrian warning lights.

2.3.4 Walking/Cycling Environment

When assessing the quality of both the walking and cycling environment, thought should be given for both day and night. Enough roadway and path lighting should be provided to ensure both vehicle traffic and pedestrian safety. According to Fruin (1971), an effective lighting design will provide constant light distribution throughout the entirety of the road, thereby ensuring a safe and comfortable pedestrian environment.
One of the most difficult tasks is achieving the appropriate amount of amenities on a street (eg. benches and garbage cans), as there is a significant effect on the overall quality of the walking/cycling environment. Providing too few amenities on a road can lack vibrancy and can make the street very uninviting, as there is no reason to use it. On the other hand, providing too many amenities can cause the street to become cluttered and look too “busy”. Thus, providing a balanced amount of amenities on a street that are safe, easy to use, convenient, aesthetically pleasing, and appropriately located, will encourage use by pedestrians and cyclists (Whyte, 1988).

Important, yet often overlooked, factors when evaluating the quality of a walking environment are the placement and quantity of benches and the frequency of public garbage cans. According to Whyte (1988), the placement public seating and benches should consider the benefits of social interaction and the level of activity on the street. Having places where pedestrians are able to sit down encourage use and will add to the aesthetics of the street. Similarly, garbage cans are very important. More often than not, garbage cans are spaced evenly along a street and the proportion of them is the same on each block (Whyte, 1988), which may not be an ideal frequency for the volume of garbage being produced by pedestrians. Garbage cans that are too infrequent, too small or poorly placed can easily overflow and/or encourage litter along the sidewalk or road. Frequently and appropriately sited garbage cans with lids or opening flaps that are designed to conceal the trash, prevent odours, and keep animals from rummaging are ideal and will create a more inviting place for pedestrians and cyclists (Whyte, 1988).

Wayfinding aids are directional maps or signs that provide assistance to people who may be unfamiliar with the area. The effectiveness of wayfinding aids depends largely on the information requirements of the pedestrians and cyclists. In some cases, street signs may be sufficient to give pedestrians and cyclists their bearings; whereas in other cases, more complex and informational signs may be needed (Moughtin, 2003). This could include signs that indicate distances and notable landmarks. Wayfinding aids enhance the trust and confidence of cyclists and pedestrians who are generally unfamiliar with the street or their surroundings (Moughtin,
Furthermore, by increasing a pedestrians trust and confidence, their sense of safety will also increase.

One of the most beautiful and aesthetically pleasing aspects of a street is the trees that line it. Trees also act as spatial boundaries between the sidewalk and street and can provide a sense of scale (Arnold, 1993). Not only do trees create shade, which makes for a comfortable walking environment, they act as visual buffers between the pedestrian and traffic flow. Thus, type of tree and where they are placed are important factors when assessing the quality of a street (Jacobs, 1961).

Building façade design is also an important element of the pedestrian environment, as it helps to create a more inviting and interesting streetscape (Gehl, 2010). The perception of walking distance can be influenced by building articulation, where buildings with continuous horizontal lines reinforce perceived distance, whereas narrow and short façades give the impression of a much more manageable distance (Gehl, 2010). At the street level, creating an effective building articulation adds visual interest and, in some cases, adds a strong sense of place that resonates with pedestrians and creates a pleasurable walking and cycling environment. In contrast, streets that have little to no building articulation can be perceived as an environment that is unsafe, uninviting, and unused. Successful walking and cycling environments strike a balance between buildings that dominate the street visually and buildings with diverse façades and styles (Moughtin, 2003).

Lastly, public transit plays a key role in evaluating the success of a street. Transit stops are a common occurrence on most streets, but the presence and quality of amenities (e.g., signage, benches, shelters) provided at these stops are significant determinants of the quality of the pedestrian environment. If bus stops are not adequately equipped for a type of climate or frequency of usage, an uncomfortable waiting environment is created, which discourages use.

### 2.4 Walkability Methodologies
According to Randall (2000), walkability is generally studied using one of three approaches: descriptive studies, multivariate studies, and hypothetical studies.
Randall argues that descriptive studies, such as walkability audits, provide an accurate method for analyzing walkability, because observed behavior often provides the best indicator of the relationship between the walkability of the environment and the walking experiences of pedestrians. Brown (2007) similarly argues that one of the best tools for measuring walkability is through audits; “walkability audits provide a rigorous tool to apply to topics of long-standing interest to environment and behavior researchers” (P.39). Through audits, aspects that could have been missed through larger scale analysis become clear, including characteristics of buildings as well as streets, signage, and obstructions.

Where Brown and Randall’s views deviate is regarding multivariate studies; these are studies that combine observational data and statistical analysis. Randall’s research shows that multivariate studies provide more accurate data, because they consider a multitude of factors that help to determine if a place is walkable or not. Brown counters this point by arguing that information gained from multivariate studies is hardly reliable, due to the lack of objectivity.

Moreover, hypothetical studies involve computer model simulations and GIS to find links between multiple variables. Researchers, such as Leslie et al. (2007) and Hess (2010), likely favour this method, since they believe that highly connected places are more likely to have higher quality pedestrian facilities. Conversely, Brown’s (2007) writing would lead one to believe that she would be opposed to this method, as there is absolutely no human element to the study. According to Randall (2000), these approaches tend to ignore important human and built environment characteristics related to psychological, social, and cultural influences.

2.5 Previous Work on Walkability of University Campuses

In reviewing the literature for studies regarding the measure of walkability on university campuses, only three studies were found: one Canadian and one American.

In the Canadian context, a very recent study undertaken by Trier (2014) evaluated the walkability of University Avenue at Dalhousie University, a busy thoroughfare street that runs through campus. This study focused more so on aesthetics with a minor focus on the street’s
design and pedestrian environment. The study employed a walkability assessment audit and a survey of pedestrians to assess the walkability of this thoroughfare, and found that University Avenue was not walkable, as it lacked colour, artwork, greenery, and adequate seating (Trier, 2014). The major finding of the assessment was that the study area was bland and became significantly duller in the winter months, while the survey generated similar conclusions and also identified other issues such as traffic, safety, and the amount of seating on campus (Trier, 2014).

The purpose of the second study, undertaken by Horacek (2012) was to rate 15 post-secondary walking path segments for path safety, quality, and comfort. Driven by rising rates of obesity in the 18-24 year old cohort of Americans, and that university campuses are common to 18 million young adults in America, using campuses as their study area was only logical (Horacek, 2012). The author argues that “although the built environment may not cause obesity, walkability of neighborhoods and communities are important environmental determinants of physical activity” (Horacek, 2012, P.9). Moreover, little is known about the extent to which universities promote physical activity through campus environments. Horacek’s (2012) study employed a criteria checklist for walkability (Appendix C). This study differs from the majority of other audits because it focusses on evaluating the walkability of an entire campus, rather than segments.

Through their checklist (Appendix C), they found that the average score of universities (n=13) was 72.71 (out of a possible 100) and that 70% of the campuses they studied, received a grade of A or B. However, almost 10% of campuses they studied received a failing score for walkability and more than half of the campus environments surveyed scored below an adequate mark on numerous path safety and quality criteria (Horacek, 2012).

2.6 Summary

As exemplified above, evaluating walkability is a priority for scholars in the field today, as a means to alleviating the considerable stresses placed on the environment, urban infrastructure, and personal health. The importance of walking and creating walkable areas has become increasingly significant in recent years. This research sought to determine the walkability of three university thoroughfares in Ontario, Canada, because of the high volume of pedestrian traffic they experience daily. The data gathered from this study can aid campus planners in
designing and updating these busy university thoroughfares, which will help to lead to a more sustainable and healthy future overall.
Chapter 3: Research Methodology

This chapter begins by providing an overview of the methods used in this study. It then discusses audit tools as a research method with an in-depth explanation of the specific type that will be used in this study and report. This is followed by a discussion of the audit tool criteria, which acts as a theoretical background for the audit criteria. This section will also outline the various data collection and analysis methods to address the research questions.

3.1 Overview

The methodology for this report began with the literature review outlined in the previous chapter. To complement this background research, key informant interviews and document analyses were undertaken. After the establishment of a strong research background, a walkability evaluation was conducted on each street located within each of the study campuses. Lastly, to complement the walkability audit, an observational analysis of each of the sites was done.

3.2 Defining Audit Tools

With increasing interest in active lifestyles and a greater concern for the quality of the built environment and public spaces, researchers have found it necessary to create audit instruments that focus both on the streetscape environment and measure the physical features that relate to walkability (Active Living Research, 2004). Audit tools are used in a range of applications to collect user perceptions and evaluate how different environments influence peoples travel behaviour. Some audits are designed for academic research, while others focus more towards community engagement. The majority of audits are purely qualitative, while some others include a quantitative component (Active Living Research, 2004; Nakazawa, 2011).

According to Brownson et al. (2009) audit tools are a systematic observational method, which require an observer to collect data in person with a specified environment. Researchers use audit tools to collect primary data on physical features that are not commonly incorporated into databases, such as GIS (Brownson, 2009). It is common that the researcher will obtain data through modes such as driving, walking, or riding a bicycle through the observation area. The scale of the project is completely dependent upon the type of audit; it can consist of entire
neighbourhoods to specific street segments within. Observed characteristics are evaluated based on explicit definitions and standardized criteria. The amount of detail varies from each audit tool; some focus on a small amount of key features, whereas others are considerably more in depth and include numerous criteria that evaluate different characteristics (Brownson, 2009).

There are numerous audit tools available that assess different aspects of walkability. Each tool is unique in the sense that there is a variation in the scope of observations and method of analysis. In comparing two widely used tools, one could examine the Physical Activity Resource Assessment (PARA), which evaluates features, amenities and incivilities of physical activity resources in urban neighbourhoods and the Environmental Assessment of Public Recreational Spaces (EAPRS) which evaluates the physical environments of parks and playgrounds, with an emphasis on evaluating physical elements and qualities with respect to their functionality (Dannenberg, 2005). The former example only has 43 criteria, whereas the latter has 712. The majority of community audit tools measures land use, streets and traffic, sidewalks, bicycling facilities, public space/amenities, architecture and building characteristics, parking/driveways, and safety indicators (Dannenberg, 2005).

3.3 PEDS Audit Tool

For this research report, the Pedestrian Environment Data Scan (PEDS) was employed (Clifton, 2007) because of how it focuses on the physical and perceptual qualities of a particular street’s built environment. In addition, the tool includes an applicable and simplistic approach, which provides an effective structure to analyze the results and compare them to a different pedestrian environment.

The PEDS audit tool is designed to be an efficient assessment of a built environment, which evaluates the presence and qualities of streetscape features that influence walkability (Brownson, 2009). The audit is applied at the segment or path level that has been tested in various environments and includes 36 criteria of streetscape characteristics that other research has shown to influence walkability. These criteria are organized into four major and one minor section: Pedestrian Facility, Environment, Road Attributes, and Walking/Cycling Environment; Subjective Assessments entails rating the overall attractiveness (see Appendix A). In each of the
four major sections, the researcher rates the sub-sections or indicates all the options that apply. There is also a section reserved for researcher comments, opinions, and observations. This makes the audit a straight-forward process and is easily repeatable. There is space on the audit form to record the date, time, and street segment. It is recommended that a map of the street segment be used as a reference when observations are made; however, before any observations are conducted, researchers are advised to walk the entire segment without completing the audit tool, as a means to develop some familiarity with the environment and gain a better understanding of the context of the street.

Once the initial walk has been completed, the researcher may address each criterion and record their observations. In order to undertake the strongest analysis of the segment, it is encouraged that the researcher goes back and forth along the street multiple times. This also allows the researcher to observe things that he/she may have missed when previously walking on the street. This entire process is repeated for each one of the street segments and once all the audits are completed, an analysis can be performed to evaluate and compare the different pedestrian environments.

3.4 Overview of PEDS Criteria

In each of the 4-overarching sections of the PEDS audit tool – Environment, Pedestrian Facility, Road Attributes, Walking/Cycling Environment – there are sub-sections that contain multiple criteria questions that focus on different aspects of the street. Each of the sections and criteria are based upon extensive research and literature done by Clifton et al. (2007) to reflect key features and attributes that are considered when assessing the walkability of a pedestrian environment.

The first section of the audit, Environment, deals with street segment features that are important when considering a large scale evaluation of the quality of the entire pedestrian environment. The sub-sections for this section include segment type, land uses, slope of the street, and intersections. Specifically, for this section, the researcher is guided to take note of aspects such as traffic volume; land use on the street, from residential to commercial to institutional; how steep, if at all, the street is; and why types of intersections or dead-ends the street has.
In the second section, the audit tool explores the types of Pedestrian Facilities on the street. The types of facilities on a street depend strongly on what type of environment the street is located within, which then dictates what activities will be held there and its vibrancy. Aspects such as types of paths and sidewalks, path conditions, quality of the path, sidewalk width and distance from the curb, accessibility, and connectivity are all examined.

The third section of the audit, Road Attributes, deals with the physical characteristics and facilities of the road. The reason for this is due to the fact that the condition, features, and size of a roadway can have a significant effect on the quality of the pedestrian environment. For this particular section, aspects such as the size of the road, speed limits, parking, traffic control devices, crosswalks, and crossing aids/devices are explored. One of the main reasons for observing the characteristics noted in this section of the audit is to assess whether or not the road attributes of the physical environment evoke a feeling of safety.

The elements of a street along with the overall image of the streetscape contribute to the quality of the walking and cycling environment. For this reason, the final section of the audit, Walking/Cycling Environment, deals with whether or not the road creates an inviting element for both pedestrians and cyclists. For this final comprehensive section of the audit, aspects such as road and path lighting, pedestrian amenities, trees, building design and articulation, wayfinding aids, setbacks, public transit, and overall cleanliness are investigated. A large reason for this section of the audit is to assess whether or not the street encourages walking and cycling. If successful, it will foster a sense of community and entice people to use the street.

More in-depth information on each one of the sections in the audit tool is located in the Audit Protocol in Appendix D.

3.5 Data Collection Methods

Three qualitative data collection methods were employed in this study, with the overarching methodology being a comparative case study analysis: a literature review, direct observations, and policy analysis. With the use of direct observations as a primary method of data collection,
subjectivity and construct validity are issues that come into question, because audit tools have an element of subjectivity, by virtue of the fact that scores or grades are assigned. By drawing on multiple sources of data, findings were triangulated to minimize the inherent subjectivity of the audit results and to increase the overall validity of the study’s recommendations (Yin, 2009). In addition to this, the background of supporting literature reduces researcher bias when analyzing the data, because of the breadth of literature consulted. The following sections describe the purpose of each data collection method and how they were incorporated into the overall research.

3.5.1 Literature Review
The main purpose of the review (presented in the previous chapter) was to give context to the research by defining walkability, uncovering the factors that make a place walkable, explore methodologies used by academics in evaluating walkability, and investigating precedents of walkability studies on university campuses.

3.5.2 Direct Observations
The primary data collection method in this report was direct observations. Segments of Laurier Avenue, Union Street, and St. George Street were all observed and audited in the month of January, with very similar weather conditions and temperatures (Refer to Appendix __). Within this overarching method, there were two forms of direct observations used to collect information at each one of the campuses: the walkability audits using the PEDS tool and photography. These direct observations were used to observe the streetscape features that were present at the street segment at each one of the campuses and assess the quality of the pedestrian environment.

The criteria captured in the audit tool provided direction and informed the researcher on what aspects to look for on the street segment. This type of direct observations are considered semi-structured, because the streetscape features and facilities to focus on were specified by the creators of the audit. The nature of the PEDS audit tool provided a systematic approach to observe and evaluate the walkability of each street along with an audit protocol, which outlines the procedural methods and how they should be followed (Appendix E). By following the steps and procedures of the audit tool, the results from the audits have strong reliability.
The second form of direct observation that was used to collect data was photographs. They were used to provide visualization and context to the observed features of the pedestrian environment. Photos and visual aids are generally used as supplementary sources of evidence in walkability assessments, and were used in this study to augment the data generated from the PEDS audit tool.

3.5.3 Document Analysis
The information that was gathered in the review of documents was drawn upon to give context to the study in areas that the audit may not have explicitly addressed. Specifically, in order to provide a well-rounded foundation of information about each of the particular streets on the campuses, Campus Master Plans were consulted, along with official plans, pedestrian plans, and relevant studies. The primary approach to analyzing the documents was through various keywords which were used to search and extract relevant sections and passages.

The document analysis providing supporting evidence regarding future implementation strategies and policies, which acted as supplementary sources of information to the audit. It also provided an understanding about the various components of the pedestrian environment that the audit may have missed or overlooked, such as social or environmental factors. Additionally, the documents were important when analyzing data and aided in the refining of recommendations. All the documents that were analyzed are described in Table 2 below.

<table>
<thead>
<tr>
<th>Document(s)</th>
<th>Laurier Avenue</th>
<th>Union Street</th>
<th>St. George Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Official Campus Master Plan</td>
<td>-Official Campus Master Plan</td>
<td>-St. George Street Revitalization Study</td>
<td></td>
</tr>
<tr>
<td>-King Edward Precinct Study</td>
<td>- City of Kingston Official Plan (OP)</td>
<td>-University of Toronto Campus Master Plan</td>
<td></td>
</tr>
<tr>
<td>-City of Ottawa 2013 Pedestrian Plan</td>
<td></td>
<td>-City of Toronto Official Plan (OP)</td>
<td></td>
</tr>
<tr>
<td>- City of Ottawa Official Plan (OP)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4:  
Introduction of Case Study Campuses and Policy Analysis

The purpose of this chapter is twofold. Firstly, it provides an introduction to, and rationale for choosing, the three campuses that were examined. Secondly, it presents findings from an analysis of documents of critical importance research project.

4.1 Rationale for the Choice of Campuses

All three university campuses that were selected for this study are located in the province of Ontario. Eligible study sites were restricted to Ontario to ensure similarities in climate and provincial policy context, and to make data collection more feasible. Once the pool of potential sites was limited to Ontario, careful consideration was placed on two factors. Firstly, selected campuses chosen must be located in, or very close to, the downtown core of the city. Secondly, selected sites must have a major thoroughfare or collector road that traverses the campus, which would serve as the main focus of the study. These factors were important because they would ensure that there were high pedestrian and vehicle volumes, which was important when assessing the walkability of each street.

Based on the criteria, the most suitable sites to study for this project were determined to be the University of Ottawa’s Laurier Avenue (Figure 4.2), Queen’s University’s Union Street (Figure 4.3), and the University of Toronto’s St. George Street (Figure 4.4). Although all of these streets function as collectors that connect surrounding areas to the downtown core, and each facilitates high levels of pedestrian volume, they also possess key differences in physical and streetscape qualities and pedestrian features. These variations lay the foundation for the comparisons and recommendations that were formed through this study.

4.2 Context

4.2.1 University of Ottawa

The University of Ottawa campus is located in the north eastern part of the city. It stretches from Mann Avenue to Daily Avenue and is bounded by Nicholas Street and Henderson Avenue, as illustrated in Figure 4.2 below. Because of the university’s close proximity to the downtown
core, high levels of both foot and vehicle traffic is expected to pass through the university, especially on the study street.

Laurier Avenue connects the heart of Ottawa’s downtown in the west to the Sandy Hill neighbourhood in the east. Between Bronson Avenue and Lyon Street North, Laurier Avenue consists of primarily high-rise residential apartments. Continuing east beyond Lyon Street, it is home to various federal and municipal government offices, including the federal Department of Finance, Ottawa Public Library, City Hall, and Confederation Square. Laurier Avenue then crosses the Rideau River and passes the Department of National Defense Headquarters, before bisecting the University of Ottawa campus. East of the campus, Laurier Avenue transforms from education institutions to almost exclusively low-density single detached and multi-unit residential properties in the Sandy Hill neighbourhood. Though Laurier Avenue does not offer a wide variety of restaurants and shops, it is a common destination for tourists year round, given the abundance of nearby historic architecture provided by Parliament and other government. For the purpose of this report it was important to note what exists on both the entirety of the street and within the study site, because of the variety of uses on the entire segment.

4.2.2 Queen’s University

Queen’s University is located in the downtown area of Kingston, Ontario, as illustrated in Figure 4.3 below. It is bounded by King Street West (south), Earl Street (north), Collingwood Street (west), and Barrie Street (east). Like the University of Ottawa, Queen’s University’s proximity to the downtown core lends its major thoroughfare, Union Street, to high levels of vehicle and foot traffic daily.

Union Street is the campus’ most heavily used street (Queen’s University B, 2014), as it is home to many of Queen’s busiest buildings, including Stauffer Library and the John Deutsch University Centre, but also because it serves as a key connecting route for Kingstonians travelling between the west end of the city and the downtown core. The entirety of Union Street extends from Barrie Street in the east, and heads southwest where it will eventually merges with King Street West (Figure 4.3). With the exception of a small portion of Queen’s University’s west campus location that abuts Union Street, the segment of Union Street from King Street
West to Albert Street, consists primarily of single detached and multi-unit residential properties. From Albert Street to Barrie Street, the land uses along Union Street are primarily institutional, serving Queen’s University’s main campus. Though Union Street itself offers few amenities in terms of restaurants and shops, it offers an array of building types and styles, both on and off the Queen’s campus.

4.2.3 University of Toronto

The University of Toronto (St. George campus) is located in downtown Toronto, Ontario. It is bounded by College Street (south), Bloor Street (north), Spadina Avenue (west), and Bay Street (east), as illustrated in Figure 4.4. Like both the University of Ottawa and Queen’s University, the University of Toronto experiences high levels of both vehicle and foot traffic daily, due to its proximity to the downtown core.

St. George Street is one of the University’s most pedestrian heavy streets, but also serves a high number of vehicle volumes. According to the City of Toronto’s pedestrian and vehicle volume counts, an average of 4,928 pedestrians and 8,622 vehicles use the road daily (City of Toronto, 2011). Like Laurier Avenue and Union Street, St. George Street serves as one of the connecting routes for accessing the downtown. The entirety of St. George Street extends from Dupont Street to College Street, where it becomes Beverly Street. The Annex District portion of the street extends from Dupont Street to Bloor Street West, where the dominant land uses are high-density residential apartments, mixed use, and heavy commercial buildings. Once south of Bloor Street West, the land use becomes exclusively institutional (education) buildings, serving the University of Toronto, as illustrated in Figure 4.1 above.
Figure 4.2: Aerial View of Laurier Avenue Study Area.
Figure 4.3: Aerial View of Union Street Study Area.
Figure 4.4: Aerial View of the St. George Street Study Area.
4.3 Policy Analysis

4.3.1 Laurier Avenue

To address evolving travel patterns on its campus, the University of Ottawa has developed their Campus Master Plan and King Edward Precinct Plan; in addition to this, transportation plans and pedestrian plans have been developed by the city. Since its inception in 1848, the University has grown to 40,000 students (University of Ottawa, 2014). As part of its commitment to sustainability, in November 2009, the University signed a pledge for the Ontario Universities Committed to a Greener World, with the end goal of transforming its campus into a model of sustainability (Council of Ontario Universities, 2009). The University’s major commitment has been to increase the promotion of active transportation on campus.

The consulting company Urban Strategies has been hired by the University to develop the new Campus Master Plan (CMP). Though the plan is under development, the consultants have identified Laurier Avenue as an important district in their plan (University of Ottawa, 2015). In 2003, The King Edward Precinct study was undertaken, which included the area along Laurier Avenue. It focused on creating a new research area at the north edge of the campus and transforming the current area to a mixed use precinct that would serve both the university and the Sandy Hill Community. Through the findings in the study, goals for the new Campus Master Plan were developed. They focussed on preservation of key heritage elements and the integration of a new public realm and pedestrian improvements along Laurier Avenue. Of particular focus in this plan is managing the integration of the campus with the neighbouring communities of Sandy Hill. This aspect was addressed through an intensive consultation process in 2005 that involved community residents, the University, and students which informed detailed criteria for evaluating the overall quality of this district (University of Ottawa, 2015). Overall, this portion of the plan aims to improve the walkability and pedestrian environment of Laurier Avenue within the campus boundaries, while better integrating with the neighbouring Sandy Hill communities to foster a more cohesive district.

The City of Ottawa has also taken steps to address the pedestrian environment of the University of Ottawa campus area in their 2013 Pedestrian Plan (City of Ottawa, 2013). The vision of this plan, as noted by the City, is to “transform Ottawa into a world-class pedestrian city where an equally vibrant and functional pedestrian realm encourages people to walk all year-round” (City
of Ottawa, 2013, P.2). They stress a walkable urban environment using design guidelines that aim to encourage social interaction and spur local economic vitality in the future. The Pedestrian Plan emphasizes the aesthetics of pedestrian space in the physical design of infrastructure, through street-scaping and updating of existing pedestrian facilities. Additionally, an organization of different land uses are encouraged, as it creates a varied and exciting mix of experiences, making walking more interesting and attractive. The pedestrian plan also places prime importance on safety (City of Ottawa, 2013). Generally, environments in which people feel safe and comfortable to walk tend to increase the overall community safety for all. Because of this, the city believes that by creating vibrant, well-lit and highly visible public spaces throughout the city, including the University of Ottawa campus, safety will be enhanced for all pedestrians in Ottawa (City of Ottawa, 2013).

Since 2005, there has been a slight decrease in walking trips in Ottawa, from 12% in 2005 to 9.5% of all trips in 2013 (City of Ottawa, 2013). While the reason for this decline is unclear, it could be partly explained by the City’s investments in cycling infrastructure, which may have encouraged some walkers to cycling. The City hopes that by 2031, the proportion of walking trips will increase to 10% (City of Ottawa, 2013). The City has also noted community development and urban form as key aspects in achieving their walking goals. Therefore, the City has placed emphasis on building new and repairing old roads to accommodate pedestrian activity, and by incorporating more grid style patterns. As the benefits of walkable streets and street networks become more apparent, high quality pedestrian facilities and connections to the surrounding areas will become much more prevalent in walkable developments in the future (City of Ottawa, 2013).

Unlike the City’s average, almost 56% of all trips shorter than 2 km in University of Ottawa area are made by walking (City of Ottawa, 2013). Thus, the recommendations from the City’s Pedestrian Plan, that pertain to this area of Ottawa have focussed more on creating tools to measure walkability and strengthening policies for pedestrians and pedestrian facilities. One such tool, which was developed by the City in 2013, measures the walkability of all areas within the City’s urban boundary. Similar tools to this would help to identify areas in the City whose pedestrian environments need to be updated or improved. The policies set in place in the Pedestrian Plan would ensure pedestrian accessibility, safety, and connectivity to key
destinations, which would include transit hubs, schools, parks, and community amenities. The success of these policies is somewhat dependent on the state of parking within the city. A goal of the City of Ottawa’s Official Plan (OP) is an enhanced pedestrian environment that links individual uses on the site, transit stops and continuous public sidewalks on the adjoining streets, and which is generally distinct from internal vehicle routes (City of Ottawa, 2003). A way this goal can be accomplished is through parking maximums, parking strategies, and reduced on-street parking. The city has noted these aspects in their policies as an approach to creating a stronger pedestrian environment and more walkable streets within the city.

4.3.2 Union Street

Established in 1841, Queen’s is one of Canada’s oldest universities, and is home to 25,000 students (Queen’s University A, 2014). Building on its legacy and history, Queen’s is looking to change the nature of its teaching and learning spaces on campus to better support its academic mission and campus life. Within this context of renewal and transformation, the future directions for the campus include the identification of places for growth beyond its main campus. Additionally, the provision of a development framework to shape this growth in a way that supports the historic character and improves existing weaknesses of the campus has been emphasized. Ensuring that campus locations are connected, safe, and accessible is a key objective of the University (Queen’s University B, 2014).

From 2012 to 2014, Urban Strategies was contracted by the University to undertake the task of creating a new Campus Master Plan for the University (Queen’s University B, 2014). This new plan for the campus considers existing campus conditions and needs, a campus vision, coordinated planning with the City of Kingston, main campus master plan, west campus master plan, implementation, and design guidelines. For the purpose of this study, the most relevant sections are the coordinated planning and main campus master plan.

Given its importance to both the Queen’s community and to Kingstonians more generally, Urban Strategies placed significant emphasis on improvements to Union Street. As the primary connector of west and main campus and one of the busiest areas for both pedestrians and vehicles, all modes of transportation on Union Street were considered and accommodated in this plan. One of Urban Strategies’ recommendations was the addition of bicycle lanes along Union
Street, which would require the removal of on-street parking. But, since this loss of parking on campus could result in increased on-street parking in adjacent neighbourhoods, there may be challenges with implementing this recommendation (Queen’s University B, 2014). Despite this potential challenge, the plan clearly prioritizes pedestrians, bicycles, and transit activity in any improvements to Union Street (Queen’s University B, 2014).

Figure 4.5: Potential Union Street Segment Cross Section if Changes are implemented

Safety, comfort, and the public realm were also emphasized as aspects that need improvements on Union Street, particularly between Albert and Barrie Street, where the highest volume of pedestrians are. Specific recommendations included more street-scaping and small amenities such as planters or street furniture, to better define the streets edge, create connectivity, and provide visual interest (Queen’s University B, 2014).

Creating a more pedestrian friendly environment is also an important goal of the City of Kingston, as mentioned in their Official Plan (OP). Incorporating a mix of uses that foster pedestrian activity and the design and construction of connected pedestrian pathways for non-motorized vehicles are emphasized numerous times by the City in the plan (City of Kingston, 2013). This is proposed through the “use of streetscape design that coordinates movement of pedestrians, cyclists and transit, and addresses accessibility matters through the application of universal design principles” (City of Kingston, 2013, P.24). In addition, alternative methods of travel are promoted by the City, by placing emphasis on pedestrians, cyclists, transit, and accessibility (City of Kingston, 2013).
4.3.3 St. George Street

St. George Street, though not as busy as neighbouring Spadina Avenue or Bay Street, is a major street in the University of Toronto campus and was the focus in the St. George Street Revitalization study (Transportation Canada, 2005). This study was undertaken by the City to demonstrate that roads could be more than a carriage for cars, but an amenity for both pedestrians and motorists. St. George Street was originally a two-lane boulevard in the affluent Annex district of the city (Transportation Canada, 2005). During the 1940s, the road was widened to four lanes and the University of Toronto acquired many of the homes along the street. By the early 1990’s, this 1.8-kilometre, 14-metre wide stretch of St. George was carrying over 7,300 cars per day, and owing to its proximity to the university, pedestrian and bicycle traffic was also relatively high (Transportation Canada, 1995). The segment of St. George Street from Dupont Street to Bloor Street is a mix of residential and commercial. As St. George Street approaches the campus, it drastically transforms from primarily residential apartments to densely populated commercial uses.

St. George Street looked much different today than it did in the early 1990’s. What pedestrians, cyclists, and motorists see today is a result of a successful partnership between the University, City, and private entities. The St. George Street Revitalization Plan was seen as an opportunity to transform the street from a 4-four lane auto dominated right of way to an amenity for pedestrians and cyclists as well (Transportation Canada, 2005). The objectives of this plan were to calm traffic, increase pedestrian and cycling amenities, and enlarge the existing open green space (Transportation Canada, 2005) and were achieved by reducing the road back to two lanes, implementing more pedestrian crossings, and adding more greenery. As a result of this plan, speeding reduced dramatically, traffic collisions decreased by 40%, bicycle volumes increased by 10%, and the general quality of life improved with the introduction of the greenery (Transportation Canada, 2005). Overall,
the revitalization project created a much more welcoming atmosphere, especially for pedestrians and cyclists.

Though the revitalization project was successful, more could be done to improve the present day walkability of St. George Street. In 2011, the University of Toronto completed their Campus Master Plan for the St. George Campus (University of Toronto, 2011). Among other aspects, this Campus Master Plan focussed on circulation, open space, and accessibility, all of which relate to the walkability and pedestrian environment of St. George Street.

St. George Street is noted in the Campus Master Plan as being important to the overall growth of the campus in the future. To improve circulation, the plan mentions that the opportunity exists for the provision of additional pathways and interior streets to the west of St. George Street, which would allow for finer grained pedestrian routes that will link the existing network of pathways east of St. George Street. Through the St. George Street Revitalization, the University improved the overall streetscape and look; they redesigned St. George with street and sidewalk paving, landscaping, signage, new gates, and improved lighting. This also contributes to the overall safety of the area, as the lights make the street more visible at night and more visually appealing overall. For the future, the University has prioritized safe pedestrian crossings, partnering with the City for further streetscape improvements, and ensuring that new developments provide pedestrian linkages indoors and out. Finally, in keeping with the University’s accessibility priorities, there are likely opportunities for improving St. George Street’s physical design to ensure it is fully accessible (University of Toronto, 2011).

Like the previous two documents mentioned above, the City of Toronto’s Official Plan (OP) (City of Toronto, 2010) has prioritized improving the downtown through transit upgrades and emphasizing walking and cycling. To accomplish this, the City has lowered parking requirements in the downtown, which includes maximum parking limits for new office developments (City of Toronto, 2010). These types of policies have helped to reinforce the expansion of transit and emphasis on walkability. The key components in this plan favour the expansion of transit and the pedestrian environment over road capacity and encourage the development of more mixed use in the downtown (City of Toronto, 2010). In addition, the quality of the design, construction, and maintenance of streets and sidewalks are important
aspects in creating an attractive downtown where pedestrians can be comfortable and safe (City of Toronto, 2010). This is especially important to St. George Street because of its location in the downtown.

After analyzing the documents related to all three campuses, it is apparent that many of the goals and recommendations outlined in each of the Campus Master Plans overlap with the municipal government priorities of the cities in which they are located. This is due to the fact that CMP’s must follow Official Plans, because any sort of development falls under the Planning Act. Overall, all three Universities appear to have placed much emphasis on creating a safer, more inviting, and friendlier pedestrian environments. Through the analysis of audits outlined in the next chapter, the question of whether these goals or aspirations have come to fruition will be addressed.
Chapter 5:
Comparative Evaluation and Data Analysis

This chapter presents and evaluates the results generated from the audits performed using the PEDS tool. The pedestrian environments were evaluated on 36 criteria under the five major themes (Environment, Pedestrian Facility, Road Attributes, Walking/Cycling Environment, and Subjective Assessment). Each section that follows identifies and compares the streetscape features of each street and how they affect the quality of the pedestrian environment, using the PEDS criteria sections; all these streets are discussed within each section. Additionally, grades were assigned for each street for each criteria of the audit. A summary of the key findings and recommendations from this analysis will follow in Chapter Six.

Segments of Laurier Avenue, Union Street, and St. George Street were all observed and audited in the month of January, with very similar weather conditions and temperatures. The audits could not be undertaken at the same time because of the geographic scope of the study; they were, however, all taken at the same time of day (~12 o’clock pm). Details of the street segments are included in Table 3 below and the raw data from the audits are located in Appendix B.

<table>
<thead>
<tr>
<th>Street Name</th>
<th>University of Ottawa</th>
<th>Queen’s University</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>From:</td>
<td>Nicholas Street</td>
<td>Barrie Street</td>
<td>Lowther Avenue</td>
</tr>
<tr>
<td>To:</td>
<td>Russell Avenue</td>
<td>Victoria Street</td>
<td>College Street</td>
</tr>
<tr>
<td>Length(^2)</td>
<td>800 metres</td>
<td>950 metres</td>
<td>1300 metres</td>
</tr>
<tr>
<td>Date/Time</td>
<td>11/01/15, 12:15pm</td>
<td>18/01/15, 12:25pm</td>
<td>25/01/15, 12:05pm</td>
</tr>
<tr>
<td>Weather/Temperature</td>
<td>Cloudy, -6°C</td>
<td>Sunny, -15°C</td>
<td>Cloudy, -13°C</td>
</tr>
</tbody>
</table>

5.1 Environment

The environment of a street can aid in shaping one’s overall perception of a street and the surrounding neighbourhood. In particular, the types of uses that exist along a street significantly influence what activities can occur, thereby shaping the overall quality of the pedestrian environment. The grades for each street in this section are located in Table 4 below.

\(^2\) Distances were calculated through Google maps.
Table 4: Environment Section Grades (A-F)

<table>
<thead>
<tr>
<th>Environment</th>
<th>Union Street</th>
<th>Laurier Avenue</th>
<th>St. George Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses In Segment</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Slope</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Segment Intersections</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

5.1.1 Uses in Segment

Although each street contained a mix of commercial, institutional, and residential, the land uses that dominated were very different on each street. Additionally, the spatial arrangements and quality of uses varied on each street.

Laurier Avenue has a mix of institutional and residential uses that services this area of the University of Ottawa. The portion of the street from Nicholas Street to Henderson Street is predominately institutional with a mix of commercial/mixed use (Figure 5.1), being mostly coffee shops and corner stores. After King Edward Avenue, the uses change from institutional to primarily multi-family and single detached residential units, which were assumed to serve students of the university. There is a small area of commercial in between King Edward Street and Nelson Street and the Angolan Embassy in this area.

Large institutional buildings dominate Union Street, as it runs through the heart of Queen’s University. There is a very small mix of commercial uses, namely a campus pub and a number of coffee shops. It is not until Frontenac Street that the land uses change substantially to predominately single detached residential.

From Lowther Avenue to Bloor Street, St. George Street has a high level of commercial uses, while once past Bloor, there is a very even mix of residential, commercial, and institutional uses that services this portion of the university. Additionally, there are small pockets of green spaces [41]
dispersed along the street. While the types of residential buildings were very similar to all the streets, these buildings were notably larger on St. George, owing to the larger student body at the University of Toronto.

5.1.2 Slope
The only street to exhibit any slope was the stretch of Union Street from Barrie Street to University Avenue, however this added little to the overall streetscape. The grade of this section of the street does not make walking or cycling difficult or strenuous for the majority of the year; however, winter seasons make it slightly more strenuous and it does make for an area of caution, as pedestrians have to be careful not to slip.

5.1.3 Segment Intersections
In terms of the type of intersection, all three streets contain both four way and three way intersections in the segment (Figure 5.2). For the most part, all of the streets contain short blocks with cross streets at every intersection. This make for a much more fluid movement of both vehicle and pedestrian traffic. The four way intersections on each street make for strong connectivity to other streets and increase the overall accessibility to surrounding areas.

5.2 Pedestrian Facility
The pedestrian facility is the foundation upon which all other pedestrian amenities or features are located. The distance from curb, width, material, and presence of obstructions are just a few of
the variables that were audited, as they can affect the quality of the pedestrian environment. The grades for each street in this section are located in Table 5 below.

<table>
<thead>
<tr>
<th>Pedestrian Facility</th>
<th>Union Street</th>
<th>Laurier Avenue</th>
<th>St. George Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of Pedestrian Facility</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Path Materials</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Path Condition/Maintenance</td>
<td>B+</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Path Obstructions</td>
<td>C+</td>
<td>B+</td>
<td>A</td>
</tr>
<tr>
<td>Buffer Between Road and Path</td>
<td>D</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Path Distance from Curb (m)</td>
<td>C</td>
<td>B+</td>
<td>B+</td>
</tr>
<tr>
<td>Sidewalk Width (m)</td>
<td>B</td>
<td>C+</td>
<td>B+</td>
</tr>
<tr>
<td>Curb Cuts</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Sidewalk Completeness/Continuity</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Sidewalk Connectivity</td>
<td>C+</td>
<td>B</td>
<td>A</td>
</tr>
</tbody>
</table>

5.2.1 Type(s) of Pedestrian Facility and Path Material

The primary pedestrian facility on all three streets evaluated was concrete sidewalks, which is a commonly used paving material. The standard type of concrete sidewalks, with cracks every metre (Figure 5.3), was observed on all three streets in their entirety. Some different kinds of texturing existed on all three of the streets, but this only occurred on small pockets of the segments. In addition to this, all of the streets had paths that deviated off of the main segment. For the most part these were all concrete walking paths, but on Laurier Avenue and Union Street, there were a couple cases of pedestrian footpaths that facilitated a moderate amount of foot traffic.

5.2.2 Path Conditions/ Maintenance

Like the path material mentioned in the above section, the quality of the sidewalk itself has an impact on the overall quality of the pedestrian environment. The relatively new sidewalks that run along St. George Street rated in good condition on the audit, as it contained little to no cracks, bumps, or holes; this could be due to the St. George Street Revitalization. In comparison, the condition of the sidewalks along much of Laurier Avenue and Union Street were much less
consistent. Some portions of both streets rated as good while others rated as fair, as they showed significant signs of wear and tear; this was even more apparent along Laurier. Out of the three streets evaluated, Laurier had the poorest quality sidewalk. There were a few noticeable areas along the sidewalk where the concrete was uneven and cracked which, accompanied by ice, could become very dangerous to a pedestrian (Figure 5.4). The poor quality of some of the sidewalk sections on both Laurier and Union might be attributable to inadequate snow removal, which permits a buildup of snow and ice. This poor path maintenance could dissuade pedestrians from using these facilities because of the perceived lack of safety (Figure 5.5).

5.2.3 Path Obstructions
The benefits of a wide sidewalk are greatly diminished with the presence of path obstructions, which take up valuable space and encroach upon a pedestrian’s comfort in the walking environment. As expected, there were a number of obstructions observed on the streets. On Union Street, the most glaring obstructions were the poles scattered along the street that are located in the middle of the sidewalk (Figure 5.6). Most notably, a light pole and the pole that holds up the traffic light at the intersection of University Avenue (at all four corners) are located right in the middle of the path before the crosswalk. These poles become an issue at busier times of the day, as they interrupt the flow of pedestrian traffic.
More transient obstructions, which disrupt flow and cause congestion, were observed, including cars and delivery trucks parked on the sidewalk, along with people lined up and waiting for food from food trucks. Lastly, the snow in the winter acts as an obstruction as well because it discourages people from walking. This notion of snow acting as an obstruction can also be applied on Laurier Avenue, as there were segments of the study area in which piles of snow had been pushed onto the sidewalk by street cleaning. St. George Street, in contrast, did not possess any path obstructions, as all of the pedestrian amenities on the sidewalk did not encroach on the portion dedicated to pedestrians.

5.2.4 Buffers Between Road and Path

Buffers on public sidewalks can provide an effective separation between vehicle and pedestrian traffic, adding an extra layer of safety for people using the street. Although some buffers may be considered an unsightly part of a streetscape, in the right application, they can provide an effective separation between vehicle and pedestrian traffic. While all three of the observed streets had some sort of buffer that separated vehicle flow and pedestrians, they differed in the magnitude and extent of these buffers. By far, Union Street had the least variety of buffers; parallel parked cars were the most common buffer along Union Street, as there is no landscaping, fencing, trees, or grass that acts as a partition. The parking buffer, however, is consistently present along Union between University and Barrie Street, as this is a very popular place for people to park at Queen’s, as illustrate in Figure 5.7.
Beyond this portion of the street segment, there are no buffers that exist for the majority of the year, while a snow bank serves as a buffer in the winter months.

Laurier Avenue has more variety of buffers on the street than Union. Like Union, Laurier has cars parked on the street that act as buffers; however the amount of cars that line the street is much less. This may be attributable to the fact that the maximum amount of time allotted to each car is one hour, and in some cases, 15 minutes. Trees and grass provided other buffers on Laurier. For the entirety of the study area, there is a ~1.5 metre wide portion of grass that followed the sidewalk on the street side, as illustrated in Figure 5.8. This grass acts as a buffer between traffic flow and pedestrians. In addition to this, every 10-15 metres there are trees that are planted in the grass area. This feature not only improves the aesthetics, it also strengthens the quality of the buffer on Laurier. Lastly, like Union, snow that accumulates helps to provide an extra divider between the street and sidewalk.

Out of the three study areas, St. George Street demonstrated the most variety of buffers that separated the sidewalk from the street. It exemplified almost every criterion given in this section of the audit tool, including trees, landscaping, grass, and cars. As mentioned before, this could be due to the St. George Street Revitalization, but great effort was put into selecting elements that are durable and capable of withstanding significant wear and tear while providing for a multitude of uses. The best observed example of this type of multiuse, as illustrated in Figure 5.9, is how the grass, landscaping, and trees are surrounded by rising flat concrete. Not only does this act as a buffer between the sidewalk and street, it also provides a place for people to sit down. These ~14 metre
buffers line both sides of the street for the entire segment. The high number of uses on the sidewalk could be interpreted as a hindrance, as the amount of amenities on the sidewalk might limit the amount of room for walking. This criterion of sidewalk width will be explored in section 5.2.6.

5.2.5 Path Distance From Curb

Similar to buffers, the distance between the road and the sidewalk can create separation between flowing traffic and pedestrians. Out of the three streets, Union was the only one to have sidewalks that were primarily right next to the curb, with no distance in between. In the case of Laurier Avenue, there are small portions of the segment where the sidewalk is right up against the curb; however, for the most part, the entire segment had sidewalks that are a maximum of 1.5 metres from the curb. This is due to the almost continuous strip of grass, as mentioned in section 5.2.4, which follows the sidewalk from the beginning of the study area til the end. Like Laurier, the distance between the curb and the sidewalk on St. George Street stays primarily a maximum of 1.5 meters on the northbound side. This is quite different from the southbound side where, for the most part, there are large portions of the sidewalk that are at the edge of the street. In addition to this, there is more than a 1.5 metre distance for small portions of the street, which occurs at various times during the segment.

5.2.6 Sidewalk Width

In addition to measuring the path distance from the curb, observations were made concerning the width of the sidewalk. This is important because the width of the sidewalk affects pedestrian comfort, perception of safety, and the overall quality of the pedestrian environment. In consulting the municipal standards for each city, they showed that each street had sidewalk width minimums. For Union Street, the minimum was 1.8 metres (City of Kingston B, 2013), for Laurier Avenue the minimum was 1.8 metres (City of Ottawa, 2006), and for St. George Street the minimum was 2.1 metres (City of Toronto, 2014). The sidewalk widths along Union Street ranged from 2.5 metres (8 feet) to 9 meters (30 feet). Overall, the majority of the sidewalk widths on Union Street were between 2.5 metres and 4 metres (8-13 feet). The widths of the sidewalks along Union Street could be wider, but because the small number of path obstructions occurs on the wider portions, foot traffic is able to flow with minimal congestion.
In contrast, Laurier Avenue’s sidewalks measured between ~1.8 metres and 2.5 metres (5-8 feet) wide. Unlike Union, there are no portions of this street where the width of the sidewalk deviates from the above range, which means a consistently narrow path. When busy, this can make for a very unpleasant walking experience, as pedestrians may have to dodge oncoming people.

St. George Street is much like Union Street in that it has a large variation in sidewalk widths. Like Union, the sidewalks are narrower in the residential segments of the street and significantly wider in the institutional segment. For instance, the sidewalk in front of the Arts and Sciences Student Union Building is approximately 14.5 metres (48 feet wide), as illustrated in Figure 5.10, whereas the residential area north of Bloor Street has sidewalk widths approximately 3 metres (10 feet). Once south of Bloor, the width of the sidewalks range from ~3.5 meters to 4 metres (11.5 to 13 feet). Out of all three streets, St. George sidewalks are the most inviting, as they provide the most room for pedestrians to walk in both directions and to stop and sit in certain areas.

5.2.7 Curb cuts, Sidewalk Completeness, and Sidewalk Connectivity

Given the context and scope of the three observed streets, there was little variation in the criteria of curb cuts, sidewalk completeness, and sidewalk connectivity. There were curb cuts at every intersection and the sidewalk was continuous throughout the entire segment at all three streets. Additionally, every cross street had sidewalks that connected to the study streets, with the exception of Union, where there is minimal connection from the eastbound side to westbound side streets (Division, Alfred, and Frontenac Street). The lack of crosswalks along Union Street forces pedestrians to either jaywalk or take an inefficient route to one of the few crosswalks at Barrie Street, University Avenue, Frontenac Street, or Collingwood Street. Because of this, the
level of pedestrian accessibility and street connectivity is not as high as that of Laurier Avenue and St. George Street.

5.3 Road Attributes

The numerous characteristics of a roadway have a significant effect on the quality of the pedestrian environment and overall look of the street. It is a difficult balancing act to accommodate both pedestrians and vehicles on a street; an aspect that many streets fail at accomplishing. The grades for each street in this section are located in Table 6 below.

<table>
<thead>
<tr>
<th>Road Attributes</th>
<th>Union Street</th>
<th>Laurier Avenue</th>
<th>St. George Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition of Road</td>
<td>B+</td>
<td>B+</td>
<td>A</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Posted Speed Limit</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>On-Street Parking</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Off-Street Parking</td>
<td>A</td>
<td>B</td>
<td>C+</td>
</tr>
<tr>
<td>Must you walk through a parking lot to get to most buildings?</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Presence of high/medium driveways</td>
<td>B+</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Traffic Control Devices</td>
<td>B</td>
<td>B+</td>
<td>B+</td>
</tr>
<tr>
<td>Crosswalks</td>
<td>C+</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Crossing Aids</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Bicycle Facilities</td>
<td>B+</td>
<td>C</td>
<td>B+</td>
</tr>
</tbody>
</table>

5.3.1 Condition of the Road

All three of the streets evaluated had roads that were in good condition, with few bumps, cracks, or holes. The road surface of St. George Street was in excellent shape, which can be attributed to its relatively recent revitalization. Similarly, the road surfaces of Union Street and Laurier Avenue looked to be well taken care of, as there were minimal areas of bumps and cracks that would have minimal effect on drivers and no areas that needed to be repaired. Moreover, all three streets exemplified clearly visible lane marking with minimal damage to them. Of note however was the poor condition of the bike lanes on Union Street; medium sized potholes were prevalent, and make for a very unsafe environment and unpleasant ride for cyclists.
5.3.2 Number of Lanes

Much like how sidewalk width affects the comfort of the walking environment, the number of lanes on a roadway is just as significant when evaluating the pedestrian environment of a street. When evaluating the minimum and maximum number of lanes that a pedestrian is forced to cross on the three study streets, only vehicle travel lanes were considered. In addition, the approximate distance in metres was taken. These numbers are illustrated in Table 7 below.

<table>
<thead>
<tr>
<th></th>
<th>Union Street</th>
<th>Laurier Avenue</th>
<th>St. George Street</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum # of Lanes</strong></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Maximum # of Lanes</strong></td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Approximate Distance</strong></td>
<td>6.6m to 15m</td>
<td>8.6m to 14.7m</td>
<td>6.1m to 9.1m</td>
</tr>
<tr>
<td></td>
<td>22 feet to 49 feet</td>
<td>28 feet to 48 feet</td>
<td>20 feet to 30 feet</td>
</tr>
</tbody>
</table>

For the most part, both Union and St. George Street are two lane roads. The only time they increase to their maximum number of lanes is at intersections when there are left turn lanes. It is at these intersections when the distance increases to the maximum. This is in contrast to Laurier Avenue where the street is primarily three lanes in the university area, which then decreases to two lanes in the residential area. Despite this, the average distance only marginally reduces. Laurier Avenue grows to four lanes at intersections and when bus lanes are added at the intersection of Laurier and Nicholas Street. On all three of the streets, there are both designated bike lanes and parking spaces along the road that were not taken into consideration when measuring the approximate distances a pedestrian must travel to cross the road. This will add to the distance at some points of the roads as, at certain times of the day, pedestrians will be forced to cross an extra lane to cross the street (whether it be a bike lane or designated parking lane). Overall, all three streets do not encourage pedestrians to cross the road at non-designated crossing areas.

5.3.3 Posted Speed Limits

The speed at which the traffic is moving is equally important to the width of the street and the number of lanes it takes to cross when assessing the quality of the pedestrian environment. The speed limit of any road within a municipality in Ontario is 50 km/h unless otherwise posted (Ontario Ministry of Transportation, 2010). In the case of all three of the evaluated roads in this study, there were posted speed limits. The speed of traffic on Union Street is listed as 40 km/h;
However, the flow of traffic is noticeably faster than this. The City has installed radars to inform motorists how fast they are travelling as a possible means of slowing down the traffic (Figure 5.12). However, this does not seem to make a difference as the majority of the observed cars were travelling above the speed limit for the entirety of the road segment. Even when the road became narrower because of cars parked on the street or weather conditions were bad, drivers still chose to disobey the posted speed limit. The only occasions when cars slowdown on Union was when they are forced to because of the presence of jaywalkers.

While Laurier Avenue also has a posted speed limit of 40 km/h, a higher percentage of drivers appear to follow the limit in comparison to Union Street. This could be due to the fact that there is a high turn-over of cars merging into the roadway, owing to the numerous 15-minute maximum zones in close proximity to housing.

Unlike Union and Laurier, the speed limit on St. George Street is 30 km/h rather than 40 km/h. The lower speed limit on St. George is indicative of the higher volume of pedestrian flow on the street and greater number of pedestrian and vehicle control devices. Being that there are more intersections, stop signs, and crosswalks, it does not make sense to have a higher speed limit, because of the “stop and go” nature of the street. This, however, does not mean that drivers follow the speed limit; though it is not as excessive as on Union, drivers still travel 10-15km/h over the speed limit, which affects one’s sense of safety as a pedestrian.

5.3.4 On-Street Parking
The presence or absence of on-street parking a street can have implications on the quality of both the streetscape and the overall pedestrian environment that go beyond just providing parking spaces. Parked cars can act as buffers between vehicle flow and pedestrians, which increases the pedestrian’s perception of safety. All three of the observed streets have traditional on-street parking on some portions of the segments, which are controlled by parking metres or passes.
There is high demand for these on-street parking spaces on all of the streets, and in particular on St. George Street and Laurier Avenue where there are relatively limited supplies of off-street parking facilities. The presence of on-street parking is often an area of contention; institutions, businesses, and Business Improvement Areas are usually strong proponents of on-street parking, while commuter cyclists often oppose on-street parking because of the hazards it can pose (e.g., “dooring”)

5.3.5 Off-Street Parking Lot Spaces
The types of off-street parking options considered in this evaluation were parking structures, underground parking lots, and surface parking lots. Two out of the three audited streets, Union and Laurier, have a significant amount of off-street parking spaces within close proximity to the street. In the case of Union Street, it had the most spaces by far with one large surface, one large underground, and one small surface lot (Figure 5.13). The majority of Laurier Avenue’s off-street parking was located in an underground lot, but there were a few spaces scattered along the segment. St. George had the least off-street parking, with only one lot. Even with this one lot, it is not noticeable when walking up and down the street because of the tree cover and vehicle access to it is from a different street. There are, however, numerous parking lots on nearby streets.

5.3.6 Must You Walk Through a Parking Lot to Get to Most Buildings?
Having parking lots between a building and the sidewalk can create a less pedestrian friendly environment, as cars become the dominating factor in the environment. There were very few instances along any of the three streets where buildings had to be accessed through a parking lot. While two of the three streets have off-street parking spaces/lots, they do not come into play when attempting to access any buildings.
5.3.7 Presence of High to Medium Volume Driveways

Driveways are important factors when evaluating the pedestrian environment of a street because of possible conflicts they pose with pedestrians. For the purpose of this audit, only driveways with relatively higher amounts of traffic were included, whereas residential driveways were not. Given the nature of the roads being on university campuses, there were not any noticeable medium or high volume driveways that were observed which would pose any threat to passing pedestrians. There were areas along Union and St. George Street where there is access for service trucks to drive across the sidewalk, as illustrated in Figure 5.14, but the occurrence of this is rare.

5.3.8 Traffic Control Devices

Traditional traffic signals, including traffic lights or stop signs, are found at every intersection of Union Street, Laurier Avenue, and St. George Street. On all three streets, the traffic signals are fixed time signals which cycle successfully without pedestrians having to push any buttons, with one exception being on Albert and Union Street at Queen’s University. On Laurier Avenue and St. George Street, there are also chokers – narrowed sections of the roadway – which act as a means of reducing speeding and increasing safety on the streets.

5.3.9 Crosswalks and Crossing Aids

The purpose of the crosswalk is to designate an area where pedestrians should cross the street and usually occur at intersections. Three types of crosswalks that were observed were a simple two-line crosswalk (Figure 5.15), zebra crosswalk, and brick crosswalks (Figure 5.16). Zebra crosswalks are usually found near schools and are preferable to two line crosswalks because they are much easier for motorists to see and react to. Brick crosswalks separate the crosswalks from the asphalt, which is both visually appealing and adds to the overall safety of the street and its pedestrians.
Zebra crosswalks were observed only on Laurier Avenue, along with brick crosswalks and two-line crosswalks. In contrast, the Union Street segment was the only one to use just two-line crosswalks. For the most part, the intersections along St. George Street use brick crosswalks, with the classic two-line crosswalks being a secondary option. While Laurier Avenue also had brick crosswalks, the contrast between the asphalt and brick was quite indiscernible, making it less effective than the ones on St. George Street.

In addition to the crosswalks, all three streets have crossing aids to make sure that pedestrians can cross the street safely. Union, Laurier, and St. George all have the traditional pedestrian signal with the white man to indicate that it is safe to cross and the orange hand that indicates that the pedestrian must wait till it is their turn to cross. With the exception of one instance at Grande Allee and Laurier Avenue, none of the observed streets had any audible signals, which is useful for notifying visually impaired or less attentive pedestrians when to cross the street. Union was the only street to use a median, which is located on small segments of the road near the intersection of University and Union. This median is often used by jaywalkers as a place to wait for vehicles to pass until it is safe to cross the street. Both Laurier and St. George have curb extensions at many of the areas with crosswalks. Curb extensions are primarily used to extend the sidewalk, reducing the crossing distance for pedestrians and allowing approaching vehicles to see each pedestrians waiting to cross. This is a traffic calming method that increases the safety of the street for both pedestrians and vehicles. The lack of crossing aids on these streets
demonstrates areas of improvement that could be undertaken to increase pedestrian safety and importance.

5.3.10 Bicycle Facilities

The location and availability of bicycle facilities are important to consider when designing a streetscape. The growing bicycle culture in many Canadian cities contributes to the need for adequate bicycle facilities. Bike lanes and bike racks were the only types of bicycle facilities common at all three of the streets. The most frequent types of bike racks observed on each of the streets are small coil racks, as illustrated in Figure 5.17, that are only able to accommodate up to two bikes. Union and St. George Street had multiple types of racks; in addition to the type noted above, they offered the more traditional type of bike racks (Figure 5.18) located on multiple portions of the street.

Given the type of climate and weather in all three cities, it was not surprising to see the majority of the bike racks empty; however, it was surprising to not see covered bike racks, especially on Union and St. George Street, because of the amount of bike racks they offer. On Laurier Avenue, there were minimal bike racks near the campus and none in the residential portion of the segment. Because of this, cyclists are forced to lock their bikes up to trees and fences, which detract from the aesthetics of the street.

The presence of bike lanes on each of the streets promotes a safer environment for cyclists because they do not have to compete with motorists for space on the road. When there are no bike lanes on streets, cyclists are forced to share the road between moving traffic and parked
vehicles, which creates hazards to bicyclists as they are forced to manoeuvre between opening car doors and moving traffic. All three of the streets have some roadway dedicated to bike lanes. In all three instances, the bike lanes are denoted by the typical white line approximately 1.5 metres from the curb.

The only exception to this was a small segment on Laurier Avenue, illustrated in Figure 5.19, in which the bike lane was painted green. This is a very good way to indicate bicycle lanes, as it is clearly marks where cyclists should be. In the case of Union Street, the bike lane only exists for half of the segment, due to the presence of on-street parking on half of the segment. This means that cyclists must merge with traffic on the portion of the street east of the Union/University intersection.

5.4 Walking/Cycling Environment

There are a variety of streetscape features that contribute to the overall walking and cycling environment. From the path lighting and trees that line the sidewalk to the types of amenities offered, these different types of elements can provide a multitude of benefits to the overall pedestrian environment of a street. The grades for each street in this section are located in Table 8 below.

<table>
<thead>
<tr>
<th>Walking/Cycling Environment</th>
<th>Union Street</th>
<th>Laurier Avenue</th>
<th>St. George Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway/Path Lighting</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Amenities</td>
<td>B+</td>
<td>B</td>
<td>B+</td>
</tr>
<tr>
<td>Are there any Wayfinding aids?</td>
<td>B+</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Number of trees shading walking Area</td>
<td>C</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Degree of Enclosure</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Powerlines along segment</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Overall Cleanliness/Building Maintenance</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Articulation in Building Design</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Building Setbacks from Sidewalk</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Building Height</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Bus Stops</td>
<td>A</td>
<td>C</td>
<td>N/A</td>
</tr>
</tbody>
</table>
5.4.1 Roadway/Path Lighting

The quality and look of a streetscape can change drastically from day to night. The right kind of lighting plays a key role in the success of this transition from light to dark. Some street lights are designed specifically to shine light onto the sidewalk and pedestrian environment (Figure 5.20) while others are made to illuminate the road surface (Figure 5.21). The right combination of these two types of lighting can create a safe and inviting space for people to enjoy and extend the usable hours of a street.

All three of the streets evaluated provide sufficient roadway lighting that ran the entire length of the segments. The roadway and pedestrian lighting on Union and St. George Street occurred every 20-30 feet and were much more consistent than that along Laurier Avenue where the pedestrian level lighting was more scattered. The various heights of lighting along Union and St. George, coupled with the lights from the buildings, provide a roadway and sidewalk that is effectively lighted and evokes a sense of safety and comfort. In addition to this, security phones attached to the pedestrian level lighting along Union make for an added layer of comfort and safety for pedestrians.

The pedestrian level lights along Laurier Avenue are effective where they are present; however, the lack of consistency in the lighting creates pockets of darkness on the sidewalk. On the western portion of the segment the lack of lighting is made up for by the brightness of the lights that come from the buildings. However, the central and eastern portion of the street is dominated by residential student housing, where there is less light that shines onto the street. This means that the only source of light on the majority of Laurier comes from road-oriented light, which is not bright enough to adequately light both the road and sidewalk. By only providing this road-oriented lighting...
and a small amount of pedestrian level lighting, vehicles are given priority on the street and pedestrians are left with an environment that feels very unsafe and uncomfortable for walking at night.

5.4.2 Amenities
The design, positioning, and frequency of amenities such as benches, garbage cans, public art, and street vendors contribute greatly to the success of a pedestrian environment. Benches, other places to sit, and garbage cans are amenities consistent on all three of the evaluated streets. The only benches along Union and Laurier are the ones reserved for bus stops (Figure 5.22). Other than these dedicated forms of seating, there are no other areas explicitly reserved for pedestrians to sit down. Along both Union and Laurier, there are areas such as stairs and raised concrete where pedestrians could sit down if they needed to, but this is not the primary function. In contrast, St. George has benches designed for pedestrians and their street buffers are multifaceted, as they also act as a place for pedestrians to sit and interact. This provides a variety of seating options for pedestrians that frequent the street. According to public space analysts, specifically William Whyte, movable seating is always the preference; however, due to the nature of the streets being located at university campuses and the volume of foot traffic, the durability of the seating is an area of importance.

Garbage cans are found regularly along all of the streets, usually at the ends of each block and near busy buildings such as libraries. One of the garbage cans along Laurier Avenue was overflowing with a small amount of trash scattered on the ground, but the majority of the garbage cans along all three streets were in good shape and well maintained. This shows that the cans are properly sized for their utility and the amount of pedestrian flow and that the frequency of garbage pickup is effective. Food vendors were a common sight along Union and St. George Street, as they cater to the steady flow of students and staff that frequent the segment of the street.
These types of vendors are important for the pedestrian environment because they entice people to use the street. Despite catering to the same demographic of people, the same cannot be said about Laurier Avenue, which was absent of street vendors of any kind. This could be due to the minimal space to put any sort of vending facilities on the street.

While there was little variety in the types of public amenities along these three streets, these amenities did differ in frequency. The amount of benches, places to sit, and garbage cans along St. George far outnumber both Union Street and Laurier Avenue. If the audit was not counting the bus stop benches along Union and Laurier, there would be almost no benches for public use on these two streets. This is an important area for improvement along these two streets, because without adequate seating, pedestrians using the street are less likely to remain on it.

5.4.3 Are There Wayfinding Aids?
All three streets had a sufficient supply of the traditional street name signs at intersections and signs to denote the name of the buildings along the street (Figure 5.24). In addition, on Union Street, there were transit maps located at each of the sheltered bus stops; this gives both transit users and pedestrians some geographic scope to where they are and how far things are away. These types of maps were absent along both Laurier Avenue and St. George Street.

5.4.4 Number of Trees Shading the Walking Area
Because the audits for this study were undertaken in the winter, the presence of trees was less of a factor because of the lack of blooming and provision of shade. Trees were present along all
three of the streets, with St. George having the greatest density of trees lining the street and Union the least dense. Unlike Union and Laurier, the trees on St. George Street are equally spaced and dense throughout the entire segment. With mostly medium building heights on St. George, the trees are a dominant feature when walking the sidewalk, without being overpowering or unmaintained. Even when there are larger buildings, the casual variation in size is not easily noticeable because of the cover of the trees.

5.4.5 Degree of Enclosure

There are numerous qualities of the built environment that can contribute to and affect the degree of enclosure on a street, which is a strong contributor to a pedestrian’s sense of comfort and safety, and impacts the overall walkability of the street. Included in this are the height and mass of buildings in relation to the size of the street, the density of buildings along the street, and, as mentioned in the above section, the presence of trees.

There was no consistent sense of enclosure along both Union and Laurier. There were areas where the degree of enclosure is high on both streets, but overall there was only a feeling of some enclosure. Though the building heights are quite uniform along both streets, except for few instances of variation, the lack in the density of trees and large open space in between buildings is the largest contributor to the lack in the sense of enclosure along the streets. The presence of this type of open space surrounding buildings on these two streets creates a monotonous and dull pedestrian experience. In comparison, the relative narrowness of the street along St. George, coupled with the density of tree cover, little space between buildings, and uniform building heights gives it a much stronger degree and feeling of enclosure than the other two streets. The greatest feeling of enclosure on St. George Street came from the dense tree canopies that shelter and enclose the pedestrian environment. The literature suggests that the ratio that is ideal for enclosure is 1:2 (Booth, 1990), which supports the notion that St. George has the highest degree of enclosure. It is important to note that there are instances of outliers when it comes to the height of some buildings on each of the streets, which is illustrated in Table 9 below; however, too much weight should not be placed on the outliers when evaluating the sense of enclosure.
Utility poles and power lines are common along all streets, whether they are exposed or underground; nonetheless, the location of these lines and poles can have an effect on the look of a streetscape and, if placed wrong, can negatively impact the walkability.

All three streets have exposed high voltage power lines, poles, and utility boxes. Even though they are located on the street, they do not act as path obstructions or take away from the overall look of the streets, because the trees along all of the streets do an effective job of hiding the lines from pedestrians. The only drawback to having the exposed powerlines is the risk of them coming down in the event of a severe storm. If this occurs, it could greatly affect the walkability, safety, and efficiency of the street, even if only for a small amount of time.

5.4.7 Overall Cleanliness and Building Maintenance

The level of cleanliness and the maintenance of buildings can be a strong indicator of the overall quality of the pedestrian environment and character of the street. There was very little variation in the overall cleanliness on all three evaluated streets. Quite surprisingly, there were no instances of any litter on the street or sidewalk along Union Street, and only small quantities of litter on both Laurier and St. George. The location, frequency, and capacity of garbage cans likely play a role in the level of cleanliness along these streets. The variation between these streets begins to surface when it comes to the building maintenance. The maintenance of buildings along Laurier was not very consistent at the time of the evaluation. The buildings in the western portion of the segment were very well maintained; however, continuing east this...
begins to change. Because most of the residential buildings along the street are occupied by students, not much care is put into maintaining the buildings or the premises. This is in contrast to both Union and St. George Street where both the institutional and residential buildings along the segments were in very good shape and well maintained. When speaking to the maintenance of pedestrian facilities, all three streets do an excellent job of making sure that signs are clear and that any visuals or electronic aspects are easily noticeable for all. This is an important aspect when evaluating the walkability of the pedestrian environment because a dirty or poorly maintained street is uninviting to pedestrians and, in some cases, could be perceived as being unsafe.

5.4.8 Articulation in Building Designs
The level of building articulation along a street is dependent upon how well the building designs and architectural elements fit together to create a unified streetscape. Architectural details and design cohesiveness play a key role in determining the character and atmosphere of a street.

Kingston, Ontario has a rich heritage and this is exemplified in both residential and institutional building designs along Union Street. Despite the mix, all the buildings fit within the existing character of both the street and the city as a whole. Relatively new buildings, such as Stauffer Library, even fit within the character because importance was placed upon preserving the heritage of the school and cohesion. As a result of this, the articulation of buildings along Union is very high (Figure 5.26).

Although each building along Laurier Avenue is unique and has interesting architectural or design elements, when put side by side, the result can appear somewhat mismatched. The variation in design from the west portion to the east portion is vast. While the mix of modern institutional with classic residential risks compromising the degree of building articulation along the street, the mix of designs gives a certain character to the street and has a positive effect on the overall pedestrian environment.
The buildings along St. George Street are quite cohesive which makes for a complementary streetscape. The majority of the buildings are under four storeys (Figure 5.27), with the exception of a few buildings that are quite a bit larger. Although there is also a mix of building styles and architectural details along the street, the repetition of brick mid-rise institutional and residential buildings help to tie the streetscape together and create a pleasant walking experience. Like on Union Street, even relatively new buildings were designed in a way to fit into the existing character of the campus, which also contributes to the articulation of the buildings.

5.4.9 Building Setbacks from Sidewalk and Building Height

None of the buildings on any of the evaluated streets are located at the edge of the sidewalk. Union Street was the only one of the streets to have the majority of setbacks being more than 20 feet from the sidewalk. On the contrary, the majority of buildings along Laurier Avenue have setbacks within 20 feet from the sidewalk. St. George Street has a very good mix of buildings that are both within 20 feet and over 20 feet from the sidewalk. This was to be expected, as St. George has a relatively even mix of residential, institutional, and commercial, whereas Laurier is primarily residential after the institutional buildings end after Henderson Street, and Union is almost exclusively institutional. It is common to see larger setbacks with institutional buildings and smaller setbacks with residential.

The heights of the buildings along a street can play a key role in the look and feel of a streetscape and pedestrian environment. Elements such as the scale of the street, views, and sunshine are all influenced by the heights of the buildings. The heights of the buildings along Union fluctuate from two storeys in the residential segment of the street to eight storeys in the institutional portion. The buildings along Union seem to be proportional to the street and the relative uniformity of the heights creates visual interest because of the size and design of the buildings.
Like Union, the majority of the buildings along both Laurier and St. George range from two to eight storeys. There are a few buildings along St. George Street that are significantly higher than the majority of the others. This is not a bad thing because variation in heights, like on St. George, can also add visual interest. Additionally, taller buildings can act as landmarks for pedestrians unfamiliar with the area. The majority of the buildings along Laurier Avenue are four storeys or below. These low building heights allow for the sun to shine on the street and the relatively small amounts of larger buildings prevent any blockage. This is an aspect that can improve the walkability of the street.

5.4.10 Bus Stops

Bus stops are an important aspect when evaluating the accessibility of a street. Bus stops usually come in three forms: a stop with shelter, a stop with a bench, or a stop with signage only. It was very surprising that there were no bus stops on St. George Street. There are numerous stops on connecting and adjacent streets, but none to be found on this segment of the street. This can be attributed to the fact that the Toronto Transportation Corporation does not go through the university. In comparison to the lack of bus stops on St. George Street, Laurier Avenue is rich with stops. Buses service the entire segment of the street and stops are provided; in total there are 7 bus stops along the 950 metre segment that service pedestrians and are placed a strategic distance away from each other. Despite this, the stops make for an uncomfortable wait, especially in the winter, as none of the stops have shelter (Figure 5.28). A handful of the stops provide a bench, but the majority only have signage. This is an area for improvement, because of the harsh winters in Ottawa.

Union Street was the only street to provide sheltered bus stops for people to use (Figure 5.29). The steel and Plexiglas shelters provide a bench for sitting, shelter from the wind, rain, and snow, and a transit map. With the new stops having an angled roof, the hope is that it will protect
from snow blowing into users face. Overall, it does a very good job of protecting pedestrians and transit users from the elements. Having this type of bus stop is very good for the overall pedestrian environment; however, bus stops are only existent on half of the segment. There are no bus stops east of the Union/University intersection, likely due to on-street parking on this portion of the street.

![Figure 5.29: Shelter seen on Union Street.](image)

<table>
<thead>
<tr>
<th>Table 10: Consolidated List of Grades (A-F)</th>
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<tbody>
<tr>
<td><strong>Environment</strong></td>
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<tr>
<td>Uses In Segment</td>
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<td>Slope</td>
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<td>Segment Intersections</td>
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<tr>
<td><strong>Pedestrian Facility</strong></td>
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<tr>
<td>Types of Pedestrian Facility</td>
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<tr>
<td>Path Materials</td>
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<tr>
<td>Path Condition/Maintenance</td>
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<td>Path Obstructions</td>
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<tr>
<td>Buffer Between Road and Path</td>
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<tr>
<td>Path Distance from Curb (m)</td>
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<tr>
<td>Sidewalk Width (m)</td>
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<tr>
<td>Curb Cuts</td>
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<tr>
<td>Sidewalk Completeness/Continuity</td>
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<tr>
<td>Sidewalk Connectivity</td>
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<tr>
<td><strong>Road Attributes</strong></td>
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<tr>
<td>Condition of Road</td>
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<tr>
<td>Number of Lanes</td>
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<td>Posted Speed Limit</td>
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<td>On-Street Parking</td>
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<td>Off-Street Parking</td>
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<td>Must you walk through a parking lot to get to most buildings?</td>
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<tr>
<td>Presence of high/medium driveways</td>
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<td>Traffic Control Devices</td>
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<td>Crosswalks</td>
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<tr>
<td>Crossing Aids</td>
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<td>Bicycle Facilities</td>
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<td><strong>Walking/ Cycling Environment</strong></td>
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<td>Roadway/Path Lighting</td>
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<tr>
<td>Amenities</td>
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<td>Are there any Wayfinding aids?</td>
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<th></th>
<th>A</th>
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<tr>
<td>Number of trees shading walking area</td>
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<tr>
<td>Degree of Enclosure</td>
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<td>B</td>
<td>C</td>
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<td>Powerlines along segment</td>
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<td>C</td>
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<tr>
<td>Overall Cleanliness/Building</td>
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<td>B</td>
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<tr>
<td>Maintenance</td>
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<td>A</td>
</tr>
<tr>
<td>Articulation in Building Design</td>
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</tr>
<tr>
<td>Building Setbacks from Sidewalk</td>
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<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Building Height</td>
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<td>A</td>
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<tr>
<td>Bus Stops</td>
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<td>C</td>
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<tr>
<td><strong>Overall Grade</strong></td>
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<td>B</td>
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Chapter 6:
Conclusions and Recommendations

Following the analysis of observations in Chapter 4, this chapter presents key findings generated from the audit data and reports on the status of where each jurisdiction is at in terms of improvements to the three streets. Several recommendations are offered to increase the walkability of each street that builds on planned improvements. Lastly, the limitations of this study and future research will be discussed briefly.

6.1 Key Findings from Audits

6.1.1 Union Street

Union Street has a rather attractive streetscape that fosters a pleasurable walking and cycling environment. The building setbacks, building articulation, sidewalk width, street maintenance, street and pedestrian level lighting, and the presence of excellent bus stops are all key elements that evoke a strong sense of safety and comfort for pedestrians, and contribute to the overall walkability of the street. However, the audit tool did reveal several aspects that compromise safety and need improvement. These aspects include creating buffers that separate the sidewalk from the street, strengthening connectivity to the other side of the street, creating designs that will slow down traffic, and implementing more crossing aids. Additionally, the conditions of the bike lanes on Union Street coupled with the speed of traffic and parked cars make for a dangerous cycling environment that only avid risk-taking cyclists would be comfortable using.

6.1.2 Laurier Avenue

While Laurier Avenue has the least attractive streetscape of all three streets evaluated, it offers several features that promote walkability, including buffers that separate the sidewalk from the road, clear and visible signage, numerous bus stops, high connectivity, mixed land use, and the presence of heritage buildings. Despite this, there are definitely some important areas of improvement. The addition of sheltered bus stops, maintenance of path conditions, implementation of more crossing aids, adding more effective pedestrian level lighting, and the incorporation of more bicycle facilities would greatly increase the overall walkability and feeling of safety on the street, especially at night. The street could also be more attractive and safe to cyclists if more bike lanes were incorporated on the street. The fact that vehicles follow the
speed limit, for the most part, makes this a space that could be extremely attractive and safe for cyclists, if proper facilities were provided.

6.1.3 St. George Street
St. George Street was the most attractive street that was evaluated in this study, and at present offers an exemplary pedestrian environment. The highlights of the street include the buffers between the sidewalk and street, the variation in sidewalk width, its high level of connectivity, the high degree of enclosure, aesthetics and building articulation, pedestrian and street lighting, and the walking amenities it provides. The majority of St. George’s weaknesses pertain to its lack of crossing aids and no bus stops along the segment. Because of the high level of connectivity and the volume of pedestrian traffic, more crossing aids would benefit the overall perception of safety on the street. Additionally, the bike lane is squeezed between moving traffic and parked cars, which may reduce the overall feeling of safety for cyclists. Despite this, St. George provides a safe and attractive walking environment for pedestrians.

6.1.4 Planned Improvements to the Three Streets
Chapter 4 analyzed current campus master plans and other documents which noted future changes and recommendations that could enhance the pedestrian environment on each of the streets. Because the campus master plan for Union Street was completed very recently, the recommendations, including those pertaining to pedestrian safety and streetscaping, have not yet been implemented. The Campus Master Plan (Urban Strategies, 2014) does not give a concrete timeline for completion, so it is unclear when these changes will be implemented. When preforming the audit and observing the street, the problems plaguing Union, which were outlined in the master plan, were very noticeable. These problems included streetscaping and creating a more pedestrian friendly environment for walkers, cyclers, and transit users. One of the recommendations in the section below directly corresponds with the campus master plan because of its importance.

Like Union Street, Laurier Avenue has not seen any of the Campus Master Plan (Urban Strategies, 2015) recommendations implemented because it is still in the process of being finalized and has a completion date of the end of 2015. These include connectivity and integration of the University with the Sandy Hill neighbourhood and the pedestrian environment
of the street within the campus boundaries. Despite this, many of the areas of importance highlighted in the City’s Pedestrian Plan (City of Ottawa, 2013) are successful along Laurier, including higher connectivity in the city through public transit. Where the street is particularly deficient at present is in the safety aspects, which will be alluded to in the recommendations section below.

Unlike the two streets mentioned above, the audit of St. George Street suggests that many of the changes highlighted in the University of Toronto’s campus master plan (University of Toronto, 2011) have been successfully implemented. Some of the enhancements on the street include linking St. George Street to adjacent networks, improved streetscapes, and making the street more accessible. Because of the work that has been done to revitalize St. George Street, recommending areas of improvement was difficult.

6.2 Recommendations

6.2.1 Union Street

To create a more inviting and comfortable pedestrian environment that better accommodates the needs of those walking on Union Street, the following recommendations encourage a focus on enhancing the sidewalk environment, measures to slow down traffic, and facilitating a higher level of connectivity on the street.

Union Street Recommendation #1: Enhance pedestrian environment by adding landscape architecture and buffers between the road and sidewalk.

As discussed in section 5.2.4, one of the most noticeable aspects missing from Union Street is the presence of a buffer that separates the road from the sidewalk. Moreover, the street is lacking in terms of landscape architecture. Combining these two pedestrian elements together would solve two problems that are hindering Union Street. Considerations should be placed on designing and implementing a consistent streetscape along Union, with planters and street furniture that make the street

Figure 6.1: University of Toronto landscape architecture and sidewalk buffers. Source: http://data.tc.gc.ca/
more visually appealing and provide a buffer between the street and the road. A great example of this can be found at the University of Toronto. This upgrade will help to increase both the safety and look of the street (Figure 6.1).

Union Street Recommendation #2:
Enhance pedestrian perception of safety by adding speedbumps and/or other traffic calming measures at numerous points on the street.
As mentioned in numerous chapters, the speed of traffic flow on Union Street is significantly higher than posted speed limit. This can and does greatly affect a pedestrian’s perception of safety and could cause a reduction in people that use the street because of fears of an unsafe environment. To reduce traffic speed and promote safer conditions, consideration should be places upon the installation of speed bumps or speed tables (Figure 6.2) at existing intersections of Union Street. Alternatively, because speed bumps and speed tables often anger drivers and cause them to speed even more, changing the road texture, planting street trees, and/or narrowing the roadway are also measures that could be undertaken. These simple implementation measures would reduce traffic speeds to the levels they should be at and would improve the overall pedestrian safety of the street.

Union Street Recommendation #3:
Enhance the pedestrian environment of Union Street by repairing unsafe bike lanes along the segment and making them more visible.
The level of safety for cycling on Union Street is lacking largely because of the condition of the bike lanes where they exist along the segment, which makes for a very unsafe cycling and can deter use. Simple repairs to the cracks and potholes would go a long way to resolving these problems along Union. In addition, because this portion of the road is very worn down, the white lines

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that denote the bike lanes are very difficult to see. Painting these lanes green and adding stencils of bikes would make for a very efficient and economical method of increasing the visibility of the lanes, because they would theoretically be visible longer than simple white lines. Making these changes would ensure that cyclists feel safer on the road and could increase the visual attractiveness of the street.

6.2.2 Laurier Avenue

Of all three streets, Laurier Avenue has the least walkable environment with the fewest pedestrian amenities or positive streetscape features. Recommendations for Laurier Avenue focus on addressing the safety aspects of the street and build upon the features already located on the street. Specifically, the recommendations focus on enhancing pedestrian safety through lighting, improving the already existing bus stops, and an increase in the width of sidewalks along the entire segment.

*Laurier Avenue Recommendation #1: Enhance the safety of the pedestrian environment by adding more pedestrian level lights to the street.*

The presence of lighting has a dramatic effect on a pedestrian’s perception of safety of a street and the usability of a pedestrian environment. As discussed in section 5.4.1, Laurier Avenue was the only segment to have an inadequate amount of pedestrian level lighting on the street; pedestrian lighting focuses on illuminating the path for pedestrians. This affects the level of pedestrian usage of the street, most notably at night, because the unsafe feeling a dark environment evokes. A simple solution to enhancing the safety of the street would be to increase the amount of pedestrian level lights and to add security phones at various points of the segments. These minor enhancements would not only make for a stronger sense of pedestrian safety along the street, it would also contribute to a more comfortable walking experience.
Laurier Avenue Recommendation #2: 
Improve transit comfort through the introduction of sheltered bus stops.
While Laurier Avenue offers a good number of bus stops along the study segment of the street, there is one glaring omission from these bus stops that is particularly important. In cities with winter climates, such as that in Ottawa, bus shelters go a long way to adding comfort for transit users, because they offer protection from the elements. Every observed bus stop along Laurier was missing any sort of shelter. With the high levels of transit usage on a campus, providing sheltered stops is imperative for ensuring comfort, especially during winter months.
In addition, sheltered bus stops often provide a place for pedestrians to sit, which is an aspect that is noticeably missing along Laurier. Adding shelters with benches to all or most of the bus stops along the 950 metre stretch will aid in improving the comfort of the pedestrian environment and making it much more inviting. Providing shelter (Figure 6.5) from the elements for both transit users and pedestrians and offering much needed pedestrian seating would aid in enhancing the level of comfort along the street.

Laurier Avenue Recommendation #3: 
Enhance the pedestrian environment through the widening of the sidewalk along the segment.
In observing all three streets, it became apparent that the narrowest sidewalks are located on Laurier Avenue. As noted in section 5.2.6, the average width of the sidewalks along Laurier average between 1.8 and 2.5 metres, which is consistent throughout the entire segment. Because of the narrowness of the sidewalk, it can become congested at busy periods during the day, which causes an unpleasant walking experience for pedestrians and acts as a deterrent to use the street. Being forced to avoid and side-step oncoming pedestrian traffic is not the most ideal way to walk. A way to alleviate this type of problem would be to widen the sidewalks to a more appropriate width. It is recommended that the sidewalk width be increased by removing on-street parking on both sides of the street at various portions of the segment. At other portions of the street, a reduction in wider grass buffers could aid in accommodating an increase in the width.
of the sidewalk. This streetscape improvement would provide additional pedestrian space and create a much more inviting atmosphere without having a significant effect on the current parking situation at the university or altering the aesthetics of the street. Naturally, removing any sort of parking is always a contentious issue, especially with the presence of businesses; any sort of removal would require additional impact studies and extensive stakeholder consultation. It is important to note that this type of recommendation could be quite costly and would take time and planning.

6.2.3 St. George Street

The St. George Street revitalization has added substantial value to the overall pedestrian environment. Building upon the existing built form and pedestrian environment, the changes to the streetscape addressed many pedestrian concerns that were highlighted prior to the revitalization. That being said, there are still a few minor areas of concern regarding the quality of the pedestrian environment, specifically related to pedestrian crossing aids and wayfinding aids to nearby transit options.

**St. George Street Recommendation #1:**

*Enhance the pedestrian environment through incorporation of more crossing aids.*

A successful pedestrian environment should offer effective means for pedestrians to cross the street. Though St. George Street does offer a few crossing aids, there are others that could be introduced, which could make for an even safer and efficient walking experience. Because of the very high volume of foot traffic on St. George Street, having more crossing aids is important for ensuring that pedestrians can cross the street safely and that vehicle drivers recognize that pedestrians are prone to crossing the street. It is recommended that pedestrian crossing warning signs and flashing warning lights be incorporated on the street, as a means to increase the overall pedestrian safety. Moreover, on some points of the road, the brick crosswalks blend into the colour of the asphalt on rainy and icy days. This should be seen as a safety hazard, as drivers may not recognize that there is a crosswalk ahead. To combat this, it is recommended...
that all brick crosswalks be made more visible for bad weather conditions. These changes will both enhance the overall safety of the pedestrian environment and improve the visual appearance of the road.

**St. George Street Recommendation #2: Introducing wayfinding aids to nearby points of interest and transit options to enhance the overall walking environment.**

As discussed in section 5.4.3, wayfinding aids are a streetscape feature that can contribute comfort and a feeling of safety to the walking environment. St. George Street does offer a few wayfinding aids, including building and street signs. Most people that use the street frequently are not in need of these aids, but for those who are not familiar with it, wayfinding aids are important tools to enhancing their feeling of comfort and safety. Because of the streets location and the extensive transit options that the city provides, it is recommended that maps with points of interest and nearby metro and bus stops be placed at strategic locations along the street. This type of wayfinding aid will help people who are unfamiliar with the street to feel more comfortable exploring the downtown area without having to use their phones and, in often cases, disrupt the pedestrian flow. With a consistent wayfinding system like this along St. George, navigating adjacent neighbourhoods becomes easier and thus more comfortable.

### 6.3 Limitations and Future Research

The objective of this study and report was to evaluate the physical and perceptual qualities of the pedestrian and streetscape environments of three inner city Ontario university campus thoroughfare streets and make recommendations on how each could be made more walkable through design. The methods used to accomplish this study included the PEDS audit tool, observational analysis, and document analyses.

The audit included 36 evaluation criteria, which helped guide observations and provided a framework to conduct a comparative evaluation. This particular audit tool focused principally on
the physical streetscape features, which were theorized to have an influence on walkability. Because the tool was made to be manageable for researchers, it excludes many other social, spatial, and environmental factors that influence walkability. This being said, the intent and objective of both the research and audit tool was to assess the physical design of the streets. Consequently, in the overall scheme, the audit tool was an efficient and effective tool to examine this aspect of walkability. To perform a more comprehensive and thorough examination of a streetscape environment and the determinants of walkability, additional evaluation criteria that capture the more social elements of walkability would need to be included in the audit tool.

After the analysis of the walkability audit outcomes, some limitations of the audit tool emerged. It became clear that, when undertaking the audit, more detailed explanations of audit criteria could have improved both the consistency and overall effectiveness. Two examples of this include slope and posted speed. For the slope criteria, approximate grade percentages would be more useful than the current options. For posted speed, it may be more appropriate to observe the operating speed of vehicles, rather than the posted speed. This would provide a more reliable and realistic measure of how fast traffic flow is on the street.

Limitations were also present with the method of analysis, which was exclusively qualitative and relied on the observations of a single researcher to both perform the audit and formulate conclusions. Some of the evaluation criteria were highly subjective, including conditions of the paths, cleanliness, articulation, and maintenance. Multiple auditors would have helped to minimize subjectivity and researcher bias, while offering numerous perspectives on the same segments that would strengthen the reliability of the evaluation and analysis. Comparable studies in the future could also benefit from incorporating a quantitative component into the design and analysis. Certain criteria in the PEDS audit tool, such as slope, width, and building height, lend themselves to a more quantitative approach.

Comparable studies in the future could also benefit from different data collection periods, in which streets are audited at multiple times of the year to see if there is any change in the outcomes. This would both add a much more comprehensive dynamic to the observations and would expand the scope of the analysis. While a change in seasons may have a minimal effect
on physical features in some places with temperate climates, seasonality is definitely relevant to streets audited in this study.

Lastly, because the recommendations were based on information obtained from thoroughfares at universities in three inner city locales in Ontario, this study has limited generalizability. The findings and specific suggestions/recommendations in the report are most applicable and relevant to the three case study streets and caution should be exercised when attempting to transfer lessons to other contexts. Recommended improvements to one street may not be suitable or practical on another street, despite their proximity to one another or their geographic scope. Specific recommendations that may not be generalizable elsewhere include the implementation of speedbumps or other traffic calming measures, the addition of bike lanes, the use of landscape architecture as buffers between the road and sidewalk, and the widening of sidewalks.
References


# Appendix A – Audit Tool

<table>
<thead>
<tr>
<th>Segment Number</th>
<th>Date</th>
<th>Study Area</th>
</tr>
</thead>
</table>

## Segment Type
- Low volume road
- High volume road
- Bike or Ped path – skip section C

## Environment
1. Uses in Segment (all that apply)
   - Housing - Single Family Dwellings
   - Housing - Multi-Family
   - Housing - Mobile Homes
   - Office/Institutional
   - Restaurant/Café/Commercial
   - Industrial
   - Vacant/Undeveloped

2. Stops
   - Flat
   - Sight hill
   - City block

3. Segment Intersections
   - Segment has 3 way intersection
   - Segment has 4 way intersection
   - Segment has other intersection
   - Segment deadends but path continues
   - Segment deadends but no intersections

4. Pedestrian Facilities (skip if none present)
   - On-street parking (if pavement is marked, check only if cars parked)
   - Parallels or Diagonals
   - Off-street parking lot spaces

5. Type(s) of pedestrian facility (all that apply)
   - Footpath (worn dirt path)
   - Paved Trail
   - Pedestrian street (closed to cars)

6. Path condition/maintenance
   - Poor (many burns/cracks/holes)
   - Fair (some burns/cracks/holes)
   - Good (very few burns/cracks/holes)

7. Path obstructions (all that apply)
   - Poles or Signs
   - Parked Cars
   - Greener
   - Garbage Carts
   - Other

8. Buffer between road and path (all that apply)
   - Fence
   - Trees
   - Hedges
   - Landscape
   - Grass
   - None

9. Path distance from curb
   - At edge
   - < 5 feet
   - > 5 feet

10. Sidewalk width
    - < 4 feet
    - Between 4 and 6 feet
    - > 6 feet

11. Curb cuts
    - None
    - 1 to 4

12. Sidewalk complianc/continuity
    - Sidewalk is complete
    - Sidewalk is incomplete

13. Sidewalk connectivity to other sidewalks/crosswalks
    - Number of connections

14. Condition of road
    - Poor (many burns/cracks/holes)
    - Fair (some burns/cracks/holes)
    - Good (very few burns/cracks/holes)

15. Number of lanes
    - Minimum # of lanes to cross
    - Maximum # of lanes to cross

16. Posted speed limit
    - None posted
    - 1 mph

17. On-street parking (if pavement is marked, check only if cars parked)
    - Parallels or Diagonals

18. 24. Bicycle facilities (all that apply)
    - Bicycle route signs
    - Striped bicycle lane designation
    - Visible bicycle parking facilities
    - Bicycle onramping
    - No bicycle facilities

19. 25. Roadway path lighting
    - Road-oriented lighting
    - Pedestrian-scale lighting
    - Other lighting
    - No lighting

20. 26. Amenities (all that apply)
    - Public garbage cans
    - Benches
    - Street vendors
    - No amenities

21. 27. Are there wayfinding aids?
    - Yes
    - No

22. 28. Number of trees shading walking area
    - None
    - Very few
    - Some
    - Many/Dense

23. 29. Degree of enclosure
    - Little or no enclosure
    - Some enclosure
    - Highly enclosed

24. 30. Powerlines along segment
    - Low Voltage/Distribution Line
    - High Voltage/Transmission Line

25. 31. Overall cleanliness and building maintenance
    - Poor (much litter/graffiti/broken facilities)
    - Fair (some litter/graffiti/broken facilities)
    - Good (no litter/graffiti/broken facilities)

26. 32. Articulation in building designs
    - Little or no articulation
    - Some articulation
    - Highly articulated

27. 33. Building setbacks from sidewalk
    - At edge of sidewalk
    - Within 20 feet of sidewalk
    - More than 20 feet from sidewalk

28. 34. Building height
    - Short
    - Medium
    - Tall

29. 35. Bus stops
    - Bus stop with shelter
    - Bus stop with bench
    - Bus stop with signage only
    - No bus stop

## Subjective Assessment: Segment
- Enter 1, 2, or 4 for 1=Strongly Agree, 2=Agree, 3=Disagree, 4=Strongly Disagree
- Rate attractiveness for walking
- Rate attractiveness for bicycling
- Rate safety for walking
- Rate safety for bicycling

---

Kelly J. Clifton, PhD - National Center for Smart Growth - University of Maryland, College Park
Appendix B – Audit Results

<table>
<thead>
<tr>
<th>A. Environment</th>
<th>Queen's University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses In Segment (All that Apply)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing-Single Family Detached</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing-Multi-Family</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Housing-Mobile Homes</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Office/Institutional</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Restaurant/Cafe/Commercial</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacant/Undeveloped</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Slope</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Slight Hill</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steep Hill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Segment Intersections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segment has 3 way intersection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Segment has 4 way intersection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Segment has other intersection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segment dead ends but path continues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segment dead ends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segment has no intersections</td>
<td></td>
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</table>
### B. Pedestrian Facility

<table>
<thead>
<tr>
<th>Types of Pedestrian Facility</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Street (closed to cars)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Paved Trail</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Footpath (worn dirt path)</td>
<td></td>
<td></td>
<td>✓</td>
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<table>
<thead>
<tr>
<th>Path Materials</th>
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<th>University of Ottawa</th>
<th>University of Toronto</th>
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<tbody>
<tr>
<td>Asphalt</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Concrete</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Paving Bricks or Flat Stone</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Gravel</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Dirt or Sand</td>
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<td>✓</td>
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<table>
<thead>
<tr>
<th>Path Condition/Maintenance</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
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</thead>
<tbody>
<tr>
<td>Good (few bumps/cracks/holes)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fair (some bumps, cracks, holes)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Poor (many bumps, cracks, holes)</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Under Repair</td>
<td></td>
<td></td>
<td>✓</td>
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<table>
<thead>
<tr>
<th>Path Obstructions</th>
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<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Poles or signs</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Parked cars</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Greenery</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Garbage cans</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Other</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<table>
<thead>
<tr>
<th>Buffer Between Road and Path</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Fence</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Trees</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Hedges</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Landscape</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Grass</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Path Distance from Curb (m)</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>At edge</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>&lt;1.5m</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>&gt;1.5m</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sidewalk Width (m)</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.2 m</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Between 1.2m and 2.4m</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>&gt;2.4 m</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Curb Cuts</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>1 to 4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>&gt;4</td>
<td></td>
<td></td>
<td>✓</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Sidewalk Completeness/Continuity</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalk is complete</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sidewalk is incomplete</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sidewalk Connectivity</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of connections</td>
<td>14</td>
<td>18</td>
<td>29</td>
</tr>
</tbody>
</table>

[83]
### C. Road Attributes

<table>
<thead>
<tr>
<th>Condition of Road</th>
<th>Queen's University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor (many bumps/cracks/holes)</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Fair (some bumps/cracks/holes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good (very few bumps/cracks/holes)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Under Repair</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Number of Lanes                           |                    |                      |                       |
| Minimum number of lanes to cross          | 2                   | 2                    | 2                     |
| Maximum number of lanes to cross          | 3                   | 4                    | 3                     |

| Posted Speed Limit                        |                    |                      |                       |
| None Posted                               |                    |                      |                       |
| (km/h)                                   | 40                  | 40                   | 30                    |

| On-Street Parking                        |                    |                      |                       |
| Parallel or Diagonal                      | ✓                   | ✓                    | ✓                     |
| None                                      |                    |                      |                       |

| Off-Street Parking                       |                    |                      |                       |
| 0-5                                       |                    |                      |                       |
| 6-25                                      | ✓                   | ✓                    | ✓                     |
| 26+                                       | ✓                   | ✓                    | ✓                     |

| Must you walk through a parking lot to get to most buildings? |                    |                      |                       |
| Yes/No                                                                 | No                  | No                   | No                    |

| Presence of med-hi volume driveways      |                    |                      |                       |
| <2                                        | ✓                   | ✓                    | ✓                     |
| 2-4                                       |                    |                      |                       |
| >4                                        |                    |                      |                       |

| Traffic Control Devices                  |                    |                      |                       |
| Traffic light                             | ✓                   | ✓                    | ✓                     |
| Stop sign                                 | ✓                   | ✓                    | ✓                     |
| Traffic circle                            | ✓                   | ✓                    | ✓                     |
| Speed bumps                               |                    |                      |                       |
| Chokers or chicanes                       |                    | ✓                    | ✓                     |
| None                                      |                    |                      |                       |

| Crosswalks                                |                    |                      |                       |
| None                                      |                    |                      |                       |
| 1-2                                       |                    |                      |                       |
| 3-4                                       | ✓                   | ✓                    | ✓                     |
| >4                                        | ✓                   | ✓                    | ✓                     |

| Crossing Aids                             |                    |                      |                       |
| Yield to Pedestrian Paddles               | ✓                   | ✓                    | ✓                     |
| Pedestrian Signal                         | ✓                   | ✓                    | ✓                     |
| Median/Traffic island                     | ✓                   |                      |                       |
| Curb Extension                            |                    | ✓                    | ✓                     |
| Overpass/Underpass                        |                    |                      |                       |
| Pedestrian Crossing Warning Sign           |                    |                      |                       |
| Flashing Warning Light                    |                    |                      |                       |
| Share the Road Warning Sign               |                    |                      |                       |
| None                                      |                    |                      |                       |

<p>| Bicycle Facilities                        |                    |                      | ✓                     |
| Bicycle Route Signs                       |                    |                      | ✓                     |</p>
<table>
<thead>
<tr>
<th>Striped bicycle lane designations</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visible bicycle parking facilities</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bicycle crossing warning</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No bicycle facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Walking/ Cycling Environment</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway/Path Lighting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian-oriented lighting</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Road-oriented lighting</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Other lighting</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No lighting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amenities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public garbage can</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Benches</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Water Fountain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street vendors/Vending Machines</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>No amenities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there any Wayfinding aids?</td>
<td>Yes/No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of trees shading walking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>None or very few</td>
<td>✓</td>
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</tr>
<tr>
<td></td>
<td>Some</td>
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<td>✓</td>
</tr>
<tr>
<td></td>
<td>Many/Dense</td>
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<tr>
<td>Degree of Enclosure</td>
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</tr>
<tr>
<td>Little to no enclosure</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Some enclosure</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Highly enclosed</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Powerlines along segment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low voltage/Distribution line</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High voltage/Transmission line</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Cleanliness/Building</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Maintenance</td>
<td>Poor (much litter/graffiti/broken facilities)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Fair (some litter/graffiti/broken facilities)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Good (no litter/graffiti/broken facilities)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Articulation in Building Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little to no articulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some articulation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Highly articulated</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Building Setbacks from Sidewalk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At edge of sidewalk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within 20 feet of sidewalk</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>More than 20 feet from sidewalk</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Building Height</td>
<td>Short</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>--------</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Tall</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bus Stops**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus stop with shelter</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus stop with bench</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus stop with signage only</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No bus stop</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

### E. Subjective Assessment

<table>
<thead>
<tr>
<th>Segment Is...</th>
<th>Queen’s University</th>
<th>University of Ottawa</th>
<th>University of Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>...is attractive for walking</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>...is attractive for cycling</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>...feels safe for walking</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>...feels safe for cycling</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

1 – Strongly Agree  
2 – Agree  
3 – Disagree  
4 – Strongly Disagree
## Appendix C – Horacek Audit Tool

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Standards for Awarding Scores*</th>
<th>Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety criteria</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian facilities*</td>
<td>No permanent facilities</td>
<td>1</td>
<td>No permanent facilities</td>
</tr>
<tr>
<td>Pedestrian/biker and motor vehicle conflict*</td>
<td>High conflict potential: fast moving vehicles, high traffic volumes, or poor visibility for foot or bike traffic</td>
<td>2</td>
<td>Sidewalk on one side of road</td>
</tr>
<tr>
<td></td>
<td>Low conflict potential: no vehicle traffic and good visibility for foot or bike traffic</td>
<td>3</td>
<td>Continuous sidewalk on both sides of road or completely away from road</td>
</tr>
<tr>
<td></td>
<td>Crosswalk quality*</td>
<td>No crosswalk at major intersection</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Crosswalk at low volume intersection</td>
<td>5</td>
<td>Low conflict potential: no vehicle traffic and good visibility for foot or bike traffic</td>
</tr>
<tr>
<td>Nighttime safety features*</td>
<td>No lights or no visible emergency call box</td>
<td>1</td>
<td>No lights or no visible emergency call box</td>
</tr>
<tr>
<td></td>
<td>Dim light or no visible emergency call box</td>
<td>2</td>
<td>Crosswalk, no traffic control (i.e., stop signs or lights)</td>
</tr>
<tr>
<td></td>
<td>Partial light or no visible emergency call box</td>
<td>3</td>
<td>Crosswalk with traffic control or walk signal</td>
</tr>
<tr>
<td></td>
<td>Partial light and visible emergency call box</td>
<td>4</td>
<td>No intersection or crosswalks are clearly marked and traffic controlled</td>
</tr>
<tr>
<td></td>
<td>Well-lit and visible emergency call box</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Path quality criteria</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Path maintenance*</td>
<td>Major or frequent tripping/falling hazards such as cracked or buckled pavement, standing water</td>
<td>1</td>
<td>No tripping/falling hazards</td>
</tr>
<tr>
<td>Path size*</td>
<td>No permanent facilities</td>
<td>2</td>
<td>&lt;3 feet wide or significant barriers to passage</td>
</tr>
<tr>
<td></td>
<td>No buffer from roadway</td>
<td>3</td>
<td>&gt;5 feet wide, barrier free</td>
</tr>
<tr>
<td></td>
<td>No buffer from roadway</td>
<td>4</td>
<td>&gt;4 feet from roadway, not adjacent to roadway</td>
</tr>
<tr>
<td>Buffer zone*</td>
<td>No buffer from roadway</td>
<td>5</td>
<td>Not adjacent to roadway</td>
</tr>
<tr>
<td>Accessible/passable for mobility/impaired*</td>
<td>Completely impassable for wheelchairs (lacks ramps, curb cuts)</td>
<td>1</td>
<td>Inconvenient for wheelchairs or other mobility impaired (lacks handrails on steps)</td>
</tr>
<tr>
<td></td>
<td>Difficult for wheelchairs or other mobility impaired (lacks handrails on steps)</td>
<td>2</td>
<td>Easy access for wheelchairs or other mobility impaired</td>
</tr>
<tr>
<td>Bikeability*</td>
<td>No designated bike lane</td>
<td>3</td>
<td>No tripping/falling hazards</td>
</tr>
<tr>
<td></td>
<td>Designated bike lane shared with parking area</td>
<td>4</td>
<td>Narrow (&lt;3 feet) designated bike lane on road</td>
</tr>
<tr>
<td></td>
<td>Wide (&gt;3 feet) designated bike lane</td>
<td>5</td>
<td>Wide designated bike lane separated from cars on road and walking path</td>
</tr>
<tr>
<td>Terrain*</td>
<td>Very hilly or steps that require extra effort</td>
<td>1</td>
<td>Very hilly or steps that require extra effort</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Moderate hilly that requires some effort</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>Flat or level, easy to walk or ride</td>
</tr>
<tr>
<td>Aesthetic*</td>
<td>Uninviting (presence of construction zones, noise, poor landscaping, no benches or water fountains)</td>
<td>4</td>
<td>Uninviting (presence of construction zones, noise, poor landscaping, no benches or water fountains)</td>
</tr>
<tr>
<td></td>
<td>Uninviting (presence of construction zones, noise, poor landscaping, no benches or water fountains)</td>
<td>5</td>
<td>Uninviting (presence of construction zones, noise, poor landscaping, no benches or water fountains)</td>
</tr>
<tr>
<td><strong>Path temperature comfort criterion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shade*</td>
<td>No shade</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Full shade</td>
</tr>
</tbody>
</table>

*Minor adaptation from Centers for Disease Control and Prevention’s Healthier Worksite Initiative Walkability Audit (Sannerberg et al., 2005).
*Created for this study
*Minor adaptation from Systematic Pedestrian and Cycling Environment Scan (SPACE) (Pihera et al., 2007).
*Scores for each criterion can range from 1 to 6; 1 = unacceptable/inevitable situation that provides poor support for walking and biking; 6 = meets the standard/ideal situation that provides excellent support for walking and biking. Descriptions to anchor the low and high ends of the scale are provided for all criteria. Where feasible, descriptors for intermediate scores (i.e., 2 to 4) are provided. Interrater reliability for criteria ranged from 93% to 97%. 

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Appendix D – Study Sites
Appendix E – Audit Protocol

The following section presents the audit protocol, which provides context for each criteria question on the audit and describes how each is evaluated. When applicable, photographs and diagrams will be included to provide visual reference and assist both the researcher and reader in identifying physical environment features. Researchers should have read and become familiar with the audit protocol prior to conducting the audit; the audit may also be used while on site. Specifics are given about how each criteria question will be evaluated and what measures will be taken during direct observation. This audit protocol is derived primarily from The PEDS audit tool, but also references the codebook from The Irvine Minnesota Inventory instrument.

Section A: Environment

0. Segment Type
For each street segment, observe the level of automobile traffic on the road. Most roads will experience some fluctuations in volume throughout the day; however, this observation is meant to represent the typical volume of traffic. The speed of vehicles should not be taken into account; rather the volume is the important factor.

- **Low volume road**: Vehicle traffic is minimal along the street segment.
- **High volume road**: There is a steady stream of vehicles at any one time travelling through the street segment.
- **Bike or Ped path-(skip section C)**: The path is designed for pedestrians or non-motorized modes of transportation so therefore, no vehicles are permitted.

1. Uses in Segment
For each street segment, identify EVERY USE that is present along the street. Only those types that have direct access, via a driveway, entrance, or walkway, to the street should be recorded.

**Housing-Single-Family Detached**: Houses for one household only, house stands alone. May be rental or owned.

**Housing-Multi-Family**: Houses for two households, houses share at least one wall. May be rental or owned.

**Housing Mobile homes (including manufactured homes)**: Freestanding units, temporary or permanent structures that are constructed elsewhere and driven to site.

**Office**
- **Office**: Includes work spaces that are not primarily oriented to the public, such as administrative facilities. Does not include industrial/manufacturing.
- Service facilities (including insurance offices, funeral homes, dry cleaning, Laundromats, etc.): Includes non-retail, non-financial facilities that may have customers, such as insurance offices, funeral homes, dry cleaning, Laundromats, etc.
- Office/service, other: Includes offices not described above.

**Institutional**
- Religious institution (church, temple, mosque, etc.): Any structure intended to hold religious/spiritual events.
- Hospital, medical facility, health clinic: Includes hospitals, urgent care facilities, and medical centers that serve large numbers of people and that resemble facilities more than offices. Does not include private doctors’ offices.
- Institutional, other: Institutional uses not described above. Does not include office (below).

**Restaurant/Cafe/Commercial**
- Retail stores/restaurant: Includes uses that sell food or other goods or (nonfinancial) services to the public (e.g., delis, restaurants, fast food, coffee shops, clothing stores, etc.)
- Bank/financial service: Includes financial institutions and those that provide financial services to the public
- Hotel/hospitality: Includes hotels, motels, bed and breakfasts, etc.
- Car dealership: Includes places that sell new or used automobiles.
- Gas/service station: Includes places that sell gas and that repair motor vehicles. Includes oil change, brakes, etc.
- Commercial, other: Commercial uses not described above. Does not include offices.

**Industrial**
- Light industrial: Includes uses involved in production of light manufacturing and industry. Typically “clean” industries. Includes auto paint and auto body repair shops.
- Medium or heavy industrial: Includes uses involved in production of heavy manufacturing and industry. Typically less clean industries. Includes chemical plants, oil wells, etc.
- Industrial, other: Industrial uses not described above. Does not include gas or service stations.

**Vacant/Undeveloped**
- Vacant: A building or structure with no occupants or furnishings.
- Undeveloped: A lot or parcel of land that is without any building, structure or improvement

**Recreation**
- Gym/fitness center: Includes public or private gymnasiums or fitness facilities.
- Movie theatre: A building where films are shown to an audience.
- Recreational, other: Recreational use not described above (e.g., pool). Does not include public spaces, above.

**2. Slope**
For each segment, estimate how steep or hilly the street is. No grade calculations are required to determine the slope of the street.
- **Flat**: No distinguishable change in grade is noticeable as you walk along the street.
- **Slight Hill**: A street that has a slight incline, where the change in grade is marginal. The slight incline does not make it difficult to walk up hill.
- **Steep Hill**: A street that has a significant incline, where the change in grade is substantial. The steepness is such that walking or even biking becomes difficult.
3. Segment Intersections
At the end of each street segment, observe and determine the type of intersection. How does the road network connect each street segment with the surrounding streets?

- **Segment has 3-way intersection**: Commonly referred to as T or Y intersections, this type of intersection connects three street segments.
- **Segment has 4-way intersection**: The most common type of intersection where two streets cross one another. This type of intersection is common with a grid street pattern. Variation can exist in terms of the angle in which the streets cross (perpendicular or skewed).
- **Segment has other intersection**: Having 3 or more street segments intersect.
- **Segment dead ends but path continues**: The flow of automobile traffic ends but pedestrians and other forms of transportation can continue via a path or walkway.
- **Segment dead ends**: The path for all forms of movement is terminated at the end of the street segment.
- **Segment has no intersections**: The street segment does not intersect with any other street.

---

Section B: Pedestrian Facility
If there is no pedestrian facility in the segment, skip to Section C: Road Attributes. Assess the type, quality, and physical characteristics of the pedestrian facility that is present along the street segment.

4. Type(s) of pedestrian facility
Identify the type of pedestrian facility that is present along the street segment. Depending on the setting, pedestrian facilities may exist on both sides of the street or only on one side.

- **Footpath (worn dirt path)**: An informal path created by repeated foot traffic straying from the provided path or sidewalk. Evidence of this type of path signals the need to create more formal pedestrian improvements.
- **Paved Trail**: a paved trail is any paved walkway that is not associated with a roadway.
- **Sidewalk**: a walkway will only be considered a sidewalk if it is associated with a roadway.
- **Pedestrian Street (closed to cars):** A street segment that is reserved for pedestrians only and vehicle traffic is prohibited. The entire right of way is designated for pedestrian use.

5. **Path Material** (Select ALL that apply)
For each street segment, identify the material the pedestrian facility is made of. Even if one material is just a patch in the sidewalk, please mark it as well.

- Asphalt
- Concrete
- Paving Brick or Flat Stone
- Gravel
- Dirt or Sand

6. **Path Condition/Maintenance**
For each segment, observe the general condition of the pedestrian facility. Pay attention to the maintenance of the surface material in terms of any signs of damage or poor upkeep.

- **Poor (many bumps/cracks/holes):** A sidewalk will be considered “poor” if a stroller cannot be pushed along the sidewalk without many jarring motions and/or if it clearly needs to be replaced (patches would not be sufficient)
- **Fair (some bumps/cracks/holes):** A sidewalk will be considered “fair” if a stroller can easily be pushed along the sidewalk with few jarring motions to the passenger and/or it only needs patches or other minor repair.
- **Good (very few bumps/cracks/holes):** A sidewalk will be considered “good” if a stroller can easily be pushed along the sidewalk without jarring motions to the passenger and/or it need no repair at this time.
- **Under Repair**: A sidewalk will only be considered “under repair” if there is evidence of work being done to improve the sidewalk. Orange cones are not enough. If construction work is being done adjacent to the sidewalk, blocking it off as a result, it is considered “under repair”.

### 7. Path Obstructions

**NOTE:** An object is only a path obstruction if it severely reduces or completely blocks off the pedestrian facility. Threshold: Could you get by in wheelchair or while pushing a stroller? For this question, you are looking at potential obstructions on ALL pedestrian facilities on the street. In other words, if there are two sidewalks and only one has obstructions, please write down those obstructions.

- **Poles or signs**
- **Parked Cars**
- **Greenery**
- **Garbage Cans**
- **Other**
- **None**

### 8. Buffers between road and path

For each segment, observe the type of buffer, if any, which exists between the pedestrian facility and the road. The level in which a buffer acts a deterrent to pedestrian movement will vary depending on the type of buffer. Some buffers only increase the space that separates the road and the pedestrian facility without preventing movement; Other types of buffers act as a physical barrier to pedestrian movement.

- **Fence**: A solid barrier that is specifically positioned to prevent pedestrians from crossing the street at undesignated crossing points.
- **Trees**: trees are only a buffer if they are part of a landscape/grass buffer or if they occur regularly enough on the street to discourage pedestrians from walking along the roadway. Trees within a grass buffer count as a buffer.
- **Hedges**: 
- **Landscape**: A strip of plants or other greenery between the road and the sidewalk. Can be flush with the ground or in a raised planter.
- **Grass**: A strip of grass along the edge of the sidewalk separating the road from the sidewalk. Often planted in between rows of trees that line the road edge.
- **None**: 

[95]
9. Path Distance from Curb
Measure or estimate the distance of the sidewalk from the edge of the curb. Take into account any of the buffers that were noted in the above question 8.
- **At edge:** The sidewalk is directly next to the curb and in turn the roadway. There is no significant buffer or barrier between the two areas.
- **<5 feet:**
- **>5 feet:**

10. Sidewalk Width
For each segment, measure or estimate the width of the sidewalk from edge to edge.
- **<4 feet:**
- **Between 4 and 8 feet:**
- **>8 feet:**

*Note: For question 9 and 10, a tape would be the best instrument to measure the distance. If no tape measure is available, measure by using your feet and rounding to the next highest integer.*

11. Curb cuts
For each segment, count the number of curb cuts that are included in the pedestrian facility. A curb cut is an inclined section of the sidewalk that makes it at the same level as the road. Curb ramps are designed for the access of wheelchairs and for those with mobility impairments.
- **None:**
- **1 to 4:**
- **>4:**
12. Sidewalk completeness/continuity
This refers to the completeness of the sidewalk WITHIN the segment.
- **Sidewalk is complete**: a sidewalk is complete if it does not have any breaks within the segment.
- **Sidewalk is incomplete**: a sidewalk is incomplete if it ends or has gaps within the segment.

13. Sidewalk connectivity to other sidewalks/crosswalks
The number of connections the segment sidewalk has to crosswalks and other sidewalks. Stop signs at the end of the segment can be treated as a crosswalk. This will be scored as follows:
- At the beginning of the segment, looking backward 180 degrees, +90 degrees and –90 degrees: how many sidewalks or crosswalks are there?
- At the end of the segment, looking forward, +90 degrees and –90 degrees: how many sidewalks or crosswalks are there?
- In the middle of the segment: are how many sidewalks or crosswalks are there?

![Segment 1](image)

**Section C: Road Attributes**

14. Condition of Road
For each segment, observe the general condition of the road. Look for any evidence of unrepaired damage or poor upkeep.
- **Poor (many bumps/cracks/holes)**: the potholes, cracks, etc. present would cause a vehicle driving the segment to rock, dip or otherwise disrupt driving.
- **Fair (some bumps/cracks/holes)**: there are potholes, cracks etc., but not enough to cause problems for a vehicle driving the segment.
- **Good (very few bumps/cracks/holes)**: there are no large potholes or other problems that would cause problems for a vehicle driving the segment.
- **Under Repair**: A roadway will only be considered “under repair” if there is evidence of work being done to improve it. Orange cones are not enough.
15. Number of lanes
Count ALL lanes one would need to cross the road at its widest point along the segment.
- Minimum number of lanes to cross _____
- Maximum number of lanes to cross _____

16. Posted speed limit
Check the “None posted” box unless there is a sign **WITHIN** the segment that displays the speed limit.
- None Posted
- (Km/h): _______

17. On-Street parking
If pavement is unmarked, check “parallel” only if there are cars parked within the segment or if parking signs are present.
- Parallel or Diagonal
- None

18. Off-street parking lot spaces
Count all off-street parking spaces in the segment. Cars in single family home driveways do not count. Only cars in actual parking lots count (apartment complexes, commercial parking, office parking etc.) There must be access to the lot from the segment.
- 0-5
- 6-25
- 26+

19. Must you walk through a parking lot to get to most buildings?
For this question, the origin point of walking to the buildings will be from the sidewalk. If there is no sidewalk, origin point will be the curb of the roadway.
- Yes
- No

20. Presence of med-hi volume driveways
High-medium volume driveways are driveways that often have cars pulling in and out, like commercial driveways or driveways of apartment buildings. Single-family residential driveways are low volume and should not be counted here.
21. Traffic control devices
Count only the traffic control devices within the street segment, not those that are visible but outside the segment.
- Traffic Light:
- Stop Sign:
- Traffic Circle: A raised island in the middle of an intersection designed to slow vehicle traffic and reduce the occurrence of accidents. Triangular traffic control devices can also be counted under this category.
- Speed Bumps: Raised strips along the road surface that act as a traffic calming measure on local roads to slow the speed of vehicle traffic. Sometimes painted orange or marked with triangles to warn drivers of their presence.
- Chicanes or Chokers: Chicanes are a series of narrowing’s or curb extensions that alternate from one side of the street to the other forming S-shaped curves. Chokers are curb extensions at midblock or intersection corners that narrow a street by extending the sidewalk or widening the planting strip.

22. Crosswalks
For each segment, note all marked crosswalks in segment. “Marked” refers to lines on the pavement (but not automobile stop lines) or signs, lights or signals.
- None
- 1 to 2
- 3 to 4
- >4

23. Crossing Aids
Locate and record the presence of any crossing aid devices that are present within the segment.
- Yield to Pedestrian Paddles:
- Pedestrian Signal:
- Median/Traffic Island
- Curb Extension
- Overpass/Underpass
- Pedestrian Crossing Warning Sign: street sign without flashing light. Children at play signs can also be included here. Yield signs for cars do not count.
- Flashing Warning Light
- Share the Road Warning Sign

Source: www.pedbikesafe.org
24. Bicycle facilities
For each segment, observe and record the presence of any bicycle facilities.
- Bicycle route signs
- Striped bicycle lane designation
- Visible bicycle parking facilities: these facilities must be useable by the public, not for private use only
- Bicycle crossing warning.
- No Bicycle facilities

Section D: Walking/Cycling Environment

25. Roadway/Path lighting
For each segment, observe and record the presence of any roadway and/or path lighting.
- No Lighting: there is no artificial lighting in the area.
- Road-oriented lighting: there are public light fixtures that aim light at the road or are very high and illuminate broad expanses.
- Pedestrian-scale lighting: there are public light fixtures that aim light at the walking path.
- Other lighting: lighting from stores, apartments etc. that lights the road and/or pedestrian path.

26. Amenities
For each segment, observe and record the presence of any amenities that are for public use. The amenities must also be visible and accessible from the pedestrian path in order to count - Anything that would be considered an accessory or additional benefit of the sidewalk environment.
- Garbage Cans: only public use garbage cans count. Residential garbage cans do not count.
- Benches:
- Water Fountain:
- Street Vendors/Vending Machines: this includes soda machines, candy machines, public pay phones, mailboxes and newspaper dispensers.

27. Are there wayfinding aids?
For each segment, observe and record the presence or lack of any wayfinding aids. Types of wayfinding aids can include maps, directional signs, or directories of public amenities or attractions.
- **Yes:** A wayfinding aid is a sign identifying the name of the cross streets. Any sign visible from the segment at the pedestrian level counts as a wayfinding aid, even if it is actually located on another segment.
- **No:**

28. **Number of trees shading walking area**
For each segment, observe and record the presence of trees that line the street and/or sidewalk. This type of vegetation in between the sidewalk and the roadway is different than a buffer in that the trees in this section are spaced far enough apart that they do act as a solid barrier.
- **None or Very Few:** the path is not shaded by any trees (or only one tree) along the segment. (less than 25% is covered)
- **Some:** the path is covered between 25% and 75% of the way.
- **Many/Dense:** more than 75% of the path is shaded by trees.

29. **Degree of enclosure**
For each segment, observe the degree of enclosure that is created in the space. Degree of enclosure refers to the edges of a site which define the visual boundaries of an open space. For this question, take into account both the architectural elements, buildings, and natural features (trees, bushes etc.) when evaluating the level of enclosure.
- **Little or no enclosure:** the view from the sidewalk is open in both directions for more than 15 feet for most of the segment. It is a wide open, unconstrained space.
- **Some enclosure:** the view is partially enclosed, but there is still some wide-open spaces.
- **Highly enclosed:** the buildings lining the street are within 10 feet of the sidewalk and there is a cross-sectional design ratio of approximately one (height) to two (width), or less.

30. **Powerlines along segment?**
For each segment, observe the presence and type of powerlines that line the street. Power lines that cross or run parallel to the segment all count in this question.
- **No**
- **Low Voltage/Distribution Line**
- **High Voltage/Transmission Line**

31. **Overall cleanliness and building maintenance**
For each segment, observe the level of cleanliness that is associated with the building and pedestrian facilities that line the street. Leaves, branches, and brush, all count towards the cleanliness based on the amount and if it is clearly visible and in the pedestrian path.
- **Poor:** there is noticeable garbage, graffiti and/or broken glass along the segment.
- **Fair**: there are a few wrappers, or other litter but no graffiti or other garbage evident.
- **Good**: there is no obvious garbage, graffiti, litter or broken glass in the segment.

32. **Articulation in building designs**
For each segment, determine the level of articulation in building design. In this context, articulation in building design refers to the way in which a building ‘reads’ from the street and positively contributes to the overall streetscape facade.

- **Little or no articulation**: the façades of buildings along the segment are unadorned and do not have many window openings.
- **Some articulation**: the façades of buildings along the segment are similar in style and/or are not very ornate.
- **Highly articulated**: the façades of buildings along the segment are complex and varied. Highly articulated does not translate into homogenous building design but rather that the design and composition of each building reinforces the character and continuity of the streetscape.

33. **Building setbacks from sidewalk**
For each segment, observe and estimate the setback distances of the majority of the buildings along the street from the sidewalk.

- **At edge of sidewalk**
- **Within 20 feet of sidewalk**
- **More than 20 feet from sidewalk**

34. **Building height**
Along each segment, note the height of the buildings that represent the dominant building height along the street.

- **Short**: 1-2 stories, except with big box buildings or other buildings with tall floors.
- **Medium**: 3-5 stories
- **Tall**: buildings taller than 5 stories

*Note: Average height is to be measured here, not the maximum or minimum height.*

35. **Bus Stops**
For each street segment, observe the type of bus shelter present on the street.

- **Bus stop with shelter**
- **Bus stop with bench**
- **Bus stop with signage only**
Subjective Assessment Section

Enter 1, 2, 3 or 4 for:
1 = Strongly Agree
2 = Agree
3 = Disagree
4 = Strongly Disagree

Segment…
… is attractive for walking
… is attractive for cycling
… feels safe for walking
… feels safe for cycling

- Response to the “attractive” question should answer the question: “would you want to walk/bike this segment?” This includes finding the area aesthetically pleasing and existence of destinations.
- Response to the “safe” question for walking should take into consideration not only walking along the sidewalk but crossing the street. The administrator should think of walking the segment with a 10 year old child. Would a child be safe walking the segment?
- Response to the “safe” question for cycling should take into consideration existence of a bicycle lane and speed of local traffic. A segment can only score a 1 in this question if the traffic goes below 25 miles an hour or there is a formal bicycle lane present.