Fostering active transportation in school communities:

A literature review and case study of a suburban Toronto high school

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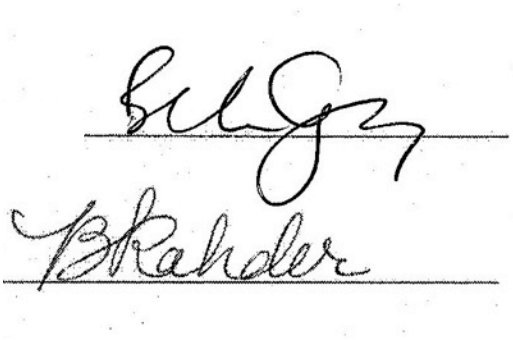

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Foreword

This Major Research Paper is my final submission to complete the Master in Environmental Studies (Planning) degree at York University. This paper links to the Plan of Study that I created to guide my graduate studies at York, which is entitled "Planning routes for sustainable well-being." The Plan of Study has guided and been shaped by my coursework, research, fieldwork, and practical experience obtained while pursuing the Master in Environmental Studies degree.

This research paper is strongly linked to investigating the second component of my Plan of Study: "Routes: streets and other public spaces for mobility and exchange." This paper delves into approaches and practices of designing streets that serve a variety of users, in particular vulnerable users such as children. It also seeks to inform planning practice to ensure it develops transportation networks and urban designs that function in a way that is equitable for all street users (learning objective 2.1). This paper also looks at education programs that teach about modes of active transportation and consultation processes that garner feedback about transportation, in order to encourage the use of healthier transportation modes, facilitate implementation of better infrastructure and policies, increase safety, and enrich education curriculum (learning objective 2.2).

This paper also touches on other elements of my Plan of Study. It focuses on urban regional planning and social policy, the third component of my Plan of Study, by investigating how planners and other city builders can communicate and consult with members of the public, including a variety of individuals and groups, in order to make the process of planning, policy and decision making more equitable, democratic and

responsive (learning objective 3.2). It also looks at community well-being and sustainability, the first component of my Plan of Study, by taking a broad view of some of the social and physical elements of communities that contribute to fostering well-being among different age groups (learning objective 1.1).

Acknowledgements

I would like to extend many thanks to my friends and family for their love, understanding, and support during the course of pursuing my Master in Environmental Studies degree at York University, and especially while writing this paper. Special thanks to my partner Laura, and my cats, Tulugaq and Cleo, who each provided valuable feedback and advice in their own ways during the course of the past two years. I would also like to express my appreciation to all my professors, instructors, and mentors, but especially Barbara Rahder and Laura Taylor for their patience, wisdom and guidance. During the course of writing this paper, I also had invaluable assistance from a number of other people, including Kristin Schwartz, Nancy Smith Lea, Katie Wittman, as well as Matt Sturgeon and a number of staff and students at West Hill Collegiate Institute.

Finally, I'd like to dedicate this paper to the memory of Ryan Dolmage, who I miss very much, and who taught me immeasurable lessons about bicycles, music, trees, books, and the value of a good shamble.

Abstract

Active transportation is a growing area of interest in planning, particularly in relation to young people, who are walking and cycling considerably less throughout North America than in previous decades. Approaches to transportation planning have undergone major shifts in recent decades, moving away from car-oriented plans overseen by rational experts, towards plans that make space for walking, cycling, and public transit, and are informed by a chorus of voices and participants. The increasing prioritization of active transportation modes evolved from advocacy, feminist, and environmental planning theorists and other urban thinkers, and now features prominently in recent planning concepts such as Complete Streets, Walkability, and New Urbanism.

The paper includes a multi-disciplinary review of literature on the subject of active transportation and young people. The first section places the subject matter in a planning context, including both planning theory and practice. The next section investigates various interventions to improve road safety for people who walk and ride bicycles, including lowering vehicle speeds on roadways, and improving pedestrian crossings and bicycle infrastructure. Finally, literature as it relates to young people and active transportation is investigated, looking at particular benefits of active transportation for youth, additional safety issues in regards to young pedestrians and cyclists, and behavioural patterns and potential for changing youth travel behaviour towards more active travel modes.

The information is then applied to a study of West Hill Collegiate Institute, a public high school in suburban Scarborough, part of the amalgamated City of Toronto.

Through a scan of the demographics and current conditions of the school's student catchment area, as well as consultation with students, a picture is drawn of a school and community where people walk only for very short trips, and very small numbers of people ride a bicycle, especially for daily commuting. Students have positive impressions about cycling and walking, but face barriers including distance, safety concerns, topography, and a lack of infrastructure.

Using the information from the literature review, study and student consultation, a plan is developed in order to make active transportation easier, safer, and more welcoming in the area around the school. Recommendations in the plan work outward, starting with the school grounds directly, then considering the immediate neighbourhood nearby, and the outer section of the catchment area. The plan also includes ways to build educational and community programming and policies that support active transportation. While the plan can be used as a guide for future transportation changes in the area, it is also meant to be an consultation and educational tool to spur discussion about how to improve road safety and active transportation in the area under study. Ideally, the plan will be further refined through additional community engagement, and the attention of local governmental agencies. The model used for this plan provides a framework that can be used by other public high schools and their communities to develop plans that focus on youth and active transportation.

1. Introduction

Moving away from car-oriented communities and towards those that foster more sustainable and healthy behaviour has become increasingly emphasized in planning and health fields over recent decades. However, there is a need for more cross-disciplinary data in this emergent area of research, especially in terms of improving coordination across disciplines, and in the highly car-dependent North American context.

Toronto has generally been quite successful in fostering many dense, walkable, transit-oriented neighbourhoods, and has seen a marked increase in cycling and walking trips, especially in the older core of the city. These successes have been in spite of the fact that investments in transit and cycling infrastructure in Toronto lag behind similar cities in North America and Europe. The current boundaries of the amalgamated City of Toronto include many former suburban municipalities that have a built form that is much more sprawling and lower-density that the older city core, creating challenges for shifting away from car-dominated travel and towards more sustainable and healthy modes such as walking and biking.

School travel, meanwhile, has seen a marked increase in car travel, and decrease in walking and biking to school, in Ontario and throughout North America, in recent decades. Ensuring school communities foster active transportation is an important step to help build healthy and sustainable travel behaviour and environmental conditions for future generations. There is, encouragingly, evidence that rates of driving among young people are dropping, and young adults are increasingly choosing more compact and walkable urban communities to live in.

This paper looks at ways to encourage active transportation in suburban communities through planning and education approaches. It examines the effectiveness of factors that can influence school travel behaviour, including educational programs, such as the Bike to School program in Toronto, as well as urban design, planning, and policy changes, such as establishing 30 km/h school zones, traffic calming, and street design. It goes on to focus on the students and surrounding community of West Hill Collegiate, a secondary school in Scarborough, a suburban community within the City of Toronto.

Young people are currently under-represented in planning consultations and decisions about transportation planning and urban design, despite the fact that they are among those most effected by long term planning decisions. By giving youth a greater voice, and encouraging planners, educators, activists, and other community builders to consider youth in their decision making, a healthier and more sustainable future for them and our cities and towns. The research done for this paper explores methods to approach students at public high schools in order to enrich planning and public consultation processes.

The following research reviews literature in planning, public health, engineering, urban design, education, and other fields on the subjects of active transportation and youth. This research is then applied to one particular high school in suburban Toronto and its surrounding student catchment area, including consulting with students, reviewing demographic and transportation information for the surrounding area, exploring current conditions, and developing a set of recommendations for improvements to both the school grounds and surrounding area to encourage active transportation.

2. Research Methods

The research methods for this project involved a review of relevant literature, the selection of a high school on which to focus the project, and the development of an active transportation plan for this school, including consultation with students and staff of the school. These methods were selected in an effort to apply a youth and public education focus to transportation planning, and to investigate the intersectionality between the fields of education and planning to achieve new insights.

The research methods used in this project were designed and shifted in response to the requirements of the public school board, as well as the staff and students at the individual school involved in the project. Working with public agencies such as public school boards can be a complicated and time consuming process for those outside of these systems, and the methods used were meant to facilitate this process. My methods were only partially successful in this regard, as I faced delays in the approval process, and I was limited in the extent I was able to carry out my consultation and collection of data, due in part to delays and necessary reliance on school staff.

The consultation process had mixed success, with the focus group being more successful than the survey in terms of providing input from students. Overall, the general methods I used were successful in that they allowed me to apply transportation planning knowledge through a lens of public education and young people in a way that provided practical suggestions for improvements on a neighbourhood scale and a framework for approaching active transportation and other planning issues that could be applied in a variety of contexts.

2.1 Literature review

The first portion of my research involved reviewing recent literature on active transportation and school travel modes and preferences, with a particular focus on adolescents and high-school-age populations. In order to situate this research in a broader planning framework, I investigated relevant theoretical frameworks, such as feminist, communicative, and environmental planning as these relate to active transportation and young people. My literature review includes studies that investigated and demonstrated the benefits of active school travel in terms of health, social wellbeing, air pollution and wider environmental factors. I also looked at planning, urban design, traffic engineering and public health literature that focused on ways to design and retrofit streets and built form, in ways that support walking and cycling, and to support behaviour change toward these modes.

2.2 Site selection

Initially, I intended to select two or three high schools in Toronto to focus on. Through contacts with Toronto-area non-profit organizations - including Cycle Toronto, Culture Link, and Evergreen, as well as the Toronto District School Board's (TDSB) Eco Schools program - I was able to connect with various schools that were interested in active transportation initiatives. These high schools sought to increase the number of students walking and biking to school, and were in the process of making plans with these non-profit groups and the board to deliver educational workshops and other activities related to biking to school. Many of the schools that had most recently expressed interested in being involved with these active transportation education initiatives were in the more suburban areas of the city. Through my research and contact

with these groups, I found that there was survey data collected from schools in the central, more densely urbanized areas of the city that had been involved with bike to school programming (Wittman, 2014), but none from suburban high schools in Toronto. I decided to focus my school selection on high schools in more suburban areas of the city, further from the core, in order to allow for a comparison with previous data gathered in the core of the city. This allowed my research to more directly focus on the relationship between built form and travel modes.

2.3 Scan of demographics and built form

Through my contacts with Culture Link and Cycle Toronto, I received a list of potential schools that had expressed interest in being involved with cycling education workshops. I did some preliminary research into the demographics and built form of the neighbourhoods around each potential school, with the goal of selecting schools in which these factors could be compared. Demographic information considered included income (median & average, and percentage of low income residents), as well as percentages of visible minorities and those born in Canada. Built form data considered included the percentages of those living in single detached houses or rental units, the walk score, bike score, and transit score of the school (using the walkscore.com website), and a scan of a map of the local area with a focus on bicycle and transit infrastructure. My initial goal was to find two schools with contrasting socio-economic status, as well as contrasting urban form, access to transit and cycling infrastructure, and walkability. I also wanted to focus on schools with a diverse population, and schools in neighbourhoods with middle to lower income, who could most benefit from a shift towards healthier travel modes.

Once I focused my research on West Hill Collegiate, I began to study its student catchment area through a series of site visits, analysis of maps, associated planning documents and legislation, and using information synthesized in the literature review. Using this information, I put together a draft active transportation plan for the area, including proposed cycling and pedestrian infrastructure improvements, policy changes, and improvements to urban design and built form. Elements of this initial plan were used to consult with the school's students and staff to further refine elements of the plan.

2.4 Final site selection

I then began the process of contacting schools to ask if they were willing to be involved in my research, receiving contact information from staff at Culture Link and the TDSB EcoSchools office. I attended a Bike to School leadership camp in March 2015, where I was able to meet many of the teachers who were leading active transportation initiatives at their schools, and speak to them further about my study. There were a few schools that expressed interest in being involved in my research. One school that initially wanted to participate failed to receive approval from their Principal, claiming they were involved in too many research projects that year. Another school offered limited access to a small pool of students, and seemed only partially committed to involvement in the Bike to School program. Staff at West Hill Collegiate Institute in eastern Scarborough expressed the strongest interest, and was most willing to engage a broad cross section of their student body in my research. I eventually decided to focus my research at West Hill Collegiate, as they had the most potential to fulfill the majority of my criteria for the project, and a more in depth study at one school promised to

provide more research value than a cursory glance at multiple schools with mixed data from each one.

2.5 Ethics approvals for research with minors

During the process of selecting the schools that would be the focus of my research, I tried to be diligent in ensuring cooperation from each school's administration and staff, to facilitate administrative approvals through the board, as well as during subsequent consultation with students. In order to administer the survey within schools in the TDSB, I needed to obtain ethics approvals, both through the Faculty of Environmental Studies' Human Participants Research Committee at York University, as well at the TDSB External Research Review Committee. The university ethics approval process was relatively straightforward and well-supported. Approvals through the TDSB, however, were more involved, requiring a detailed application, in addition to a vulnerable sector police records check, and submission of all supplementary materials, such as surveys and permission forms, with nine copies of each delivered to their office. This process was delayed when my initial application was deferred, based on the perceived involvement of CultureLink and the Bike to School program with my research, and the status of their arrangement with the school board. This was eventually resolved in early May, allowing me to fully engage with West Hill Collegiate for the purposes of consultation and research, including beginning distribution of the survey, and contact with students for focus groups.

2.6 Consultation with high school population

Survey

While contacting high schools to be involved in my study, one of my key asks was assistance in the distribution and administration of a survey of a broad cross-section of the student body at each school. A larger set of survey responses would help ensure that the results would more meaningfully represent the travel behaviour, attitudes, and opinions of the student population as a whole.

One of the goals of my study was to compare data to previous studies done by researchers and community organizations at other high schools in Toronto (Wittmann, 2014), so I used many of the same questions as previous studies, and made changes in consultation with these other organizations and groups. Changes to the survey were mostly focused on delving deeper into particular areas of interest, such as how travel behaviour is formed, how it changes over time, and to attempt to answer questions raised by previous surveys.

The survey included questions about current, past, and preferred travel modes, basic demographic information (e.g. gender, grade level, and how long they've lived in Canada), how students make transportation choices (e.g. role of parents, perceptions and barrier to modes of transportation), and other information such as how far students travel to school (see appendix A for the entire survey). Some of the key questions investigated in previous studies were related to how decisions about school travel were made - whether by the student themselves, by their parents/guardians, or as a negotiated decision between the family. This led me to add a question about the travel preferences of the adults in each respondent's family (Question 11). It also made me

wonder about how decisions about travel modes progress over time, so I also added a question asking how respondents have travelled to school in the past, during their elementary school years (Question 9). I wanted to broaden the survey beyond its cycling focus, to look in more detail at perceptions of walking, so I added questions such as: "I feel comfortable walking along streets near my school" (Question 24), and modified other questions about cycling to include walking (Question 34). Proximity to services is an important indicator of walkability and bikability, so I also wanted to get a sense of how easy students felt that it was to access nearby services (Question 41).

Staff members at West Hill Collegiate agreed to help send home consent forms to parents and guardians and collect them from students, and to distribute the survey to all of the grade 9 and 10 physical education and health classes at the school. This process meant that I needed to rely heavily on staff to carry out the majority of the survey process, and I was not able to be directly involved. This process started in early May, and seemed to go smoothly at first, with approximately one hundred surveys distributed to six physical education and health classes. Unfortunately, very few parental consent forms were returned, and response to the survey was much poorer than I'd hoped. Since it was necessary to rely on staff, as a researcher there was little I could do to influence this process and receive a better response. Many of the survey responses I did receive were from the athletic council, a group of students at the school who met regularly to organize events and initiatives at the school, and who were most directly involved in active transportation and other active living initiatives at the school.

Program observations and focus groups

A few cycling workshops were held at West Hill Collegiate in May 2015, organized by the Bike to School program. I observed one of these workshops, which included basic safety and skills lessons, including how to property adjust and fit a helmet, how to ensure a bicycle is in basic working condition (via an ABC quick check), short riding exercises including practicing shoulder checks and riding around obstacles, as well as a ride along quiet local streets in the surrounding neighbourhood. During this workshop, I was able to observe the students' reaction to and engagement with the activities, as well as the students' attitudes about and comfort levels with riding a bike.

I also organized a focus group with members of the West Hill Collegiate athletic council, in order to further investigate student perceptions about school travel, and their ideas for what would improve their local urban environment, beyond what was in the survey. The focus group began by going around the room with students saying how they usually get to school, and the general area where they live. Subsequent questions that guided the focus group discussions included: how their travel changed over time since elementary school, and how they perceive it may change in the coming years; what they enjoyed or did not enjoy about their commute to school; what barriers they faced to walking and cycling; and, what would make it more appealing to walk or bike to school or near their homes (See Appendix B for the full set of focus group questions).

2.7 Analysis of survey results, focus groups, and observations

Upon the completion of the survey, I broke the data from the survey down into separate categories, and analyzed it in the context of other studies and literature in the field of active school travel. I looked for differences and points of comparison between

West Hill Collegiate and data gathered from schools in the more densely urbanized central area of Toronto. My analysis considered my findings through the lens of theoretical planning approaches, as well as ideas in planning about mobility, walkability, and sense of place. I also considered related research within the fields of education, health, and psychology about social interaction, cognition, and human development.

2.8 Summary & conclusion

Information from the consultation with the high school students, including the survey, focus groups, and observations was incorporated into the initial research done about the area to develop a final active transportation plan for the school's catchment area. The final plan suggests a series of improvements based on distance to the school, and prioritized according to: low, medium, and high intervention in terms of cost and extensiveness of changes; the potential effectiveness of the improvements in terms of improving safety and encouraging active transportation modes according to the literature; and, the priorities identified in the consultation process. The final report will be shared with the school's staff and administration, board staff, as well as municipal representatives, in the hopes of influencing decision making in the future. I also hope it will be used as a potential teaching tool to spark discussion and further modifications going forward about fostering sustainable, active modes of transportation at the school and in the surrounding community.

3. A review of literature in fostering active transportation: Planning, road safety, and behaviour change

3.1 Introduction

This section reviews literature on active transportation, particularly in relation to planning, road safety, and young people. Active transportation is associated with a well documented set of benefits in terms of individual as well as wider societal and environmental wellbeing. People who live in neighbourhoods that encourage walking and cycling tend to exhibit higher levels of physical activity, and lower incidences of obesity, diabetes, respiratory and cardiovascular diseases. Walkable and bikeable neighbourhoods have also been shown to help reduce greenhouse gas emissions, noise and air pollution, crime, and inequity, improve social interaction, and demonstrate economic benefits such as increased property values and benefits to local businesses. (Forkes, Smith Lea, & Sztabinski 2010; Roseland 2012; Speck 2013; Toronto Public Health 2012)

Approaches to transportation planning have undergone major shifts over the past 50 years, moving from car-oriented models overseen by rational experts, towards more walking, cycling, and transit oriented models, and with more effort being made to include a multitude of voices and participants in plans. This can be seen in recent planning concepts such as Complete Streets, Smart Growth, New Urbanism, and Transit-Oriented Development. Transportation planning has also seen a greater focus on young people, in response to increasing concerns about youth health and fitness, and

decreasing numbers of young people walking or biking to school, and decreasing independence in play, socializing, and travel for youth.

There are two key reasons parents and young people give for not using active modes for trips to school or other destinations: proximity and concerns about safety. The importance of proximity should be addressed by both planners and school administrators, so that residences and destinations, including schools, are within reasonable walking and cycling distances. Planners and municipal government have a particular role to play to support active travel among youth, by providing safe and welcoming infrastructure for walking and cycling. Educators can work with planners to provide programming that connects students to their communities, teaches students the rules of the road for walking and cycling, basic cycling skills, and helps young people develop healthy habits in engaging in physical activity as part of their regular daily routine.

Given the importance of road safety, the effectiveness of various interventions to improve road safety is investigated and assessed in this section, with a focus on pedestrians, cyclists, and young people. These interventions are organized according to key safety principles for environmental changes to roadways, such as controlling speeds, and separation of pedestrians and cyclists from motor vehicles.

3.2 Active transportation & planning

Active transportation & planning theory

Within planning and urban studies literature, transportation plays a key role in how a city is experienced. Lynch (1960) highlights the importance of paths in how people understand and imagine their cities and neighbourhoods, asserting that “paths,

the network of habitual or potential lines of movement through the urban complex, are the most potent means by which the whole can be ordered" (p. 96).

Throughout the post-war years of the 1950's and 60's, transportation planning, and the paths that ordered the whole, were largely geared towards the automobile, with wide roads and expressways providing routes to car-dependent, low-density housing, malls, and industrial parks (Hodge & Gordon, 2014, p. 109-111). This was in keeping with the rational-comprehensive view of planning in this era, which emphasized promoting economic relations within a capitalist system, and that saw new technology as the way to fix the social problems of cities (Rahder, 2010, p. 124). The car-dominated and pedestrian hostile environment that planning philosophies of this age created was furthered by the economic power structure of the time, including planning boards dominated by those such as "realtors, car dealers, and others with a keen personal interest in advancing auto use, and little thought for long-term consequences" (Kunstler, 2013).

Meanwhile, Jane Jacobs was presenting a different view of transportation that prioritized urban, people-centred paths made for walking through our cities - a perspective that would gain prominence in coming decades. Her seminal book *The Death and Life of Great American Cities* (1961), devotes three chapters to "the uses of sidewalks," highlighting the public space that streets serve. Jacobs notes that "streets in cities serve many purposes besides carrying vehicles, and city sidewalks serve many purposes besides carrying pedestrians" (1961, p. 29). One of three chapters in the book on sidewalks focuses on the use of sidewalks in "assimilating children," in which Jacobs

laments that sidewalks "go unrecognized and unrespected as the uniquely vital and irreplaceable organs of city safety, public life and child rearing that they are" (p. 87).

Jacobs strongly influenced future waves of planning approaches. One of these was advocacy planning, which rejected the view of the planner as an impartial technician, and instead posited a practice that "openly invites political and social values to be examined and debated" (Davidoff, 1965, p. 331). This led to push back against major motor vehicle-oriented transportation projects such as proposed expressways that would destroy existing neighbourhoods. Jacobs herself was involved as an activist in successful fights against expressways in New York City and Toronto (Hodge & Gordon, 2014).

Jacobs' ideas about transportation and planning are also echoed in feminist planning theory, which criticizes traditional planning as a masculine domain, and sees the growth of car-centric suburban development as an expression of male views of "appropriate family living" that denies women access to jobs and transit (Fainstein, 2005). Transportation planning often prioritizes peak hour commutes to work "rather than the erratic movements of women responsible for both domestic duties and paid work" (Saundercock & Forsyth, 1992, p. 50). These assertions are reinforced by findings that women planners are less likely than men to concentrate on transportation in their practice (Rahder & O'Neill, 1998, p. 252). This link between feminism and transportation goes back to the 1890's when bicycles first became popular, and became associated with the suffragette movement, as they allowed women greater independence and mobility, and changed social norms. Susan B. Anthony once said that the bicycle "has done more to emancipate women than anything else in the world" (Bathurst, 2011). Feminist

planning has been a key force pushing transportation planning toward more transit and active transportation oriented approaches.

Environmental planning theory has much to offer transportation planners, as car-centred transportation and land use planning has had serious ecological consequences. Transportation contributes to environmental problems both directly and indirectly at a variety of scales, including effects on climate change, biodiversity, the urban landscape, as well as air, soil and water quality (Rodrigue, Comtois & Slack, 2013). Generally, most transportation planners take a conservationist view of the environment, citing the environmental benefits, for instance, of moving from single-passenger motor vehicle travel to public transit, as this results in less fossil fuel being burned, and cleaner (although not pristine) air. This conservationist approach uses an argument of efficiency, in keeping with the principle of conservation, in which it is believed resources should be used sparingly and efficiently, and an "optimal" level of pollution can be reached (Beatley, 1989, p. 5-8). A preservationist, by comparison, focuses on keeping environmental resources in their present state (Beatley, 1989, p. 5), and thus would plan only for human-powered walking and cycling - although even bicycles use up metals and other natural resources in their manufacture.

History shows us how the urban forms of these two varying ideas of environmental ethics look quite different. Walking cities, that the preservationist might advocate for today, were the major urban form for thousands of years, consisting of "dense, mixed use areas no more than 5 km across." Cities based on transit, before the emergence of the automobile, spread 20-30 km with dense clusters following rail lines and stations (Newman & Kenworthy, 2007, p. 294), and this is the common vision of

conservationist planners today. Meanwhile, few environmental planners today would advocate for much of the dispersed, car-oriented urban sprawl we see today around major cities, although the history of planning shows how this suburban development was the result of Ebenezer Howard's "Garden City" idea of balancing the benefits of the natural world of the country with the amenities and employment of the city (Hodge & Gordon, 2014).

Bioregionalism is an environmental planning philosophy that can help bridge the gap between these different ethics, suggesting that "people should not live the same everywhere," and that connections to and observations of the natural environment and local geography can help people understand how to appropriately use the land (Jacobs, 1995, p. 91-92). Bioregionalism prioritizes the cultural ideas and myths we have around place, and seeks to organize human society "within the ecological capacity of a natural region" (Gray, 2007). The relationship with the earth and geography extends to community relationships, and bioregionalism seeks to "reformulate and re-conceptualize what it means to be a member of a community" (McGinnis, 2000). Walking and cycling can both be ways to gain greater connection to both one's local geography, on a human scale, as well as build community and increase social capital.

This relationship with nature and the environment is central to planning approaches of all kinds, and needs to be approached carefully. Typically, the city has historically been seen as a corrupting influence on people, and conversely "the countryside is the only way to find solitude, innocence, and happiness." This rural tradition is a double-edged sword, as it has helped to show people "the importance of nature and rural ecosystems" (Newman & Kenworthy, 1999, p. 263-4), but such

nostalgia for small towns and open spaces has also been a factor in encouraging suburban sprawl and its associated problems (Beauregard, 2003, p. 71; Kunstler, 2013), as with the Garden City model. Similarly, cars are tied to idealized myths of freedom, progress, wealth, and the American Dream (Lutz & Fernandez, 2010, p. 13-15). It will be important for planners to tell different kinds of stories around transportation in order to strengthen public deliberation and move toward a more collective and sustainable future that prioritizes active transportation, similar to the approach advocated by Beauregard (2003), that ties together elements of communicative and environmental planning.

Active transportation & planning practice

Active transportation has been increasingly prioritized in the planning profession. The Ontario Professional Planners Institute (OPPI), for instance, has released a number of papers in recent years linking health, sustainability and the built environment. They have also worked to advocate for planning and urban design approaches that address issues such as health, air quality, economic vitality and social cohesion through active transportation and related concepts (2007). Other planning and related institutions have also released studies focusing on active transportation, along with many Canadian municipalities, and provincial and federal agencies (Transport Canada, 2011). Non profit organizations have sprung up throughout North America with active transportation as central to their mandate, including the Toronto Centre for Active Transportation, 8-80 Cities, and the Victoria Transport Policy Institute in Canada, and the National Complete Streets Coalition in the United States. Concepts related to or which include active transportation as a key element are also rising to prominence, with

terms such as Complete Streets, Walkability, Healthy Communities, Complete Communities, New Urbanism and Smart Growth being increasingly central in planning discourses.

Complete Streets, as Transport Canada (2010) notes, is a recent term that describes streets that "are designed to be safe, convenient and comfortable for every user, regardless of transportation mode, physical ability or age" (p. 1). Key to a complete street is the prioritization of active transportation modes, and the safety of users of all modes. Equity is also an important factor of Complete Streets, as they are also meant to ensure inclusion of vulnerable groups, particularly children, older adults, and people with disabilities (Smart Growth America & National Complete Streets Coalition, 2014). In the last decade, the concept has grown in acceptance, and is now endorsed by planning and transportation organizations such as the Congress for the New Urbanism and the American Planning Association. There are also a growing number of jurisdictions with specific Complete Streets policies throughout North America, with 712 jurisdictions in the United States that currently have implemented them (Smart Growth America & National Complete Street Coalition, 2015).

Another term that is growing in usage in fields including planning and public health is "walkability," a term used to describe and quantify to what degree a given area is welcoming to pedestrians. Speck (2012) suggests that a walk must be useful, safe, comfortable and interesting for it to achieve walkability. Various, more specific measurements have been used to investigate and define walkability, including factors such as proximity and connectivity between destinations, density, land-use mix, the presence of sidewalks, and scenery (Frank *et al.*, 2006; Frumkin *et al.,* 2004; Glazier *et al.*,

2014; Roseland, 2012; Toronto Public Health, 2012). “Bikeability” is related term that has been used in the active transportation literature to describe and assess cycling environments (Winters, Brauer, Setton & Teschke, 2013).

The concept of “healthy communities” or “healthy cities” is one that spans both the public health and planning fields, with organizations as diverse as OPPI (2007), the Heart and Stroke Foundation of Canada (2011), and the Ontario Healthy Communities Coalition (OHCC) advocating for and researching this as a topic. The approach of healthy communities is simply to recognize the link between land use planning and health outcomes. The healthy communities approach originated with the World Health Organization, who in the 1980’s defined the term to recognize that health goes beyond medical care to include factors such as education, peace, shelter, food, income, stable ecosystems, sustainability, social justice, and equity (Roseland, 2012). Active transportation is frequently cited as a key element of healthy communities (OHCC, 2012; OPPI, 2007).

3.3 Active transportation & road safety

One of the key elements of fostering active transportation is creating a safe environment for walking and cycling. As Pucher & Dijkstra (2000) state, "the neglect of pedestrian and bicycling safety in the United States has made these modes dangerous ways of getting around" (p. 25). They go on to note that countries in Europe have successfully improved pedestrian and cycling safety through a variety of measures, including better walking and cycling infrastructure, urban design, traffic calming in residential neighbourhoods, and strict enforcement of laws that protect people who walk and bike (Pucher & Dijkstra, 2000). In Canada, Arason (2014) points out that our "road crash fatality rate per 100,000 persons in the population is over double that of the world's best performers," (p. 8) such as the United Kingdom. Hope can be found in countries such as the Netherlands, which has seen its road crash fatality rate drop from 24.6 persons per 100,000 persons in 1970 to 4.0 in 2011 (Arason, 2014). Not coincidentally, the countries that have the lowest rates of collisions, injuries and fatalities for all road users, including drivers, such as the Netherlands, are those that prioritize pedestrian and cyclist mobility.

Much of the literature on road safety and active transportation looks at pedestrian and cycling safety separately, with a much larger body of research and data available regarding pedestrian safety. However, upon reviewing the literature in each area there are many common principles in protecting both cyclists and pedestrians. Retting, Ferguson & McCartt (2003) separate engineering measures to reduce collisions between pedestrians and motor vehicles into three main categories: speed control, separation of pedestrians from vehicles, and increasing visibility of pedestrians.

Authors who have written on cycling safety, such as Jacobsen & Rutter (2012) and McDonald (2012), have pointed to similar issues of speed control and spatial separation of vehicles and cyclists. Perhaps since bicycles tend to move faster than pedestrians, visibility is less central in literature on cycling safety, but it is still a factor in many crashes (Bíl, Bílová, & Müller, 2010). Often, literature regarding improving visibility for cycling involves visibility aids for cyclists, such as lights, reflectors, and brightly coloured clothing (Kwan & Mapstone, 2006; Wood, Lacherez, Marszalek & King, 2009), rather than engineering designs to improve visibility. Pucher & Dijkstra (2003) suggest that common methods to make both walking and cycling safer include better facilities, traffic calming residential neighbourhoods, urban design oriented away from cars and toward people, restrictions on motor vehicle use, better traffic education, regulations, and enforcement.

In order to identify and assess interventions to improve safety for all active transportation modes, the following sections describe evidence about methods to lower speeds, particularly along streets in residential areas. Lower speeds are effective in improving both pedestrian and cyclist safety. Further sections look at ways to separate vehicles from pedestrians and cyclists, both along roadways, and at intersections and other crossing points for pedestrians and cyclists on arterial roadways with higher motor vehicle traffic volumes. Since approaches to separating pedestrians and cyclists are quite different, two different sections address these issues.

Lower speeds & speed limits

Lower speeds and improved road safety

Lower speeds are widely considered one of the key ways to improve safety for all road users, particularly pedestrians and cyclists. Various authors have shown that higher speeds increase the risk and severity of accidents, injuries, and casualties, since drivers have less time to stop to avoid a crash (Anderson, McLean, Farmer, Lee & Brooks, 1997; Arason, 2014; Toronto Public Health, 2012; WHO, 2013). Nilsson (2004) found that a 10 percent increase in speed, for instance, results in a 21 percent increase in all injury accidents. Data collected in Saskatchewan found that "casualties will be reduced by about 7 percent for every one km/hr (0.62 mph) reduction in average travel speed on provincial highways" (Liu & Popoff, 1997, p. 8). Other studies have found similar associations between speed, collisions, and injuries (Arason, 2014; Taylor, Lynam, & Baruya, 2000). Studies have also demonstrated that pedestrian fatalities greatly increase when vehicle speeds exceed 50 km/h, including recent findings in Toronto that have shown that the vast majority of vehicle collisions involving pedestrians and cyclists occur on roads with posted speed limits of 50 km/h or higher (Toronto Public Health, 2015). Lower motor vehicle speeds are also associated with reduced risk of bicycling injury (Harris *et al.*, 2012).

Speed is especially important for avoiding collisions involving children, who are overrepresented in pedestrian as well as cycling injuries and casualties (Kraus *et al.*, 1996; Wann, Poulter & Purcell, 2011). Children are usually injured midblock, often on residential streets, and in front of their home or a park (Kraus *et al.*, 1996). Data from Toronto shows that 24 percent of pedestrian injuries among those under the age of 19

occurred midblock, compared with 16 percent of the population at large; these midblock collisions are more likely to result in more severe injury or death for pedestrians of all ages, since vehicles are likely to be traveling at higher speeds relative to intersections (Toronto Public Health, 2015). Since young children "have difficulty judging vehicle distance and velocity and lack the relevant cognitive skills required to make valid and consistent crossing judgements," Retting *et al*. (2003, p. 1457) suggest that "in residential settings with large numbers of children, speed management appears to offer the greatest potential for injury prevention." Children have particular difficulty perceiving vehicles traveling faster than 20 mph (32 km/h) (Wann *et al*., 2011). Pedestrian accidents involving children have been found to be three times higher in places where speeds exceed 40 km/h (Roberts, Norton, Jackson, Dunn & Hassall, 1995). Toor & Havlick (2004) state that "vehicle speed is the decisive factor in determining neighborhood safety for kids aged 5 to 12" (p. 133), and the OECD (2004) recommends that speed reduction is key to "improve the overall safety of road users, in particular children" (p. 10). Many of the same principles in protecting children also apply to protecting seniors, who may develop similar cognitive impairments, such as dementia, that effect their safety as pedestrians.

Strategies and approaches to lowering speeds

There are a variety of ways to lower the speed of automotive traffic, including policy changes such as lower speed limits, engineering changes to roadways to calm traffic, or education and enforcement of traffic laws (Archer *et al*., 2012; Lindenmann, 2005; WHO, 2013). Engineering and urban design changes to streets are certainly a key part of slowing traffic. This can be done through a variety of traffic calming

improvements. One key way to reduce speeds at midblock locations is by narrowing lanes, which can be achieved not only by the placement of curbs, but also by simply repainting roadway markings (such as through adding bike lanes, or implementing zigzag or "dragon teeth" lane markings), or by narrowing lanes at key points with the use of "chokers" or "neckdowns" that extend the curb at key locations into the street. Chokers and neckdowns can also be placed on alternating sides of the roadway to create chicanes or "serpentine streets" that slow drivers down and induce them to pay greater attention as they are forced to make turns. Speed humps are a midblock speed control measure commonly used in North America, which along with rumble strips induce drivers to slow down at particular points in the roadway, reducing overall average speeds (Arason, 2014; Litman, 1999; WHO, 2013). Some of these and other speed control devices can also be used to calm traffic speeds at intersections, and are described in more detail in the section on intersection improvements in this paper. Traffic calming has been shown to substantially reduce collisions involving pedestrians and cyclists (Toor & Havlick, 2004; WHO, 2013).

There is debate around which methods of speed control are most effective. The simplest way to lower speeds is to change the posted limit. However, there can be limitations to this approach on its own. Some studies show that road design has a greater effect on a driver's speed than the posted speed limit (Archer, Fotheringham, Symmons & Corben, 2008). Wilmot & Khanal (1999) found that changes in speed limit only change the average speed "one-half to one-quarter the change in speed limit" (p. 317). Speed limits lower than the intended design of the roadway can increase the speed differential of traffic, which can be a safety risk, although more recent research

has shown that this in only true with large deviations in speed deviations of 15 mph (24 km/h) or more (Wilmot & Khanal, 1999), so this only applies to faster arterial roads rather than low-speed residential streets. There are also concerns that low speed limits can frustrate drivers, lower compliance, and create a false sense of security (City of London, n.d.). There are ways to mediate differences between the posted speed limit and roadway design, however, such as through enforcement (Archer *et al.*, 2008). As with other road safety improvements, speed control interventions are most effective when they use a comprehensive, integrated approach with varied methods that are applied to entire neighbourhoods rather than individual streets.

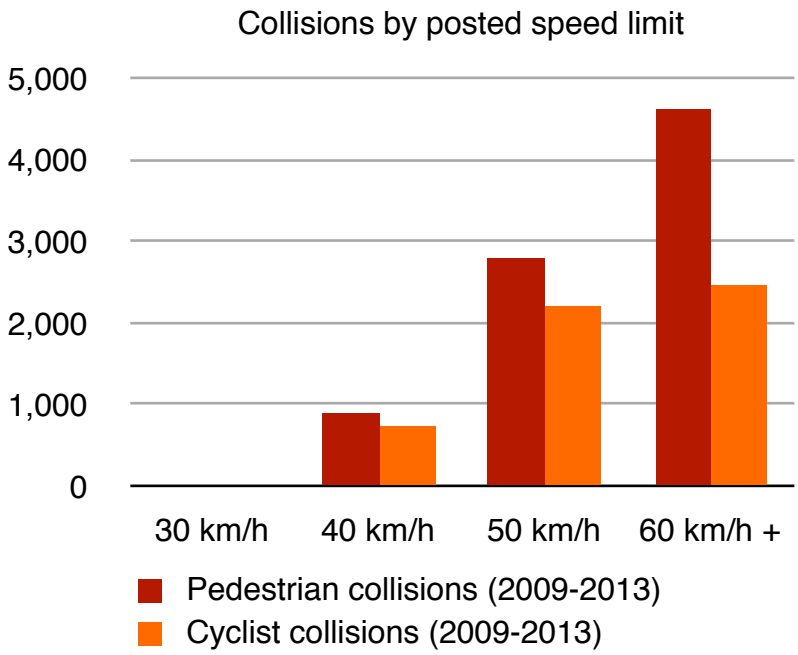

Figure 1: Collisions by posted speed limit.
Data: Toronto Public Health, 2015.

Setting speed limits

Currently, speed limits in North America are generally set as close as possible to the observed speed that 85% of vehicles are not exceeding, based on observations of the behaviour of drivers. This is often referred to as the "operating speed" or "design speed" of the roadway. Critiques of this approach, such as Arason (2014) and Tingvall & Haworth (1999), advocate a "Vision Zero" philosophy that involves setting speed limits

based on the kinds of road users found in a particular area and potential for damage from collisions, and then designing the road accordingly. This keeps speeds "to a level commensurate with the inherent safety of the road system" (Tingvall & Haworth, 1999). The OECD (2004) has followed this philosophy in recommending that "roads with high pedestrian and bicyclist activity have designated limits no higher than 30 km/h" (p. 10).

School speed zones

In North America, lower speed limits are often applied in a limited way through "school speed zones," usually only on sections of roads within one or two hundred metres of a school where pedestrians must cross to get to and from the school, and often only in force during school hours. These speed limits are usually set in relation to the regular speed limit on the roadway, such as a 30 km/h school zone on a 40 km/h road, although some jurisdictions have a set limit for all school zones. In Ontario, individual municipalities set their own rules and speed limits for school zones. In Alberta, speed limits have also been lowered in zones near playgrounds as well as schools (Tay 2009). In Ontario, municipalities have the ability to set "Community Safety Zones," where lower speed limits are implemented, typically 40 km/h, and speeding fines are doubled (Arason, 2014). This limited approach to lower speed limits can be effective to varying degrees, depending on the context and whether additional speed control measures or signage is employed. One study in the United States found that about half of the cars within school zones complied with the speed limit, a rate that was improved in locations where there were signs with flashing lights and crossing guards (ITE, 1999). A study in Saskatoon that tracked a reduction of the speed limit in from 50 km/h to 30 km/h from 8:00 am to 5:00 pm Monday to Friday in school zones found that the

average speed of motorists was reduced from 54.5 km/h to 44.5 km/h, resulting in improved child pedestrian safety. However, with only 23% of motorists complying with the posted 30 km/h speed limit, there are limitations to changing the posted speed in an area designed for 50 km/h car travel (Lazic, 2003). Other studies have found better results regarding compliance in school zones. A study in Calgary by Kattan, Tay & Acharjee (2011) found a mean speed of 32 km/h in 30 km/h school zones, and an 85th percentile speed of 38.8 km/h. While 54 percent of vehicles drove at speeds higher than 30 km/h, only 10 percent drove at speeds more than 10 km/h over the speed limit. This study also looked at factors that contributed to compliance with speed limits in school zones, and found that it improved on roads with fewer lanes, less fencing, where children or speed display devices were present, and in larger zones.

Slow zones: low speed residential neighbourhoods

There is mounting evidence that lowering posted speed limits on a more comprehensive neighbourhood or community-wide basis has a number of advantages, especially given the low cost and relative simplicity of implementing lower speed limits compared to other speed control measures. Litman (1999) details the costs of typical traffic calming measures, and at roughly $100 per sign, lower speed limits are far less expensive to implement on a broad scale compared to other traffic measures, which usually cost thousands of dollars and often only control speeds for a short section of roadway. Kloeden, McLean, & Lindsay (2004), in a study examining cost-effective ways to improve road-safety in South Australia, found that lower speed limits were "potentially the most effective road safety measure available" (p. 2). An OECD (2004) report on child pedestrian safety takes a Vision Zero approach, recommending the

prioritization of speed reduction and "setting speed limits according to the function of the roads within a hierarchy," including "limits no higher than 30 km/h" on "roads with high pedestrian and bicyclist activity" (p. 10). Archer *et al*. (2008) suggest that speed limits are "perhaps the most significant factor in determining a driver's choice of speed" (p. xii), and note that lowered speed limits lead to "considerable reductions in road trauma... minor impact on average travel times... a more attractive and liveable environment," and an increase in energy efficiency (p. 45). Rossy, Sun, Jessen & Newman (2012) point out that most studies that indicate reduced posted speed limits on their own do not reduce speed have been "limited mostly to high-volume, high-speed roads," and that lower speed limits are effective in residential neighbourhoods. The World Health Organization (WHO, 2013) has also listed lower speed limits among measures that have been proven effective at increasing pedestrian safety.

Many case studies around the world have taken a closer look at the effectiveness of lower speed limits in particular residential areas, or "slow zones," and found them to be effective in reducing overall speeds and improving safety. A report done for the City of Edmonton that studied a series of pilot projects to reduce speed limits from 50 km/h to 40 km/h in residential areas found a significant reduction in both operating and mean speeds of traffic (Edmonton, 2011). A study in Switzerland of 30 km/h zones found decreases in both overall accidents (15 percent) and accident severity (27 percent) in 30 km/h zones (Lindenmann, 2005). Another study of 20 mph (32 km/h) traffic speed zones in London found a 41.9 percent reduction in road casualties overall, and a 48.5 percent reduction among those under 15 years of age, when compared to adjacent

areas (Grundy *et al*., 2009). Cairns, Warren, Garthwaite, Greig, & Bambra (2014) reviewed a number of independent studies of 20 mph zones or limits, and found there was "convincing evidence that these measures are effective in reducing accidents and injuries, traffic speed and volume, as well as improving perceptions of safety" (p. 4).

Lowering speed limits city-wide

Some jurisdictions have implemented a more comprehensive approach to lowering speed limits. Pilot projects in Springfield and Columbia, Missouri, in which speed limits were lowered from 30 mph (48 km/h) to 25 mph (40 km/h) in selected neighbourhoods, showed statistically significant reductions in average speeds on streets within the study area, as well as some reductions in speeds even on adjacent streets. Other than oversized signs with safety messages, these pilot projects included no additional road engineering improvements other than speed limit reductions. Both cities have since expanded the 25 mph speed limit to all local streets (Rossy *et al*., 2012).

Archer *et al*. (2008) point out that there were significant reductions in crashes and crash trauma after the reduction of the default urban speed limit in Australia from 60 km/h to 50 km/h. Lancashire County in the United Kingdom now has a 30 km/h speed limit in all residential areas and near all schools, and early indications are that deaths and injuries are being reduced with this approach (WHO, 2013). Lower speed limits can not only improve safety, but also encourage people to walk and cycle. In Freiburg, Germany, the speed limit has been lowered to 30 km/h on 90 percent of the city's streets, contributing to an impressive 52% of all trips in the city now being done on foot or by bike (WHO, 2013). The World Health Organization (WHO, 2013, p. 32) states that

these "comprehensive approaches to speed limits for entire geographical areas is likely to be more effective than the fragmented approach of home zones or individual streets where one car trip can involve streets with three or four different speed limits." Recently, in 2014, New York City has followed this advice and reduced its city wide speed limits from 50 km/h to 40 km/h (Toronto Public Health, 2015).

In Toronto, the Public Health Department has called for lower speed limits on multiple occasions, including lowering the citywide default speed limit from 50 km/h to 40 km/h (Toronto Public Health, 2015). Now, the Toronto East York Community Council area within the City of Toronto is set to establish a default 30 km/h speed limit on all residential and some collector roads, in response to calls for safer streets in local communities. This is expected to be in place by the end of 2015. However, this will only apply to the central area of Toronto, and suburban areas of the city such as Scarborough still have a 50 km/h default speed limit, with 40 km/h limits on most residential streets.

Separating pedestrians through safer crossings & intersections

While separating pedestrians from motor vehicle traffic at midblock locations is usually quite simply done via sidewalks or other pedestrian pathways outside of the roadway, it is at the points where pedestrians must cross the roadway and mix with vehicles where separation becomes more important and complicated. Simply stated, crossing the road increases the risk of pedestrian injury, particularly on busy arterial roads. This is often where many of the services that pedestrians wish to access are located. The majority of pedestrian and cyclist collisions with motor vehicles occur on high speed arterial streets, and at intersections, where there is a high number of conflict

points between vehicles and other road users, particularly between turning vehicles (Toronto Public Health, 2015; WHO, 2013). Improving pedestrian crossings can achieve many of the principles of traffic calming and traffic safety, including helping to reduce vehicle speeds, separating pedestrians and vehicles, and increasing pedestrian visibility (Retting, Ferguson & McCartt, 2003). Pedestrian crossing infrastructure can often also be combined with other traffic calming measures to achieve differing pedestrian safety principles to varying degrees, and improve overall safety. An OECD report on keeping children safe in traffic recommends that, "outside residential areas where low speed limits are less feasible and roads are wider with heavier traffic flows," attention should be focused on "designing safe places to cross the road" (OECD, 2004, p. 10).

Intersections, particularly if they have high traffic volumes or are poorly designed, can overstimulate drivers and make it difficult for them to notice pedestrians (Arason, 2014). Between 2000 to 2009 in Canada, 22 percent of all pedestrians were struck while they had the right-of-way crossing at a controlled intersection (Arason, 2014). In Toronto, a recent analysis of crash data found that the majority of pedestrian collisions occurred at intersections, and in the vast majority of these cases (67 percent) the pedestrian had the right-of-way (Toronto Public Health, 2015). This data points to the importance of improving intersection treatments and crossings to increase pedestrian safety, and the inadequacy of many current intersection and crossing designs.

The following analysis looks at particular features of signalized and controlled crossings and intersections, followed by other treatments that can be used to improve the safety of pedestrian crossings.

Signalized crossings

Adding traffic signals to high-speed intersections has been shown to generally reduce conflicts between pedestrians and vehicles (Retting, Ferguson & McCartt, 2003), and reduce the total number of crashes (USDOT & ITE, 2004). Adding traffic signals at midblock locations have also been shown to reduce pedestrian crashes by as much as 56 percent (Huang & Petritsch, 2007).

At current signalized intersections, there are a number of improvements that can be put in place to help reduce conflicts among different road users and improve safety. One is to simply change the signal timing or phasing in ways that prioritize pedestrian safety. For instance, pedestrians can be given an advance start to cross intersections, ahead of motor vehicle traffic. This head start of a few seconds, known as a "leading pedestrian interval," reduces the common incidence of pedestrians being hit shortly after leaving the curb by making them more visible when motor vehicles begin moving from a stop. Various authors have shown the safety benefits of a leading pedestrian interval (USDOT & ITE, 2004; Van Houten, La Plante & Gustafson, 2012; Van Houten, Retting, Farmer & Van Houten, 2000).

Another option, appropriate for urban intersections with high pedestrians volumes, is a pedestrian scramble. A pedestrian scramble is a signal phase that stops motor vehicle traffic in all directions, while pedestrians are allowed to cross in all directions, even diagonally. During this phase, cars cannot turn either right or left. Scrambles have been found to significantly reduce the conflicts and collisions involving vehicles and pedestrians at intersections (Arason, 2014; Kattan, Acharjee & Tay, 2009;

Figure 2: A pedestrian scramble at the intersection of Dundas & Yonge Streets in Toronto.
www.spacing.ca / Sam Javanrouh

Retting *et al*., 2003; USDOT & ITE, 2004). Speck (2012), however, has noted that dedicated cycle intersections can compromise pedestrian convenience, particularly if the cycle prioritizes vehicles and keeps pedestrians waiting at the intersection for longer intervals between phases. Pedestrian phases should always be timed to ensure pedestrians of all ages and abilities have adequate time to cross the road (Retting *et al*., 2003).

Turning movements are the source of many accidents, particularly those involving pedestrians (Arason, 2014; Toronto Public Health, 2015), so tools to limit or control tuning movements can be effective to improve road safety. Banning right turns on a red light at intersections can substantially increase safety for pedestrians, cyclists, and in terms of overall crashes (Preusser, Leaf, DeBartolo, Blomberg, & Levy, 1982; USDOT & ITE, 2004), while also being an effective complementary measure along with leading pedestrian intervals (AECOM Canada, 2009). Van Houten *et al*. (2012) note that very few right turn on red crashes are fatal for pedestrians (less than 1 percent), and that the benefits of restricting a right turn on red is most appropriate at intersections with high pedestrian volumes. The turning radii of curbs at the corners of intersections can also be shortened to force vehicles to make tighter and slower turns, while also

providing the benefits of shorter crossing distances and improved visibility of pedestrians (WHO, 2013).

The majority of injuries or deaths of pedestrians from turning vehicles occurs when cars are making a left turn (Arason, 2014). Left turns are particularly complex maneuvers that tax the cognitive resources of drivers (Schweizer *et al*., 2013). One way to address this issue is to phase signals so that motor vehicles cannot turn left at the same time that pedestrians are allowed to cross the street, an intervention that has shown reductions in pedestrian accidents and total crashes (Arason 2014; USDOT & ITE, 2004). More effective, as mentioned below, are roundabout intersections, which eliminate left turns altogether.

In Toronto and other cities, many pedestrian signals at intersections have been changed to "countdown" signals that tell pedestrians how many seconds are left to complete their crossing. They are meant to provide more information to pedestrians that they can use to time their crossing safely. A substantial number of studies of countdown signals in various North American cities have found improved pedestrian safety with this measure (Markowitz, Sciortino, Fleck, & Yee, 2006; Van Houten, La Plante, & Gustafson, 2012), including an analysis that found them to be among the most cost-effective measures of reducing collisions (Rocchi *et al*., 2011). Studies in Toronto, which has implemented countdown signals broadly throughout the city, have shown mixed results, with one demonstrating no impact on pedestrian safety, and a follow up study that used a more complex analysis finding a 26 percent increase in the number of pedestrians hit by vehicles at intersections with countdown signals (Richmond et al.,

2014). More studies should be done to determine the cause of the discrepancies between these studies. It may be that pedestrian countdown signals are more appropriate for some types of intersections than others. Their relatively low cost to implement at existing intersections makes them a worthwhile tool to add to a suite of pedestrian crossing improvements.

Arason (2014) describes the features of the best crosswalks as those that are simple and "remove as much decision-making from drivers and pedestrians as possible and... [to ensure] that only one road user movement occurs at any one moment in time" (p. 130). He recommends the "Puffin" crosswalk, used in the United Kingdom, as a model that should be replicated in Canada. It features a Walk/Don't Walk signal on the near side of the street, near the pedestrian, so that the pedestrian's view of the signal light is not obstructed or confused by other signals, and does not distract the pedestrian once they have started crossing the road, leaving them free to pay attention to traffic. Puffin crosswalks also have dramatic zigzag lane markings, and an advanced stop line for cars. A Transport Canada report recommends this treatment be piloted in Canada "at locations with a high volume of pedestrians and cyclists or there are a large number of reported collisions involving vulnerable road users" (AECOM Canada, 2009, p. 48).

Controlled intersections & unsignalized crossings

Stop signs, particularly multiway stop sign controls, can produce lower vehicle speeds, and on roads with low traffic volume have been shown to decrease pedestrian collisions, even in comparison to traffic signals in certain circumstances (Persaud, Hauer, Retting, Vallurupalli & Mucsi, 1997; Speck, 2012). Converting an unsignalized intersection from a two-way stop to a multi-way stop can reduce total crashes by about

53 to 74 percent depending on the context (USDOT & ITE, 2004). Replacing yield signs with stop signs can also reduce collisions (USDOT & ITE, 2004). Stop signs, however, can be limited in effectiveness as they are often ignored by drivers, or may not be seen due to visibility issues at intersections (Retting, Weinstein, & Solomon, 2003). Too many stop signs also have the drawback of potentially discourage cycling by slowing down bicyclists and forcing them to exert more energy on their trip (Fajans, & Curry, 2001), although these problems could be avoided with "Idaho stop" rules that permit cyclists to treat stop signs as yields, or with roundabouts. The effectiveness of stop signs can be improved by increasing their visibility, such as by adding a flashing beacon to a stop sign, or by improving nearby sightlines (Rocchi, Chow, Kenny, Arsenault, & Dilgir, 2011).

Various flashing lights or beacons can be used to improve the safety of pedestrian crossings. These are usually operated by the pedestrian pushing a button, which activates a series of flashing or solid lights to signal to drivers that they must stop. Often these are strung on wires above the crosswalk. Examples of this type of crosswalk include the "Hawk," or "pedestrian hybrid beacon," which have been shown to reduce crashes involving pedestrians by 69 percent (Arason, 2014; Van Houten *et al*., 2012). Pedestrian-activated lights embedded in the pavement at crosswalks are particularly effective; one study in Kirkland, Washington found that this type of intervention doubled the compliance levels of motorists who stopped (Toor & Havlick, 2004). The effectiveness of crosswalks with flashing lights and beacons can vary widely depending on the design employed, and the responsiveness and design of the methods used to activate them (Van Houten *et al*., 2012).

Road markings

Perhaps the poorest form of crossing is a marked pedestrian crossing that is not complemented by any other form of infrastructure or additional controls. Studies have found no significant difference in safety between unmarked and marked crossing sites unless additional safety features were used (WHO, 2013; Zeeger *et al*., 2005). In some cases, marked crosswalks are found to be less safe than an unmarked roadway (Retting *et al*., 2003), as pedestrians falsely believe they are safer, and are more likely to attempt crossing "without due caution" (WHO, 2013, p. 33), especially on busy, high-speed, multi-lane roads. Marked crossings can be effective and help separate pedestrians from vehicles, but only when combined with other safety measures, such as signalized crossings, signage, raised medians, narrowed roadways or other road markings (Van Houten *et al*., 2012; WHO, 2013).

Providing an advanced stop line can improve a marked pedestrian crossing, whether at a midblock location, or a controlled or signalized intersection, increasing the percentage of drivers yielding to pedestrians. Similarly, by moving stop bars back further away from crosswalks at intersections, less drivers stop in the crosswalk, and conflicts between vehicles turning right on red lights and pedestrians are reduced (Van Houten *et al*., 2012). Stop lines combined with "stop" messages on the pavement and additional signage can further improve safety (USDOT & ITE, 2004).

Another completely different approach is to create "naked streets" that take out all roadway markings as well as most or all signage. This approach forces drivers to pay closer attention, and has improved road safety in a number of areas and towns in which it has been tried, such as Wiltshire county in Britain, and the town of Christianfeld in Denmark (Speck, 2012).

Raised medians, pedestrian refuge islands & curb extensions

Raised medians, pedestrian refuge islands, and curb extensions all work on essentially the same principle, by offering shorter and simpler crossing distances for pedestrians to negotiate, and improving separation of vehicles from pedestrians. Raised medians can be installed near intersections, or along the entire roadway, and in both cases offer pedestrian safety benefits, particularly along arterial streets. Raised medians can reduce crashes involving pedestrians by 69 percent (USDOT & ITE, 2004). One study in Orlando, Florida found that the risk of pedestrian-motorist crashes was 6.5 times higher on an arterial street with no median than one with a median (Huang & Petritsch, 2007).

Figure 3: A raised crosswalk with differentiated pavers, along with a raised centre median / pedestrian refuge island.
www.pedbikeimages.org / Dan Burden

Pedestrian safety islands, or mid-block medians, provide pedestrians "a protected place to be when they are at the halfway mark of their road crossing journey" (Arason, 2014, p. 145). Even at a non-signalized intersection, a raised median with a marked crosswalk can reduce collisions between vehicles and pedestrians by 46 to 56 percent (Arason, 2014; USDOT & ITE, 2004). Fencing can be added to a pedestrian

Figure 4: A curb extension narrows the roadway, allowing for shorter crossing distances as well as calming traffic.

safety island to help shield pedestrians from traffic, while also guiding them into a position to look towards oncoming traffic. This intervention is known as "the Danish Offset" (Arason, 2014). These kinds of pedestrian refuges can be particularly helpful in guiding children in crossing the road, helping them to consider only one direction of traffic at a time (OECD, 2004).

Curb extensions offer similar pedestrian safety benefits by shortening crossing distances for pedestrians, improving the separation from traffic and visibility of pedestrians, while also narrowing the roadway to reduce vehicle speed (WHO, 2013).

Raised pedestrian crossings & intersections

While speed humps are commonly used in North America, less frequently employed are raised crosswalks, which offer both speed control and traffic calming benefits, as well as improving separation between pedestrians and vehicles by sending the signal to drivers that they are entering pedestrian space. One analysis found that raised pedestrian crossings reduced accidents by 39 percent (Arason, 2014, p. 120), and other studies have also found benefits of raised crosswalks (USDOT & ITE, 2004). Raised crossings are usually not suitable for high-speed environments, however, and should be clearly marked to provide advance warning to drivers (WHO, 2013). They can be appropriate, however, on local and collector roads where they meet arterials to mark the transition to a lower-speed environment.

Roundabouts

One of the safest intersection designs is a roundabout, sometimes known as a traffic circle, a circular intersection in which vehicles enter at low speed and yield to other vehicles upon entry to the intersection. Roundabouts are effective because they

Figure 5: A roundabout in Denmark that incorporates bicycle & pedestrian infrastructure.
www.pedbikeimages.org / Ryan Snyder

reduce vehicle speeds, as well as the number of conflict points between motorists and pedestrians - particularly left turns, which are eliminated entirely in a roundabout design. Installing roundabouts in place of conventional intersections, including both traffic lights and stop signs, is a very effective speed control measure, and can reduce collisions with pedestrians by 75 percent (Retting, Ferguson & McCartt, 2003). Although the initial cost of installing roundabouts can be quite high compared to other measures, Rocchi *et al*. (2011) did a cost-benefit analysis that found converting stop-controlled intersections to roundabouts can be highly cost-effective in reducing collisions. Although roundabouts take up more space than a conventional intersection, "squareabouts" that use less physical space can be employed to address this issue (Arason, 2014). Although roundabouts have many benefits, especially for pedestrians, they can have negative effects on cyclists safety (Arason, 2014; Teschke *et al*., 2012).

Improving visibility

Visibility is an important aspect of pedestrian safety (Retting *et al*., 2003; WHO, 2013), and there are a number of ways to improve visibility for drivers and all road users. More than half of all fatal pedestrian crashes happen at night, so improving lighting is important (Retting *et al*., 2003). A number of studies have shown that improved lighting along roadways and at intersections can reduce collisions between

pedestrians and motorists, at night as well as during the day (Arason, 2014; Retting *et al*., 2003; USDOT & ITE, 2004). Obstructions should also be moved away from intersections, including parked cars, bus stops, and overgrown vegetation (Arason, 2014; Retting *et al*., 2003; Roberts, Norton, Jackson, Dunn, & Hassall, 1995).

Overpasses and underpasses

Bridges or tunnels are one way to ensure complete separation of pedestrians from traffic. However, they should be employed carefully, as they are only effective if placed in a location that is convenient, secure, and results in walking distances that are comparable to other routes. If a more direct route is available, or the overpass or underpass is perceived to be unwelcoming or a place where criminal activity may take place, pedestrians may not use the route, and may end up crossing at other unsafe locations (WHO, 2013). Overpasses and underpasses are far more effective in midblock locations where pedestrians have few options to cross, rather than at intersections (USDOT & ITE, 2004).

Separating cyclists through dedicated bicycle infrastructure

As with travel on foot, distance is highly correlated to travel by bicycle (Emond & Handy, 2012; Pucher & Dijkstra, 2000; Schlossberg, Greene, Page, Johnson, & Parker, 2006). However, travel by bicycle can allow people to travel longer distances, and three to four times faster than by walking (Winters, Brauer, Setton, & Teschke, 2010). Many people, however, choose not to travel by bicycle because of the real and perceived danger posed by motor vehicle traffic (Jacobson & Rutter, 2012; Pucher & Dijkstra, 2000; Pucher & Dijkstra, 2003). While reducing the speed of car traffic is important for both

pedestrians and cyclists, and similar traffic calming interventions can work to increase the safety of all users of active transportation modes, separating cyclists from vehicle traffic usually involves different infrastructure than that used for pedestrians. While sidewalks and crosswalks oriented to pedestrians are common throughout North America, infrastructure that separates cyclists from motor vehicles, usually through various types of bike lanes, is less common in North America, and often less effective, than bicycle infrastructure found in Europe (Pucher & Dijkstra, 2003). Since, generally, "approximately 90 percent of cyclist deaths involve motorists" (Jacobson & Rutter, 2012, p. 143), clearly the most effective way to reduce the risk of cycling deaths is to separate cyclists from motor vehicle traffic. In Europe, where riding a bike is much safer than North America, the separation of cyclists from high-speed and volume traffic is "considered a fundamental principle of road safety" (Furth, 2012, p. 105).

Not only does dedicated cycling infrastructure make people safer while riding their bikes, it also encourages more people to cycle, or to ride more often (Pucher, Dill & Handy, 2010). Although people are often at greater risk of injury or death on the roads while riding a bicycle than those in vehicles, the health benefits of riding a bicycle regularly for transportation have been shown to outweigh the risks (Jacobson & Rutter, 2012).

There are a variety of methods to separate cyclists from pedestrians, ranging from striped roadway markings, to separated paths. Other bicycle infrastructure doesn't separate bicycles from traffic on a particular roadway, but guides bicycles to routes on calmer, lower-speed and volume streets via signed bicycle routes, or adds roadway markers or signage on a route to alert drivers to the presence of cyclists.

Adding roadway markings to indicate that a vehicle travel lane is to be shared by drivers and bicycles, and showing cyclists where they should ride in the roadway, are often called "sharrows." There are studies that show these can increase the distances between cyclists and passing motorists, as well as cyclists and parked cars (City of Toronto, 2014, September; Pucher *et al.*, 2010), however there is limited evidence as to the overall safety benefits of sharrows. One study done in Toronto and Vancouver found no significant risk reduction in the presence of shared lanes, and found that they were less safe than randomly selected control sites, particularly if they were on streets where parked cars were present. This does not mean that all shared roadway infrastructure is unsafe; the same study found that designated bike routes with signage on quiet residential streets were very safe, even more so than a painted bike lane on a major street, particularly when accompanied by traffic calming measures on these streets (Teschke *et al.*, 2012). Furth's (2012) analysis of the Dutch *Design Manual for Bicycle Traffic* suggests that bikes should only operate in mixed traffic on streets with speed limits of 30 km/h or less, with traffic volume of less than 5000 motor vehicles per day.

Creating a separate lane on the roadway through pavement markings only, creating on-road painted bicycle lanes, is the most common way of separating bicycles from motor vehicles in North America. This form of infrastructure can increase the number of cyclists on the road (Pucher

Figure 6: A painted bike lane on a major arterial road, Toronto.

et al., 2010), and result in greater safety and comfort for cyclists than streets without bike lanes (Furth, 2012; Teschke *et al.*, 2012). They are also a low-cost and require less space on the roadway than other forms of more separated bicycle infrastructure. Their safety can be reduced in the presence of car parking (Teschke *et al.*, 2012), where they can increase the risk of "dooring" - cyclists being hit by car doors - although this can be minimized through proper design (Furth, 2012). On-road painted bike lanes are most appropriate on two-lane through streets where there is no parking (Furth, 2012). Painted bike lanes can also be added to streets that are restricted to one-way for motor vehicles, in order to allow cyclists to travel safely in both directions, a treatment known as a contraflow bike lane (Furth, 2012).

On multi-lane, arterial streets with higher volumes and traffic speeds, greater separation than a painted line is needed for cyclists to be safe. In these cases, on-street bike lanes should be separated by physical barriers as bollards, curbs, creating a separated bike lane, or cycle track. Bike lanes can also be provided as standalone paths outside of the roadway entirely, as are often found in parks, or along railways or hydro corridors. These off-street paths through parks are sometimes provided as multi-use paths, for the use of pedestrians and other active modes such as skateboards or in-line skates, although these multi-use paths are less safe for

Figure 7: Queen's Quay in Toronto features a multi-use trail that is primarily used by bicyclists, but is shared with users of other modes.

cyclists than if they are bike-only paths (Teschke *et al.*, 2012). These fully separated bike lanes are the safest form of cycling infrastructure, and their installation has been shown to dramatically increase numbers of cyclists, and decrease collisions. (Furth, 2012; Pucher *et al.*, 2010; Teschke *et al.*, 2012).

In addition to separated bike lanes, improvements can also be made at intersections to keep cyclists separated from motor vehicles and improve safety. As with pedestrians, many collisions with cars and cyclists occur at intersections, particularly when a vehicle is turning. A bicycle box, a painted area in front of the motor vehicle stop line, is an area where cyclists can stop and be more visible to cars, and avoid the likelihood of being hit drivers making right turns. A "jug-handle" left turning space for bicycles, either through a bicycle box or a separated space in the intersection, gives cyclists an opportunity for a two stage left turn, rather than turning left with vehicles in the centre of the intersection, an intimidating and dangerous maneuver. Dedicated signal phasing and timing for bicycles at intersections with high volumes of cyclists can also help reduce conflicts between other modes (Arason, 2014). This signal phasing can be coordinated to create a "green wave," where signals give cyclists green lights at consecutive intersections (Buehler & Pucher, 2012; Arason, 2014).

3.4 Active transportation & young people

Active transportation among children and youth is a burgeoning area of study. There is a growing body of evidence showing that the benefits of walking and cycling can be particularly pronounced for school-age children and adolescents. Benefits of active school travel include improved physical and mental health, more robust social relationships, better academic performance, reduced costs, and improved safety, including less traffic-related injuries among children (Cook, 2010). Despite this, the number of children traveling to school by bike or on foot has been dropping in recent decades. However, there remains strong potential to improve the rates of active transportation among youth. This can be demonstrated by countries that have had success in encouraging walking and biking among young people, and recent changes in travel behaviour among young adults in North America. Some key ways to encourage active transportation among young people are through improved safety and urban design oriented towards walking and cycling, better planning of communities to put school and other key services for youth within walking distance, and educational programs.

Benefits of active transportation for young people

Despite the fact that "75% of Canadian kids aged 5-19 participate in organized physical activities or sport" (p. 25), Canada lags well behind other countries in terms of overall physical activity levels. This is a particular problem among older children and adolescents, as physical activity levels drop precipitously as children age; while "84% of Canadian kids aged 3-4 are active enough to meet guidelines [of physical activity], this falls to only 7% of kids meeting guidelines at ages 5-11, and only 4%

meeting guidelines at ages 12-17" (Active Healthy Kids Canada, 2014, p. 10). In the United States, "one third of high school students engage in no strenuous physical activity" (Toor & Havlick, 2004, p. 130).

One key way to address the problem of low rates of physical activity among youth is via active transportation, as many studies have shown associations between levels of physical activity and walking or cycling to school (Garrard, Rissel & Bauman, 2012; McDonald, 2012; O'Brien, Ramanathan, Gilbert & Orsini, 2009). Students who use active modes to get to school are more active throughout the day compared to those who are driven to and from school, and students who bike to and from school or at least 1 hour per week demonstrate improved cardiovascular fitness (ParticipACTION, 2015). Increasing physical activity is helpful for physical health on many levels, such as reducing the risk of heart and cardiovascular disease, diabetes, osteoperosis, and obesity. Physical activity is especially important for children to develop strength, flexibility and bone mass, particularly during the early years of adolescence (Active Canada 20/20, n.d.; ParticipACTION, n.d.; U.S. Department of Health and Human Services, 2008) .

Despite the links between active transportation and physical activity levels, studies have not established a direct, causal link between active travel and obesity or body mass index (McDonald, 2012; O'Brien *et al*., 2009). Charreire *et al*. (2012) suggest that the apparent lack of a direct link may be the result of lag time between active behaviour and changes in body mass index. There have been studies that demonstrate associations between built form that is hostile to active transportation, such as low-density urban sprawl, with obesity (O'Brien *et al*., 2009). A study in Toronto, for

instance, found that individuals living in less walkable areas were up to one-third more likely to be obese or to have diabetes. The researchers concluded that walkable urban environments are important to achieving the health outcomes of increasing physical activity, and combating obesity and diabetes (Glazier *et al*., 2014).

Shifting modes of transportation can also improve air-quality, thus improving health outcomes. Neighbourhood design and the provision of services within walking distance has been shown to reduce vehicle-related air emissions (Toronto Public Health, 2012b). Toronto Public Health (2007) has found that "children are particularly vulnerable to the health impacts of traffic given their immature physiology and immune system which are still under development," and children are also exposed to more air pollution than adults, since they "spend more time outdoors, engaged in strenuous play or physical activity" (p. 6). Children also have narrower airways than adults (O'Brien *et al*., 2009). A number of studies have found associations between living near a major road or other locations with higher levels of air pollution and children's asthma and lung function, and childhood cancers, particularly leukemia (O'Brien *et al*., 2009; Toronto Public Health, 2007).

Research has also shown associations between active transportation modes with higher levels of self-reported happiness, relaxation, and lower levels of depression, anxiety, stress, and hostility, although again direct causal association has not been proven (Garrard *et al*., 2012; Janssen & LeBlanc, 2010; O'Brien *et al*., 2009). Some of these benefits on emotional and mental well-being can be limited, however, by the "psychological distress associated with with the actual and perceived risks of cycling in

traffic," and "potential discrimination and victimization of cyclists as minority road users" (Garrard *et al.*, 2012, p. 39).

There is also a growing body of evidence about the benefits of physical activity on cognition and academic attainment and performance (Garrard *et al.*, 2012; Singh, Uijtdewilligen, Twisk, Van Mechelen & Chinapaw, 2012; Tomporowski, Davis, Miller, & Naglieri, 2008). One Spanish study, for instance, found a positive association between active commuting to school and cognitive performance among adolescent girls (Martínez-Gómez et al., 2011).

Increased independence is known to be an important part of human development, especially during adolescence, and thus the independence afforded to young people by active transportation modes is both psychologically important, as well as an attraction of walking and cycling for youth. The social bonding that is facilitated by walkable neighbourhoods with less vehicle traffic, as shown by authors such as Appleyard (1981), is particularly beneficial to youth. Restricting the independent mobility of young people may impede the psychological development of children, as well as their social development, as "active commuting is... used by children to meet with friends for spontaneous and non-structured play" (O'Brien *et al.*, 2009, p. 29). Cycling has similar benefits to independence, as McDonald (2012) has noted: "riding a bicycle brings newfound independence and the ability to travel faster and farther, bringing within grasp destinations that previously were out of reach" (p. 235).

Safety & Young People

Throughout the literature on active transportation, it is clear that roads in North America and in many countries worldwide put children and young people at increased

risk of injury or death. Children between the ages of 5 and 9 are at particular risk, with the highest rate of injury in the United States (Barton & Schwebel, 2007; Retting *et al*., 2003). In urban Africa, a study found that 68% of road traffic injuries were among children and adolescents (World Health Organization, 2013). In Canada, the leading cause of injury and death for children over the age of one is traffic collisions (O'Brien *et al*., 2009). Overall, Canada ranks around the middle of the pack among OECD countries in total traffic fatality rate among children aged 0-14, with a lower fatality rate than the United States, but nearly double that of countries such as Sweden and the United Kingdom (OECD, 2004). The most likely cause of death for people aged 15 to 24 in Canada is a motor vehicle crash (Arason, 2014), and in Toronto, the second highest proportion of pedestrian injuries and fatalities is among youth age 15-19 (Toronto Public Health, 2015). These high rates of death are in part due to the nature of injuries children receive in motor vehicle collisions; children are more likely to receive injuries to their head and neck than adults, injuries which tend to be more life-threatening (WHO, 2013). Not only are children as a broad group at particular risk from traffic injury and fatality, but children with disabilities, or from poor or minority households, face even greater risks (WHO, 2013; Zho & Lee, 2008).

There have been lower percentages of children being injured as cyclists and pedestrians in recent decades, however this is likely due to lower numbers of children riding bikes and walking rather than an increase in safety (Jacobson & Rutter, 2012; Smart Growth America & National Complete Streets Coalition, 2014). As with adults, cycling is a much more dangerous way to travel than by car for children, particularly in North America (McDonald, 2012).

Children and youth are more likely to be injured on their way home from school rather than on their trip to school. This may be because young people are more likely to be walking for their trip home from school than the trip to school, or because they are more likely to be engaged in outdoor play or trips to other locations (O'Brien *et al.*, 2009). Children are typically engaged in play when they are struck by motor vehicles (Arason, 2014). This suggests the importance of greater enforcement during the late afternoon, after school is let out. It also points to prioritizing safety improvements not only near schools, but also near playgrounds, parks, residential areas, or other areas where children are likely to be engaged in play.

As mentioned in the previous sections of the paper focusing on traffic safety, children lack the cognitive skills to be able to assess crossing distance and the velocity of approaching objects, such as vehicles (Retting *et al.*, 2003). Children, particularly younger children and boys, have less ability to "inhibit impulses when faced with novel or desirable stimuli," which increases their "urges to cross a street quickly to chase a lost toy or return home" (Barton & Schwebel, 2007, p. 518). As a result, collisions with vehicles involving children often occur at midblock locations (Retting *et al.*, 2003; Toronto Public Health, 2015), pointing to the importance of speed control measures to improve safety for young pedestrians at these locations. The lack of crossing judgement skills among children also suggests that solutions for crossings and intersection treatments should be cognitively simple, such as pedestrian refuge islands, which allow children to focus on one direction of traffic at a time on a two-way roadway. It should be noted that children develop cognitive skills quickly, with cognitive leaps around the ages of seven or eight resulting in much safer pedestrian behaviour (Barton & Schwebel, 2007). Youth only fully

develop the ability to concentrate on a single thing for a long period of time, along with their motor skills, including the ability to fully master riding a bicycle, upon entering high school at around 13 or 14 years old (OECD, 2004). However, this coincides with a rise in risk-taking behaviour among young people as they go through adolescence (Arason, 2014). Research suggests that, due to their cognitive limitations and particular needs, children should be prioritized in active transportation safety, as recommended by the WHO (2013) and others (Arason, 2014). Parental supervision has been shown to strongly improve pedestrian safety (Barton & Schwebel, 2007).

Visibility, another key principle of pedestrian safety, is particularly important given the smaller size of children. It is especially important that road designs ensure children remain visible and are not obscured by landscaping or parked cars (Arason, 2014; WHO, 2013). Designing vehicles to provide better visibility, particularly from the rear, can also help reduce the likelihood of collisions with children (Arason, 2014).

Another important factor to recognize about road safety as it relates to young people, particularly as they progress through adolescence, is young drivers. Younger drivers "have a fatality crash rate about double that of other drivers," and when time spent on the road is taken into account, drivers aged 16 to 24 are five times more likely to be killed than those aged 25 to 44, and are also a greater threat to other drivers, pedestrians and cyclists (Arason, 2014, p. 14). A majority of passenger vehicle-related deaths during normal school travel hours in the United States occur when a teenager is driving (Transportation Research Board, 2002). One way to approach this problem is to raise the age of licensing drivers to 18, as is done in many European countries (Arason, 2014). Since young drivers put themselves and others at much greater risk, shifting

young adults, including high school students, away from car travel and towards public transit and active modes becomes all the more important.

Travel behaviour among young people

Unfortunately, despite the many benefits of active transportation modes, there have been troubling trends in school travel in recent decades, with increasing numbers of students being driven to school, and substantial decreases in the number of students who walk and bike to school, particularly among elementary school students (Metrolinx, Green Communities Canada & University of Toronto, 2014; Speck, 2013). In Canada, while 58 percent of Canadian parents walked to school when they were kids, only 24 percent of their children walk to school today, including a drop of four percent from 2000 to 2010 (Active Healthy Kids Canada, 2014; ParticipACTION, 2015). Meanwhile, other countries have found much more success in fostering active transportation. In the Netherlands, roughly half of primary school children bike to school, and only 14 percent are driven. In Denmark, two-thirds of 15-year-olds bike to school, and cycling rates tend to increase through childhood into adolescence, until teenagers reach driving age; similar rates 12 to 14 year-olds bike to school in Jiangsu Province, China (McDonald, 2012).

There is research that shows strong potential for increased active travel among youth (Lewis, 2008), including studies that show youth prefer active travel over other modes (Garrard *et al*., 2012; O'Brien *et al*., 2009). Active travel appeals to young people because it allows opportunities to assume greater responsibility, engage in social interaction, and for experiences in nature (McDonald, 2008). However, there is a vast difference between these preferences and observed behaviour: one study found that a

total of 75 percent of Ontario elementary students preferred walking or biking to school, including nearly 27 percent of students who preferred cycling, but only 3.5 percent were actually riding a bike to school regularly (O'Brien *et al.*, 2009). This points to the potential for active transportation among youth if barriers are removed. Youth who do walk or bike to school are more likely to use active transportation modes to travel to other destinations (Dollman & Lewis, 2007), so encouraging active transportation to school has great potential to expand the total number of active trips made by young people, and develop habits that could extend into adulthood.

Parental control, including car ownership and how the adults in the family get to work, plays a central role in how students get to school (Lewis *et al.*, 2008). Parental control and perceptions of transportation modes may explain the difference between preferred and actual school travel modes. As children get older, they attain greater independence over their modes of travel, particularly starting around age 10 (OECD, 2004; McDonald *et al.*, 2010). This coincides with a leap in cognition around that age, although children remain at greater risk from traffic well into adolescence (Arason, 2014). Parents of younger children and girls are more likely to make decisions about school travel for their child, and are more likely to be influenced on that choice based on the traffic environment (O'Brien *et al.*, 2009). Although young people have fully developed the cognitive skills to negotiate traffic by the time they get to high school, travel decision making among parents and students remains a negotiated process during these years (Emond & Handy, 2012; Wittman, 2014).

There are a variety of barriers that prevent children and their parents from negotiating a decision to walk or bike to school, with the two most prevalent being

distance and fear of traffic danger (Panter, Jones & van Sluijs, 2008; Rossy *et al.*, 2012). McDonald (2008) found that 48 percent of students aged 5-13 living within 1 mile (1.6 km) from their school walked, but that dropped to 3 percent if their trip to school was more than 1 mile. The importance of proximity of student households to schools in relation to rates of walking to school shows the need for thoughtful geographical placement of schools within communities, so that parents and students feel that walking is a realistic option. It may also be necessary to keep schools small, opening new schools in appropriate locations rather than expanding existing schools, and not closing schools if it means making it more difficult for many students to walk or bike to school. It is especially important to emphasize cycling when schools are too far away from many students' homes to walk, but may still be within a 10 to 30 minute bike ride. This is especially true for high schools, which generally attract students from a wider geographic areas, and have older students who are more likely to want to cycle and who have developed the cognitive skills to do so safely on a variety of road contexts. In addition to distance to school, active commuting among young people is also associated with the number of friends that children have who live in close proximity to their home (O'Brien *et al.*, 2009).

The second most prevalent barrier parents and youth face is fear of traffic danger (Panter, Jones & van Sluijs, 2008; Rossy *et al.*, 2012). McDonald (2012) notes evidence that the restrictions that parents place on children's travel due to safety concerns have

increased in recent years. O'Brien *et al*. (2009) looked at a number of studies that find that "in general, negative parental perceptions of the physical environment are associated with lower rates of active transportation among youth, even if youth have positive perceptions of the neighbourhood" (p. 19-20), which is often the case. There is often a marked gender difference in perceptions of road safety, with parents of boys more likely than parents of girls to perceive their neighbourhood as safe (O'Brien, 2009), and boys more likely to walk or bike to school (Larsen *et al*., 2009).

Some groups of students may face additional barriers to active transportation. Zho & Lee (2008) found that neighbourhoods in the United States with higher poverty or more Hispanic students had fewer environmental supports for walking, and faced greater danger from traffic as well as crime. Toronto Public Health (2012) has found similar associations between neighbourhoods which are less walkable and those with lower incomes. Despite the poor walking conditions in low income neighbourhoods, McDonald, Deakin & Aalborg (2010) found that minority students from lower income households were more likely to walk to school, as they had fewer alternatives to walking and cycling, largely due to a lack of vehicle access. This information points to the importance of ensuring that all students are able to walk to school safely, regardless of their economic, racial, or ethnic background. Gender also plays a role, with a number of studies showing that young females are less likely to walk or cycle than males, despite boys being more likely to engage in risky pedestrian behaviour, and more likely to be injured as a pedestrian (Barton & Schwebel, 2007; O'Brien *et al.,* 2009).

Although active travel is dropping among children and adolescents in North America, as young people mature into their twenties they are less and less likely to have a driver's license, and more likely to choose to live in dense, walkable urban communities (Speck, 2013; Sivak & Schoettle, 2012). In contrast to public elementary schools and high schools, universities in North America often have very high rates of travel by bike or on foot to and from campus, with some reporting active transportation mode shares of over 50 percent (Toor & Havlick, 2004). These counterintuitive trends in travel patterns between high-school aged adolescents and young adults as they enter post-secondary school or the workforce is an area on which there is little research. Perhaps as teenagers move into young adulthood, and gain more independence in decisions around travel and accommodations, they then shift towards the active transportation modes and walkable environments that they always preferred, but had been held back from previously by more conservative and fearful suburban parents.

Christensen, Chatterjee, Marsh, Sherwin, & Jain (2012) suggest that "transitional life events" can trigger changes in travel behaviour, and that using these events can help foster active travel modes. Perhaps this helps explain the modal shifts observed among young adults, as when young people get older, they experience the pivotal events of graduating high school, pursuing post-secondary education or getting a job, and at each pivotal point become increasingly likely to bike or change travel behaviour. Perhaps the shift from elementary to high school can similarly be used to leverage active travel behaviour; for instance, by focusing active travel programs on students as they enter high school in grade nine.

There are a variety of educational strategies that have been used to encourage active school travel. Interventions are more effective if they focus on specific goals, such as active transportation in particular, or even specific skills such as those involved in safe road crossings, rather than broader aims, such as within general physical activity or environmental programs (Chillon, Evenson, Vaughn & Ward, 2011; OECD, 2004). The OECD (2004, p. 56) recommends that for road safety education to be effective, it should be "part of a lifelong learning scheme," be part of the school curriculum, include quality resources, and be "targeted and tailored to take in to account" the differences in traffic safety risks across different population groups.

Stasiuk, Dubinski, Paterson & Pope (2013) investigated various education programs that sought to encourage active transportation to and from school, and identified walking school buses, walk to school days, as well as safe routes to school and cycling education programs as being effective. "Walking school buses" involve adults supervising groups of children on their trip to and from school along organized route. Although these programs have been shown to be difficult to sustain over the long term, there is evidence that they are successful in encouraging students to walk to school, results which persist even after organized walking groups disband (Muchaka & Behrens, 2012). Walk to school days, which simply encourage walking on one or a few days a week, provide incentives to students to walk to school through promotional items and activities, have been shown to increase walking as much as 31 percent (Stasiuk *et al.,* 2013). Safe Routes to School programs are more extensive, and may include walking school buses or walk to school days, along with pedestrian and bicycle safety activities, themed based school assemblies and classroom activities, information

and promotional materials for parents, police involvement, or even safety improvements to nearby sidewalks, crosswalks and intersections; such interventions can increase walking as much as 114 percent (Stasiuk *et al.,* 2013). Cycling programs involve a similar variety of promotion strategies and changes to physical infrastructure. Since both Safe Routes to School and cycling programs may involve a variety of educational approaching involving students as well as parents, and non-educational changes such as infrastructure improvements, it is difficult to assess the success of individual elements of these multi-faceted active transportation initiatives, as noted by McDonald (2012) and the OECD (2004).

McDonald also notes that cycling education programs in many jurisdictions hesitate to allow children practice their skills on the road, which may limit their effectiveness. An OECD (2004) report suggests that "child pedestrians learn best at the roadside or a close approximation," and that skills training for pedestrians, bicyclists and drivers should be practical rather than involve "presentation of abstract rules in the classroom" (p. 45).

Education and safety programs for child cyclists often focus on promoting helmet use, as helmets reduce the instance of head injuries, which are more common among children in roadway collisions (WHO, 2013). Bike helmet promotion campaigns have been found to be effective in increasing the wearing of helmets (OECD, 2004). Helmets are required by law for children in Ontario, and in much of North America (McDonald, 2012). However, some have suggested these laws contribute to reducing rates of cycling, thus negating the health benefits of decreased head injuries (Jacobsen & Rutter, 2012).

Schools are important sites for cycling education, as they can provide universal, accessible, and affordable cycling education programs. Green Communities Canada & Share the Road (2012) recommend cycling education be added to the school curriculum in grades 5 through 7. Currently, in Toronto as well as much of Canada, schools are dependent on outside agencies to implement cycling education. Parents in major cities in Canada can sign up their children for a CAN-BIKE course, an education program organized by Cycling Canada. Many of these courses, however, are not available in many communities, and can be costly, making them inaccessible to many families. As with similar programs in other countries, these programs have been shown to be effective in improving skills and knowledge, but can be inconsistent in how they are delivered (OECD, 2004).

It has been shown that better infrastructure on school grounds can support active travel, such as the installation of bike racks (Green Communities Canada & Share the Road, 2012). Education can work in concert with infrastructure and environmental changes, such as with route planning, which can both be an educational tool, as well as a way to identify solutions to improve sections of key school routes.

A number of authors have found links between rates of active transportation and the built environment, such as Frumkin, Frank & Jackson (2004), who describe correlations between denser urban form, mixed land use and active transportation. Frumkin *et al*. also note that while sprawling suburban streets may offer safe environments for small children at play, the lack of connectivity of such environments becomes less safe and welcoming as children get older, and their territories expand (p. 117). Larsen *et al.* (2009) found a correlation between students walking and biking to

school and higher land use mix, as well as shorter trips and the presence of street trees. Larsen *et al.* also note that "younger populations are less mobile and more influenced by the features in their local surroundings and therefore more likely to benefit from increased walkability in local neighbourhoods" (p. 520). Davison & Lawson (2006) found positive associations between the physical activity of children aged 3 to 18 with the presence of sidewalks and controlled intersections, and access to destinations and public transportation - essentially the markers of walkability. Not all evidence finds the same association, however; Lewis (2008), interestingly, finds no clear difference between downtown and the suburbs in terms of walking and biking between home and school in the Quebec elementary school context. Larsen *et al*. (2009) also found that active travel to school was associated with lower residential densities, which is somewhat counter to common thinking in planning that associates walkability with higher density. Overall, most literature suggests that urban design and the built environment is a very strong influence on whether students walk or bike to school.

3.5 Summary & conclusion

The evidence presented throughout this literature review highlights the importance of active transportation for young people, and suggests the need to encourage more of them to choose to walk or bike as part of their daily commute to school and to other destinations in their neighbourhood. I explore this topic further in the following sections in which the research in this literature review is applied to the development of an active transportation plan for West Hill Collegiate Institute, a high school located in Scarborough, Toronto, Canada. I approached students at the school via

focus-group-style interviews and a questionnaire, to ask them how they could be encouraged to shift to active transportation modes for their daily travel, what barriers they faced to choosing these modes in their community, what they found appealing about these and other modes, how their parents and family members influence their travel choices, and what changes they wanted to see on their neighbourhood streets. I also analyzed the surrounding neighourhood in the context of this research, looking for planning, urban design and engineering interventions that could be put to use to improve the safety and general environment in a way to prioritize walking and cycling.

4. Area study & consultation with West Hill Collegiate Institute students

4.1 Area Study

Current conditions

West Hill Collegiate Institute (WHCI) is a public secondary school located in eastern Scarborough, part of the amagamated city of Toronto. It is located on Morningside Avenue, a busy major arterial road, just north of Kingston Road, next to Highland Creek and Morningside Park. WHCI is part of the Toronto District School Board, and the catchment area for students who attend the school extends mostly to the north, all the way to the northern border of Scarborough and the City of Toronto at Steeles Avenue.

WHCI's location to the far south of its catchment area, rather than at its geographical centre, creates unique challenges for developing an active transportation plan for the school. Although the students living south of Highland Creek are all within easy walking distance, mostly on quiet residential streets, the large portion of the student body living to the north may find it more difficult to be able to

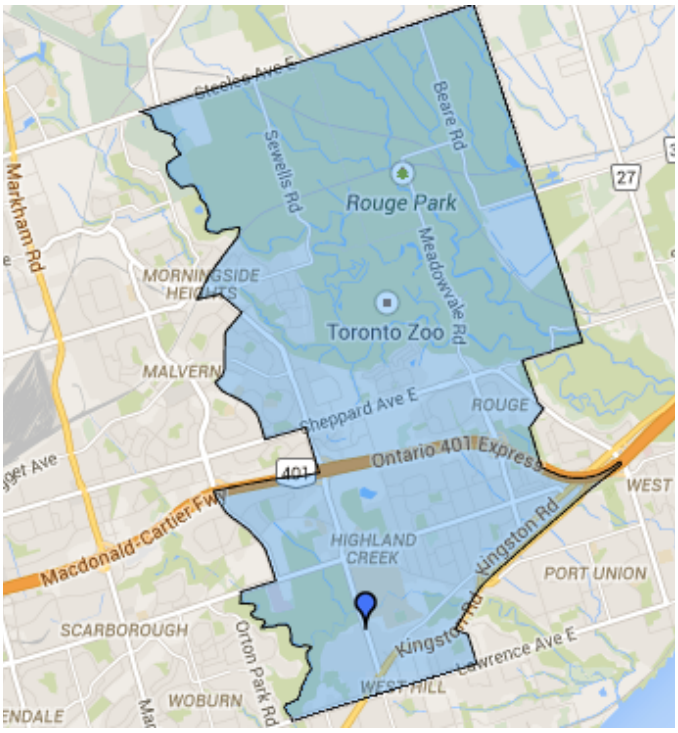

Figure 8: West Hill Collegiate student catchment area

walk to school on a regular basis throughout the school year, due to distance as well as geographic barriers. However, most of the catchment area is within a 20 to 30 minute distance by bicycle, making encouraging cycling and improving bicycle safety and infrastructure key to improving active transportation on a broad scale. Improving transit can also help in terms of achieving the goal of incorporating physical activity into students daily lives, as transit users tend to walk more and be more physically active (Speck, 2013; Toronto Public Health, 2012).

Highland Creek and Morningside Park, located immediately to the north of the school, while assets in terms of trails and recreational space, also serve to separate the school from much of its student body due to its topography and large size, which may discourage active travel to school by students living to the north, even if they are relatively close by. Students living north of the 401 expressway in the WHCI catchment area have an additional physical and psychological barrier to overcome, along with a particularly intimidating distance to travel to school, although still within a reasonable cycling distance.

WHCI fronts on to Morningside Avenue, a major four-lane arterial with a 60 km/h speed limit. Over 13,000 cars travel each day on the section of Morningside in front of West Hill Collegiate, with higher volumes close to the 401 highway (City of

Figure 9: West Hill Collegiate, view from main entrance at Morningside Avenue.

Toronto, 2013). There is a signalized crosswalk in front of the school that allows crossings at the south side of the intersection only. The closest other signalized crosswalks are located 300 m to the south at Tefft Road, and 1.1 km to the north at Ellesmere Road. The school is also accessible for students via a walking and bicycling path that connects to Weir Crescent behind the school to the west.

In terms of other transportation options, the 116 Morningside bus stops in front of the school, running north to Finch Avenue, south to Guildwood Parkway and Eglinton Avenue East, and connecting to Kennedy subway station to the west. The 116 bus offers frequent service of 10 minutes or less between buses throughout the day, and carries over 20,000 passengers each day (Munro, 2013). Students also have the option of taking a school bus to travel to and from school.

The nearby West Hill residential neighbourhood features relatively quiet streets with a mix of 40 and 50 km/h speed limits. Many residential streets do not have sidewalks, or only have sidewalks on one side of the street. Other neighbourhoods within the catchment area, such as Highland Creek and the Rouge, have a similar mixture of intermittent sidewalks running along residential streets. Major streets running through the catchment area include

Figure 10: Sidewalk inventory
Green: sidewalks on both sides of street;
Orange: sidewalks on one side of the street;
Red: No sidewalks; Blue: Multi-use trails
Source: City of Toronto (2011), http://bit.ly/1LPMDfE

Kingston and Ellesmere Roads and Sheppard Avenue East. These major streets generally lack residential frontage, and are instead fronted by a mix of commercial, industrial, and institutional use, generally at a low density. The intersections on Morningside at Ellesmere Road and Sheppard Avenue East are both among the ten most dangerous in Toronto in terms of rate of collisions (Khandaker, 2015).

There is a multi-use trail running along the Highland Creek valley system beside West Hill Collegiate. However, the trail runs on the opposite side of the creek from the school, and along with the depth of the valley makes use of this trail for travel to and from school difficult. The only other bicycle infrastructure within the WHCI catchment area is found north of Ellemere. This includes a north/south bike lane along Collins Road, an east/west route along the portion of Sheppard Avenue east of Morningside, and some disconnected trails near the Toronto Zoo and Rouge Park. Other signed bike routes exist just to the south of West Hill Collegiate, but end at the borders of the catchment area.

Demographic and travel data

In order to draw a rough picture of the people who live in in the catchment area, and by extension the families of students who attend West Hill Collegiate Institute, City of Toronto neighbourhood and Ward profiles, drawn from 2011 Census and National Household Survey data, were used. This scan of demographic data involved looking at a number of different neighbourhoods, as the WHCI catchment area doesn't fit well with local political wards or neighbourhood boundaries. Overall, based on this information, students who attend WHCI most likely live in single-detached houses as part of a larger than average family, and are likely to be part of a visible minority group.

There are large numbers of immigrant families, with those of Sri Lankan, Filipino, Indian, Guyanese, and Jamaican origins being most prominent. While overall, household income levels are roughly average or above average compared to the City of Toronto as a whole, income levels vary widely within the catchment area, with some neighbourhoods home to high numbers of low-income families. Two neighbourhoods close to WHCI in the catchment area, West Hill and Morningside, have been identified by the City of Toronto as Neighbourhood Improvement Areas (NIAs): neighbourhoods which require special attention due to scoring low on measures of equity and wellbeing (City of Toronto, 2014, March). While the population in the neighbourhoods that comprise the WHCI catchment area is growing, and there are higher percentages of young people over the age of 14 compared to the rest of the city, the number of children under the age of 14 is lower than elsewhere in Toronto, so student population at WHCI may not grow much in the coming years.

West Hill Collegiate itself falls in the West Hill neighbourhood, although its student catchment area only comprises a northern section of the community. West Hill is a modest neighbourhood, where median and average incomes are somewhat lower than the average for Toronto ($47,000 and $56,000 per year, versus $52,000 and $71,000 for the city as a whole). Low income people represent 25 percent of the population, significantly higher than the city rate of 19 percent. 51 percent of residents were born in Canada, roughly equivalent to the rest of the city, although there are more visible minorities than elsewhere in the city. West Hill residents are more likely to live in a single-detached house than the City of Toronto average (34 to 25 percent), and somewhat less likely to live in an apartment building. (City of Toronto, 2014e)

The Highland Creek neighbourhood should give a better idea of the student population of WHCI, as it falls entirely within the catchment area of the school, and is located just to the northeast. Highland Creek residents are less likely to be born in Canada than the Toronto average (43 percent to 49 percent), with 71 percent of residents being visible minorities (versus 49 percent in all of Toronto). Household incomes are significantly higher compared with the city as a whole, and the low-income population is only 8 percent, less than half of the city rate. The low-density built form of Highland Creek is demonstrated by the 83 percent of families that live in single detached dwellings, with very few living in any kind of mid to high density apartment building. (City of Toronto, 2014c)

A substantial portion of the Rouge neighbourhood falls within the West Hill Collegiate catchment area to the north. It is a particularly large community in the northeastern corner of Scarborough. Again, a majority of residents live in single-detached houses, and few live in apartments, although there are higher than average percentages of residents living in semi-detached houses, row houses, and duplexes in the

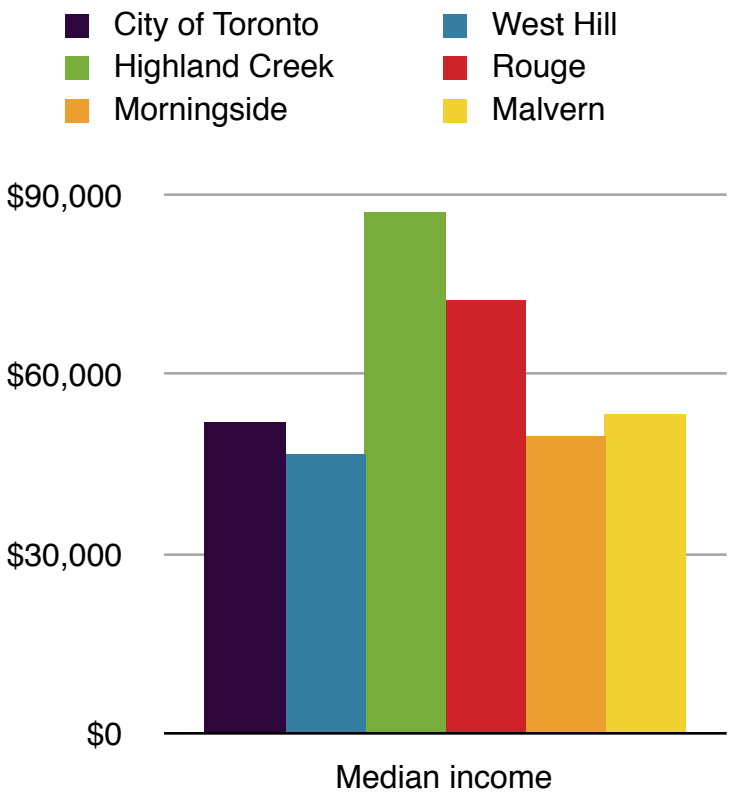

Figure 11: Graph depicting median incomes of neighbourhoods with the WHCI study area.
Source: City of Toronto, 2014a, 2014b, 2014c, 2014d, 2014e

Rouge. The neighbourhood again has higher median and average household incomes and a smaller percentage of low-income households, but closer to the city-wide rate than in Highland Creek. 79 percent of Rouge residents are visible minorities. (City of Toronto, 2014a)

The catchment area of West Hill Collegiate also includes small portions of the Morningside and Malvern neighbourhoods. These are both somewhat lower income neighbourhoods compared with elsewhere in the catchment area, with similar demographics in terms of immigration and number of visible minorities, and an urban form denser than Highland Creek and the Rouge. Both Morningside and Malvern are similar to West Hill in terms of the percentage of residents living in houses as opposed to apartments. (City of Toronto, 2014b; City of Toronto, 2014d)

Some further insights can also be gained from looking at the demographics within the political boundaries of Ward 44 - Scarborough East, whose northern half encompasses a large portion of West Hill Collegiate's catchment area. Ward 44 has larger households, with higher numbers of couples with children, and higher numbers of children in each family, compared with the rest of the city of Toronto. Most of these children are older, as Ward 44 has lower than the city average in terms of the percentage of children under 14, but higher percentages of young people 15 years of age and older (City of Toronto, 2014f).

Looking at Ward 44 is particularly useful to determine the mode share of the area. According to the 2011 Transportation Tomorrow Survey (DMG, 2011), 59 percent of daily trips by residents of Ward 44 are made by drivers, with an additional 18 percent traveling as a passenger in a car, both higher than the city-wide rates of 50 & 14 percent

respectively for these modes, and among the highest rates of automobile commuting in the city. 17 percent of daily trips in Ward 44 are made by public transit, 13 percent by TTC and 4 percent by GO train, although these rates rise to a combined 22 percent during peak AM travel. Trips by walking or biking are made by 5 percent of residents in Ward 44 each day, with this number rising to 7 percent during peak morning hours, compared to 9 to 11 percent of walking and cycling trips made by residents of Toronto as a whole. Again, we see the car-dominated nature of the neighbourhood in these numbers, although there are still significant numbers of people traveling by transit, bicycle, and on foot. Ward 44 residents take more trips each day, own more vehicles, and have more drivers per household than in the City of Toronto as a whole. These numbers are similar in other Wards (42 & 43) that overlap with the West Hill Collegiate catchment area.

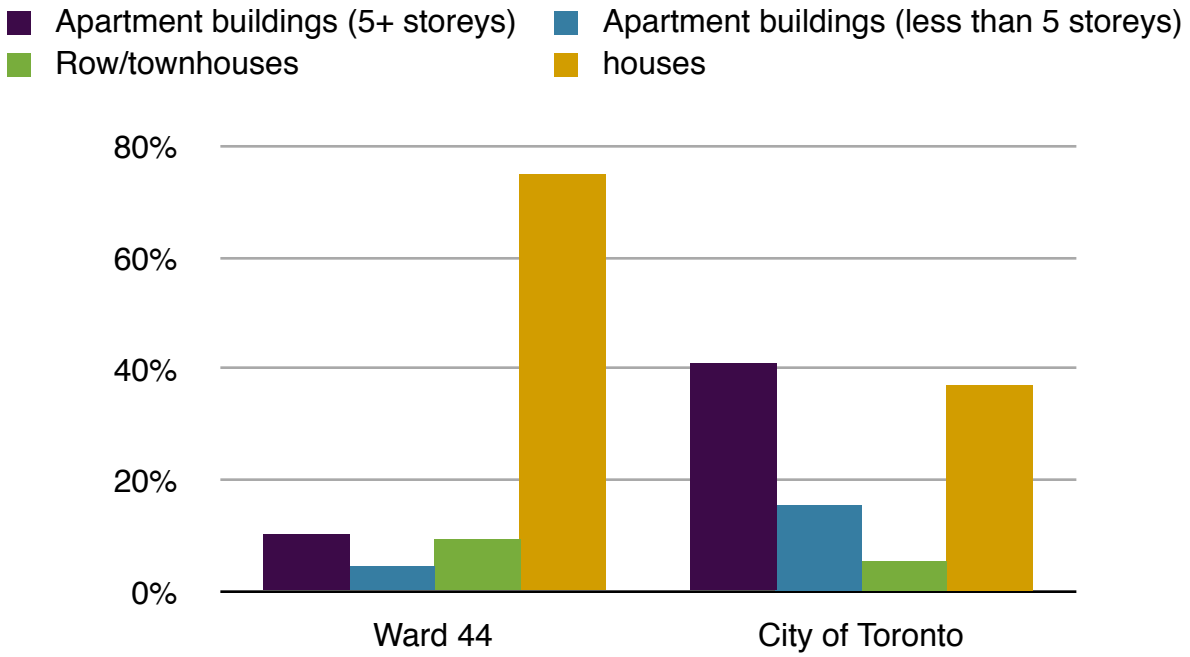

Figure 12: Types of built form in Ward 44. (City of Toronto, 2014f).

4.2 Consultation with students

Survey

The survey was originally meant to be the main focus of the consultation process for this project, but due to a very limited response rate, very little can be concluded from the survey in terms of representing the views of a broad cross section of West Hill Collegiate students. Many of the students who responded were the same members of the Athletic Council who were also involved in the focus group (described below). The following observations focus on the survey responses that showed a very strong pattern or preference, or which differed markedly from previous surveys of students attending high schools in the core of the city of Toronto. Further survey data would need to be collected in order to confirm the observations made below to see if they reflect the school's student population accurately, although many are in keeping with previous studies on school travel behaviour. (For the entire survey, see Appendix A.)

In terms of demographics, all of the students who filled out the survey had lived in Canada since birth except one. This is notable in part due to the high numbers of immigrant families identified within the wider demographic scan, and since other studies done in Toronto (Wittmann, 2014) showed a much higher proportion of students who were more recent immigrants. This may have more to do with the students who responded to the survey, however, rather than an accurate reflection of the student body. It's also worth noting that most students said that one or both of their parents were not born in Canada, suggesting that many students came from more established immigrant families.The gender split in survey respondents was 6:4, male to female.

Travel preferences among survey respondents were mixed, with most respondents saying they took a bus to school, either the school bus or public transit. A few students arrived by car, either driving or as a passenger, with only one student saying they walked, and none who rode a bike to school regularly. Almost no students said they ever rode their bike to school, and very few said they rode their bike for any reason during a typical week. The survey indicated that students had shifted away from active travel between elementary school and high school, as most students said they walked to their elementary school when they were younger, a finding that was supported by the focus group as well (see below). Very little gender difference could be observed from the small sample size, although it is worth noting that all of the students who travelled by car to school were male.

Very few conclusions can be drawn from these mixed results, although they do point to a lack of active travel among students at West Hill Collegiate. The lack of students cycling, not only to school but for other reasons, suggests that initiatives to encourage recreational cycling may be a good place to start, since there are good recreational bike trails near the school, and since other surveys suggest that students who bike to school are more likely to ride recreationally (Wittman, 2014). Considering most students who responded to the survey were involved in athletic initiatives, the lack of cycling among this group is all the more remarkable, and would likely have been repeated even if a broader set of responses had been received. The shift away from active travel modes from elementary school to high school is to be expected to some degree, as high schools tend to have much larger and more geographically dispersed

catchment areas. However, it is likely exacerbated by the poor geographic location of West Hill Collegiate at the far south of its catchment area.

All of the students who responded to the survey reported that their families had at least one car at home, with the majority having two vehicles, with an average of 1.9 cars per household. This is much different than survey results of downtown schools, where less than half of the households at some downtown schools reported owning motor vehicles (Wittman, 2014). Studies have found that households with larger numbers of cars result in less frequent trips to school by active modes among children and youth (O'Brien *et al.*, 2009). All of the students who responded to the survey said that adults in their family traveled to work or other destinations by car, with two students saying adults in their family also traveled by public transit. All students said they knew how to ride a bicycle, and most owned a bicycle, roughly in keeping with similar surveys.

Interestingly, on the question of who makes the decision about school travel, the results were exactly split, with an equal number of students saying they decided on their own versus those who said their parents decided, and two respondents saying the decision was negotiated between themselves and their parents. Previous studies have shown that most high school students in Toronto say they make this decision on their own (Wittman, 2014). The high percentage of students saying their parents decided on their mode of travel at West Hill is especially surprising given that all of the survey respondents were older senior students in grades 11 & 12, mostly aged 17 or 18. Also contrary to previous survey results was that the majority of students claiming that their parents decided their travel mode were male. Parental influence in student travel

decision making are worthy of future study, and should be included in any potential future studies at this school and others in the surrounding area. Overall, the responses in this survey are in keeping with other studies that suggest that parents have a strong influence on student travel, even among older high school students (Emond & Handy, 2012; O'Brien *et al.*, 2009).

Roughly half of students said the reason for choosing their mode of transportation was because it was "easy" or "affordable," with a few choosing "speed" as the reason, along with a mix of other responses. Most students said they lived too far away to ride a bike to school, while a few said they considered cycling to school unsafe, preferred other modes, or did not own a bicycle, along with a mix of other responses. Students were most likely to describe bicycling as "fun," while the other recurring words in responses included it being "easy" and a couple of variations describing health and fitness benefits, eg: "easy way to get fit," and "good for your health."

Figure 13: "Why do you choose [your] mode of transportation?" Word cloud of responses.

Figure 14: "In 2 to 5 words, what do you think about bicycling?" Word cloud of responses.

Most students who completed the survey lived quite far from school, with only one student living within 1 km, and another living within 2 km of the school. The majority of students lived 4 km or more away from the school, including one student that lived further than 5 km away. This suggests a much more

dispersed student population at West Hill Collegiate than at urban Toronto high schools, where the majority of students tended to live within just a few kilometres of their school (Wittman, 2014). It is also even more dispersed than the catchment area boundaries would suggest. Active travel to school tends to decrease the further away from school students live, so these findings do not bode well for encouraging active transportation, especially walking (Emond & Handy, 2012; McDonald, 2008; Pucher & Dijkstra, 2000; Schlossberg, Greene, Page, Johnson, & Parker, 2006). However, these findings also point to the potential for cycling at the school, as cycling is three to four times faster than walking, and 5 km can be easily bicycled in 20 to 30 minutes, considered a historical and preferred travel time for regular trips (Montgomery, 2013; Pucher & Dijkstra, 2000; Schiller, Bruun & Kenworthy, 2010; Winters, Brauer, Setton, & Teschke, 2010).

Most students said they never wore a helmet while riding a bicycle, although most also said that wearing one "is important to stay safe while cycling," perhaps in part because they did not think it was "fashionable or stylish." This is not unusual, as students often report disliking wearing helmets (Emond & Handy, 2012).

Very few strong observations could be drawn from the later questions in the survey that gave students a range of responses from agreeing or disagreeing with statements about transportation. This was due to both the small sample size, along with a broad variation of responses to most of these questions. Most students agreed that they had a good place to lock their bike at home, although few said the same about having a place to store their bike at school. Most students agreed that biking was "a fast and convenient way to get around," but few students could see themselves riding a bike

in the winter. Students strongly agreed that they have access to places to be physically active, and agreed that cycling to school was a good way to "stay/become fit and healthy." They also agreed that "there are lots of services near my school that are easy to get to on foot or by bike." They agreed that they felt comfortable walking along streets near the school, although results were notably more mixed about whether they felt comfortable riding a bike on these same streets.

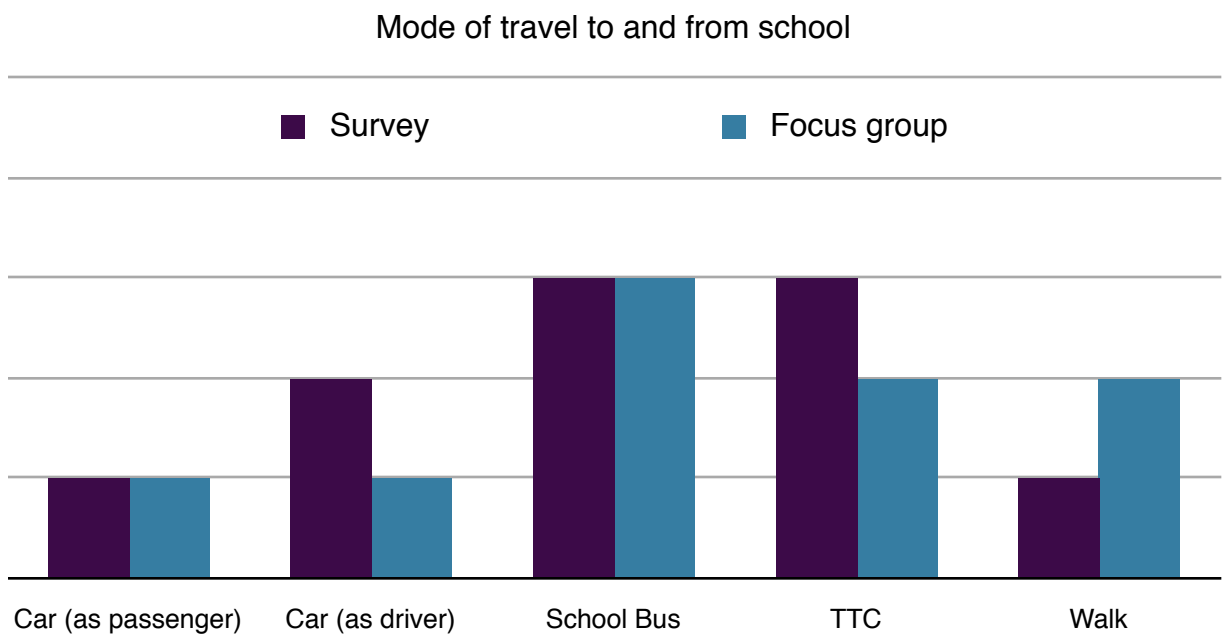

Figure 15: Graph depicting mode of travel to and from school reported by WHCI students. who completed the survey and participated in the focus group.

Focus group

I met with a group of eight students who were members of the West Hill Collegiate athletic council, a group of student leaders who work with school staff to organize physical activity programs at the school. The group consisted of senior students with a particular interest in athletics and healthy living, included students of

diverse backgrounds, and was split equally between male and female students. The focus group questions can be found in Appendix B.

The students in the focus group reported traveling to school via a range of transportation modes, with half of the students taking a bus, either the school bus (3) or public transit (2). Two students walked to school, one student drove themselves to school, and no students cycled to school. In keeping with the research, distance was the primary reason for whether they chose to travel to school by active modes. All of the students who currently walked to school lived nearby, south of Highland Creek. Those students said traveling by any other mode didn't make sense, given their proximity. Students living north of Highland Creek said they were unlikely to walk or bike to school due to the distance and the hills they would need to climb. The students said that they all walked to school when in elementary school, mostly because their elementary school was much closer to their home.

Students mostly cited speed in terms of what they enjoyed or did not enjoy about their commutes. Those taking the bus complained of it being slow, and the one student who drove to school citing a five minute commute by car compared to a 20-25 minute commute when they had previously taken the bus.

Students did not have much to suggest in terms of improving walking to school, saying that it was primarily distance that kept them from walking. There were many barriers mentioned about cycling to school, however, in addition to distance. These barriers to cycling included topography ("too many hills"), not owning a bicycle, safety both on the road as well as a lack of safe parking on school grounds, the condition of roadways (eg. potholes), and concerns about "getting sweaty." Improvements

suggested in terms of cycling improvements included adding bike paths, with one student noting the recent addition of a bike lane on Collins Road as the kind of improvement that could encourage cycling.

4.3 Summary & conclusion

The consultation process revealed a lack of students using active transportation to get to school, particularly cycling, despite generally positive feelings about cycling and walking. It also indicated a shift away from active transportation since elementary school, where most students walked to school, and high school. However, few students were driven or drove themselves to school; many took public transit or the school bus. Students were most likely to suggest that proximity was their greatest influence on whether they walked to school, while safety and a lack of safe bike storage at school were the major barriers to cycling. Parental influence on school travel seemed particularly high among students at WHCI, and parents were likely to drive to work and for other trips, and own multiple cars.

As mentioned in the methodology section earlier in this paper, the response rate to the survey was disappointing, and much lower numbers of students responded compared to the number of surveys distributed. Because of this, the results cannot be considered statistically significant in representing a substantial portion of the student body at WHCI. Ideally, the survey should be distributed again in the near future in order to obtain a more representative sample that is academically valid.

The focus group, although more successful in terms of following the methodology I had laid out when I started, also had limitations. While students were responsive and helpful, they had limited insights in terms of their travel behaviour, and

it was difficult to spark discussions that spread beyond generalities in the brief time set aside for the session. The time limitations also meant I was not able to draw on visual material I had prepared, to determine more specific preferences in walking and cycling infrastructure. Also, due to delays in completing the survey, the focus group was done before the survey results could be analyzed. Because of this ordering of the consultation, I was not able to follow up to ask specific questions to clarify or dig deeper into the results of the survey. Additional focus groups done with different groups of students, possibly with more time, and including visual materials, would help gain more valuable input from the student body.

Overall, the consultation was useful in providing some evidence that, as with many other public schools across North America in recent years, scant numbers of students at WHCI are likely traveling to school by walking or biking, almost assuredly less than other high schools in the urban core of Toronto. The consultation process also served its broad goal of providing basic guidance in developing an active transportation plan for the school, as the next section describes in detail. The survey and focus group described in this section should only be considered a preliminary consultation, and the following transportation plan should not be considered a final set of recommendations, but a way to spark further discussion among students, school staff, parents, and other community members as part of a more thorough public participation and planning process.

5. West Hill Collegiate Institute Active Transportation Plan

5.1 Vision and goals of the West Hill Collegiate Active Transportation Plan

The vision of the Active Transportation Plan for West Hill Collegiate Institute (WHCI) is to foster an environment where students are encouraged to travel to school and other destinations by walking, biking, or other active modes so that they will be physically and mentally healthier, cognitively ready to succeed in school, be more socially engaged with their local community, more independent, and reduce their footprint on the environment. Students of WHCI and other nearby schools, parents of these students, as well as local residents, will be able to travel throughout the community more safely and comfortably by all modes of travel. Improved mobility will also benefit the local economy, increasing local property values, commercial business, and access to jobs, while improving air quality and reducing noise pollution.

The plan will primarily seek to improve the environment for active transportation in terms of safety, urban design and transportation infrastructure. Recommendations are organized according to three main geographic areas: the school property itself; an area within walking distance where pedestrian improvements are prioritized; and the surrounding catchment area, where cycling improvements and safety at major intersections are prioritized. An additional set of recommendations is also offered in terms of recommending directions for future education programs, social events, and community connections to encourage walking and cycling. This model is meant to be flexible, so that it can be used to develop similar active transportation plans for other high schools.

The recommendations suggested for the WHCI campus itself can be undertaken directly by the school administration and the board, with the assistance of school staff, and if possible with the involvement of students as part of class or extracurricular projects. The area within walking distance of the school to be prioritized for pedestrian improvements, largely along local roads, for the purposes of this plan, will be the West Hill neighbourhood, particularly the section of the catchment area south of Highland Creek. The third geographic area considered by the Active Transportation Plan will be the large portion of the catchment area north of Highland Creek, where interventions will mostly focus on cycling connections and safety, and major arterial roads and intersections. Improvements to these latter areas will need to be undertaken by City of Toronto staff in Transportation Services, with the support of local residents and their political representatives. Other key stakeholders within the catchment area include other City of Toronto agencies, such as the Planning and Parks and Recreation departments, the Toronto Zoo, Rouge Park, the Toronto Region Conservation Authority,

Figure 16 & 17: Approaching the school from the west via the multi-use trail that connects to Weir Crescent.

and, importantly the University of Toronto, whose Scarborough campus falls within the catchment area, and which has its own long term master plan. Within each geographic area, each specific recommendation is organized by low, medium, or high intervention, based factors such as cost, potential construction disruption, and magnitude of the change from current conditions. (For a condensed version of the plan, see Appendix C.)

5.2 Recommendations

On-campus & immediate area nearby

There are a number of recommendations that WHCI's administration, in partnership with the school board, should be able to carry out on their own, with relatively minimal cost or disruption to the current environment. An informal path has been created through the school's back field by individuals traveling between the concrete pathway from Weir Crescent to the school building, wearing away the grass underneath students' feet. This is the most direct route from the Weir Crescent pathway to the school, and this well used walking path should be formalized using gravel or pavers. Additional landscaping improvements can further enhance the pathway, as well as potentially serving as an improved public gathering space for students and the community. These improvements could include plantings of native trees and plants, or a vegetable garden, and involve students in ways that enrich curriculum learning. The main goal of these improvements would be to create a more welcoming environment for students who walk, and ensure they feel valued on the last portion of their trip to school.

There are also opportunities for improvements to the current paved section of the pathway that connects to Weir Crescent. Adding a curb cut in front of the pathway would improve bicycle access, as well as accessibility. Signage, an archway, or public art welcoming people to West Hill Collegiate would also enhance this entry-point for pedestrians, and, similar to landscaping improvements on school grounds, could be done as a student project that enriches learning and builds student connections with their school and local community.

Along the side of the school facing Morningside Avenue, there are a few potential ways to improve accessibility and the pedestrian environment. The main entryway to the school from Morningside is currently dominated by a very wide driveway for vehicles, and does not provide a very welcoming environment for students or staff arriving by walking or bicycling. This environment could be improved through new landscaping, planting areas, and seating. Tall bushes or even a green wall could help enliven the blank windowless brick walls that dominate the school building itself at the front of the school.

Figure 18: Image of West Hill Collegiate campus. The current informal path, which could be upgraded through landscaping improvements, is circled in yellow. Other interventions include a new pedestrian connection (orange), and improvements to the main entryway (blue).
A new connection to the creek trail system (purple) could be provided via a bridge (red) and use of the current service roadway (green).

Bike parking racks are already scheduled to be installed in the fall at WHCI, and the main entrance would be a good place to locate these. Bike parking should also be installed at the back of the school and anywhere that students may arrive by bicycle.

North of the main entrance, a chain link fence runs along the school grounds parallel to Morningside Avenue. An opening in this fence could allow for a new pathway leading to the school from the north, connecting to an existing concrete path on school grounds. This would give students a more direct route to the school if they are coming from the north, rather than needing to walk all the way to the end of the fence to the south. Some young trees have recently been planted along this section, and more trees and vegetation like this can help buffer the school grounds from the busy, noisy traffic on Morningside Avenue, as well as absorb air pollution.

Immediately in front of the school, a signalized crossing offers pedestrians and vehicles access to the school, although only the south side of the intersection permits pedestrian crossings. This could put pedestrians at risk, including transit users accessing the bus stop on the east side of the street, as it forces them to cross the WHCI driveway, and could result in people attempting to cross on the wrong side of the intersection where there is no current crossing. The intersection should be adjusted to allow space for

Figure 19: The main entrance to West Hill Collegiate

Figure 20: With no bike racks, there are few locations for cyclists to lock up their bike.

safe pedestrian crossings at either side of the intersection. Other simple interventions to make the intersection safer could involve marking the pedestrian crossing more clearly using "zebra" or "ladder" striping or differentiated pavers, or by adding pedestrian refuge islands. Curb extensions and a raised crosswalk with differentiated pavers could also be considered as higher level interventions along the pedestrian crossing over the West Hill Collegiate driveway, which would help slow drivers as they enter school grounds, signal to them they are entering a space they should take extra care in, as well as offering aesthetic improvement to the school's entryway.

Interventions on the school's property could be done directly by the school and board administration. Although improvements to the intersection and signalized crossing on Morningside Avenue, a major arterial, are not directly under the control of the school, the school administration, staff and students could be influential if they were to push for and work with municipal government representatives for better safety at this intersection.

Figure 21: Sidewalk and signalized intersection in front of WHCI, looking north on Morningside Avenue.

Figure 22: Pedestrian crossing in front of WHCI, and northbound bus shelter.

Recommendations for the West Hill neighourhood

Students living within the southern portion of the school's catchment area in the West Hill neighbourhood south of Highland Creek are far more likely to walk to school, as per the findings during the focus group, as well as research which has shown that proximity is the most important determinant in whether a student walks to school (McDonald, 2008). However, the second most important determinant is safety, and fear of traffic can push students and parents away from walking (Panter *et al.*, 2008; Rossy *et al.*, 2012). With this in mind, pedestrian safety and a welcoming walking environment should be prioritized for interventions within the West Hill neighbourhood adjacent to West Hill Collegiate.

Evidence suggests that lower speed travel by vehicles greatly improves safety for both pedestrians and cyclists (Anderson *et al.*, 1997; Arason, 2014; Harris *et al.*, 2012; Liu & Popoff, 1997; Nilsson, 2004; Taylor *et al.*, 2000; Toronto Public Health, 2012; WHO, 2013), particularly among children (Kraus *et al.*, 1996; Retting *et al.*, 2003; Wann *et al.*, 2011). There are a number of different ways to reduce speed of vehicles, with one of the most cost-effective being lowering the posted speed limit (Kloeden *et al.*, 2004). The speed limits on residential streets near the school are generally set at 40 km/h. Speed limits of 30 km/h would be more appropriate for a residential setting that prioritizes pedestrian and cyclist safety, especially where many youth are present. This is especially important in the short term, as many of the local residential streets lack sidewalks. It is also important on residential streets immediately adjacent to West Hill Collegiate, and nearby elementary schools West Hill Public School and St. Margaret's Public School, where children and young people are most likely to be present. Traffic

calming measures, such as speed humps, neckdowns, and chicanes at midblock locations, and curb extensions and raised crosswalks at intersections, can further ensure vehicle speeds are minimized on these residential streets.

Another key principle in improving pedestrian safety is the separation of pedestrians from vehicle traffic. Sidewalks are key to this separation, and to creating a safer and more welcoming environment to foster active travel (Davison & Lawson, 2006). However, many residential streets near West Hill Collegiate do not have sidewalks, or only have sidewalks on one side of the street. Priorities for adding sidewalks should include streets without any sidewalks currently, streets that provide key connections, particularly those closest to WHCI or other schools in the vicinity, such as Amiens Road, Fairwood Crescent, Beath Street, Craggview Drive, and Falaise Road. This is in keeping with City of Toronto policy that all residential streets should have sidewalks on at least one side (City of Toronto, 2000). Some streets that currently have sidewalks on just one side of the street that are key pedestrian routes such as Warnsworth Street should also be upgraded to have sidewalks on both sides. Long term, the goal should be set for sidewalks on all residential streets in the area.

An alternate approach to new sidewalks on some residential streets could be to establish "woonerfs," or home streets, on which there continue to be no sidewalks, but instead

Figure 23: Sidewalk inventory: closeup on West Hill. Green: sidewalks on both sides of street; Orange: sidewalks on one side of the street; Red: No sidewalks; Blue: Multi-use trails *Source: City of Toronto (2011), http://bit.ly/1LPMDfE*

comprehensive traffic calming infrastructure is put in place, with roadways narrowed substantially, and speed limits of 30 km/h or even less established, so that cars travel slower and yield to pedestrians and cyclists. It should be noted that in order for this shared street approach to be effective, given the current conditions in the area, interventions would likely need to be much more extensive than installing sidewalks.

Morningside Avenue runs directly in front of West Hill Collegiate, as well as West Hill public school located just to the south at Amiens Road, and has a 60 km/h speed limit. This speed limit should be lowered to 50 km/h for at least this section of roadway from Kingston Road to West Hill Collegiate to prioritize safety for students and other pedestrians of all ages in this section. This section of Morningside could also be redesigned through narrower lanes and a raised median in portions of the roadway to calm traffic and improve pedestrian safety. It should be noted that the roadway is quite wide at roughly 15 metres, and narrowing lanes to the City of Toronto's current recommended width of 3.2 metres would free up a great deal of space for safety improvements and active transportation infrastructure. In addition to improving the crossing right in front of West

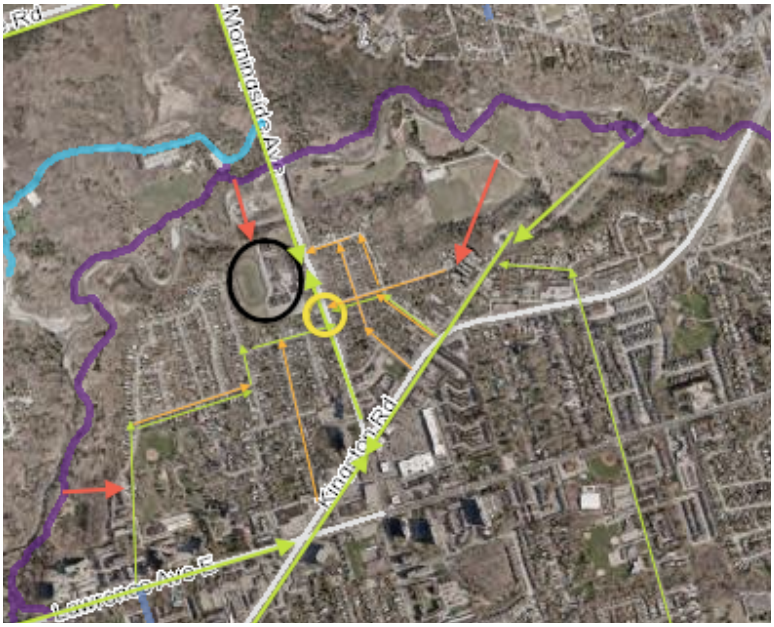

Figure 24: Recommended active transportation route improvements near WHCI.
Black: West Hill Collegiate; Yellow: new pedestrian crossing; Red: potential new connections to Highland Creek trail; Orange: pedestrian routes prioritized for new sidewalks and traffic calming; Green: bicycle routes

Hill Collegiate, an additional crossing should be added where Morningside meets either Warnsworth or Beath Streets, to give pedestrians another safe crossing opportunity in this section. Such a crossing could involve the addition of curb extensions, a pedestrian refuge island, flashing pedestrian beacons, a fully signalized crossing, or some combination of these options. Simply planting trees or other vegetation along Morningside Avenue could also improve the experience of walking along Mornginside by providing shade and shelter, and better buffering sidewalks from traffic. Widening the sidewalk on Morningside from its current 1.5 metre width to the city's recommended 2.1 metre width should also be considered (City of Toronto, 2010; R.E. Millward Associates Ltd., 2006).

For cyclists, the nearby bicycle routes that currently exist do not connect to West Hill Collegiate directly. The simplest and lowest-cost way to improve cycling connections is to install a signed route, or bicycle boulevard, along low-speed residential streets in the area. A route along Galloway, Craggview, Warnsworth, Beath, and Fairwood roads would provide an arching east-west bicycle connection through the area.

Painted bike lanes on Morningside Avenue would be the easiest and cheapest way to provide a north-south bike route along this major arterial, while also helping to narrow the roadway, improving safety for all road users at a low cost, and could be done without removing any travel lanes, given the current width of the roadway. This solution would offer minimal separation for cyclists, however, and thus have limited safety benefits. A better solution to improve cyclist safety and encourage people to try cycling would be fully separated bicycle lanes. These could be installed on the roadway itself, provided travel lanes were removed and Morningside were given a "road diet,"

an often effective way to improve cycling and pedestrian safety while still maintaining motor vehicle traffic flow. Although potentially more disruptive to the current road configuration, this could still be done at a very reasonable cost. Bike lanes could also be installed outside of the current curbs of the roadway and within the right of way, potentially providing more of a buffer between pedestrians and car traffic, and maintaining four travel lanes, although at a higher cost to implement. More potential bike lanes on nearby arterials are described in the section below regarding the surrounding catchment area.

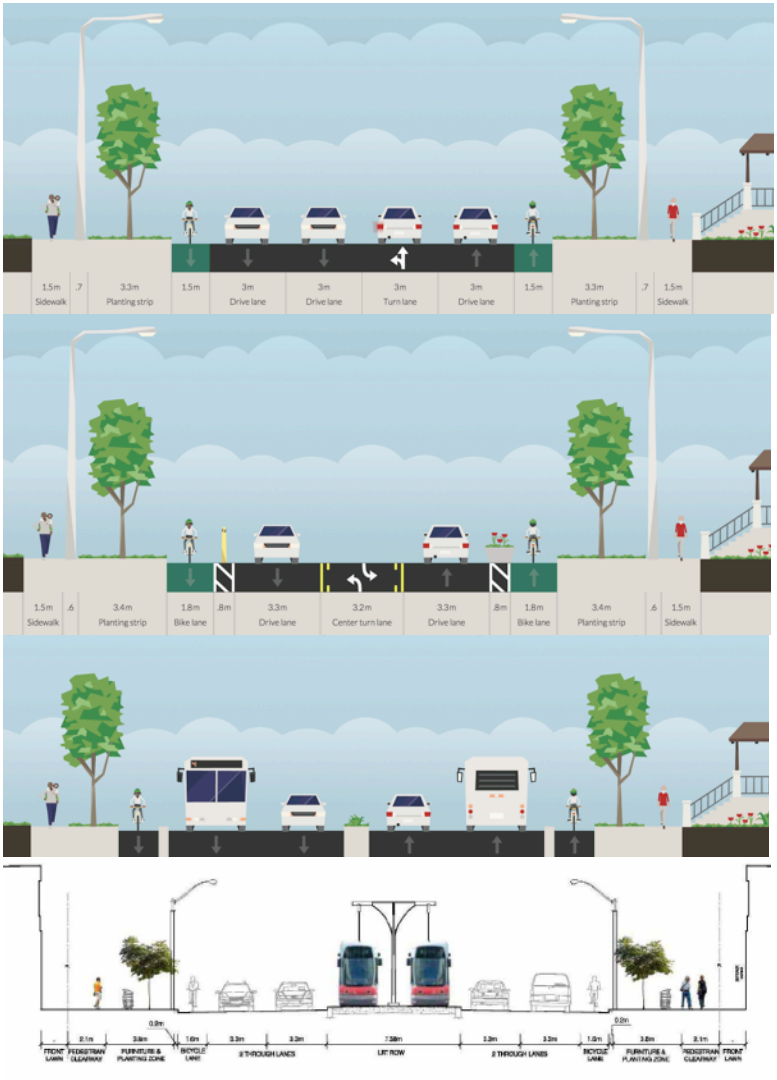

Figure 25: Cross-sections for potential street redesigns for Morningside Avenue near West Hill Collegiate.

1. Travel lanes narrowed, allowing room for painted bike lanes. *Low intervention.*

2. A road diet, with 4 travel lanes modified to 2 travel lanes, a centre turning lane (which would allow for wide raised medians & pedestrian refuge islands at strategic locations), and separated bike lanes on the roadway. *Medium intervention.*

3. Dedicated bus lanes added to current roadway, plus a new raised median, wider sidewalks, and separated bike lane added above curb outside of current roadway. *Medium-high intervention.*

4. Scarborough-Malvern LRT alignment. *High intervention.*

The main cycling connection that currently exists near West Hill Collegiate is the multi-use trail running through Highland Creek and Morningside Park. Unfortunately, since it lies at the bottom of a valley, and runs on the opposite side of the creek to the school, it does not offer much value as a bike route to school. This could be remedied by adding a bicycle and pedestrian bridge running over Highland Creek just north of the school and west of Morningside Avenue. This would connect the multi-use trail to the City of Toronto Parks and Recreation service yard and existing roadway on the south side of the creek, and up to Morningside Avenue, or even directly to the school grounds. There are limited other possibilities for connection points due to the wall of private residences that back onto the creek valley, but a couple of other potential connection points do exist, including from the east end of Beath Street, and to Galloway Road at West Hill Park. These would need to be investigated further for feasibility, as the topography is quite steep at these locations, and vegetation may need to be removed to provide trail access, particularly if it is to be accessible to all users.

Interventions to improve active transportation infrastructure in the West Hill neighbourhood would be controlled by the municipal government, and would need to obtain broad community support. Parents of students at the many schools in the area would hopefully support many of these recommendations, and school staff and administration would likely be an influential source of support. Ideally, changes to the road environment such as traffic calming measures, new sidewalks or bike lanes would be implemented at the same time as regular road maintenance, new development, or other construction, to minimize disruption to residents.

Recommendations for the northern catchment area & surrounding neighbourhoods

Most of the students within the catchment area live north of Highland Creek, most of it a fair distance away from WHCI. This makes it more difficult to encourage walking trips to school in this area. However, there are some key areas along major arterial roads where pedestrian safety is currently compromised, and these should be improved urgently. Also, there is great potential to improve cycling to school within this area, as even the northern portions are within a half-hour bike ride of campus.

As mentioned, establishing bike lanes on Morningside Avenue, running in front of WHCI, would greatly encourage students to bike to school. It is especially important that bike lanes on Morningside run north of WHCI, over the Highland Creek bridge, as there are limited north-south connections in this area. Bike lanes extended further, along the entire length of Morningside Avenue would offer a key north-south bike route for residents of all ages to access key destinations including the waterfront, Highland Creek, Morningside Park, the University of Toronto Scarborough campus, Rouge Park, and the Toronto Zoo. Bike lanes along Morningside already exist on its northern portion near Finch Avenue East, and Morningside Avenue south of Coronation Drive is currently a signed bicycle route. Bike lanes on Morningside Avenue have already been considered in the past, and were included in the 2001 City of

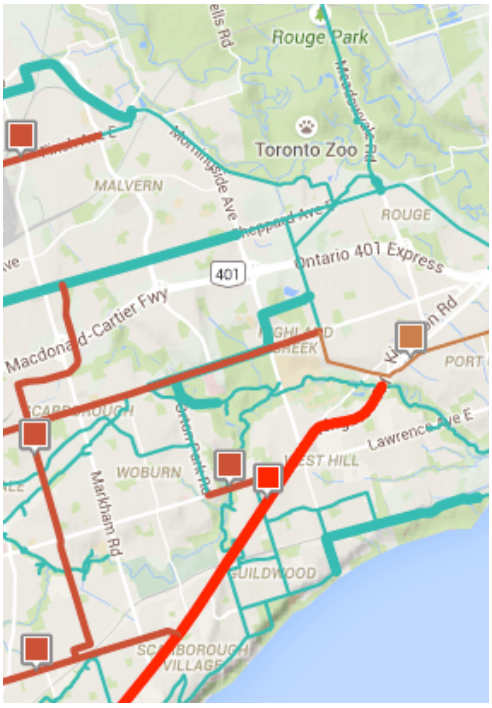

Figure 26: Draft routes for new City of Toronto cycling network plan (2015) near WHCI.
Green: current & planned routes
Brown & red: potential future routes.

Toronto Bike Plan, and as part of the University of Toronto Scarborough Campus Master Plan (2011). Bike lanes on Morningside could be phased in, with the first phase running south of Ellesmere to the current signed route south of Coronation Drive.

Other major arterials that could accommodate bike lanes include Ellesmere and Kingston Roads, both of which are included in the City of Toronto Bike Plan (2001), and have been included on the draft consultation map for the updated City of Toronto bicycle network plan (City of Toronto, 2015). Ellesmere Road was also included in the University of Toronto Scarborough Campus Master Plan (UTSC, 2011). In addition to bike lanes on major arterials, opportunities should be sought for local connections on which signed routes could be established on quieter local street to connect to arterials and major destinations. However, these opportunities are limited due to many transportation barriers, such as the "loop and lollipop" nature of the street layout in the residential areas in the north of the catchment area which provide poor connectivity. Opportunities for additional pedestrian and cycling pathways should be sought in these neighbourhoods to improve this connectivity. Better wayfinding for cyclists and pedestrians can help them locate these routes, as well as navigate to key destinations and transit hubs.

Two of the major intersections in the West Hill Collegiate catchment are among the ten most dangerous in the city from 2009 to 2013, in terms of rate of collisions per thousand vehicles (Khandaker, 2015). They are both along Morningside Avenue, at Ellesmere Road and Sheppard Avenue East. Some improvements have recently been implemented at Ellesmere Road and Morningside Avenue, including a raised median and painting "zebra" stripes along the crosswalks. These improvements should also be

added at Morningside & Sheppard. Other improvements could include advanced pedestrian signals, tighter curb radii at the intersection corners, median refuges for pedestrians, and shortening crossings through narrower lanes or curb extensions. A more extensive intervention could involve turning one of these signalized intersections into a roundabout. Morningside and Ellesmere may be a particularly good candidate for a roundabout, as the nearby parkland offers potentially more space to implement it.

Active transportation improvements could also be combined with transit improvements along Morningside Avenue and in the surrounding area. The current 116 bus route runs alongs Morningside, connecting north to Finch Avenue East, and to the Bloor-Danforth subway to the west. Service along this route could be improved in the short term by giving buses a dedicated lane. Long term, this route has been considered for upgrading to an LRT route, as the Scarborough Malvern LRT. Planning for Toronto LRT routes have generally included bike lanes, and offer the opportunity for street redesigns oriented to pedestrian safety and comfort.

As with the recommendations for the neighbourhood immediately adjacent to West Hill Collegiate, the interventions in this section would need to be implemented by

Figures 27 & 28: Satellite images from Google maps (left) and the 2012 basemap from the City of Toronto's mapping tool (right) shows the striping of the pedestrian crossings and improved median at Morningside Avenue and Ellesmere Road, one of the most dangerous intersections in the city.

local municipal government representatives, and should be installed in concert with regular road maintenance or other construction work. As many of them focus on arterial roadways, broad approval would be needed not just by residents in the immediate vicinity, but the broader population, and city and community council.

Recommendations for educational and community programming

WHCI just began involvement with cycling education programming, including the Bike to School program and Bike to School Week, in the spring of 2015. These programs are both run through the TDSB's EcoSchools office. Continuing and expanding involvement with this and other EcoSchools programming will be key to increasing the rates of active travel at WHCI. Involvement with other environmental or physical activity initiatives would also be helpful to support active travel to school at WHCI. Some organizations, such as Evergreen or the TD Friends of the Environment Foundation, could assist with funding to improve landscaping around the school, and support active transportation projects and school programming.

Ongoing educational programming should start in grade 9, when students enter high school, as this is a major life event that can be used to encourage shifts to healthier behaviour, such as cycling or walking to school. Cycling is a good focus of active school travel initiatives, given the wide boundaries of the school's catchment area. A bicycle building and training program would be an useful initiative for WHCI to start, as it would help students develop useful skills, as well as provide access to bicycles for free, something that should help encourage the significant numbers of lower-income students to start cycling.

The TDSB (2014) currently lists WHCI as an under-utilized school, and it is currently being studied by the board to determine ways to reduce surplus space, possibly resulting in the movement of students between schools, and even the closure of the school. Closing the school would likely result in an expanded catchment area, making active travel to school more difficult, and this is not recommended. Moving students between schools and adjusting the catchment area, however, could be appropriate, since WHCI is not centrally located within its current catchment area, making active travel by students living well to the north of the school more difficult. As identified earlier, the section of the catchment area north of the 401 expressway is particularly far and difficult to travel to WHCI from, so it could be appropriate to send students who live in that area to another high school to the north.

Unfortunately, the demographics of the area, with fewer younger children than the city average, suggest that there will be less high school age students in the near future. Long term, however, better transit and active transportation infrastructure may help reduce car dependency and make the neighbourhoods more desirable for young families to move to the area. Trends show young adults are increasingly attracted to neighbourhoods that are walkable and transit oriented (Speck, 2013; Sivak & Schoettle, 2012).

Programs in the community can also support active transportation. In the core area of Toronto, there are numerous independent bike shops, volunteer driven do-it-yourself repair hubs, and various walking tours. Many of these are lacking in Scarborough and the neighbourhoods around WHCI. City-wide non-profit organizations and programs can assist with fostering active transportation in Scarborough and the neighbourhoods around WHCI. In recent years, a number of

Jane's Walks have been held in the surrounding area, walks in which individuals are encouraged to join their neighbours to tell stories about their communities. Scarborough Cycles is a program that was recently launched by a set of non-profit organizations: the Toronto Centre for Active Transportation, Cycle Toronto, the Toronto Cycling Think & Do Tank, and CultureLink. Scarborough Cycles seeks to build capacity "among local agencies, institutions and individual to address barriers to cycling and create new cyclists," including through initiatives such as bike hubs that will offer access to resources (TCAT, 2015). Programs such as these should be encouraged and expanded.

Other local community organizations and initiatives should be sought out for involvement in programs such as these, or help support active transportation in other ways. Some possibilities include the East Scarborough Storefront, the Scarborough Centre for Healthy Communities, and the Scarborough Women's Centre. Other nearby organizations that could assist with potential active transportation initiatives include the University of Toronto Scarborough campus, and Rouge park. The City of Toronto should also be a major partner in active transportation and related initiatives. WHCI is located in West Hill and close to Morningside, both identified as Neighbourhood Improvement Areas. These neighbourhoods are recognized by the city as requiring special attention, and supported by city Neighbourhood Action Teams, and is the focus of funding and assistance by organizations such as the United Way (City of Toronto, 2014g; United Way Toronto, n.d.).

5.3 Summary & conclusion

This plan and its recommendations are designed to be used to stimulate further discussion within the community, rather than being a prescriptive set of instructions to follow. It is hoped that the plan can be used to help planners and others gain understanding of how a suburban community can be shaped to foster active transportation, with a public school and its students at the centre of a planning process and dialogue. The plan as written incorporated some information from students at WHCI, but much more consultation would be needed with students and staff at the school, and with residents in the surrounding community to make the plan a reality. This section of the paper is meant to complement Appendix C, which is a more condensed and accessible version of the plan, designed for wider distribution.

In order to further refine the elements of the plan, the following sections describe what the community could look like with low-intervention, medium-intervention, and high-intervention sets of changes:

A low-intervention set of changes to the school grounds of WHCI would involve improving the pathway from Weir Crescent and formalizing the "desire line" along the school's back field that it connects to with some basic landscaping improvements and plantings. Bicycle parking racks would be installed. The front of the school would add some basic design improvements, including new vegetation and new access points from Morningside Avenue. Better pedestrian crossing markings and advanced pedestrian crossing signals would be added at the intersection on Morningside in front of the school, and at other major intersections where there are safety concerns in the study area. Lower speed limits would be established on some streets near WHCI, and

immediately in front of the school. A signed bicycle route would run nearby along residential streets, and a painted bike lane would be added along Morningside Avenue between Kingston Road and Ellesmere, and some other arterial streets in the surrounding area. Improved wayfinding signage would be added for cyclists and pedestrians to more easily navigate towards major destinations such as shopping areas and to Guildwood GO station.

A more involved, medium-intervention approach would involve more extensive improvements to the school grounds, such as seating and more involved landscaping work. Intersections in the study area would be improved with additional measures such as pedestrian refuge islands, raised medians, curb extensions, differentiated pavers, raised crosswalks, and tighter curb radii. A new pedestrian crossing with flashing pedestrian beacons would be added along Morningside Avenue at either Warnsworth or Beath Street. Residential streets would have sidewalks installed where they are currently absent, and traffic calming interventions would be added in strategic locations, including speed humps and neckdowns. Bike lanes with greater separation than painted lines would be added to Morningside, Ellesmere and Kingston roads. One or more new access points to the Highland Creek trail would be added.

Long term, the goal should be for higher intervention changes to the roadway environment that prioritize people who walk, bike, and take transit. The entryway to the school and the crosswalk in front of it would be completely redesigned to maximize pedestrian safety and comfort. The new pedestrian crossing along Morningside Avenue to the south of the school would be a fully signalized crossing. A new pedestrian cycling bridge would be built over Highland Creek to improve access south of the creek near

the school. Bike lanes that are fully separated from the roadway would be on all major arterials. This would include Morningside Avenue, which would become a truly Complete Street, with wider sidewalks buffered by trees and other plantings from the roadway, and an LRT route connecting to key destinations throughout Scarborough and the City of Toronto. Roundabouts would be installed along Morningside at Ellesmere and Sheppard, for maximum safety of all road users.

Ultimately, it is up to WHCI and its surrounding neighbourhoods, residents, businesses and other stakeholders may decide whether they prefer one of these visions, or some components of these recommendations, over others. A sensible approach would be to start with the low-intervention recommendations for which there is the greatest community support. However, as new development and road construction occurs, there may be opportunities to quickly implement some of the higher-intervention recommendations, again if they are welcomed by community members. It is hoped that this plan will help people in the area realize that there are many options available to improve mobility in their community, and that they need not accept the status quo of a largely car-dependent community. None of these recommendations are meant to impede the ability of vehicles to move around the area, but are meant to give people more options and improve mobility for everyone, no matter their age or preferred mode of travel. As further development comes to the area with time, it is likely that there will be greater demand for active transportation, and it is hoped that this plan can be a part of how that development can work as part of a pedestrian and cyclist centred community.

6. Conclusion

Active transportation is a growing area of interest in the fields of planning and public health, particularly in relation to young people, who are walking and cycling considerably less in North America than in previous decades. The substantial physical and mental health, social, economic, and environmental benefits of active transportation are well documented. Despite this, active transportation is rarely a central concern of teachers or school administrators, and it is not included in the curriculum in a significant way in Ontario, unlike in countries such as the Netherlands, where children receive education about cycling and walking in traffic at school starting at age 4 (McDonald, 2012). This paper has endeavored to chart out a path for a planning approach and practice that includes schools at its centre, and builds stronger connections between the fields of planning, public health, and education.

Through the process of researching this paper, I have investigated a few key ways that active transportation can be fostered using a multi-disciplinary approach. One of the key elements of encouraging active transportation, as the literature shows, is by improving road safety. This is especially true for young people, who are at particular risk of injury on roadways in North America. A comprehensive road safety approach primarily involves changes to the road environment, through planning, urban design, and engineering changes, such as traffic calming interventions, intersection improvements, and dedicated active transportation infrastructure.This can be supported by policy changes, one of the most cost-effective being lower speed limits. Speed management is a key principle of a road safety approach that prioritizes youth. Youth also fare better with crossings that are cognitively simple, making

interventions such as pedestrian refuge islands and raised medians particularly appropriate in areas with large numbers of young people. Cyclists benefit from having bicycle routes on calm residential streets, and fully separated bicycle lanes on busier streets, and this is especially true of young cyclists. Of course, engineering and design interventions are less useful if young people do not know safe pedestrian and cycling behaviours, so education is also a key component of road safety, and should be built into our school curriculum.

There are also safety issues with having large numbers of teenage drivers, who cause considerably more damage behind the wheel than those who are older. While the risks young drivers cause to themselves and others is well documented, approaches to dealing with this problem have mostly centred on better driving education. Perhaps a more effective approach could be simply to shift young adults who are of driving age away from motor vehicle use and towards other modes. The best way to do this is likely to make transit and active transportation more attractive and feasible for the daily trips of young people.

Despite the negative trends of active travel among youth, there are encouraging signs. In countries where walking and cycling is prioritized through stronger road safety, better dedicated infrastructure, and education, the majority of children and adolescents bike or walk to school. Even in North America, where rates of active transportation are low, youth report a strong preference for active modes. Clearly, most of our environments, as well as attitudes of parents, are holding back children from acting on this preference. Parents are often the ones making school travel decisions, even into high school. This pent up demand seems to be exploding as youth enter their

twenties, when they are less and less likely to get drivers licenses, and increasingly choosing to live in dense, walkable, transit-centred neighbourhoods.

Given these positive signs, there are a few things that can be done to encourage active travel to school among students. One is to ensure schools are centrally located within a catchment area that does not leave the family residences of students too far away. A smaller catchment area is always better, for walking as well as cycling. This is usually not a problem for elementary schools, but is a challenge for high schools in less dense suburban areas. This is where fostering cycling is especially important; while a younger child may only be reasonably expected to cycle one or two kilometers, an adolescent of high school age should be able to easily bike three to five kilometers as part of their school commute.

Another approach to encourage active travel to school is to develop education programs that teach road safety and cycling skills, and encourage walking and biking on a regular basis. Such programs should take advantage of transitional life events, such as entering high school, where the likelihood of changing habitual behaviour, such as daily travel, is higher. Education programs that foster active transportation should take advantage of young people's preferences for walking and biking, and their desire for greater independence, which active modes provide. Education programs should focus on specific goals, be part of the school curriculum, and be adequately resourced. They should also be targeted and tailored to certain groups who face challenges to active travel, such as girls, or low-income and minority youth. Cycling and Safe Routes to School programs have been shown to be effective ways to encourage young people to bike and walk to school, although there is little evidence as to the effectiveness of

individual elements of these programs. Researching the specific aspects of such active transportation initiatives is a worthwhile area for further study.

The West Hill Collegiate Active Transportation Plan and associated consultation with students put the literature studied in this paper into a practical context. Initially, the consultation for this plan, particularly the student survey, was meant to make up the bulk of this paper, by producing a broad set of data that represented a large portion of the student body at this suburban Toronto high school. This data, it was hoped, would offer insights into student modes of travel and attitudes towards walking and cycling. Due to the small response rate of the survey, it was difficult to make observations about its results, as some were mixed. Overall, a picture was painted of a school with low numbers of students arriving at school by active modes, with no one cycling to school among the respondents. Parents of students tended to travel by car, and families usually owned multiple vehicles. Parents also had a strong say in the travel choices of their adolescent children. Many students lived quite far from school. It would be worthwhile to try the survey again in an effort to get more responses, and see if some of these observations were maintained in the wider student body, and whether more insights could be gleaned. Carrying out similar surveys and consultations at other suburban Toronto high schools would also be worthwhile, to further investigate active transportation in this context.

Similarly, the focus group that I did with a group of students found minimal active travel to school. Students who walked were those who lived very close to school, but as soon as they lived any distance away, they were likely to travel by bus - either public transit or a school bus - or by car. They felt that distance was the main barrier they faced

for walking, while safety, topography, and a lack of safe bike parking and bike lanes on main streets were identified as barriers to cycling. The focus group was largely successful as a consultation tool, but limited insights could be gained in a short time. Additional focus groups may have been helpful, as would the opportunity to spend more time with these and other students. I would have especially liked to have done another focus group after the survey results were analyzed, but this was not possible due to time constraints and scheduling for this project. I would also have liked to have had a focus group consisting of grade nine students, as my literature review identified major life events, such as entering high school, as being key to changing behaviours such as travel habits. Future studies or active transportation initiatives should focus on this group of students, particularly in the fall shortly after they begin high school.

Developing a plan and set of recommendations for West Hill Collegiate Institute was in some ways a simple process - with little to no traffic calming or bicycle infrastructure, wide roadways, and a lack of sidewalks on some residential streets, the surrounding area is in some ways a blank slate, on which a variety of interventions can be implemented. However, while most of the individual improvements are quite simple, combining them all together creates a substantial, and potentially costly set of changes. In the plan, I attempted to make the interventions incremental in nature, but with the car-centric nature of so much of the neighbourhood, it would take some time to make even the low-intervention changes recommended in the plan.

There were a few major issues to overcome in the active transportation plan, many of which I was only able to address in part. The limited access over Highland Creek, for instance, is one I only partially solved through a couple of additional access

points over the creek, and by improvements along Morningside Avenue. The awkward, northern heavy catchment area of WHCI was and remains a challenge to encouraging active transportation. While bike lanes on Morningside and major intersection improvements would certainly help, there may not be much that can be done to get students living north of the 401 expressway to travel by active modes to school. The best solution for these students may not involve design interventions, but instead by shifting the catchment area of WHCI and sending students living in these northern neighbourhoods to another high school located closer to home. This points to the importance of the school board in taking a planning approach that places high schools in locations easily accessible for students traveling by a variety of modes. It is also a reminder that transit should be considered as an important complement to active transportation to high schools.

Ultimately, any kind of planning is a negotiated approach between planners, various municipal and other governmental representatives, residents, businesses, and other interests. Placing a high school at the centre of this process, and looking through a lens of mobility, I believe has the potential to shift planning processes significantly. Firstly, it puts youth at the centre, rather than working-age adults, who are often the focus of planners. Parents, families, and children can be powerful groups within planning processes. Such a focus in planning has the potential to move the dominant concerns of planning away from economic and business matters, that often prioritize a wealthy minority of people, and towards a planning that is more universal and welcoming for people of all walks of life. Family and youth-focused planning, however, often focuses on younger children and their parents, while adolescents are somewhat

forgotten. But all children grow into adolescence, and deserve spaces on our streets and in our communities to travel, play and socialize safely and independently.

This research, study, and plan is part of an open and ongoing planning process, of which this paper is only a snapshot. If any of the recommendations listed in the plan are to be realized, it will require further study, consultation, and more support from the public. In eastern Scarborough, it may require a large public transit investment in the area to help shift people away from primarily traveling by private automobile. Planned improvements to the Lakeshore East GO Train line to the south, and an LRT route through the area, could be the kind of changes that are needed, as they could kickstart large numbers of people traveling to transit hubs by walking or biking.

One thing that is clear is that there is huge potential for active transportation among high school populations, and this is as true in Toronto and Scarborough as it is elsewhere in the world. Young people, particularly adolescents, want to walk, ride a bicycle or skateboard; they prefer these active modes, and the greater independence they provide. But we are holding them back by placing so many barriers in their way, with streets that are designed primarily for people who drive, with people who walk and bicycle often only included as an afterthought. We can also do more to teach young people to travel safely on foot or by bike. Together, students, parents and teachers, along with planners, educators, engineers, public health professionals, municipal officials, can transform our communities. I hope this paper serves as a guide that shows people that we already have the evidence and tools we need to foster much more active transportation among young people, we just need to work together to put these solutions in place.

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Appendices

Appendix A: Active School Travel Survey distributed to West Hill Collegiate students

Active School Travel Survey

1. What grade are you in? ▫ 9 ▫ 10 ▫ 11 ▫ 12

2. What is your gender: ▫ Male ▫ Female ▫ Other

3. How old are you? _____

4. Was one or both of your parents born in Canada? ▫ Yes ▫ No

5. How long have you lived in Canada? ▫ Since birth ▫ 0–5 years ▫ 6–12 years

6. How do you usually travel TO school? (please select only one option)
   ▫ Car - driven by parent/adult or others ▫ Car - drive myself ▫ School bus
   ▫ TTC ▫ Walk ▫ Bike

7. How do you usually travel when you LEAVE school? (please select only one option)
   ▫ Car - driven by parent/adult or others ▫ Car - drive myself ▫ School bus
   ▫ TTC ▫ Walk ▫ Bike

8. Why do you choose the mode(s) of transportation indicated in questions 6 & 7 (select all that apply)
   ▫ Easy ▫ Social ▫ Speed ▫ Because of the weather ▫ Safety
   ▫ Enjoyable ▫ Affordable ▫ My parents choose ▫ Other: _____

9. Thinking back to when you were in **Elementary** School, how did you travel to school the majority of the time? (please select only one option)
   ▫ Car - driven by parent/adult or others ▫ School bus
   ▫ TTC ▫ Walk ▫ Bike

10. Who makes the decision about how you travel to or from school? (select one option)
▫ Usually I decide
▫ Usually my parents/guardian decides
▫ Sometimes I decide, sometimes my parents decide, or we decide together
▫ Other: _____

11. How do the adults in your family usually travel to work or other destinations? (please select all that apply)
   ▫ Car ▫ TTC ▫ Walk ▫ Bike ▫ Other: _____

12. Do you own a bicycle, or have access to one? ▫ Yes ▫ No

13. Do you know how to ride a bicycle? ▫ Yes ▫ No

14. Do you have a Metropass (monthly TTC pass) ▫ Yes ▫ No

15. How many cars does your family own: _____

16. In a typical week, how many times do you ride your bike to or from school as your primary mode of travel? (please count a trip to school separately from a trip from school on the same day) ____

17. In a typical week, how many times do you ride your bike for work, fitness, recreation, or fun without the intent of getting to or from school? _____

18. If you do not ride a bicycle to or from school, why not? (mark all that apply, if you select *other* – please write down the other reason)

▫ Live too far
▫ Prefer other modes of transportation
▫ Do not find it enjoyable
▫ Consider it unsafe
▫ Parent's decision not to
▫ Do not own a bicycle
▫ Other: _____

19. If you ride a bicycle, do you wear a helmet?

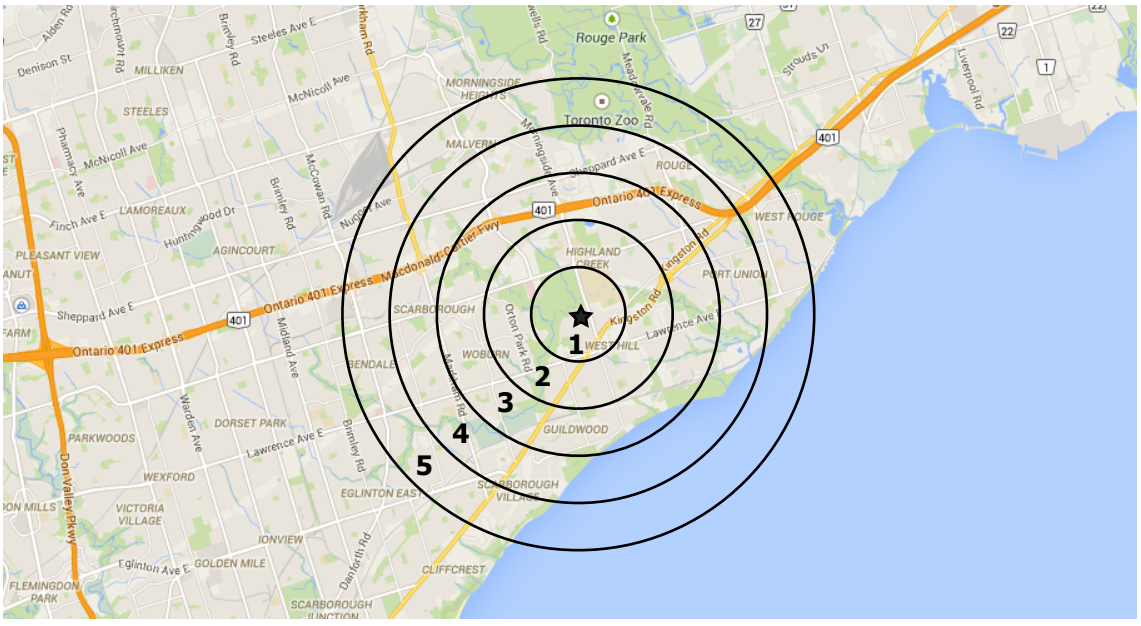
▫ Always ▫ Mostly ▫ Sometimes ▫ Never

20. In 2 to 5 words, what do you think about bicycling?

_____

21. We would like to know how far you travel to school. Please use the map below to indicate which area you live in. Each area is indicated by a circle. (*your school* is the black star in the middle).

▫ 1 ▫ 2 ▫ 3 ▫ 4 ▫ 5 ▫ Beyond circles



Please rate on the scale of 1 to 5 whether or not you agree with the following statements:

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Choose not to answer
22. People in my immediate family think it is dangerous for me to ride a bike in Toronto.	1	2	3	4	5	N/A
23. Wearing a helmet is important to stay safe while cycling.	1	2	3	4	5	N/A
24. I know how to ride a bike safely, even in busy traffic.	1	2	3	4	5	N/A
25. I feel comfortable riding a bike on the streets near my school.	1	2	3	4	5	N/A
26. People I admire ride bikes to get around in the city.	1	2	3	4	5	N/A
27. I have a good place to store or lock my bicycle at home.	1	2	3	4	5	N/A
28. I have a good place to store or lock my bicycle at school.	1	2	3	4	5	N/A
29. I can ride my bicycle all year long unless there is ice or snow on the ground.	1	2	3	4	5	N/A
30. I believe that it is fashionable or stylish to ride bikes in Toronto.	1	2	3	4	5	N/A
31. I believe that biking is a fast and convenient way to get around Toronto.	1	2	3	4	5	N/A
32. I believe that it is fashionable or stylish to wear a helmet when cycling.	1	2	3	4	5	N/A
33. I cannot see myself riding a bicycle in the winter in Toronto.	1	2	3	4	5	N/A
34. I have access to places to be physically active.	1	2	3	4	5	N/A
35. I enjoy the way physical activity while cycling or walking makes me feel.	1	2	3	4	5	N/A
36. Cycling to school is a great way to stay/become fit and healthy.	1	2	3	4	5	N/A
37. I believe that biking is a fast and convenient way to travel to school.	1	2	3	4	5	N/A

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Choose not to answer
38. I believe we should reduce our impact on the environment.	1	2	3	4	5	N/A
39. Wealthy people ride bicycles for transportation	1	2	3	4	5	N/A
40. People I admire drive cars to get around in the city.	1	2	3	4	5	N/A
41. There are lots of services (stores, community centre, library, etc.) near my school that are easy to get to on foot or by bike.	1	2	3	4	5	N/A
42. My peers see bikes as fun or cool.	1	2	3	4	5	N/A
43. Only low-income people ride bicycles for transportation.	1	2	3	4	5	N/A
44. If I leave my bike locked up somewhere it will be stolen.	1	2	3	4	5	N/A
45. I feel comfortable walking along streets near my school.	1	2	3	4	5	N/A

46. What do you think could be done to make walking and biking better around your school?

_____

_____

_____

_____

_____

Thank you for your time!

Appendix B: Focus group questions

Active transportation in high school communities: Focus group questions

Opening: go around the table and have everyone say:
1.) the general area where they live;
2.) how long they've lived there, and
3.) how they usually get to school.
(3-5 min.)

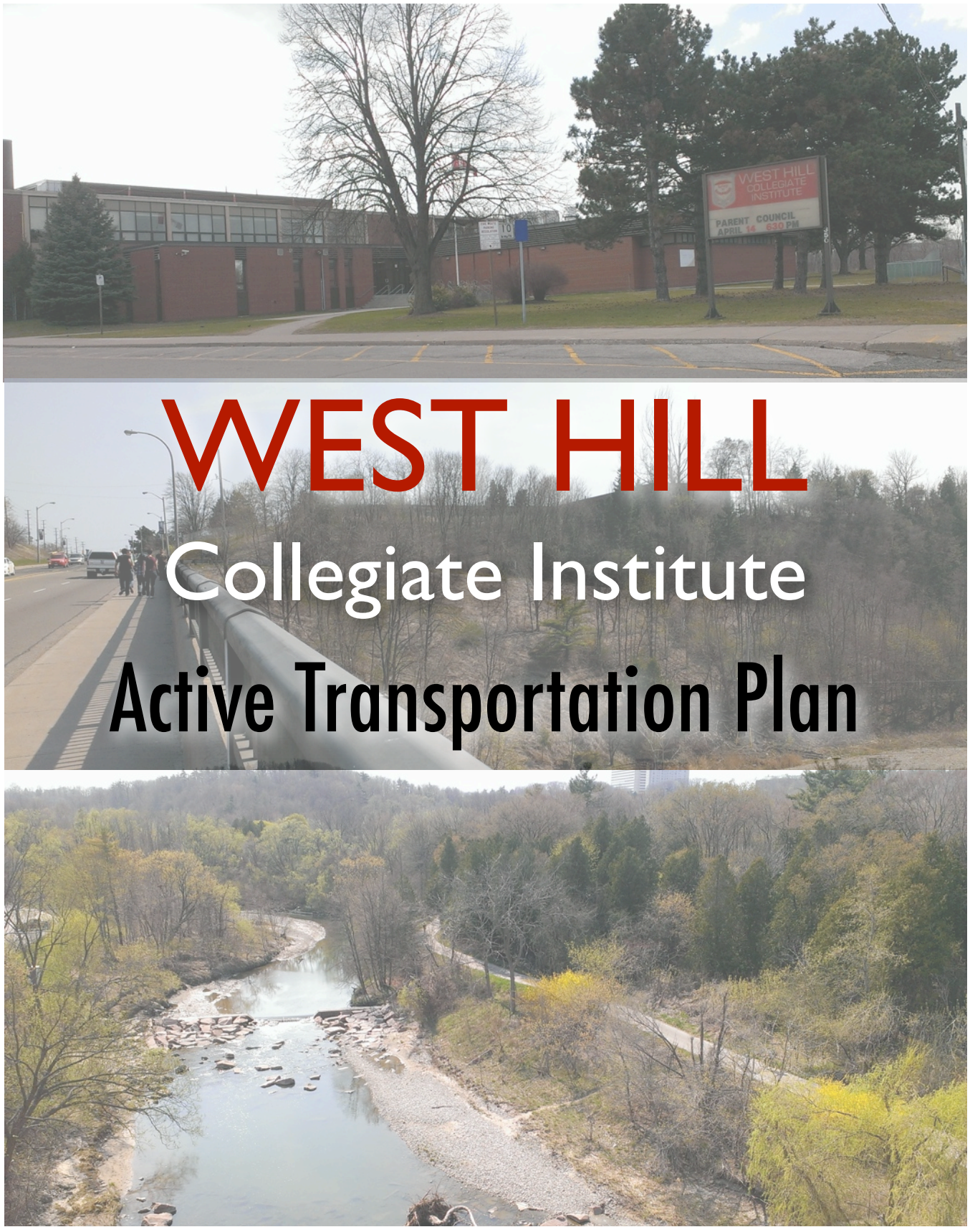
Has the way you travel to school changed since you were younger? If so, why?
What do you envision yourself doing after you're done school? (university? college? work?), and how to you expect to travel after high school?
(3-5 min.)

What do you like about how you get to school, and what do you not like?
Why do you get to school the way you do?
(3-5 min.)

What would make it more appealing to walk to school?
What would make it more appealing to bike to school?
What are the barriers you face to walking or riding a bike?

Follow up questions:
What could your school do to make it easier, safer, and more comfortable to walk or bike to school?
What kinds of events/activities/clubs would you like to see?
What kind of physical changes would you like to see on school grounds (eg. pathways, more trees, more benches).
What kind of changes would you like to see along the streets near your school and home?
(5-10 min.)

Appendix C: Condensed West Hill Collegiate Institute Active Transportation Plan

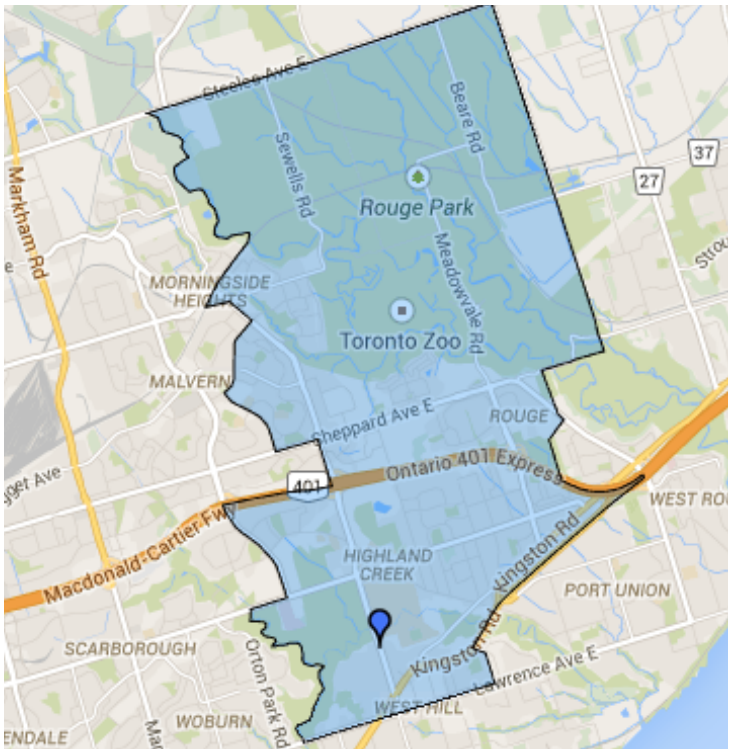


West Hill Collegiate Institute Active Transportation Plan

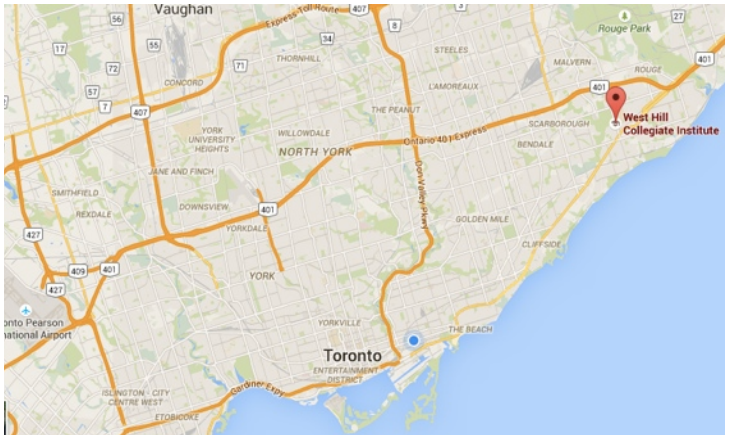
Overview & current conditions

West Hill Collegiate Institute (WHCI) is a public secondary school located in eastern Scarborough on Morningside Avenue just north of Kingston Road. It is part of the Toronto District School Board, and the catchment area for students who attend the school extends mostly to the north, all the way to the northern border of the City of Toronto at Steeles Ave.

WHCI's location to the far south of its catchment area, rather than at its geographical centre, creates unique challenges for developing an active transportation plan for the school. Although students living south of Highland Creek are all within easy walking distance, mostly on quiet residential streets, the large portion of the student body living to the north live outside of walking distance. However, all of the catchment area is within a 30 minute trip by bicycle, making encouraging cycling key to increasing active transportation to WHCI.



West Hill Collegiate student catchment area



West Hill Collegiate in Toronto context

Highland Creek and Morningside Park, located right next to the school, are assets in terms of trails and recreational space. However, they also serve to separate the school from much of its student population due to the topography and large size of this parkland. Students living north of the 401 expressway that cuts through the middle of the West Hill catchment area have an additional physical and psychological barrier to overcome, along with an intimidating distance to travel to school.

WHCI fronts on to busy Morningside Avenue, a major four-lane arterial with a 60 km/h speed limit. Over 13,000 cars travel each

day on the section of Morningside in front of the school[1]. There is a signalized crosswalk in front of the school that allows crossings at the south side of the intersection only. In addition to Morningside Ave, the school is also accessible for students walking and biking via a path that connects to Weir Crescent behind the school.

The 116 Morningside bus runs in front of the school, running north to Finch Avenue, south to Guildwood Parkway and Eglinton Avenue East, and connecting to Kennedy subway station to the west. The 116 bus offers service of 10 minutes or less between buses throughout the day. Students also have the option of taking a school bus.

The nearby West Hill residential neighbourhood features relatively quiet streets with 40 km/h speed limits. Many residential streets do not have sidewalks, or only have sidewalks on one side of the street.

Other neighbourhoods within the catchment area have a similar mixture of occasional sidewalks running along quiet residential streets. Major streets running through the catchment area include Ellesmere Road and Sheppard Avenue East. These major streets are generally fronted by a mix of commercial, industrial, and institutional uses, usually low density. The intersections on Morningside at Ellesmere Road and Sheppard Avenue East are both are both among the ten most dangerous in Toronto in terms of rate of collisions[2].

There is a multi-use trail running along the Highland Creek valley system beside West Hill Collegiate. However, the trail runs on the opposite side of the creek from the school, and along with the depth of the valley makes use of this trail for travel to and from school difficult. The only other bicycle infrastructure within the catchment area is found north of Ellemere. This includes a north/south bike lane along Collins Road, an east/west route along the portion of Sheppard Avenue east of Morningside, and some routes near the Toronto Zoo and Rouge Park.

Approaching the school from the west via the multi-use trail that connects to Weir Crescent.

Pedestrian crossing in front of West Hill Collegiate, and northbound bus shelter.

Approaching West Hill Collegiate from the north via bridge over Highland Creek.

View of WHCI main entrance from across Morningside Avenue.

Morningside Avenue, just south of WHCI.

Residential street near West Hill Collegiate with sidewalk on one side.

Residential street near West Hill Collegiate with no sidewalks.

Local demographics & travel behaviour

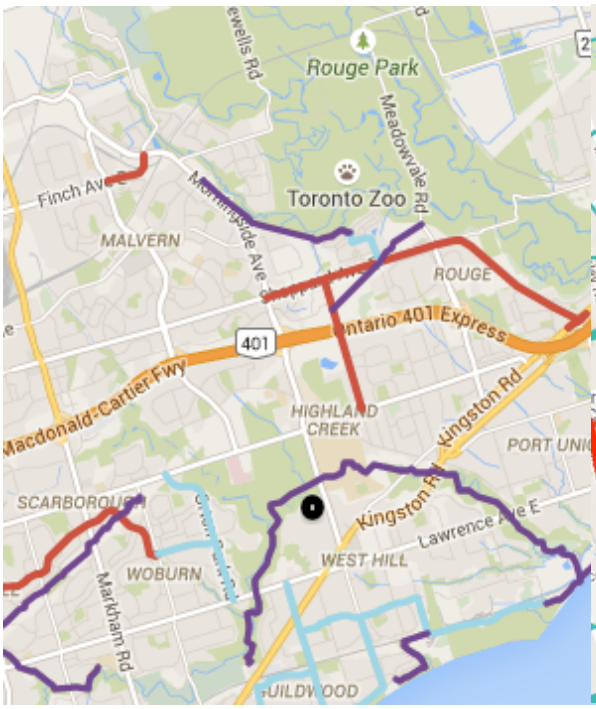
Using City of Toronto neighbourhood[3] and Ward[4] profiles, drawn from 2011 Census and National Household Survey data, as well as the 2011 Transportation Tomorrow Survey[5], a rough picture can be drawn of the people who live in the WHCI catchment area. Overall, the majority of residents live in single-detached houses as part of a larger than average family with 2 or more children, and are likely to be visible minorities. They are quite likely to come from an immigrant family, with Sri Lankan, Filipino, Indian, Guyanese, and Jamaican origins being most common. While overall, household income levels are roughly average or above average compared to the City of Toronto as a whole, income levels vary widely within the catchment area, and some neighbourhoods have high numbers of low-income families. Two neighbourhoods in the catchment area were identified as Neighbourhood Improvement Areas due to their low scores on equity measurements.

People who live within the catchment area are more likely than people elsewhere in Toronto to drive or travel as a passenger in a car for their daily trips, although a substantial number of trips made by those in the area are made by transit, bicycling, and walking, particularly during peak travel hours, when over 20 percent of residents travel by these modes.

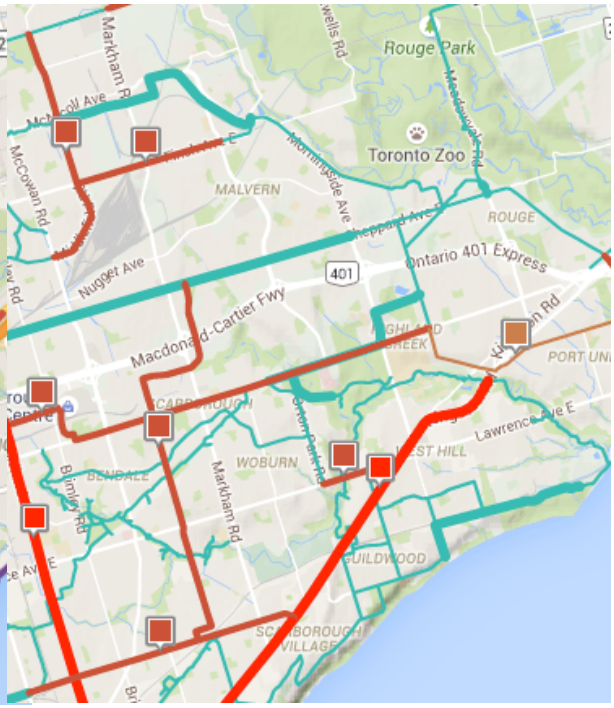
Examples of built form in the West Hill neighbourhood.

Relevant documents & policies

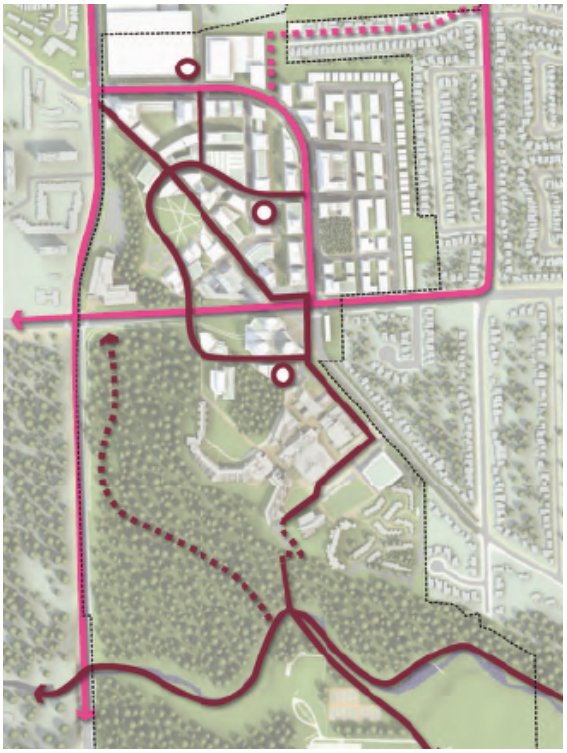
- ☑ City of Toronto Bike Plan (2001)
- ☑ Toronto Official Plan (2010)
- ☑ Toronto Pedestrian Charter (2002)
- ☑ Toronto Road Classification Criteria (2000)
- ☑ Toronto Walking Strategy (2009)
- ☑ Toronto Vibrant Streets Guidelines (2006)
- ☑ University of Toronto Scarborough Campus Master Plan (2011)



Current Bike routes
Red: bike lanes; Blue: shared roadways;
Purple: multi-use trails



Draft bike routes for new Toronto bike plan
Green: current & planned routes
Brown & red: potential future routes.



Bicycle network plan from University of Toronto Scarborough Campus Master Plan (2012), including routes on Morningside and Ellesmere.

Sidewalk inventory
Green: sidewalks on both sides of street;
Orange: sidewalks on one side of the street;
Red: No sidewalks; Blue: Multi-use trails

Recommendations for street & urban design interventions

Recommendations to improve conditions for active transportation on local streets in terms of safety, urban design and transportation infrastructure are focused on and organized by three main geographic areas. The first geographic area is **on-campus and immediately adjacent to the school**. Most of these changes can be undertaken directly by the school administration and board, in some cases as student projects. The **West Hill neighbourhood**, for the purposes of this assessment, includes the section of the catchment area south of Highland Creek, and mostly focuses on local roads and pedestrian improvements. The **surrounding catchment area and neighbourhoods** includes the entire student catchment area north of Highland Creek. This section mostly focuses on cycling connections and safety along major arterial roads. Improvements in these latter two areas would need to be undertaken by City of Toronto staff, with the support of local residents and political representatives.

Within each geographic area, each recommendation is classified as being a low, medium, or high intervention, based on factors such as cost, potential constuction disruption, and magnitude of the change from current conditions.

On-campus & immediate area nearby

- Formalize the "desire line" along the south end of the schools' back field with a landscaped path, and additional landscaping improvements, such as planting trees or other vegetation. Low intervention
- Improve pathway from Weir Crescent, including an accessible ramp connecting the sidewalk to the street, and signage welcoming you to West Hill Collegiate. Low intervention
- Bicycle parking racks should be provided at the main entrance and rear of the school. Low intervention
- Open up a section of the fence along Morningside Ave to the north of the main entrance to open up a new pathway leading to the school. Low intervention
- Improve Morningside Ave entrance to make it a more welcoming pedestrian environment and public gathering space through urban design and landscaping improvements, such as seating and new planting areas. Low-medium intervention

Image of West Hill Collegiate campus. The current informal path, which could be upgraded through landscaping improvements, is circled in yellow. Other interventions include a new pedestrian connection (orange), and improvements to the main entryway (blue). A new connection to the creek trail system (purple) could be provided via a bridge (red) and use of the current service roadway (green).

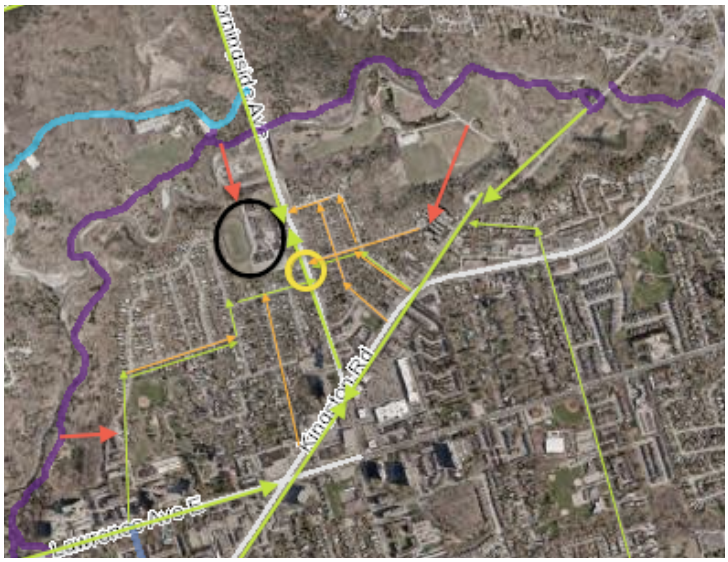
- Improve pedestrian crossing on Morningside Ave in front of school just south of entryway through allowing pedestrians to cross on both sides of the intersection, as well as zebra stripes/pavers, advanced signal phasing for pedestrians (low intervention), a pedestrian refuge island (medium intervention), or some combination of these measures. Low-medium intervention
- Improve the crossing along the entry roadway with "ladder" or "zebra" markings (low intervention), differentiated pavers, and/or a raised crosswalk (medium intervention).

The main entrance to West Hill Collegiate

A single cyclist has locked their bicycle to the best place they could find near the front of the school.

West Hill neighbourhood

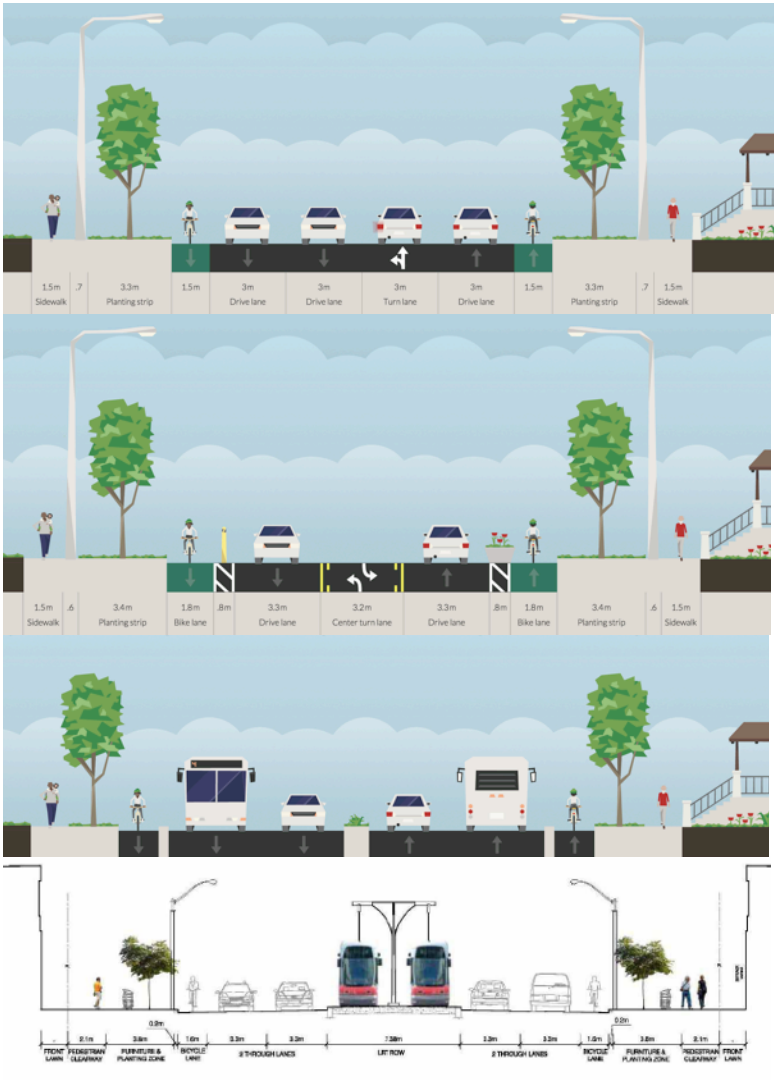
- Lower speed limits to 30 km/h on residential streets, at least those close to West Hill Collegiate and nearby elementary schools. Low intervention
- Lower speed limit from 60 km/h to 50 km/h on Morningside Avenue, at least from Kingston Road to West Hill Collegiate. Low intervention
- Establish signed/boulevard bicycle route through area along Galloway/Craggview/ Warnsworth/Morningside/ Beath/Fairwood/Old Kingston Rd. This will connect to the current signed route on Galloway at Lawrence in the west, to the Highland Creek trail system to the east. Low intervention
- Add sidewalks to residential streets. Priorities should include streets without sidewalks, particularly Amiens Rd., Fairwood Cres., Beath St., Craggview Dr., Falaise Rd., etc. Other streets



Black: West Hill Collegiate; Yellow: new pedestrian crossing; Red: potential new connections to Highland Creek trail; Orange: pedestrian routes prioritized for new sidewalks and traffic calming; Green: bicycle routes

with only sidewalks on one side that are on key pedestrian routes should have sidewalks added on the other side (eg. Warnsworth St). Long term, a goal should be set for sidewalks on all residential streets. Medium intervention.

- Implement traffic calming initiatives on residential streets, including potentially: speed humps, neckdowns, curb extensions, raised crosswalks. Medium intervention
- Implement traffic calming initiatives on Morningside Avenue, including potentially: narrower lanes and a raised median. Medium intervention
- Add a new pedestrian crossing along Morningside at Warnsworth or Beath Street intersections. This crossing could involve the addition of curb extensions, a pedestrian refuge island, flashing pedestrian beacons, (medium intervention), a signalized crossing (high intervention), or some combination of these.
- Improve connections to Highland Creek trail from the south. Possibilities include: a pedestrian/cycling bridge over Highland creek just west of Morningside Ave to connect to service yard and existing roadway on the south side of the creek; connection to Beath St. through park; connection to Galloway Rd/West Hill Park. Medium-high intervention



Cross-sections for potential street redesigns for Morningside Avenue near West Hill Collegiate.

1. Travel lanes narrowed, allowing room for painted bike lanes. *Low intervention.*

2. A road diet, with 4 travel lanes modified to 2 travel lanes, a centre turning lane (which would allow for wide raised medians & pedestrian refuge islands at strategic locations), and separated bike lanes on the roadway. *Medium intervention.*

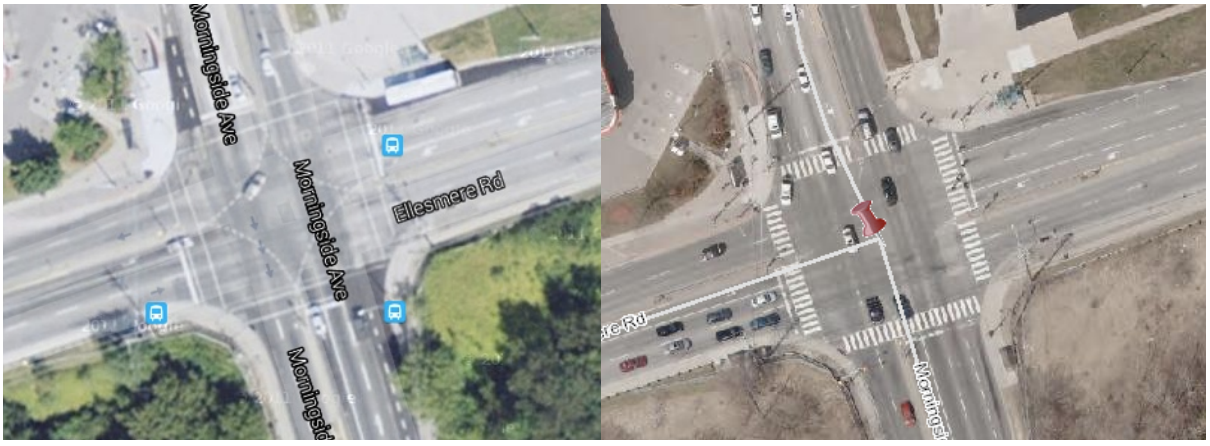
3. Dedicated bus lanes added to current roadway, plus a new raised median, wider sidewalks, and separated bike lane added above curb outside of current roadway. *Medium-high intervention.*

4. Scarborough-Malvern LRT alignment. *High intervention.*

In surrounding catchment area & neighbourhoods

- Establish bike lanes on major streets, including Morningside Ave and Ellesmere Road (especially between Conlins Rd & Orton Park Rd.), as well as Kingston Road, as suggested in previous planning documents[6][7][8]. These bike lanes could easily be installed as painted lanes (low-intervention), or separated from traffic via a variety of design options (medium-high intervention)
- Improve cycling and pedestrian connection to Guildwood GO station, including improved wayfinding, and upgrading Galloway from a signed route to bike lanes. low intervention
- Intersection improvements on Morningside at Ellesmere Road and Sheppard Avenue East should be prioritized, as they are both among the most dangerous intersections in Toronto. The curbed median and "zebra"/"ladder" stripes at Ellesmere Road should also be added at Morningside & Sheppard (low-intervention). Other improvements could include advanced pedestrian signals (low-intervention), tighter curb radii, median refuges for pedestrians, and shortening crossings through narrower lanes or curb extensions (medium-intervention). Long term, roundabouts could be considered for these intersections, particularly Morningside & Ellesmere, where there is more space to expand the intersection (high-intervention).
- Accelerate Scarborough/Malvern LRT - this would have the most potential to improve mobility throughout the area over the long term. high intervention

Map of original transit city plan, with Scarborough Malvert LRT route running through the study area.



Satellite images from Google maps (left) and the 2012 basemap from the City of Toronto's mapping tool (right) shows the striping of the pedestrian crossings and improved median at Morningside Avenue and Ellesmere Road, one of the most dangerous intersections in the city.

Educational and community programming

- Continue and expand involvement with the Bike to School program, Bike to School Week, and other programs affiliated with the TDSB EcoSchools office.
- Look for opportunities for funding improvements through school grounds, including funding opportunities through organizations such as Evergreen or TD Friends of the Environment Foundation.
- Consider modifying WHCI's catchment area boundaries as part of the TDSB's Long Term Program and Accommodation Strategy[9].
- Avoid closure of WHCI or surrounding schools, as this could further expand the catchment area, and undermine active school travel goals
- Connect with community groups and programming, including the recently launched Scarborough Cycles project, and local organizations such as the East Scarborough Storefont, the Scarborough Centre for Active Communities, and programs run through the City of Toronto.

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