CENTERING VULNERABILITY IN ROAD SAFETY INITIATIVES IN YORK REGION

School of Urban and Regional Planning
Queen's University

Centering Vulnerability in Road Safety Initiatives in York Region

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Foreword

The contents of this report do not necessarily represent the views of York Region. The views and recommendations throughout this document come directly from the authors of this document.

Land Acknowledgement

York Region is located within the traditional territory of many First Nations, including the Chippewas of Georgina Island and the Mississaugas of the Credit. These lands are now home to many diverse Indigenous Peoples. We also acknowledge that York Region falls under Treaty 13 with the Mississaugas of the Credit and the Williams Treaties with several Mississauga and Chippewas First Nations.

Additionally, Queen's University is situated on traditional Anishinaabe and Haudenosaunee territory. We are grateful to be able to live, learn and play on these lands.

Figure 1.0. "Humility" by Portia Chapman.

Figure 1.0 is an art piece is entitled Humility, it was completed by Portia Chapman, an Indigenous artist and Queen's fine arts alumna. (Source: Portia Chapman)

We recognize that Indigenous Peoples are disproportionately affected by traffic collisions. A 2005 report found that across Canada, Indigenous Peoples were between three and six times more likely to die as a result of traffic collisions.[*] Additionally, this report identified that the rationale behind these statistics is likely attributed to the disproportionate distribution of services, highlighting the importance of an equity lens to guide future road safety initiatives.

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[*] Karmali, Shahzeer, et al. "Epidemiology of severe trauma among status Aboriginal Canadians: a population-based study." *CMAJ* 172.8 (2005): 1007-1011.

Project Acknowledgments

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Dr. Patricia Collins, our faculty supervisor from Queen's University. Her valuable feedback and critical questions shaped the scope of this project and brought this real-world project into our education as future professional planners. Dr. Collins always made time to assist us every step of the way.

Our Key Informants, a group of experts in their respective fields that helped bring different perspectives to this work. These individuals included planners, traffic engineers, police officers, and walkability activists.

Our fellow Queen's Planning Students, Faculty, and Staff who provided us with an opportunity to receive constructive feedback prior to the final client presentation.

Meet the Team

This report was written collaboratively by a group of eight Master of Urban and Regional Planning students from Queen's University. This report was completed as part of SURP 823: Social Planning Project Course under the direction of Dr. Patricia Collins.

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Executive Summary

Report Purpose

The purpose of this report is to provide recommendations for York Region to effectively improve road safety for vulnerable populations. These recommendations incorporate an equity lens developed through an analysis of York Region collision data and a comprehensive investigation into the determinants of road vulnerability. The recommendations are aimed at enhancing the current work being done by York Region and its municipal partners to improve road safety for the residents of York Region.

In 2015 York Region released the Built Environment and Health Action Plan as a framework to guide collaboration within the Region to develop health supportive projects, policies, and programs. York Region has identified road safety as an integral aspect of public health and a main concern of York Region's residents. The Region and its municipal partners are considering implementing Vision Zero principles and require an equity lens to inform road safety policies and programs.

This report focuses on the safety of pedestrians and cyclists. The research used for this report explores how personal and environmental determinants influence the safety of vulnerable road users, i.e., pedestrians and cyclists but will not provide an in-depth review of how motorist behaviour affects overall road safety.

Research Methodology

This report used a mixed methodology research approach:

- **An academic literature review** reviewed 53 academic articles to document spatial, socio-economic, and individual-level determinants of traffic injuries and fatalities.
- **A news media review** was undertaken to understand how determinants of traffic injuries and fatalities are being framed to the general public in North America.
- **Four case studies** were completed to review current approaches to road safety initiatives.
- **York Region collision data analysis** using York Regional Police Motor Vehicle Collision data and York Region Traveller Safety Reports and census data.
- **Site observations** were conducted to visit 11 intersections in York Region that have high collision frequencies and pedestrian safety improvements.

- **Semi-structured interviews** with five professionals who have expertise in road safety initiatives and/or working with vulnerable populations were conducted to gather insight on vulnerability in road safety.

Key Research Findings

✱ **Pedestrians and cyclists are well established vulnerable road users who face greater risk of traffic injuries and fatalities**

✱ **Vulnerable populations at greatest risk: Children and Youth, Older Adults, Racialized Individuals, Immigrants and Newcomers, Individuals Experiencing Homelessness**

Lower-income individuals are at higher risk of traffic injuries and fatalities because of transportation inequity

Walking and cycling are more cost-efficient modes of transportation.

✱ Lower-income individuals are more likely to walk, cycle, or take public transit which exposes them to traffic more frequently as well as to the systems that receive less public investment.

Individuals holding multiple at-risk identities face higher risk of traffic injuries and fatalities

✱ These individuals are extremely vulnerable due to the compounding exposure to multiple socio-economic and/or spatial determinants.

The language used to describe and frame traffic collisions is important

✱ The language used to characterize traffic collisions establishes how the public perceives and understands road safety issues, which can influence the level of action that needs to be taken

Reimagining traditional approaches to road safety

✱ Conventional approaches to road safety have not done enough to make roads safer for vulnerable populations.

More responsibility and actions to address road safety should come from the system designers who hold decision-making power.

Recommendations

Research results revealed that there are a variety of ways to address the needs of vulnerable road users. While the Region currently produces a significant amount of productive road safety initiatives and interventions, the following recommendations were developed to guide the Region in areas that require improvements. Additionally, the recommendations provide guidance on how to apply an equity lens to effectively target vulnerable road users. The recommendations are categorized using the 5 E's model, Evaluation, Engagement, Engineering, Enforcement, and Education. The following is a summary of the 'Start' recommendations for York Region.
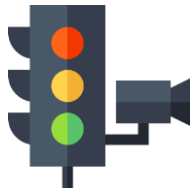
Evaluation　　**Engagement**　　**Engineering**

Enforcement　　**Education**

EVALUATION

A.1	Collect additional socio-economic and socio-demographic data to clearly identify those most at-risk.
A.2	Collect data on vehicle make, model, year, and after-market modifications.
A.3	Collect temporal volume of cyclists and pedestrians.
A.4	Include severity of injury in collision reports.
A.5	Analyze the spatial relationship between traffic related-inquiries and reports and high collision areas to investigate whether there is a discrepancy between collisions and inquires.

A.6	Centralize collision data and make it publicly available.

ENGAGEMENT

B.1	Partner with non-profit organizations and community groups that understand and are more familiar with target communities.
B.2	Apply a Gender-Based Analysis Plus (GBA+) lens to design public engagement strategies and events.
B.3	Prioritize the collection of lived experience data at public engagement events.
B.4	Use a participatory planning approach to create road safety policy and new road safety interventions.
B.5	Prioritize engagement with those in lower-income areas where active transportation is more likely to be relied upon and populations are harder to reach.
B.6	Ensure diversity amongst staff working in public engagement and that all staff understand their own positionality prior to the engagement process.
B.7	Reduce barriers for newcomers to participate in public engagement.
B.8	Use multi-lingual recruitment materials and ensure translators are available at public engagement events.
B.9	Hire external consultants who specialize in certain engagement techniques in road safety planning projects if there are no York Region employees who have the expertise.

ENGINEERING

C.1	Increase investment in pedestrian and cyclist infrastructure beyond the Municipal Streetscape Partnership Program (MSPP) and the Pedestrian/Cycling Municipal Partnership Program (PCMPP).
C.2	Enhance street illumination on blocks surrounding high pedestrian activity locations.

C.3 Expand the implementation of traffic calming devices.
- Example: street trees, concrete planters, speed humps, and roundabouts.

C.4 Implement traffic signal-based safety improvements concurrently with improvements to the built environment.

ENFORCEMENT

D.1 Expand the regional red light camera program by focusing on high frequency collision intersections, as identified in the York Region Traveller Safety Report (2020).

D.2 Increase safety initiatives around school zones.

D.3 Increase enforcement on distracted driving.

D.4 Target enforcement at intersections with new traffic regulations to ensure motorist compliance with changes.

EDUCATION

E.1 Review and update current programming to ensure that messaging surrounding road safety is up to date.

E.2 Educate the public on the implementation of new safe street designs and providing guidance on how to use them.

E.3 Expand existing population-specific strategies for road safety initiatives.

E.4 Create a York Region Task Force dedicated to education-based initiatives aimed at reducing traffic injuries and fatalities.

E.5 Re-evaluate education programs that target pedestrians including 'Be Visible Be Seen' and 'Cross Smart', that perpetuate the idea that vulnerable road users are responsible for avoiding collisions.

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Terminology

The terms that have been selected for this list are the most frequently appearing terms throughout this report. Terms that are used in individual chapters or do not appear as frequently are available for reference in the Glossary.

Built Environment: The human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or green space to neighbourhoods and cities that can often include their supporting infrastructure, such as water supply or energy networks.

Diversity: The presence of a wide range of human qualities and attributes within an individual, group or organization. Diversity includes such factors as age, sex, race, ethnicity, physical and intellectual ability, religion, sexual orientation, educational background, and expertise.

Equity: Fairness, impartiality, even-handedness. A distinct process of recognizing differences within groups of individuals and using this understanding to achieve substantive equality in all aspects of a person's life.

Equity Lens: A framework that includes a set of questions to be considered when making decisions regarding policies, programs, or initiatives. The lens acts as a guide to help understand how decisions and actions either break down or reinforce barriers that disproportionately affect vulnerable populations.

Exposure: Being in a situation which has some risk of involvement in a traffic collision.

Gender-Based Analysis Plus (GBA+): An analytical process used to assess how different women, men, and gender diverse people may experience policies, programs, and initiatives.

Inclusion: Appreciating and using our unique differences – strengths, talents, weaknesses and frailties – in a way that shows respect for the individual and ultimately creates a dynamic multi-dimensional organization.

Individual-Level Determinants: A range of individual characteristics and behaviours that are determinants of one's exposure to traffic collisions and risk of traffic injuries and fatalities.

Intersectionality: Seeks to understand and analyze the complexity of human experiences and the interconnectivity of social categorizations.

Lived Experience: Personal knowledge of the world gained through direct participation and involvement in the event or phenomenon.

Positionality: Positionality examines how differences in social position and power shape identities and access in society.

Risk: A factor that raises the probability of adverse outcomes.

Road Safety: Measures such as improvement to road system, infrastructure, and vehicles used to prevent road users from being killed or seriously injured.

Road Violence: The epidemic of deaths and serious injuries that occur on roadways and in our transportation systems.

Social Determinants: The conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life.

Socio-economic Determinants: Refer to a specific group of social and economic factors within the broader determinants of health. These relate to an individual's place in society, such as income, education, or employment. Experiences of discrimination, racism, and historical trauma are important social determinants for certain groups such as Indigenous Peoples, LGBTQ+, and Black Canadians.

Spatial Determinants: A variable that may increase or detract from the suitability of a location for the presence of a particular land-use or land-cover category.

Traffic Calming: Commonly associated with physical features such as: speed humps, raised intersections, and roundabouts. They are installed on a road to reduce the speeds at which vehicles travel, to discourage through traffic, to improve road safety, and to improve comfort levels for all road users.

Traffic Collisions: (inclusive of injuries and fatalities) For this report, this is the involvement of a vehicle that collides with another vehicle, pedestrian, or cyclist and may result in injury, fatality, or property damage.

Vision Zero: A strategy to eliminate all traffic fatalities and serious injuries, while increasing safe, healthy, equitable mobility for all.

Vulnerability: An internal risk factor of the subject or a system that is exposed to a hazard and corresponds to its intrinsic tendency to be affected, or susceptible to damage.

Vulnerable Road User: Refers to pedestrians and cyclists who are easily injured and killed in a car-dominated road space.

1.0 Introduction & Background

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1.0 Introduction

1.0.1 Project Overview and Scope

In 2015, York Region released the Built Environment and Health Action Plan as a framework to guide collaboration within the Region to develop health supportive projects, policies, and programs.[1] York Region has identified road safety as an integral aspect of public health and a main concern of York Region's residents. The Region and its municipal partners are wishing to implement Vision Zero principles and require an equity lens to inform road safety policies and programs.

The primary purpose of this report is to provide recommendations for the York Region to effectively improve road safety for vulnerable populations. These recommendations incorporate an equity lens developed through an analysis of York Region collision data and comprehensive research into the determinants of road vulnerability. The recommendations are aimed at enhancing the current work being done by York Region and its municipal partners to improve road safety for York Region's residents.

This report focuses on the safety of pedestrians and cyclists. The research used for this report explores how spatial, socio-economic, and individual-level determinants influence the safety of vulnerable road users, i.e., pedestrians and cyclists, but will not provide an in-depth review of how motorist behaviour affects overall road safety.

1.0.2 Project Objectives

The primary objective of this report is to provide recommendations for York Region to effectively improve road safety for vulnerable populations. These recommendations incorporate an equity lens developed through an analysis of York Region's collision data and comprehensive research into the spatial and socio-economic determinants of traffic-related injuries and fatalities. The recommendations are aimed at enhancing the current work being done by York Region and its municipal partners to improve road safety for the residents of York Region.

1.0.3 Overarching Framework

To achieve an equitable transportation system for vulnerable road users, an intersectional framework must be applied to road safety. Intersectionality seeks to understand and analyze

the complexity of human experiences and the interconnectivity of social categorizations.[2] An intersectional approach considers historical and social context and recognizes the unique experience of individuals.[3]

In addition to recognizing an individual's unique experiences, it is crucial to understand positionality. Positionality examines how differences in social position and power shape identities and access in society.[4] Understanding an individual's positionality contributes to developing an equitable system for all road users.

The development of an equitable system builds upon the relevancy of intersectionality and positionality in relation to equity. The application of an equity lens specifically assists with understanding the relationship between social position and access through a series of qualitative questions. An equity lens is a framework that includes multiple questions to be considered when making decisions regarding policies, programs, or initiatives.[5] The purpose of equity is to ensure that everyone has equal access to results and benefits.[6] Equity, specifically health equity, is determined by the conditions in which people are born, grow, live, work, play, and age.[7] Spatial determinants, socio-economic determinants, and individual-level determinants impact an individual's exposure and vulnerability. Vulnerability represents the physical, economic, or social susceptibility of a person or community to sustain damage in the case of threatening circumstances.[8] The application of an equity lens can assist with identifying determinants and protecting vulnerable populations from threatening circumstances. Applying an equity lens to road safety assists with determining which populations face disproportionate levels of traffic risk and prioritizing interventions to address these disparities and inequities.

1.0.4 Research Methodology

The recommendations were developed through a two-pronged approach, using both qualitative and quantitative methodologies. An analysis of academic literature, news media, case studies, and key informant interviews was conducted to provide insight into key road safety issues affecting vulnerable populations within other municipalities. A review of academic literature was conducted to identify the spatial determinants, socio-economic determinants, and individual-level determinants of traffic injuries and fatalities. The news media review focused on analyzing how traffic injuries and fatalities are framed within the media. The analysis also reviewed how spatial determinants, socio-economic determinants, and individual-level determinants are depicted within traffic-related articles. The case study analysis focused on reviewing road safety strategies from North America, as well as the origin of the Vision Zero strategy, to provide a review of best practices. The case studies were selected for their Vision Zero principles and/or effective public engagement. Semi-structured key informant interviews were conducted

with five professionals who have expertise in road safety initiatives and/or vulnerable populations.

This was done in conjunction with an analysis of York Region collision data and site visits to York Region intersections to understand and observe York Region's built environment. Using collision data from the past three years, a spatial relationship between collisions and vulnerable communities was investigated. Furthermore, key collision trends were identified, and York Region built environment characteristics at high frequency collision locations were evaluated.

1.0.5 How to Read This Report

This report has been organized to be either read in its entirety, or separately by specific chapters regarding each research method. Chapters 2-7 provide research findings and insights gathered on the topics of spatial and socio-economic determinants of traffic injuries and fatalities. Within the chapter, each respective method draws connections between vulnerability and road safety. The methodologies and findings from each chapter are then brought together in Chapter 8 for a comprehensive discussion which sets the foundation for the recommendations in Chapter 9.

1.1 Background

1.1.1 Road Safety

Traffic collisions resulting in injury or fatality have been decreasing steadily in Canada, however, the statistics are still staggering. Traffic collisions resulted in 1,762 fatalities and 140,801 injuries in Canada in 2019.[9] Approximately a third of fatalities were among pedestrians, cyclists, and motorcyclists, while the remaining were motorists/occupants.[9] The most vulnerable age group is 25-34, as this age cohort experienced the most injuries and fatalities.[9] Risk of injury, however, is not solely associated with mode of transport or age. Recent studies have determined a relationship between socio-economic status and traffic collisions, generally determining that low socio-economic status and deprivation lead to greater risk of being injured in traffic collisions.[10] A 10-year study of traffic collisions in British Columbia found that lower socio-economic status was associated with higher rates of injury collisions, pedestrian collisions, fatal speeding collisions, and fatal collisions.[11]

Understanding these relationships is crucial to creating equitable road safety, yet many municipalities have not incorporated socio-economic factors into decision-making, York Region being one of them. The first step is understanding the regional context and collision trends.

1.1.2 York Region

York Region is a diverse region located north of Toronto and south of Lake Simcoe (Figure 1.1). The entire region stretches across 1,776 square kilometers and includes nine municipalities. The Region is Ontario's fastest growing regional municipality, with a current population of approximately 1.2 million residents.[12]

York Region has seen a 7.5% population increase since 2011 and is forecasted to grow to approximately 2.02 million by 2051.[12] Older adults aged 65 and over were identified as the fastest growing age group between 2011-2016, increasing by 34% from 2011 to 2016.[12] Additionally, recent immigrants account for 10% of all immigrants in the Region and 49% of the population self-identified as a visible minority.[13]

Table 1.1 shows the population distribution amongst York Region's nine municipalities from 2016 census data.

1.1.3 Road Safety in York Region

York Region has a highly developed Regional Road transportation network which sees approximately 2.6 million vehicle trips daily and more than six billion vehicle-kilometres of travel annually.[14] Compared to provincial averages, York Region experiences lower traffic injury and fatality rates, and has been experiencing a decline in collisions over the past decade.[14] This can be attributed to engineering improvements, stricter legislation and enforcement, and recent safety

Figure 1.1. Map depicting the nine municipalities in York Region (Source: York Link)

Table 1.1. York Region's population distribution.

Municipality	Population
Vaughan	306,230
Richmond Hill	195,020
Markham	328,970
King	24,510
Aurora	55,450
Whitchurch-Stouffville	45,840
Newmarket	84,220
East Gwillimbury	23,990
Georgina	45,420

initiatives.[14] Furthermore, due to the COVID-19 pandemic, and subsequent public health measures, there was significantly less road activity in 2020, leading to a 10-year low in the number of collisions on regional roads. However, improving road safety continues to be a main priority for the region.

The latest *York Region Traveller Safety Report* (2020) identified several key collision trends and areas where improvements can be made. In 2020, there were 4,538 collisions in York Region, where 1,085 of which resulted in injury and 15 in fatalities.[14] Pedestrians and cyclists were involved in 181 collisions and were the most vulnerable road users: 94% of pedestrian and 84% of cyclist collisions result in injuries or fatalities.[14] Motorists were identified as being at-fault in the majority of pedestrian and cyclist collisions, with intersections being the most frequent collision location.[14]

York Region collision data will be further analyzed in Chapter 5.

1.1.4 York Region Safe Mobility Initiatives

York Region conducts on-going monitoring of collision statistics, released in the annual Traveller Safety Report. This report summarizes the previous year's collision data, identifying key trends and safety measures. This monitoring is performed in conjunction with several safety initiatives undertaken by multiple partners within the Region.

The most substantial measures have been focused on the built environment, with several road design changes being implemented within the Region. This includes improved pavement markings, lane realignments, improved traffic signals, implementing roundabouts, and pavement resurfacing.[14] The Region's Transportation Master Plan and various Design Guidelines contain approaches to improve pedestrian and cyclist safety through road and intersection design, laying the groundwork for engineering improvements.

The Region has undertaken several enforcement initiatives, including red light cameras and an automated speed enforcement system, both of which are aimed at changing motorist behaviour.[14] Furthermore, the York Regional Police (YRP) developed a Road Safety Strategy for 2018-2023. This strategy focuses on continuing education and enforcement campaigns to reduce impaired, inattentive, and aggressive driving, promote the use of seatbelts, and educate vulnerable road users.[15]

The Region has several awareness campaigns aimed at education and changing motorist behaviour. These include campaigns aimed at ensuring pedestrians, cyclists and motorists maintain visibility despite adverse conditions, reducing inattentive driving, and eliminating speeding.[14]

1.1.5 Vision Zero

The Vision Zero framework originated in Sweden where policies were first introduced by the government in 1997 guided by the principle that all traffic-related injuries and deaths are preventable. Vision Zero is the belief that "accidents" should be viewed as predictable and preventable.[16] This approach shifts away from the thinking that transportation networks inherently cause injury or death and instead shifts the focus upon designing a complete system that is safe for all users. In other words, Vision Zero's goal is to eliminate severe traffic injuries and fatalities. The Sweden case study in Chapter 4 will further discuss the original Vision Zero approach.

Vision Zero preventative policies can be compared to public health agencies taking proactive and preventative measures such as vaccinations against deadly diseases to prevent widespread harm. As stated by the Centre for Active Design, "…the public health imperative behind Vision Zero is clear: increasing the safety of our streets not only saves lives, but also makes it easier and more enticing for people to engage in daily physical activity by walking and biking".[17]

A Vision Zero advocacy group called the Vision Zero Network created the graphic displayed in Figure 1.2 to highlight how Vision Zero differs from the traditional approaches to road safety. The main takeaway from the graphic is that Vision Zero requires a long-term, cooperative, and system-wide approaches.

TRADITIONAL APPROACH

Traffic deaths are INEVITABLE

PERFECT human behavior

Prevent COLLISIONS

INDIVIDUAL responsibility

Saving lives is EXPENSIVE

VS

VISION ZERO

Traffic deaths are PREVENTABLE

Integrate HUMAN FAILING in approach

Prevent FATAL AND SEVERE CRASHES

SYSTEMS approach

Saving lives is NOT EXPENSIVE
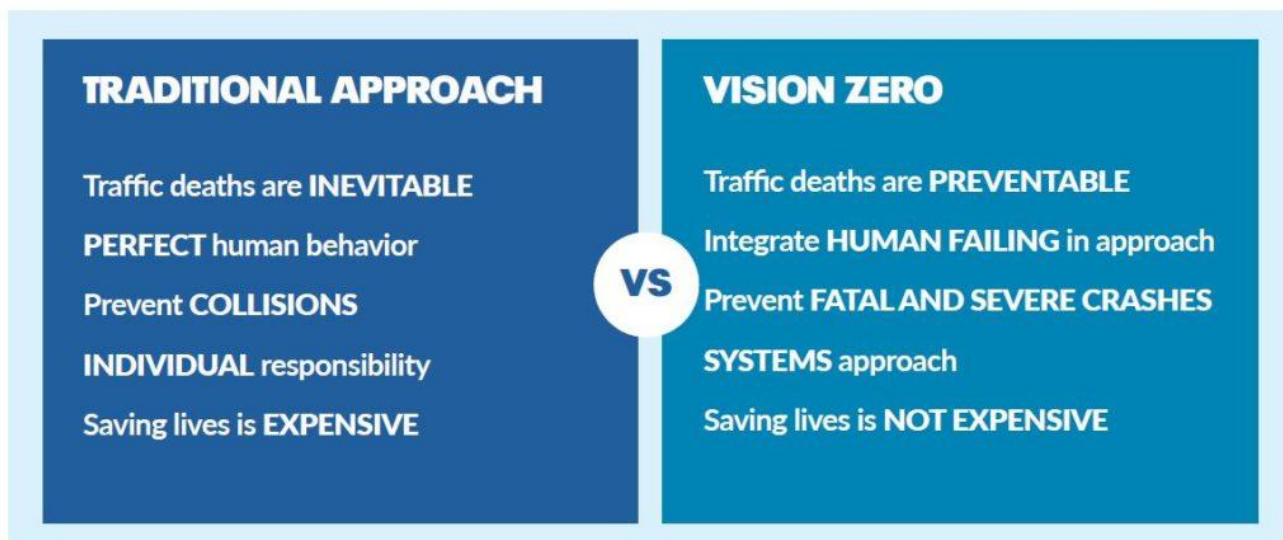
Figure 1.2. Comparing and contrasting traditional approaches to road safety the Vision Zero Approach (Source: Vision Zero Network)

Seeing the success in Sweden, many other countries, regions, and municipalities around the world have also implemented Vision Zero policies in the past twenty years, as seen in Figure 1.3.

Figure 1.3. Map of countries that have adopted a Vision Zero approach (Source: Parachute Canada).

Vision Zero policies have gained popularity across Canada, and have been introduced in the following places:

- Edmonton, AB (2015)
- Montreal, QC (2016)
- Province of British Columbia (2016)
- Toronto, ON (2016)
- Vancouver, BC (2016)
- London, ON (2017)
- Province of Manitoba (2017)
- Region of Peel, ON (2017)
- Brantford, ON (2018)

- Calgary, AB (2018)
- Halifax, NS (2018)
- Trois-Rivières, QC (2018)
- Saskatoon, SK (2018)
- St. Albert, AB (2018)
- Hamilton, ON (2019)
- Kingston, ON (2019)
- Region of Durham, ON (2019)
- Surrey, BC (2019)

The non-profit organization, Parachute Canada, has been a champion of the policy in Canada by bringing awareness to Vision Zero rationale and research. An educational campaign entitled '#EndDeathsOnOurRoads' was started in 2021 by the organization to bring road safety awareness to Canadians through social media advertisements, billboards, and partnerships with national corporations.[16]

Rationale for the Vision Zero movement is also supported by the United Nations (UN) and World Health Organization (WHO). Both organizations support a Safe Systems Approach to infrastructure design and policy. A report commissioned by the WHO estimated that by 2030, traffic collisions would be the fifth most common cause of fatality globally.[18] The UN predicts that without serious intervention, 13 million fatalities and 50 million injuries because of traffic collisions will occur worldwide by 2030.[19] In response to this global concern, the UN General Assembly passed a resolution declaring a *Decade of Action for Road Safety 2021-2030*, with the overall goal of reducing traffic fatalities and injuries by 50%.[19] The UN additionally added road safety into the Sustainable Development Goals.[19] As a nation, Canada has signed onto this UN resolution and agenda goal. Additionally, Canada has created the *Road Safety Strategy* (RSS) 2025 that also takes a Safe Systems Approach to promote road safety across all levels of government, the private sector, and other non-governmental stakeholders to work towards making Canada's roads the safest in the world.[20] From these precedents, York Region can draw all necessary rationale to support the introduction of further Vision Zero policies.

2.0 Academic Literature Review

2.0 Academic Literature Review

2.1 Introduction

The objective of the academic literature review was to document the spatial and socio-economic determinants of traffic-related fatalities and injuries. Using the trends in the findings for spatial and socio-economic determinants, the academic literature informed the key determinants that affect a road users' overall level of risk.

2.2 Methodology

Inclusion criteria for the literature review were developed to capture articles that would be most relevant to the York Region context. Specifically, articles published within the last 10 years and from the North American context were prioritized for inclusion. PubMed and Google Scholar were used to conduct the literature searches using the terms listed below:

1. "Spatial determinants" OR "Built environment" OR "Infrastructure"
   AND
   "Traffic injuries" OR "Road safety" OR "Traffic collisions" OR "Road injuries" OR "Vision Zero"

2. "Socio-economic status" OR "Socio-economic determinants" OR "Lower-income" OR "Older adults" OR "Seniors" OR "Children" OR "Pedestrian" OR "Marginalized "
   AND
   "Traffic injuries" OR "Road safety" OR "Traffic collisions" OR "Traffic collisions" OR "Road injuries" OR "Vision Zero"

The literature review team consisted of three members. One member searched the literature using keywords related to spatial determinants; a second member searched the literature using keywords related to socio-economic determinants; and a third member searched for literature using key authors identified in the initial search and key journals focused on traffic injury prevention for additional relevant sources.

A total of 53 articles were reviewed and managed with a data extraction table. The table captured article name, year, main findings and recommendations, limitations, search terms used, country of study, and its relevance to York Region. From here, common themes were identified. Some themes such as "inattentive road users" and "physical disability", could not be categorized under the spatial and socio-economic determinant categories. As a result, a new category – individual-level determinants – was created to capture these themes. Figure 2.1. provides an overview of the number of included sources by determinant keyword. It is important to note that some articles fell into multiple determinant groupings.

Results by Determinant Keyword

Determinant Keyword	Value
Lower-income Status	19
Age	17
Gender	12
Street Type & Design	10
Education	6
Race	6
Inattentiveness	5
Infrastructure Type & Design	5
Land Use	5
Publict Transit	4
Urban vs Rural	4
Cognitive Impairments and Neuro-developmental…	3
Cycling Infrastructure	3
Immigrants or Newcomers	3
Population Density	3
Road Safety Knowledge	2
Use of Protective Equipment	2
Mobility Impairments	1
Motorist Aggression	1

Legend: ■ Spatial Determinant ■ Socio-economic & Demographic Determinant ■ Individual-level Determinant

Figure 2.1. Academic literature review results organized by determinant keyword, revealing the number of sources included from each determinant.
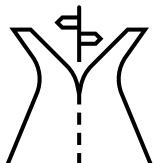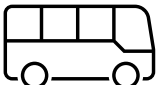
2.3 Key Findings

Spatial Determinants

This section summarizes emergent themes from the academic literature regarding how urban design and the built environment – referred to as spatial determinants – contribute to traffic injuries and fatalities. The spatial determinants of road safety attribute pedestrian risks to traffic speeds and volumes, which are shaped by land use patterns, population density, street hierarchy and design, intersection design, and supportive infrastructure for alternative modes of travel.

Table 2.1. Spatial determinants of traffic collisions

Determinant	General Findings About Traffic Collision Risk	Source
Land Use	Areas with high levels of pedestrian activity (commercial zones in urban areas) experience a higher frequency of pedestrian collisions compared to areas with lower levels of pedestrian activity (industrial zones, single-family suburbs) • Traffic collisions are least likely in single-family residential areas Areas with a greater number of schools have higher frequencies of traffic collisions due to high pedestrian activity	[21], [22], [23], [24]
	Cyclist collisions are less likely to occur in areas with mixed land use Areas with mixed land use and public park space are associated with less severe cyclist injuries	[25]
Population Density	Pedestrian and cyclist collisions occur more frequently in areas with high population density • Child pedestrian collisions increase with higher levels of multi-family dwellings • Higher population density increases pedestrian activity and increases likelihood of collisions As population density increases, individual risk does not increase proportionally as there is a safety in numbers effect as pedestrian numbers increase	[26], [27], [28]
Urban vs. Rural Settlements	Pedestrian and cyclist traffic fatalities are more likely in rural environments, however, collision frequency is higher in urban areas	[27], [28], [29], [30]
Street Type & Design	Traffic injuries and fatalities have been observed to occur at a greater frequently on wide arterial roads with a greater number of traffic lanes. Pedestrian injuries at an intersection increased by 13% with the addition of an extra lane of traffic, likely due to longer crossing distances increasing pedestrian exposure to traffic	[21], [22], [31], [32], [33]
	Pedestrian-motorist collisions are more likely to occur on streets with less gradient change	[34]
	Pedestrian's risk of injury and fatality increases on streets with poor lighting and streets with parked vehicles obstructing views of the intersection Pedestrians' perception of safety is also increased on well-lit streets, and streets with increased signage	[32], [35]
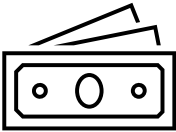
Determinant	General Findings About Traffic Collision Risk	Source
Street Type & Design 	Street trees and planters reduce traffic collisions on arterial roads by 5-20%	[23], [36]
	Street trees and planters create a well-defined edge of the road that act as a protective factor for pedestrians on the sidewalk	
	Vehicle speeds over 45km/hr increase the likelihood for cyclist fatalities	[37]
	30km/hr speed restrictions on roads with vulnerable cyclists is recommended to reduce the risk of cyclist fatality	
Intersection Type & Design 	An increased number of intersections along a street, and thus smaller block sizes, is associated with lower motor-vehicle collisions and decreased pedestrian mortality rates	[31], [38]
	4-legged intersections exhibit a significantly higher risk for pedestrian collisions than 3-legged intersections	[22]
	Simplification of intersections protects pedestrians of all ages from collisions, but primarily protects both child and older pedestrians • Sidewalk availability at intersections and permissive right-turn lanes were both associated with increased safety for all pedestrians • Motor-vehicle collisions involving older adults are less likely to occur at intersections with traffic lights, left-turn restrictions, and only one-way streets Older adults were more likely to be involved in motor vehicle collisions at intersections with all-way stops and while performing left turns at these intersections	[39], [40]
Cycling Infrastructure 	The presence of bike lanes is associated with a 50% reduction in cyclist injuries and areas with a high density of bike lanes reduced the number of severe collisions for all road users	[27], [41]
	The presence of cycling tracks at roundabouts and intersections, street lighting, paved surfaces, and low-angled grades are all reduce the number of cyclist injuries and fatalities	[41]
Public Transit 	Pedestrian collisions were more likely to occur in areas with a high density of public transit stops and on popular transit commute routes	[21], [26], [39], [42]
	Safety interventions should be targeted at regions with a high density of transit stops to ensure users can safely access transit	
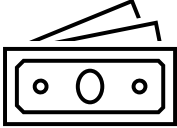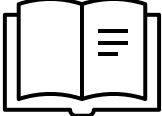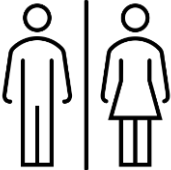
Socio-economic and Demographic Determinants
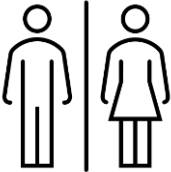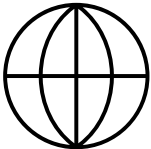
The review of the academic literature was also used to determine the socio-economic and demographic determinants of road risk. Various socio-economic and demographic determinants of vulnerability to road traffic collisions were identified, including age, income, education, gender, visible minority groups, and newcomers or immigrants. These socio-economic and demographic determinants also overlap with spatial factors discussed above, thereby compounding the burden of road traffic collisions that some populations face (e.g., children living in denser, high-traffic neighbourhoods).

Table 2.2. Socio-economic and demographic determinants of traffic collisions

Determinant	General Findings About Traffic Collision Risk	Source
Age	School-aged children walking or cycling to school are more likely to be involved in a traffic collision • As the distance between home and school increases the level of risk increases	[26], [43], [44], [45], [46], [47], [48], [49]
	Children aged 15-19 are a specific group of pedestrians that are at higher risk of being involved in a traffic collision • Increased exposure to traffic • More likely to engage in risk-taking behaviour	[10], [30], [48], [50]
	Children are at an increased risk when there is a lack of designated play areas	[26], [30],[43], [45], [48], [50], [51]
	High population density, high-traffic volumes, and high-traffic speeds contribute to a child's increased risk for traffic injury and fatality	[26], [43], [44], [48], [52], [54]
	Child pedestrians from lower-income families are more likely to suffer a traffic injury or fatality • More likely to live in high density areas • Roads not separated according to vehicle type • Walking in areas near major highways and roads	[26], [30], [43], [44], [45], [51]
	Children living in lower-income neighbourhoods are exposed to more non-local traffic increasing risk • More likely to walk or cycle	[26], [46], [48], [51]
	Child pedestrians who belong to visible minority groups are at a greater risk of being involved in traffic collisions	[26], [54]

Determinant	General Findings About Traffic Collision Risk	Source
Age	• More likely to live in a densely populated neighbourhood • Increased levels of traffic	
	Older adult pedestrians aged 65+ are frequently identified as being more vulnerable for traffic injury and fatality • Increased difficulty while walking • Fear of falling • Crossing evaluation capability • Lower levels of pedestrian confidence	[40], [52], [54], [55], [56]
	High-traffic speeds, short crossing times and poor sidewalk quality contribute to older adults' increased level of risk for traffic injury and fatality	[52], [54], [55]
	Raised medians, 3-way intersections, and street trees make a positive contribution to the safety of older adult pedestrians	[40]
	Increased frequency of bus stops increases risk for older adult pedestrians	[40]
Lower-income individuals or neighbourhoods	Lower-income individuals are more likely to walk or cycle, exposing them to more traffic	[26], [27],[57]
	Pedestrians and cyclists are at an increased risk of getting into a collision in lower-income neighbourhoods where there is: • Greater population density • Greater transit use • Higher exposure to traffic • Presence of more major roads • More 4-legged intersections	[10], [26] [58], [59],[60]
	Lower-income neighbourhoods have more infrastructure that is in poor repair putting pedestrians and cyclists at greater risk, including: • Potholes • Faded road markings • Broken or missing sidewalks • Poor or limited lighting	[60]
	Traffic calming devices such as speedbumps are implemented in higher-income regions before lower-income regions	[30], [60]

Determinant	General Findings About Traffic Collision Risk	Source
Lower-income individuals or neighbourhoods	Lower-income neighbourhoods are more likely to receive non-local traffic than higher-income neighbourhoods exposing lower-income individuals to more traffic • Non-locals drive at faster speeds • Non-locals are unfamiliar with the neighbourhood's safety culture • Higher-income neighbourhoods are more closed-off to non-local traffic lessening traffic exposure for higher-income pedestrians and cyclists	[46], [58],[60]
	Child pedestrians from lower-income families are more likely to be involved in a traffic injury or fatality • More likely to live in high density areas • Roads not separated according to vehicle type • Walking in areas near major highways and roads	[26], [30], [43], [44], [45], [51]
	Children from lower-income families are more likely to walk than children of higher-income families exposing them to traffic	[46], [47], [50], [52], [57]
	Children from lower-income families who belong to a visible minority group are more at risk of being in a traffic collision • More likely to walk	[26], [54]
Education Level	Pedestrians with less than a high school education are more at risk of traffic collisions • More likely to walk • Live in dense neighbourhoods	[27], [48], [53], [59], [61]
	Children whose mothers have less education are more likely to cross more roads	[47]
	Men who walk and have a lower level of education are more likely to be in a traffic collision	[27], [61]
Gender	Boys who walk or cycle are more likely to suffer a traffic injury or fatality	[30], [48], [50], [51]
	Men who walk or cycle are more likely to suffer a traffic injury or fatality	[27], [50], [52], [56]
	Men with a lower level of education are more likely to be involved in a traffic collision	[27], [61]

Determinant	General Findings About Traffic Collision Risk	Source
Gender	Young, Indigenous men who walk are more likely to be involved in traffic collision	[53]
	Older men (65+) who walk are more likely to be involved in a traffic collision • Men are less cautious than women when crossing	[62]
	Older women (65+) who walk are more likely to be involved in a traffic collision	[53], [56]
Race	High density, Hispanic communities are at an increased risk for traffic injury and fatality • Lack of active transportation networks	[26], [28], [48], [63]
	Predominately Black communities experience higher frequencies of traffic collisions • Lack of active transportation networks	[28], [63]
	Pedestrians and cyclists in predominately Asian communities have a lower risk of being involved in a traffic collision	[26]
	Black pedestrians under the age of 65 are more likely to be involved in a traffic collision	[52]
	Young, Indigenous men who walk are more likely to be involved in traffic collision	[53]
	Indigenous pedestrians living on reserve are at a greater risk of being in a traffic collision: • Less safety features including guard rails, road markings, pedestrian and cycling infrastructure • Poor road conditions including unpaved roads, limited maintenance, high speeds, long distances to travel, and further distances to emergency medical services	[53]
Immigrants or Newcomers	Newcomers under the age of 65 have an increased risk for traffic injury and fatality while walking or cycling • This may be due to transferring between safety cultures • More likely to walk or cycle, increasing their exposure • Inadequate access to appropriate resources to support safe cycling	[26], [48], [63]

Individual-level Determinants

Individual-level determinants include individual behaviours and abilities that may place individuals at greater risk of traffic injuries and fatalities. Several individual-level determinants associated with individual behaviour include distractions from technology-related use, motorist aggression, and the forgoing of protective equipment. Differences in cognitive and physical abilities such as having a neurodevelopmental disorder or mobility impairment may alter perception of road layouts and road-crossing behaviour. These individual-level determinants may overlap and allude to some of the spatial determinants identified at the start of this section, pointing to how the built environment is an important contributing factor to increasing risk of traffic injuries and fatalities.

Table 2.3. Individual-level determinants of traffic collisions

Determinant	General Findings About Traffic Collision Risk	Source
Inattentiveness	Inattentive driving increases risk for collisions	[64], [65]
	Frequent mobile phone usage affects driving performance by contributing to slower reaction times, being a distraction from adhering to traffic signals, and reducing the ability to drive within the correct lane	[64]
	Mobile phone usage among pedestrians and cyclists causes distraction and sensory deprivation, negatively affecting the perception of the auditory environment	[65]
	Headphone usage among pedestrians causes distraction and sensory deprivation, increasing risk of being involved in a traffic collision	[66]
	Wearing headphones is the most common technology-related distraction among cyclists and increases risk of being involved in a traffic collision	[67], [68]
Motorist Aggression	Motorist aggression, more commonly known as "road rage", is associated with higher risk of collision	[69]
Use of Protective Equipment	Helmet usage is low among bike share cyclists and men	[67]
	Helmet usage is less frequent among older students in the tenth grade or higher increasing their risk of severe injury if they are in a collision	[48]
Road Safety Knowledge	Road safety education reduces the likelihood of being involved in traffic collisions	[59]
	Children whose parents are informed about road safety practices have increased helmet use and safe cycling practices	[54]
	Road safety education among children does not guarantee improved road safety knowledge	[54]

Determinant	General Findings About Traffic Collision Risk	Source
Cognitive Impairments and Neuro-developmental disorders	People with Alzheimer's are more vulnerable to traffic collisions due to differences in road-crossing behaviours as a result of being more affected by daylight conditions, faster vehicle speeds, and short time gaps to cross the road	[55]
	Age-related visual cognitive decline such as diminished visual processing speeds and lower selective visual attention places older adults at greater risk of traffic collisions	[70]
	Individuals with Attention Deficit Hyperactivity Disorder and DCD tend to choose unsafe crossing gaps	[71]
	Individuals with ASD perceive road layouts differently	[71]
	Children with intellectual disabilities have difficulty finding safe places to cross the road	[71]
Mobility Impairments	People using wheelchairs face a substantial disparity in pedestrian mortality • Poor pedestrian environments and infrastructure (e.g., lack of traffic controls and crosswalks) increase pedestrian death risk among wheelchair users	[72]

2.4 Limitations

Finding all the determinants of traffic fatalities and injuries is challenging considering the scope is broad. It is recognized that not *all* determinants of traffic fatalities and injuries have been identified. For instance, the topic of "political will", which may create hindrances such as timely renovation of roads and sign boards, is briefly touched upon in a paper written by Kulharni and may be a determinant that could impact a road user's vulnerability.[64] However, the decision to focus on spatial and socio-economic determinants was based on what would be most applicable to the York Region context.

Another limitation is that many of the studies examined in the literature were context dependent. While similar patterns emerged that indicated some of the built environment, socio-economic, and individual-level determinants, spatial analysis and observations may reveal more accurate determinants that exist within York Region's context. Additionally, as a result of the refined search strategy, other determinants of traffic fatalities and injuries such as the presence or absence of accessibility features, homelessness, employment, food security, and access to health services were not reviewed or identified. The common themes that emerged from the literature review also produced an additional category of road traffic collision determinants. Consequently, with the addition of a third category as a result of the initial search strategy, it is recognized that there may be additional literature on determinants that was overlooked.

For example, determinants that may have been overlooked in the literature review include the extent of the vulnerability of older adults and the impact of race on vulnerability from an Ontario perspective. However, there were limited sources located that specifically discussed older populations and their relationship to traffic collisions. This topic is still important to consider, especially as older adults are frequently referred to as a vulnerable population in much of York Region's literature, as well as in the various sources that were identified in the literature review.

Race was also determined to be a factor that can influence a road users' level of risk. However, studies that were reviewed looking at race were primarily based on data from the United States. There was only one study found on Indigenous populations and it was based in British Columbia. More studies on race that reflect Canadian populations would have been beneficial for the context of the study.

Lastly, the terminology used in academic sources may have led to limitations in the findings. For example, studies utilized the term "safety culture" when referring to newcomers and their relationship to road traffic. The term "safety culture" is vague and may generalize how newcomers may experience road traffic in the North American context.

2.5 Conclusion

The academic literature identified lower-income individuals, older adults, youth (particularly school-aged children), immigrants and newcomers, and racialized individuals as vulnerable populations. Additionally, individuals who hold multiple at-risk identities face a disproportionately high risk of being involved in traffic collisions.

Several individual-level determinants were identified in the academic literature review. These determinants place emphasis on an individual's behaviour or ability as factors that increase traffic collision risk. By drawing attention to the individual's level of ability or behaviour, this shifts the responsibility of any collisions onto the individual. Instead, other underlying spatial or socio-economic determinants that create inequities should be criticized when traffic collisions occur.

In both the socio-economic determinant and individual-level determinant categories, several of the identified determinants referenced spatial determinants as a contributing factor to increasing risk of traffic injury and fatality. With both socio-economic and individual-level determinants referring to spatial determinants, this indicates that the current built environments are facilitators of risk. People in positions of power, such as planners, policymakers, and road engineers, must reflect upon the design and implementation of these spaces to ensure safe and livable streets for all road users.

3.0 News Media Review

3.0 News Media Review

3.1 Introduction

An extensive review of relevant news media was conducted to better understand how the determinants of traffic injuries and fatalities in North America are being framed in the media. This is an important exercise as the ways in which news media frame particular issues influence how those issues are addressed through public policies and other mechanisms. Similar to the academic literature review, the news media review focused on the framing of spatial and socio-economic determinants of traffic collisions, with an emphasis on which populations news media identified as vulnerable to road safety issues.

3.2 Methodology

The search for relevant news media was guided by a series of pre-developed search terms (see Appendix A: News Media Search Terms for a complete list of search terms). Using the database Factiva, eligible articles were published after 2009 and based on the North American context. Articles that specifically focused on York Region and Ontario were prioritized for review. Findings from the news media review were organized into three topics: spatial determinants, socio-economic determinants, and individual-level determinants. Figure 3.1 provides a breakdown of the region the article is from, while Figure 3.2 provides an overview of the number of sources reviewed for each determinant keyword. It is important to note that some articles fell into multiple determinant groupings.

Results by Region

- Canada (outside of Ontario)
- United States
- Ontario
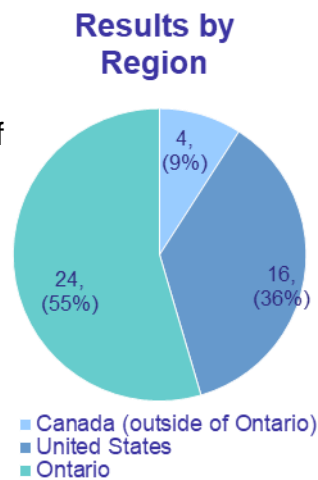
Figure 3.1. News media review article breakdown by geographic region.

Results by Determinant Keyword

- Spatial Determinant
- Socio-economic & Demographic Determinant
- Individual-level Determinant
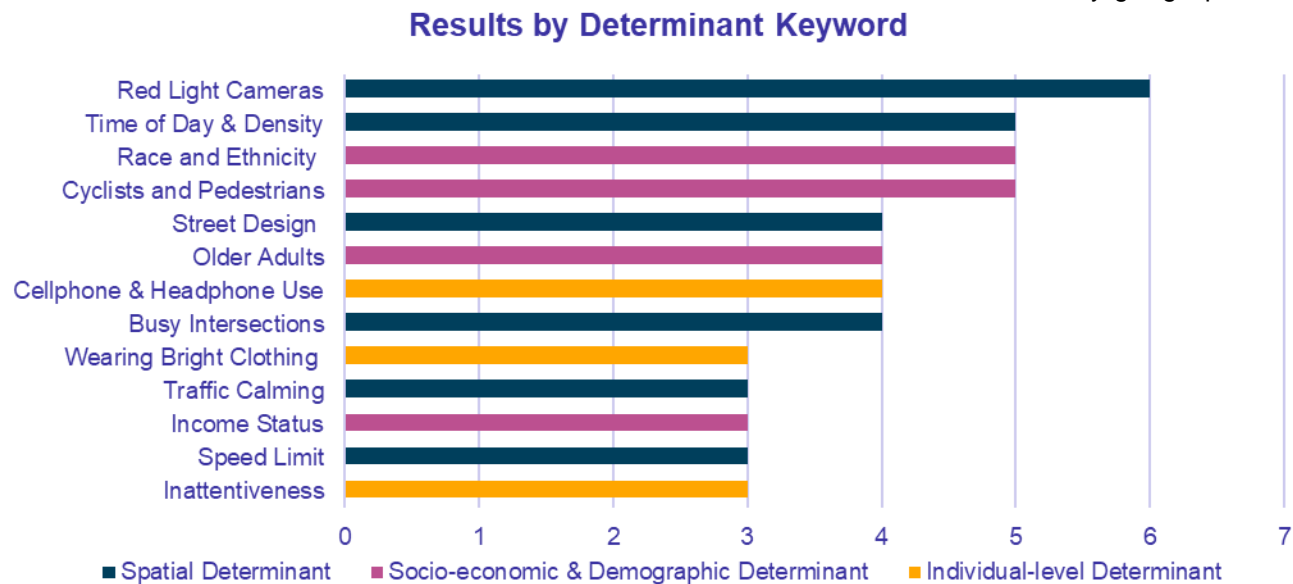
Figure 3.2. News media review results organized by determinant keyword.

3.3 Key Findings

Spatial Determinants

Several common themes emerged regarding spatial determinants of traffic collisions including street design, speed limits, traffic calming, time of day, intersections design, and red-light cameras.

Street Design

Pedestrian unfriendly street design, and its connection to traffic fatalities, was a common theme in the news media. For example, one article highlighted the historically high rates of pedestrian fatalities in Florida that were subsequently reduced through policies that both accommodated and supported pedestrian and cyclist safety.[73,74] In Ontario specifically, Scarborough has faced media scrutiny for poor road design, with critics calling into question the common use of wide roads that facilitate high volume and high-speed traffic.[75] In 2018, Scarborough accounted for 46% of all pedestrian deaths in the GTA, despite the borough containing just 23% of the GTA's population.[75] Communities across Ontario have similarly faced criticism about road design, specifically around it being unsupportive for children walking to school.[75] Thus, the media also emphasized the need for more programs and measures to slow down and remove traffic from particular streets to enable children to safely walk to school.[75]

Speed Limits

The association between high-speed and fatal collisions was common across a wide variety of articles reviewed. For instance, in the United States, 75% of all fatal pedestrian collisions happened in zones where the speed limit was 50 km/hr or higher.[77] In Canada, several studies have confirmed that higher speed limits are associated with increased fatalities.[76,78,79] Researchers in Quebec, discovered that the number of fatal accidents on the province's roads decreased from 4% to 1% when speeds were lowered by at least 20km/hr.[78] Additionally, a study surrounding Quebec and British Columbia's highways found that when speed limits were increased by 10km/hr, the number of fatal incidents increased by over 20%.[79] Overall, high speeds were associated with higher risk for both motorists and pedestrians.

Traffic Calming

Several articles focused on the absence of traffic calming measures and the occurrence of traffic collisions. For example, in both Bracebridge and Peterborough, Ontario, recent articles noted that busy intersections associated with traffic collisions have a lack of installed traffic calming measures.[80,81] The use of zigzag traffic calming measures was also criticized regarding their ineffectiveness of traffic calming in Markham, Ontario. Critics claimed that rather than producing the intended effect of slowing vehicles down and providing a safer experience, the

opposite was happening, and vehicles were being forced closer to cyclists, increasing the risk of traffic injuries and fatalities.[82]

Time of Day and Pedestrian Density

The time of day was also identified as a spatial determinant of risk. For example, traffic collisions generally peak during rush hours, when the highest number of people are on the road.[83] In Toronto, pedestrian collisions increase by over 30% during evening commute hours.[84] This trend has also been mirrored in York Region, with the highest proportion of incidents occurring during the morning and afternoon rush hours when the streets are at their busiest.[85] Additionally, nighttime hours also see a disproportionate amount of traffic collisions. For example, while roads see substantially less traffic at night, 50% of traffic deaths occur at night.[86] Furthermore, a 2018 report found that in the United States 76% of pedestrian fatalities, and 50% of cyclist fatalities, occur at night.[87] All in all, the time of day significantly impacts the level of risk and exposure for pedestrians and cyclists.

Intersections

The increased frequency of traffic collisions at high-traffic intersections was a commonly discussed theme in the news media. Vancouver, for example, has seen high rates of collisions at a few intersections, particularly those where high volumes of motorists, cyclists, and transit riders converge.[88] In British Columbia, intersections have proven to be one the deadliest places for pedestrians, accounting for 75% of all collisions involving pedestrians.[89] Ontario cities, such as Ottawa, have also struggled with high rates of collisions at busy intersections.[90] As well, according to an annual road safety report, the majority of all collisions in York Region happened at an intersection.[85] To conclude, it is clear intersections play a significant role in the relationship between vulnerable populations and road safety.

Lack of Red Light Cameras

Red light cameras, and their efficacy, was a popular topic of focus in news media. One article noted that Toronto's introduction of 50 red light cameras has had a substantial positive impact, with the percentage of speeding vehicles in 40 km/hr zones falling from 49% to 28% within a year of implementation.[91] Meanwhile, the introduction of red light cameras at 20 intersections in York Region led to a 50% reduction in collisions,[92] and a 72% reduction in T-bone collisions.[93,94] At the Green Lane and Yonge Street intersection, incidents dropped from 14 in 2013 to only four in 2014, while the Highway 7 and Weston Road intersection saw a reduction from 15 to 9 incidents over the same time frame.[93] The presence of red light cameras was found to be a successful tool for reducing traffic collisions.

Socio-economic & Demographic Determinants

The socio-economic determinants that emerged from news media coverage of road safety included race, age, vulnerable road user type, and neighbourhood income.

Race

The burden of traffic injury and fatality is not shared equally, and a person's race plays a significant role. One trend in the news media was that traffic injuries and fatalities often disproportionately affect people of colour, including, Black, Latino, and Indigenous communities across North America.[95, 96] For example, in Berkeley, California, the highest injury corridors are all clustered around Black and Latino neighbourhoods with underfunded infrastructure.[97] Just south of Berkeley, in Los Angeles, there are a small number of streets that account for a significant share of the traffic fatalities in the city. Concentrated in Black and Latino neighbourhoods, the cities "high injury network" makes up 70% of the total traffic fatalities in the region.[98] Unfortunately, this trend is not limited to California and was common among numerous articles spanning across different states. In fact, from 2010 to 2019, Black people were killed by motor vehicles at a rate 82% higher than the rest of the population.[99] Possibly due to Canada's lack of socio-economic data collection, our search uncovered very little in the news media about the relationship between a person's race and road safety. Therefore, it should be noted, this section largely drew from American sources.

Age

Age was another demographic determinant that was mentioned in several articles. In general, older adults, those above 65, are disproportionately affected by road violence. For example, in 2017, older adults made up over 20% of those killed in pedestrian-motorist collisions in the United States.[100] In Canada, cities and regions are faced with the same trend. In Toronto, pedestrian fatalities among older adults are on the rise from already dangerously high numbers.[101] The percent of pedestrian deaths where the victim was over 65, increased from 60% in 2016 to 80% in 2019.[101] Overall, the staggering statistics of older adults disproportionately involved in traffic injuries and fatalities reinforce their increased level of risk and vulnerability.[102]

Vulnerable Road Users

Pedestrians and cyclists are well-established vulnerable groups with regards to traffic injury and fatality. According to several articles, despite overall traffic fatalities stagnating or decreasing over the past decade, incidents involving pedestrians and cyclists have been increasing. For instance, spanning from 2010 through 2019, the United States saw a 51% increase in pedestrian fatalities.[103] Meanwhile, over the same period, the number of passengers and motorists killed annually remained relatively the same. In Canada, from 2010-

2016, pedestrian deaths increased by 11%, despite the total number of traffic fatalities decreasing by 15% over that same period.[104] Additionally, cyclists in both the U.S. and Canada are facing the same trend; while overall deaths are decreasing on roads, cyclist deaths are on the rise.[87] In York Region, from 2008-2016, crashes involving pedestrians and cyclists rose 3% annually. This trend has led to public outcry in the region, and even the development of a community-led safety task force in Vaughan.[105] Overall, the increase in cyclist fatalities in York Region is alarming and requires intervention.

Neighbourhood Income

Neighbourhood income levels were also commonly mentioned in the newspaper articles that were reviewed. Overall, pedestrians in lower-income neighbourhoods account for a disproportionate share of the victims of traffic injuries and fatalities. A review of traffic fatalities in the United States from 2008-2012 revealed that the pedestrian fatality rate is double in lower-income communities, in comparison to higher-income neighbourhoods.[106] In Ontario, several studies have explored the link between lower-income neighbourhoods and traffic collisions. For example, between the years 2005-2018, children in lower-income areas were 52% more likely to be struck by a vehicle than those living in higher-income neighbourhoods.[107] In Toronto specifically, from 2008-2018, collisions in which a pedestrian was killed or seriously injured occurred 50% more often in lower-income communities compared to higher-income communities.[108] All things considered, lower-income neighbourhoods are disproportionately involved in traffic injuries and fatalities.

Individual-level Determinants

Individual-level determinants such as mobile phone and headphone use, clothing, and inattentiveness were commonly reported in the media as contributing factors to traffic collisions.

Mobile Phone Use and Headphone Use

The use of mobile phones was frequently discussed in articles reporting on traffic collisions. Motorists' use of hand-held electronic devices while driving significantly reduces their attention and increases the risk of a collision.[109] In 2016 alone, the number of fatal crashes involving mobile phones rose 87.5%, while non-fatal mobile phone-related accidents rose 48%.[110] Additionally, pedestrians' use of mobile phones while walking has been noted as a direct factor in traffic collisions.[111] The use of mobile phones while walking or crossing a street has been identified as the cause behind hundreds of pedestrian mishaps.[111] In response to the increased use of mobile phones while driving or walking, numerous articles outline safety tips to avoid collisions, with law enforcement agencies emphasizing the need for pedestrians to look up from their phones while walking.[112]

Wearing bright clothing

The colour of road users' clothing was a commonly noted theme in news media coverage of road safety. Pedestrian and cyclists wearing dark clothing were often documented as a factor in traffic collisions. In one case, Halton Regional Police noted that a pedestrian struck and killed by a car was wearing dark clothing and walking on a poorly lit road, which may have been a contributing factor in the collision.[113] The colour of pedestrian and cyclist clothing is frequently mentioned, and law enforcement urge pedestrians to wear reflective clothing and make eye contact with motorists prior to crossing at a marked crosswalk.[112, 114] However, the emphasis placed on a pedestrian's or cyclist's clothing puts the onus on vulnerable road users to avoid being struck by a vehicle rather than placing the responsibility on motorists to drive with caution and care.

Inattentiveness

Inattentiveness of all road users is a common trend identified as a contributing factor to traffic collisions. Inattentiveness can also include the use of mobile phones or headphones while driving, walking or cycling. Between 2008-2012 in the City of Toronto, "inattentive" pedestrians were about 40% more likely to be injured or killed in a collision with a vehicle.[112] The inattentiveness of motorists contributes to motorist error and has been found to be increasing in pedestrian and cyclist collisions.[115] In 2017, the Ontario Provincial Police (OPP) reported that inattentive motorists were the source of 83 traffic fatalities, surpassing speed-related deaths, alcohol-related deaths, and lack of seat belt use. Since 2009, 692 people have been killed on OPP-patrolled roads in collisions that involved an inattentive motorist. Additionally, in 2017, the OPP responded to 8,711 non-fatal crashes that were linked to a motorist's inattentiveness.[116] In the City of Hamilton specifically, inattentiveness was the leading contributing factor to all traffic collisions.[117] Evidently, inattentiveness of all road users, specifically motorists, was reported as a contributing factor to traffic collisions across Ontario.

3.4 Limitations

While this chapter explored a variety of determinants related to traffic injuries and fatalities, we recognize that the presented list is not exhaustive and could be expanded in further research. Similar to the literature review, we chose to focus on spatial, socio-economic, and individual-level determinants as we deemed these the most relevant to the York Region. To ensure the scope of the project was not too broad, research on topics such as political or bureaucratic determinants were not included, and thus could be explored in future research projects. Additionally, this research was limited in the sense that news articles are often short and provide limited detail in comparison to scholarly articles. Therefore, the available relevant information contained in reviewed articles was often brief and lacking in depth.

Additionally, there were limited newspaper articles that discussed the relationship between race and traffic collisions in Canada. Therefore, the findings regarding race largely drew from American sources. This limited the findings and likely made them less applicable to the York Region population.

As well, the different terminology used in various newspaper articles may have limited the research findings. For example, as the research progressed, it was noted that some articles preferred terms such as 'traffic violence', or 'road violence', while others used terms such as "fatal collisions". Therefore, using the original search strategy, articles containing particular terminology and vocabulary may have been missed.

3.5 Conclusion

The news media review identified a series of spatial, socio-economic, and individual-level determinants that increase the risk of traffic injuries and fatalities. In completing the research, it was found that many news articles tended to emphasize and focus on individual-level determinants such as mobile phone use, rather than criticize spatial determinants such as lack of infrastructure. Additionally, many of the news articles which discussed individual-level determinants framed the victimized pedestrian as the at-fault road user. For instance, blaming a pedestrian wearing headphones for being hit by a car, as opposed to discussing the physical elements that could have influenced the collision, was common.

Overall, news media can shape public perception regarding collisions and who is at fault. The use of particular language impacts how the issue is framed, for example, the term 'violence' grabs people's attention, while 'accident' implies no one is held accountable. In general, this review used the most accurate terminology and therefore did not perfectly mimicking the original authors terminology. However, we encourage the use of non-diminishing language when considering road safety.

Through the news media review process, several vulnerable populations who were involved with a disproportionate number of traffic collisions were also identified. These include older adults, visible minorities, those living in lower-income neighbourhoods, pedestrians, and cyclists. Based on these findings, it is recommended that York Region prioritizes engagement with the identified vulnerable populations. This aims to break down barriers in communication and more effectively understand how vulnerable populations are affected by traffic collisions. Additionally, effective strategies identified in the spatial determinants section of this Chapter should be expanded and/or introduced in the York Region. For instance, expanding the region's red light camera program and reducing speed limits on high-collision roads.

4.0 Case Study Analysis

4.0 Case Study Analysis

4.1 Introduction

Four case studies were identified and examined to determine the best approaches to Vision Zero based on its implementation in other jurisdictions. The case study analysis informed useful road safety strategies which may be applicable to York Region. The case studies were selected based on their strategies for implementing Vision Zero principles, monitoring of implementation approaches, an application of an equity lens, and/or effective public engagement. The following case studies were examined:

1. Renewed Commitment to Vision Zero: Intensified efforts for transport safety in Sweden[118]
2. New York City Vision Zero Action Plan[119]
3. City of Edmonton Safe Mobility Strategy 2021-2025[120]
4. Region of Peel Vision Zero Road Safety Strategic Plan[121]

4.2 Methodology

Sweden's Vision Zero report was selected to examine the origin of the Vision Zero movement and to better understand the core elements that are needed to apply a Vision Zero approach. *New York City's Vision Zero Action Plan* was chosen as it was the first North American city to implement Vision Zero and encountered numerous barriers to reducing traffic injuries and fatalities. The City of Edmonton's *Safe Mobility Strategy* was a Canadian example that successfully applied an equity lens and collected lived experiences as a qualitative research methodology. These strategies align with York Region's goals of effectively engaging vulnerable populations to enable regional and municipal safe mobility initiatives that support greater health and social equity. Lastly, *Peel Region's Vision Zero Strategic Plan* was selected due to its collision data collection methodologies, public engagement, and regional priorities, in addition to having a similar upper and lower-tier government structure to York Region and its municipalities.

The qualitative analysis of the four case studies identified the strengths, limitations, and lessons learned for each case study. The key takeaways were summarized and incorporated into the final recommendations to be utilized by York Region. The complete analysis of each case study is detailed in the following section.

Case Study: Sweden

Title of Report	Renewed Commitment to Vision Zero: Intensified efforts for transport safety in Sweden[118]
Name of Coalition	Riksdag (Government Offices of Sweden)
Location	Sweden
When it Started	In 1997 Vision Zero was initially introduced by Swedish government, and the commitment to Vision Zero ideals were renewed in 2016.

Context and Background

In 1997 the Swedish Government developed Vision Zero, a long-term strategy for improving road safety. The Vision Zero approach focuses on designing transportation systems for all road users with the ultimate goal of eliminating injuries and fatalities on Sweden's roads. Sweden successfully reduced traffic injuries and fatalities by half between 2000 and 2010. However, following 2010, Sweden experienced a stagnation of results. This stagnation required Sweden to make a new commitment to Vision Zero in 2016. The purpose of the new commitment is to present targets and challenges in areas of transportation safety and determine the direction for future improvements. The new Vision Zero policy aims to bring Sweden closer to zero traffic injuries and fatalities.

Vision Zero Framework

Sweden implemented Vision Zero policies across all transportation systems extending beyond roadways and including rail, maritime, and air transportation.

Prior to 1997, Sweden did not have an official road safety strategy that

Figure 4.1. The principles, core elements, and action areas of the Safe Systems Approach incorporated in the Renewed Commitment to Vision Zero (Source: Vision Zero Challenge).

incorporated a Safe Systems Approach.

Simply put, the Vision Zero approach places the responsibility of imposing safety standards on those who own and manage infrastructure opposed to those who use it. Additionally, the renewed Vision Zero strategy emphasizes the importance of cooperation across the various organizations and agencies that manage transportation systems, to reduce traffic injuries and fatalities.

Summary of Key Findings

Sweden has successfully implemented Vision Zero policies and transformed the approach to road safety. The Swedish Transport Administration reported that between 2000 and 2010, the total number of traffic fatalities was halved. The reduction in traffic fatalities is attributed to the widespread implementation of the Vision Zero approach and various improvements to the overall transportation system, specifically improvements to vehicle fleets and road infrastructure. *The Renewed Commitment to Vision Zero* focuses on designing roads so that collisions do not end in serious or fatal injuries. The policy outlined numerous safety measures such as barrier separation of roads that reduce the possibility of a collision, widespread reduction in speed limits, and implementation of traffic calming measures in urban areas. Additionally, Sweden has improved their data collection system through the incorporation of multiple inputs. The STRADA database includes information from the Swedish Police and hospitals to receive full coverage in statistics of traffic injuries. The introduction of an extensive data collection methodology has led to efficiencies in identifying problem areas and creating data-driven solutions. For instance, research found that about 60% of fatalities are motorists, emphasizing the importance of developing built environment improvements, that reduce the risk of fatalities. The commitment to improving road safety for both motorists and active transportation users was essential in Sweden's recommitment to Vision Zero.

Strengths

The implementation of the Vision Zero framework in Sweden has been a proven success. A key strength of Vision Zero is the emphasis of a systems wide approach that recognizes human error is inevitable. With this understanding, the Vision Zero approach seeks to mitigate the risk of traffic collisions generated by human error. It is crucial to account for human error through proactive transportation planning instead of reactive planning. Proactive planning seeks to recognize areas of concern prior to the occurrence of a traffic injury or fatality.

Additionally, the *Renewed Commitment to Vision Zero* policy identifies challenges and opportunities of factors influencing road safety. For instance, the policy considers the impact of external factors such as traffic volume and composition. The policy provides a well-rounded analysis of all factors contributing to road safety and identifies the programs in place to address such factors. Furthermore, the policy has improved upon existing programs and introduced new programs to address factors contributing to road safety.

Limitations

Although Vision Zero is globally recognized as an effective approach to road safety, Sweden's Renewed Commitment to Vision Zero policy does not clearly incorporate an equity lens. The policy does identify the intention to improve road safety for vulnerable road users, which they define as pedestrians, cyclists, and motorcyclists, however, the only demographic or socio-economic determinant mentioned was older age.

Research findings indicated that the number of cyclists and pedestrian fatalities in Sweden has declined, but not nearly as much as motorist fatalities. Additionally, cyclists account for the largest portion of serious traffic injuries, which could be attributed to the increase in cycling activity. While the identification of cyclists and pedestrians as vulnerable road users exemplifies an effort to consider vulnerable populations, there needs to be a greater consideration of the additional demographic or socio-economic determinants that further increase vulnerable road users' level of risk.

The exclusion of an analysis of risk and exposure for vulnerable road users limits the success of Sweden's approach to reducing traffic injuries and fatalities, as it essentially ignores socio-economic determinants of collisions. Furthermore, the *Renewed Commitment to Vision Zero* policy does not discuss a specific engagement approach for understanding the contributing factors to vulnerable road users' disproportionate level of risk and their ideas for road safety solutions. The Vision Zero policy discussed the importance of cooperation amongst agencies, including government agencies and civil society organizations, but did not mention the importance of public input beyond volunteer organizations. Additionally, the principle of 'cooperation' does not extend beyond those in decision-making roles and enforces road safety solutions decided on by experts and design standards. The absence of an equity lens and a distinct approach for engaging with the public hinders the overall success of Sweden's approach to reducing traffic injuries and fatalities, specifically amongst vulnerable road users.

Lessons Learned

Although Sweden's government structure differs from York Region, the overall Vision Zero approach could be applied to the Region. Sweden's Vision Zero approach is a monumental framework that challenges the current approaches to road safety. The key takeaways from Sweden's *Renewed Commitment to Vision Zero* is the importance of a holistic view of road safety through a safe systems approach as well as the necessity of cooperation amongst agencies. The application of a safe systems approach is crucial as it aims to develop and improve mobility networks for all road users. Additionally, although York Region does not have the constraints of adhering to the standards of the European Union, the emphasis on cooperation between agencies and comprehensive management in Sweden's strategy is greatly applicable to York Region. To ensure a safe transportation system for all road users, improvements must be made to the built environment, engagement strategies, data collection methodologies, and cross-collaboration between key decision-makers.

Case Study: New York City

Title of Report	NYC Vision Zero Action Plan[119]
Name of Coalition	Vision Zero Task Force in New York City
Location	New York City, New York, USA
When it Started	The process towards Vision Zero in New York started in 2014 with 63 initiatives to reduce traffic related death and serious injuries on the streets of New York City.

Context and Background

New York City was the first North American city to commit to Vision Zero. The municipal government of New York decided the prevalence of traffic injuries and fatalities is unacceptable and preventable through the implementation of Vision Zero policies. As a result, the Vision Zero Action Plan was created by the City as a foundation for ending all traffic injuries and fatalities on the streets of New York City. The *Vision Zero Action Plan* was created in 2014 as the initial step to make New York City streets safer.

Vision Zero is a critical effort to provide New Yorkers with the opportunity to live safer lives. The Vision Zero Task Force of New York City is comprised of various key member agencies and offices, such as City Hall, Mayor's Office of Data Analytics, the Police Department, Law Department, Department of Health & Mental Hygiene, and Taxi & Limousine Commission, that work together to coordinate initiatives. A core part of their Vision Zero approach was communicating with the public to raise awareness of high-risk driving choices and engage with New Yorkers about their concerns and ideas for safety solutions. The Action Plan was created through the analysis of traffic collision data from 2008 to 2012 to understand the nature and causes of traffic collisions in New York City and to create strategies that can effectively protect people on the streets.

Vision Zero Framework

New York City's Vision Zero initiatives consider traffic collisions as a policy issue which can be reduced through the implementation of various strategies to make streets safer. Based on the analysis of their traffic collision data, four frameworks were used to implement safer street initiatives. The four frameworks used in the plan include: law enforcement, legislation, street design and regulation, and public education.

Table 4.1. The four frameworks used in the New York City Vision Zero plan.

Four Frameworks	Safer Street Initiatives Examples
Law Enforcement	Enhance training of officers on recording crashes for future analysis Increased enforcement at problematic intersections Deployment of speed cameras and red-light cameras
Legislation	Full local authority over speed limits and red-light cameras Increase penalties for dangerous driving Creation of the Hayley and Diego Law - "Failure to exercise due care" for additional enforcement tools against drivers who carelessly injure pedestrians and cyclists
Street Design and Regulation	Changes to signals Street geometry and markings Turning and parking regulations
Public Education	Demonstration on Truck's Eye View to show blind spots

Key Findings

New York City's 6-year report for the *Vision Zero Action Plan* attributed an increase in bicycle trips to the creation of more cycling infrastructure and proper timing signals which reduced the time that cyclists need to stop. However, in 2019, there was an increase in cyclist fatalities, which could be attributed to the failure of certain Vision Zero strategies or due to the increased cyclist activity. Overall, New York City was successful in increasing cyclist ridership but was not successful in reducing cyclist fatalities. It is inconclusive whether Vision Zero strategies were the reason for the reduction in motorist-pedestrian fatalities as fatalities were decreasing before New York City implemented Vision Zero in 2014.

New York City combined the efforts of its community, governments, and private industries to work towards implementing initiatives for safer streets. New York City created the Vision Zero Task Force which is a group of key agencies and local stakeholders who work together to organize road safety strategies and initiatives, including street safety outreach programs at schools, awareness campaigns and increased enforcement of speeding violations. The establishment of the permanent Vision Zero Task Force created consistent efforts towards New York City's Vision Zero and ensured that there is an active role in overseeing initiatives and tracking the progress in reducing collisions. Further, this task force is broken into working groups to consult on specific sections of the Vision Zero strategies. These working groups include data, marketing, fleet (large vehicles), and bicycle monitoring groups, which have been created to delegate responsibilities and create cross-collaboration within the task force.

Strengths

New York City's Vision Zero initiatives have gained both national and international attention as an example of a best practice in road safety, particularly due to the City's data-driven approach.

A 6-year report was completed in 2020 to review the changes in road safety following the implementation of Vision Zero in New York City.[122] Figure 4.2 compared traffic fatalities data by transportation mode in New York City from 2000-2019. Although the number of traffic fatalities did not decrease consistently year by year, there was an overall trend of decline in fatalities among pedestrians and motorists. However, it is difficult to solely credit the Vision Zero initiatives with these

Figure 4.2. Comparing traffic related fatalities data in New York City (2000-2019) (Source: New York City Mayor's Office of Operations).

results as the decline in fatalities had been occurring prior to the implementation of

the Vision Zero Action Plan. The Vision Zero 6-year report does not explain the reasoning for the decline in fatalities prior to the Action Plan, making it difficult to determine the success of Vision Zero in reducing traffic fatalities.

Limitations

Although pedestrian and motorist fatalities have declined in the past 20 years, cyclist fatalities remain consistent. The 6-year report focused on the "success" of the bicycle infrastructure, as there was an increase in bicycle trips among New Yorkers, however, the number of cyclist fatalities involved in traffic collisions did not decrease. It is difficult to assess whether this is a failure of the Vision Zero program or a symptom of success as there were more people cycling due to improved infrastructure.

New York City Vision Zero initiatives focused on painted bicycle lanes which did not provide perceived safety for cyclists. Most cyclist collisions occur in the outer boroughs of New York where there is a lack of comprehensive bike lanes. Cyclists are calling upon the Visons Zero Task Force for separated bicycle lanes that connect to more areas of the city to prevent cyclists from being in dangerous traffic situations alongside motorists.[123]

Overall, New York City's Vision Zero plan is commonly referred to as a Best Practice of Vision Zero strategies, but the inconclusive results of this Action Plan make it difficult to firmly draw any conclusions regarding the success of road safety strategies in New York City.

Lessons Learned

New York City used a data-driven approach to assess the success and failures of the implementation of the Vision Zero approach. Data-driven decisions allowed for the monitoring of traffic collisions before and during Vision Zero implementation in the city. Using data to identify collision trends is crucial for monitoring traffic flows and identifying dangerous intersections. York Region should continue to collect collision data as well as collect data on the individuals involved in collisions to measure the success of safety improvement initiatives.

New York City exemplified the importance of connectivity within the city. Connectivity has proven to reduce risk to cyclists and pedestrians as well as increase the attractiveness of using active modes of transportation. Connectivity of active transportation networks is crucial for cyclists and is a strategy that York Region should implement to improve connectivity within the Region.

Case Study: City of Edmonton

Title of Report	Safe Mobility Strategy (SMS) 2021-2025[120]
Name of Coalition	Vision Zero Edmonton
Location	Edmonton, Alberta
When it Started	The process towards Vision Zero in Edmonton started with the Road Safety Strategy in 2016-2020.

Context and Background

In 2016, the City of Edmonton released the first *Road Safety Strategy* 2016-2020, and thus far, there has been a reduction in traffic collisions in the city. Since 2016, the safe mobility strategy has been improved to achieve the long-term goal of zero traffic fatalities and serious injuries. The 2021-2025 strategy is based on five years of collision data, lived experience data, and lessons learned from road safety initiatives and strategies around the world.

Purpose of the Safe Mobility Strategy

The purpose of the *Safe Mobility Strategy* is to achieve Vision Zero through creating safe and livable streets in Edmonton. Edmonton wants to grow their city into a city that is built for people and generates a broader societal benefit. The *Safe Mobility Strategy* uses the guiding principles of Vision Zero, in addition to the four strategic goals set out in *ConnectEdmonton*, the City's Strategic Plan, to generate broader societal benefits. The principles of the *Safe Mobility Strategy* are outlined in the following:

- We all move
- We all deserve to move safely
- We are connected
- We are successful when we work together
- We are informed by analytics, lived experience and research

Vision Zero Framework

The *Safe Mobility Strategy* seeks to achieve Vision Zero by changing the conversation in two critical ways:

1. Explicitly connecting road safety to the vision and goals of *ConnectEdmonton* and the City Plan.
2. Building upon the traditional disciplines of engineering, education, enforcement, engagement, and evaluation to achieve a more equitable transportation network.

Themes and Key Actions

Table 4.2 below outlines the *Safe Mobility Strategy* implementation plan categorized into four themes. The themes and key actions are based on feedback received from community members during the second phase of public engagement.

Table 4.2. *Safe Mobility Strategy* Implementation Plan

Themes	Key Actions
Community of Safe Communities	Traffic safety community activation Vision Zero development Initiative positive enforcement campaigns Speed limit reduction
Safety at Every Step	Safe crossings School safety Project integration Vision Zero and city policy
Listen, Learn, Lead	Strategic collaboration with the Edmonton Police Service Safe Mobility Academic Working Group Expanded monitoring technology Partnering to advance safety priorities
Equitable Safety	Proactive safety reviews Prioritization criteria Focused relationship building to address inequity Project transparency and communication

Key Findings

Public engagement is crucial for applying an equity lens to transportation safety research. The *Safe Mobility Strategy* included two phases of public engagement; the first phase focused on understanding people's lived experiences with road safety, and the second phase focused on asking citizens to provide feedback on draft themes and key actions for the *Safe Mobility Strategy*. The engagement plan for the *Safe Mobility Strategy* was built to be an inclusive process based on Gender-Based Analysis Plus (GBA+). GBA+ is an analytical tool that assesses how different people may experience policies, programs, and initiatives.[124]

FIGURE 6
High Crash Neighbourhoods (2015–2019)
vs. 311 Traffic Safety Inquiries (2017–2019)

High Crash Neighbourhoods

Number of 311 Traffic Safety Inquiries
1–9
10–19
20–29
30–39
40–49
50–59
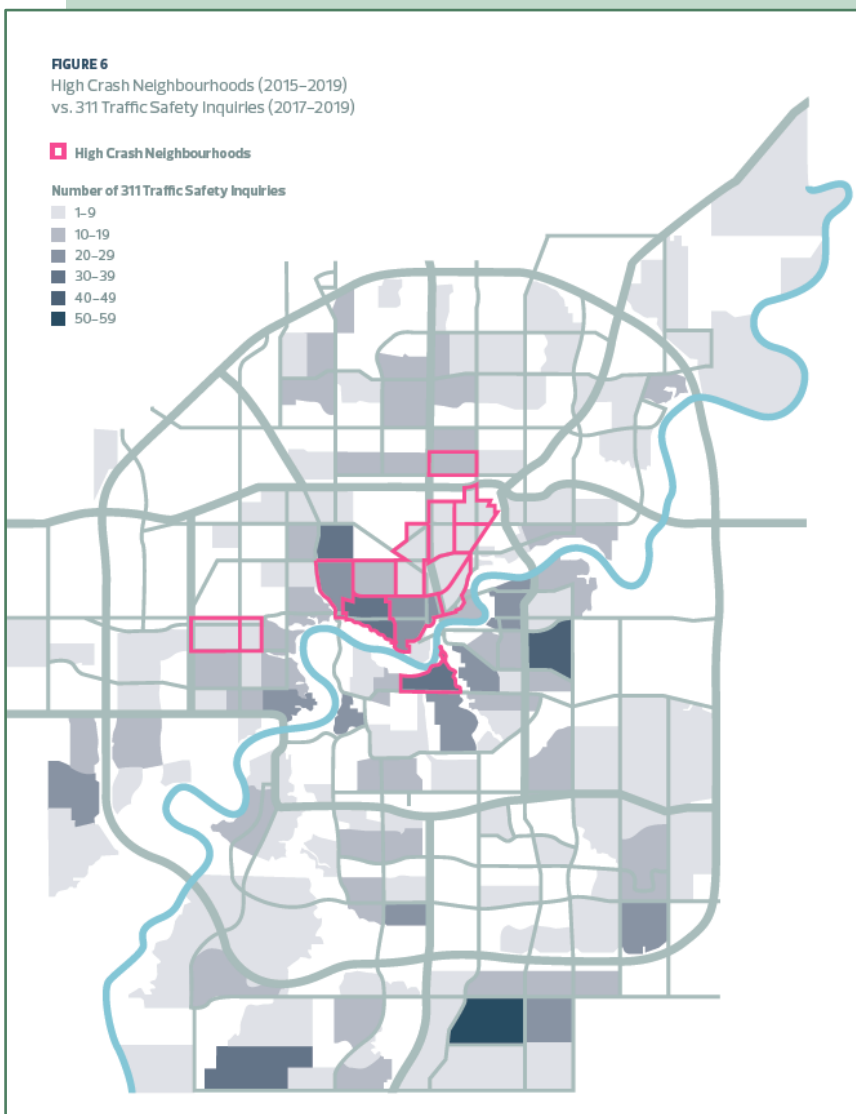
To further engage with under-represented citizens, community organizations were contacted to determine the best engagement approach for vulnerable populations. The City of Edmonton also analyzed where the High Crash Neighbourhoods are around the city and compared them to the neighbourhoods where there are the highest number of 311 traffic-related inquiries. The comparison of these two maps showed very little overlap, and therefore required an in-depth conservation to pinpoint the reasons for this disconnect (Figure 4.3).

Through public engagement, the City of Edmonton found that neighbourhoods with higher numbers of 311 inquiries tend to be wealthier. This trend likely reflects that such residents have more

Figure 4.3. High Crash Neighbourhoods (2015-2019) vs 311 Traffic Safety Inquiries (2017-2019) High Crash Neighbourhoods (2015-2019) vs 311 Traffic Safety Inquiries (2017-2019) (Source: City of Edmonton).

time and capacity to file traffic complaints and are more likely to believe that their complaints will be addressed. In comparison, the High Crash Neighbourhoods tended to be home to more residents that are lower-income and may not speak English or French as their primary language. Additionally, research found that Indigenous Peoples, lower income households, older adults, and linguistic minorities are more exposed to failures in the transportation system that result in serious injury and fatal collisions. Furthermore, Indigenous Peoples and People of Colour may have very different levels of opportunity and comfort with engaging with government agencies.

Strengths

The City of Edmonton's *Safety Mobility Strategy* emphasizes the importance of applying an equity lens to ensure that the most vulnerable users are protected. The strategy was informed by the Crash and Equity Analysis which analyzed crash patterns and identified those most impacted by road safety issues by incorporating a GBA+ lens. The incorporation of a GBA+ lens assists with identifying inequality and emphasizes the various identity factors that contribute to an individual's level of risk and exposure. An equity lens was also applied through the inclusion of two phases of public engagement that focused on understanding lived experiences and receiving feedback on draft themes. The inclusion of multiple equity approaches contributed to an overall equitable strategy that ensures the equal protection of all road users.

Limitations

The City of Edmonton's comparison of where the High Crash Neighbourhoods are around the city to the neighbourhoods where there are the highest number of 311 traffic-related inquiries showed little overlap. The quantitative analysis of the 311 traffic-related inquiries alone provided no insights into people's level of comfortability and experience reporting traffic-related inquiries. To pinpoint the disconnect and understand the rationale behind the disconnect, in-depth conversations with community organizations were required. Through public engagement, the City of Edmonton identified the factors contributing to this disconnect. Without the engagement of community organizations, the 311-traffic related inquiry analysis would have been inconclusive.

Lessons Learned

The City of Edmonton's *Safe Mobility Strategy* effectively applied an equity lens to the Vision Zero Framework and road safety. The strategy included a multitude of

equity approaches such as public engagement focused on understanding lived experiences, engagement with community organizations, and applying a GBA+ lens. The *Safe Mobility Strategy* is an exceptional example of how to apply an equity lens to road safety to ensure the safety of all road users, but most importantly vulnerable populations. York Region should apply a GBA+ lens to road safety initiatives and focus on understanding lived experiences to actively reduce discrimination and ensure equal outcomes for all road users.

Case Study: Region of Peel

Title of Report	Vision Zero Road Safety Strategic Plan[121]
Name of Coalition	Visions Zero Peel
Location	Regional Municipality of Peel, Ontario
When it Started	2017

Context and Background

Peel Region is situated in the western GTA and shares a similar area and population to York Region. Consistent with York Region, Peel Region has several highly urbanized cities and a complex transportation network that sees high-traffic volumes. In 2017, Peel Region formally adopted Vision Zero and developed the *Road Safety Strategy Plan* (RSSP) based upon its principles.

Vision Zero Framework

The RSSP is a data-driven plan with three main inputs: collision data, public input, and regional priorities. Through an analysis of collision data, six "emphasis areas" were identified as main priorities for safety improvement: intersections, aggressive, distracted, and impaired driving, pedestrian collisions, and cyclist collisions. Additionally, through public input "awareness areas" were created based on the areas of greater concern among residents, however, the collision data did not support their inclusion in the emphasis areas. Countermeasures were developed to reduce the frequency and severity of motor vehicle collisions. These countermeasures are assigned to the emphasis areas and fall under four categories: Engineering, Education, Enforcement, and Empathy. Engineering is composed of physical changes to roadways, Education aims to change road user behaviour, Enforcement includes both police staffed and automated enforcement, and Empathy is aimed at putting road users in the position of each other.

Implementation started with the establishment of the 'Peel Vision Zero Road Safety Task Force', which included representatives from the Region, Public Health, Peel Regional Police, Ontario Provincial Police, and Transit. This turned to the goals of institutionalizing road safety within Peel Region, prioritizing countermeasures through data analysis, creating a communications plan, and then finally implementation and monitoring of the plan. Several countermeasures have been

implemented since the release of the RSSP in 2018. These mainly include engineering and enforcement measures, including constructing fully protected left turn lanes, adding cycling infrastructure, developing an automated speed enforcement system, and expanding the red light camera program.[125]

Key Findings

Creating a dedicated road safety Task Force and strategy plan is crucial in implementing safety measures. The RSSP identified road safety issues within Peel Region, developed measures tailored to mitigate the issues and outlined a framework for implementing and monitoring the countermeasures. This provided a strong foundation for implementation which has so far been successful, as several of the countermeasures described in the RSSP have since been implemented and monitored.

Furthermore, the RSSP highlights the need to develop a Vision Zero culture and involve multiple agencies in road safety decision-making. There were 17 partner agencies involved in the development of the RSSP, all of which were able to help guide the project objectives and processes. The group of partners also helped create a more holistic approach to road safety, as the input came from diverse groups specializing in different areas.

Strengths

The RSSP provides a strong framework for implementing road safety initiatives. The plan delineates an implementation plan which includes the lead agency, support agencies, timelines, and a brief description of each countermeasure. In total the RSSP provides 109 countermeasures, and guidelines for countermeasure prioritization, providing a strong foundation to begin implementing safety improvements. Furthermore, the focus on creating countermeasures tailored towards specific road safety issues allowed for direct and easily measured safety initiatives, which has led to successful monitoring.

Additionally, the objectives of changing organizational culture and creating a dedicated task force for road safety improves inter-organizational cooperation and creates accountability for road safety. The Task Force developed formal Terms of Reference, including a mandate, membership, meeting times, and roles and responsibilities. The Task Force was also given the task of institutionalizing road safety in the Peel Region through developing a culture across the supporting agencies that prioritize road safety. Initiatives were developed, specifically with the

objective of creating a Vision Zero safety culture within dec and promoting Vision Zero to community agencies.

Limitations

Despite the strengths of the RSSP, there are several aspects that it does not consider or reference in the report, most notably equity or demographic data. As a result, Peel Region's ability to assess socio-economic disparities in road safety is limited

Additionally, given the high-level overview the plan provides, there are aspects of the decision-making process that are not detailed. The RSSP is strongly guided by data analysis, public input, and regional priorities; however, minimal detail is provided in the description of the methodologies used to assess these inputs. Thus, it is unclear the exact process used to identify areas of greater interest for improvements.

Considering the RSSP was recently implemented, there is limited evidence of its success. However, the 2019 update report found that fatal collisions had dropped by 29% and injury collisions had dropped by 15% from 2017 to 2019, suggesting success of the plan.[125] However, the current efficacy of the RSSP's measures remains unclear. Most of the emphasis areas had seen a decline in collisions from 2017 to 2020, however, these results could be a result of less vehicle traffic due to public health measures during the COVID-19 pandemic. Many of the emphasis areas had been experiencing an increase in collisions prior to 2020, indicating little effect from the RSSP's countermeasures. Pedestrian collisions are the only emphasis area that has experienced a consistent decline from 2017 to 2020.

Lessons Learned

The Peel Region RSSP is a strong example of a framework that was used to provide an implementation plan to identify areas in which road safety initiatives are required. The RSSP provides a template for creating a dedicated road safety strategy and task force. Additionally, it exemplifies the importance of creating an inter-agency road safety culture and creating clear organizational accountability. York Region should develop a similar multi-disciplinary task force across agencies with the goal of developing a dedicated plan for reducing traffic collisions. Such a plan would enable a more focused approach to road safety and create accountability. Furthermore, tracking the results of the plan and any related updates will be a strong indicator of the effectiveness of the countermeasures used and can inform York Region's own decision-making.

4.4 Limitations

A key limitation of the case study analysis is that only a single strategic plan or policy was reviewed from each country/region/city. Some places such as the City of Edmonton had several documents related to Vision Zero and road safety initiatives, and other places may have had additional road safety research that was not available to the public.

Furthermore, as noted in the Vision Zero section in Chapter 1, there have been 18 examples of Vision Zero being implemented in Canadian municipalities, regions, or provinces, but they were not all reviewed. Some of these areas only recently introduced Vision Zero policies and limited data is available at this time regarding any findings that would benefit future areas looking to design and implement a Vision Zero framework.

Another limitation is the scope of each of the cases examined. Not all cases considered or referenced equity or demographic data, which limited the insights that the team was able to glean about how each case addresses socio-economic disparities in road safety.

Furthermore, given the high-level overview of the cases that was conducted, there are aspects of the decision-making process that are not detailed. Therefore, it is unclear the exact methodologies that were used to identify areas of greater interest for improvements, resources allocated, etc.

4.5 Conclusion

By reviewing the precedents of Vision Zero policy from other areas that have tried innovative solutions, York Region can learn from their trials and determine which methods are most applicable for the Region. Built environment alterations such as creating dedicated and better-connected active transportation networks were successful in both New York City and Sweden. These alterations act as effective measures that mitigate traffic collisions, as well as encourage active transportation. Performing GBA+ analyses are effective in identifying which populations are most at risk of being involved in a traffic collision. GBA+ also aids in comparing the spatial relationship between traffic inquiries and collision frequency that can provide insight into which populations are most comfortable in reporting collisions. Both strategies provide strong data for equity-based decision-making and can provide a better understanding of road users and their relationship with road safety. Lastly, all cases illustrated the importance of having a road safety plan and an interorganizational team dedicated to road safety. This provides the framework for implementing and monitoring safety initiatives and creates organizational accountability for road safety.

5.0 Collision Data Analysis

5.0 Collision Data Analysis

5.1 Introduction

To further understand the vulnerability of road users within York Region, collision and census data was analyzed to identify key trends. This chapter provides an overview of the primary road safety issues facing York Region, as developing an understanding of these problems is essential for creating targeted and data-driven road safety decisions. Overall, the goal of this analysis was to identify high volume collision areas and provide discussion surrounding what is happening at these locations. In particular, the spatial relationship between collisions and deprived communities was emphasized. Following a brief summary of collision statistics, the analysis is broken into four parts, identifying the who, where, when, and why of collisions within the York Region.

5.2 Methodology

The data analyzed was obtained from two main sources: York Regional Police Motor Vehicle Collision (MVC) data and the *York Region's 2021 Traveller Safety Report.*[14] The York Regional Police MVC data was provided by the client and contained all reported vehicle collisions from 2018 to 2020 within York Region. Furthermore, the MVC data provided locational information that was utilized in the "Where" analysis, specifically analyzing the relationship between collision location and multiple deprivation dimensions. Census data from 2016 was also retrieved and analyzed in relation to top collision locations identified in the *York Region 2021 Traveller Safety Report.* The *York Region 2021 Traveller Safety Report* also provided a comprehensive summary of collision trends from 2020, as well as statistics from previous years.[14]

5.3 Key Findings

Overview

In 2020, there were 4,538 total collisions within York Region. Of these collisions, 100 (2.2%) involved pedestrians, and 81 (1.8%) involved cyclists, representing a substantial decline from 2019, seen in Figure 5.1. This decline is likely attributable to the 19% reduction in traffic volumes in York Region due to the stay-at-home measures implemented in response to the COVID-19 pandemic. Prior to the pandemic, total collisions and pedestrian collisions had been generally declining, while cyclist collisions trends were less concrete, as an increase in collisions was seen in 2019. These trends can be seen in Figure 5.1, Figure 5.2, and Figure 5.3.
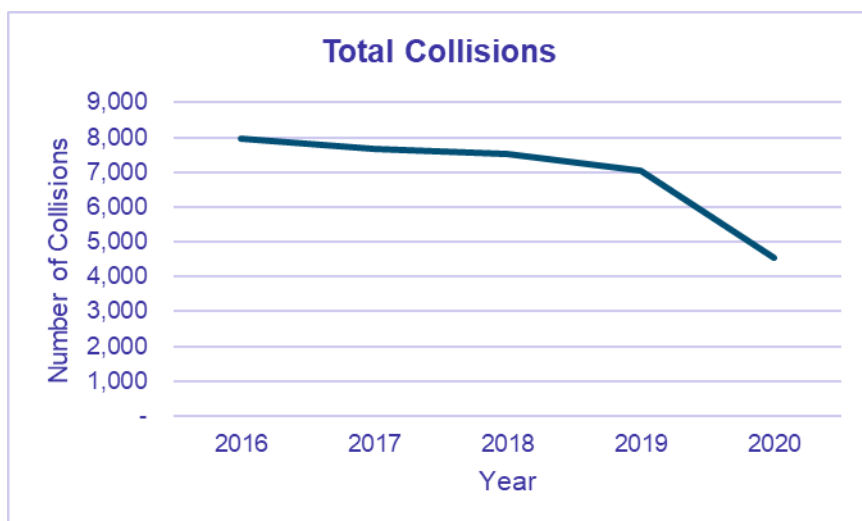
Total Collisions

Figure 5.1. York Region total collisions, 2016-2020.

Pedestrian Collisions
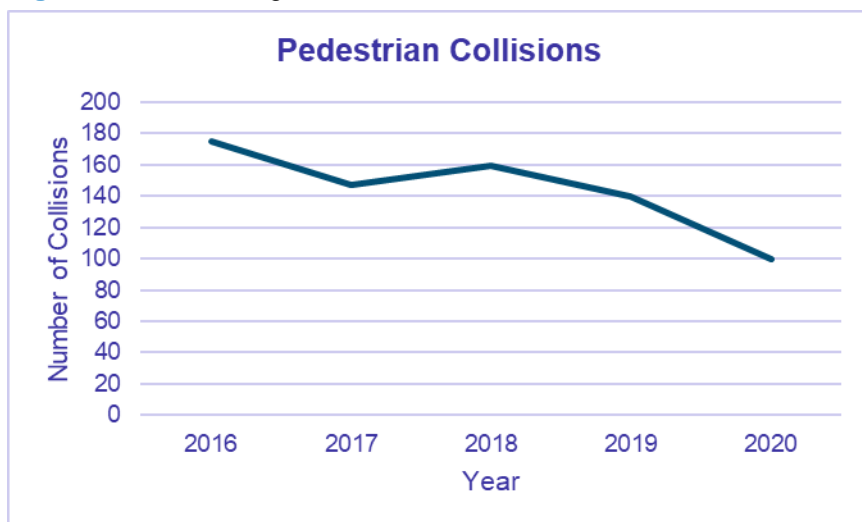
Figure 5.2. York Region pedestrian collisions, 2016-2020.

Cyclist Collisions
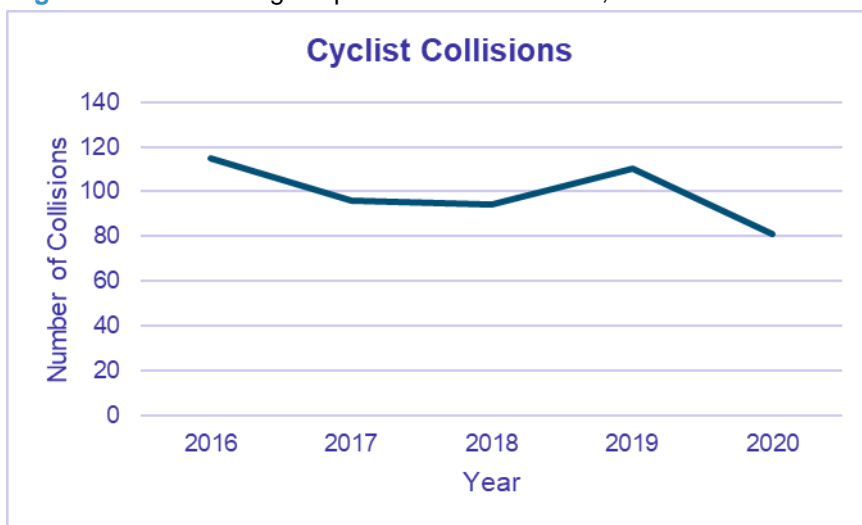
Figure 5.3. York Region cyclist collisions, 2016-2020.

Who

Analyzing the "who" of collisions is crucial in determining the relationship between socio-economic status and the risk of being involved, injured, or killed in a collision. Unfortunately, the MVC data source utilized in this report did not provide extensive socio-economic data. Therefore, the analysis was performed solely on the mode of transport and age.

Table 5.1 to the right displays the injury/fatality rate per 100,000 population for road users in 2019 and 2020.

Table 5.1. Injured or killed road users per 100,000 population, 2019 and 2020.

Mode Type	2019	2020
Motorists	14.6	8.7
Pedestrians	1.0	0.7
Cyclists	0.8	0.6
Motorcyclists	0.3	0.4
Trucks	0.8	0.5

Compared to pedestrians and cyclists, motorists experience the highest injury/fatality rate per 100,000 people, owing to the significantly greater amount of driving trips relative to other modes of travel in the Region. In 2020, for instance, 2,155,155 daily trips were made by vehicle (94.9%) in York Region, compared to 104,192 (4.6%) walking trips and 12,181 (0.5%) cycling trips. While the rates of injury and fatality are higher for motorists, pedestrians and cyclists are at a much higher risk of being injured or killed when involved in a collision compared to motorists in York Region. This is exemplified in Table 5.2 which displays the percent of collisions that resulted in injuries or fatalities for all collisions, pedestrian collisions, and cyclist collisions from 2018 to 2020. In 2020, 91% of pedestrian collisions resulted in injury or fatality whereas only 24% of all collisions resulted in injury or fatality. As well, 88% of cyclist collisions resulted in injury or fatality. Thus, pedestrians and cyclists are more likely to be injured or killed when involved in a collision than a motorist.

Table 5.2. Percentage of collision type that resulted in injuries or fatalities, 2018 to 2020.

	2018	2019	2020
Total Collisions	26%	27%	24%
Pedestrian Collisions	96%	94%	91%
Cyclist Collisions	78%	86%	88%

Age
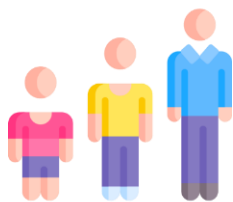
Age plays a key role in collision trends, as there are clear relationships between age and the vulnerability of motorists, cyclists, and pedestrians. These trends are gathered from York Region collision averages from 2018-2020.

Motorists

Young motorists aged 20-24 experience both the highest at-fault and fatality rates among all motorists in Ontario. This is attributable to the higher rates of speeding and dangerous driving among this age group. In York Region, rates of these dangerous driving habits decline notably as age increases as seen in Figure 5.4.
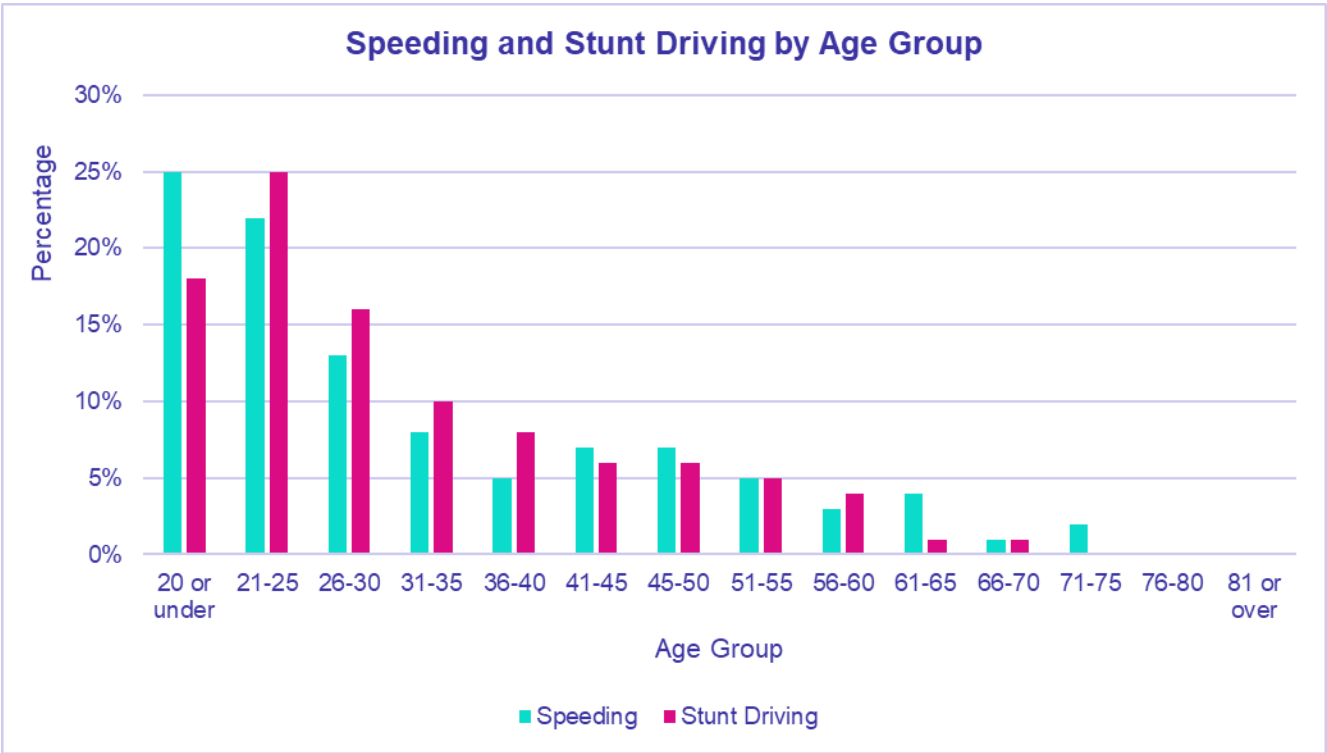
Figure 5.4. Percentage of stunt driving and speeding infractions by age group in York Region, 2020.

Pedestrians

The pedestrian collision age profile displays two striking patterns. First, younger pedestrians, aged 15-24, experience considerably higher injury rates than pedestrians 25 and over. In 2017, for instance, 16 to 19-year-old pedestrians had the highest rate of emergency department visits. Secondly, elderly pedestrians have the highest fatality rate, with the fatality rate generally increasing with age. In 2017, pedestrians 70 years of age or older had the highest rate of hospitalizations.

Cyclists

Younger cyclists experience the highest injury and fatality rate; cyclists aged 15 to 19 experience the highest injury rate, while cyclists aged 20 to 24 experience the highest fatality rate, and twice that of any other age group.

Where

The York Regional Police data was spatially analyzed to identify geographic areas with the highest frequency of collisions. Supplemental information was obtained by the *2021 York Region Traveller Safety Report* to identify the most frequent cyclist and pedestrian collision locations, as this information was not provided in the MVC data. A further description of the methodology and full-sized maps are found in Appendices B and C.

Collision Hot Spots

High frequency locations (Hot Spots) were identified for each of the study years. 'Hot Spots' are calculated by the number of points that fall within the neighbourhood defined in GIS programming. These 'Hot Spots' include all collisions involving motorists, pedestrians, and cyclists. The majority of the collisions occurred in urban areas that have higher volumes of traffic and a higher distribution of roadways, including freeway and arterial roads, compared to rural areas. Intersections are the most frequent location for collisions; 67% of motorist, 87% of pedestrian, and 82% of cyclist collisions occurred at an intersection in 2020. Collision Hot Spot maps can be seen in Figure 5.5.

2018 Traffic Collision Hot Spot Locations
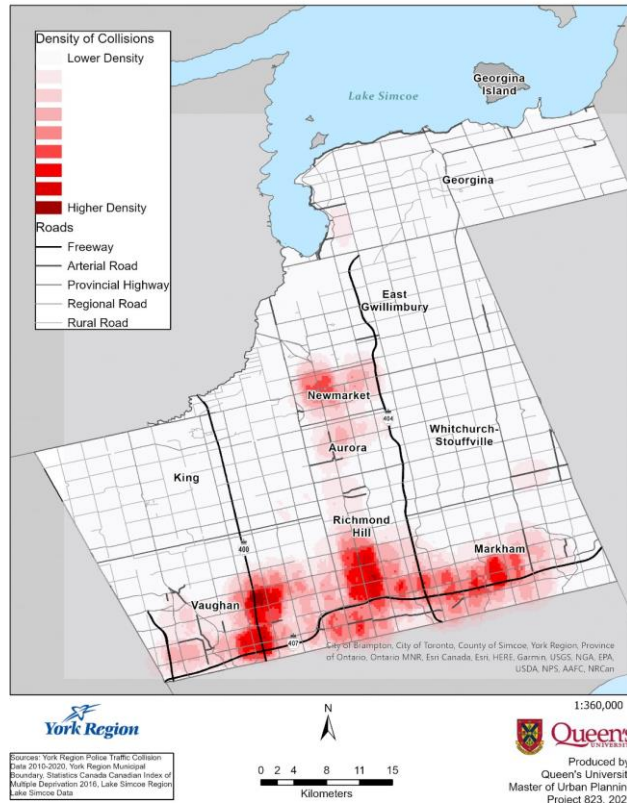
2019 Traffic Collision Hot Spot Locations
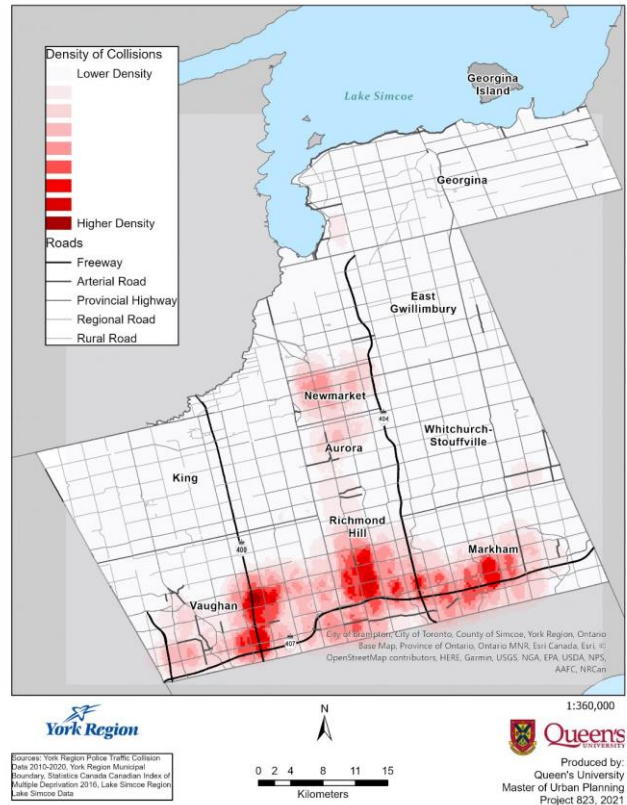
2020 Traffic Collision Hot Spot Locations
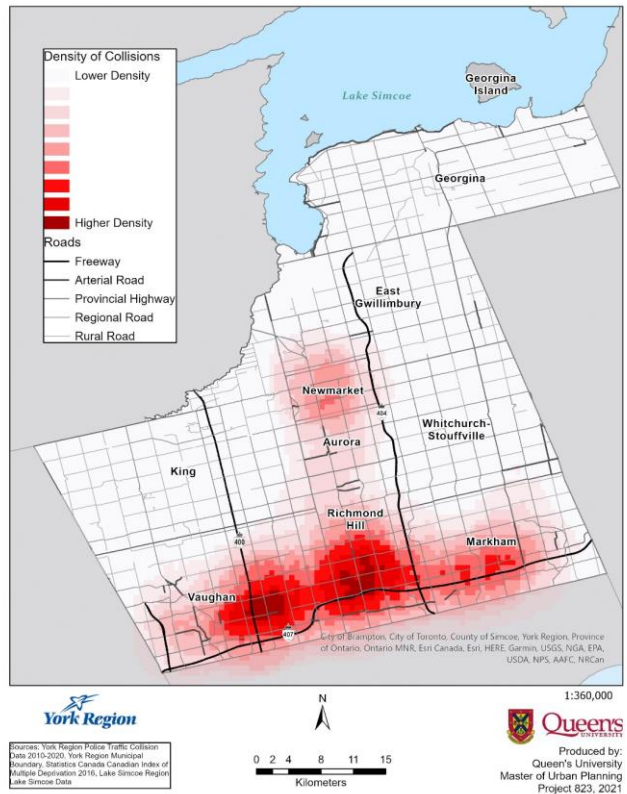
Figure 5.5. York Region traffic collision hot spot maps from collision data from 2018, 2019, and 2020.

Multiple Deprivation Analysis

To understand the relationship between collisions and socio-spatial vulnerability in York Region, the 2018 to 2020 collision data was compared to the 2016 Canadian Index of Multiple Deprivation (CIMD) using GIS. The CIMD is based on four dimensions of deprivation (Appendix B: Spatial Analysis Methodology): residential instability (1), economic dependency (2), ethno-cultural composition (3) and situational vulnerability (4).[126] Each of these four dimensions are given a score of 1 through 5 – one being the least deprived and five being the most deprived – at the dissemination area level (see Figure 5.6- Figure 5.9)

The CIMD is used to illustrate and better understand the inequalities that exist in different geographical areas across York Region.[126] Utilizing the four dimensions of deprivation, the CIMD aids in identifying the most deprived regions located within urban areas. In summary, the following socio-spatial patterns were revealed for the four dimensions:

- The economic dependency dimension shows the most heterogeneity of deprived areas as the most deprived quintiles can be found throughout the Region, including more rural areas such as Georgina.
- The ethno-cultural composition dimension shows the most highly deprived areas are focused in the urban areas of the region, particularly in the southern portions of Richmond Hill and Markham.
- The residential instability dimension has the least dissemination areas with a deprivation quintile of 5 when compared to the other 3 dimensions, and the most deprived areas are focused mainly in the urban areas.
- The situational vulnerability dimension shows the most deprived areas in urban areas however, some rural areas such as Georgina also have deprived areas with a quintile of 5.

The relationship between deprivation, based on the CIMD, and collision locations were analyzed to determine if there was a significant correlation. The results of this analysis revealed no significant relationship, suggesting there is no correlation between neighbourhood-level vulnerability and collision frequency. However, the aggregation of traffic collisions by road user type coupled with the predominance of collisions involving only motorists masks the potential correlation between neighbourhood-level vulnerability and the locations of collisions involving vulnerable road users specifically. Collision location data for pedestrians and cyclists specifically is required to fully address the question of whether neighbourhood-level vulnerability is correlated with collision risk.
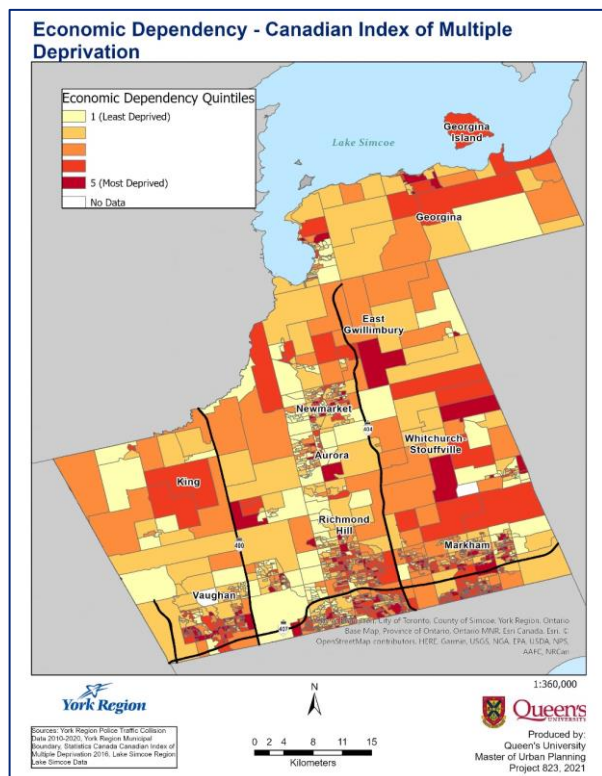
Figure 5.6. 2016 CIMD - Economic Dependency Quintiles, York Region.
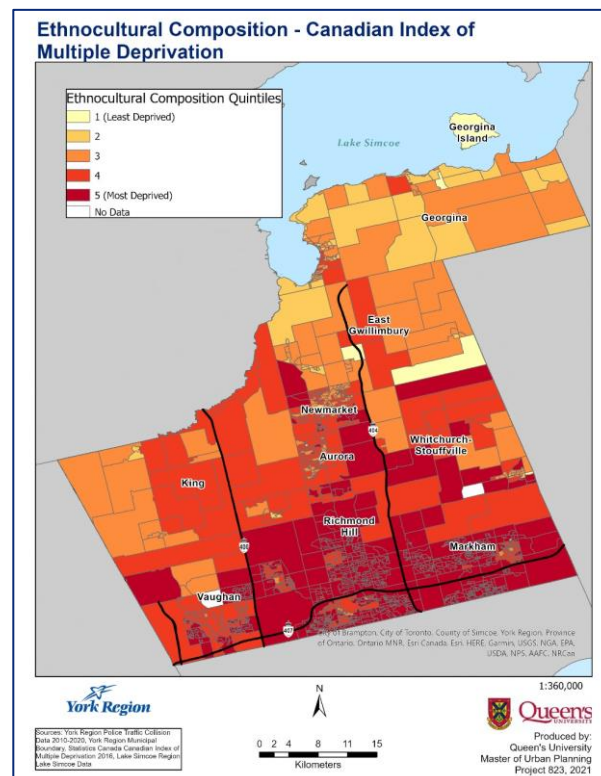
Figure 5.7. 2016 CIMD - Ethno-cultural Dependency Quintiles, York Region.
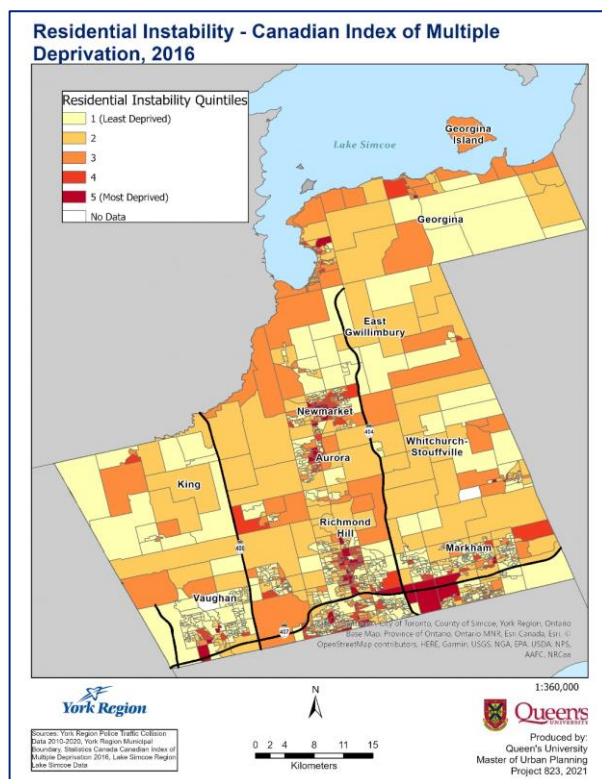
Figure 5.8. 2016 CIMD - Residential Instability Quintiles, York Region.
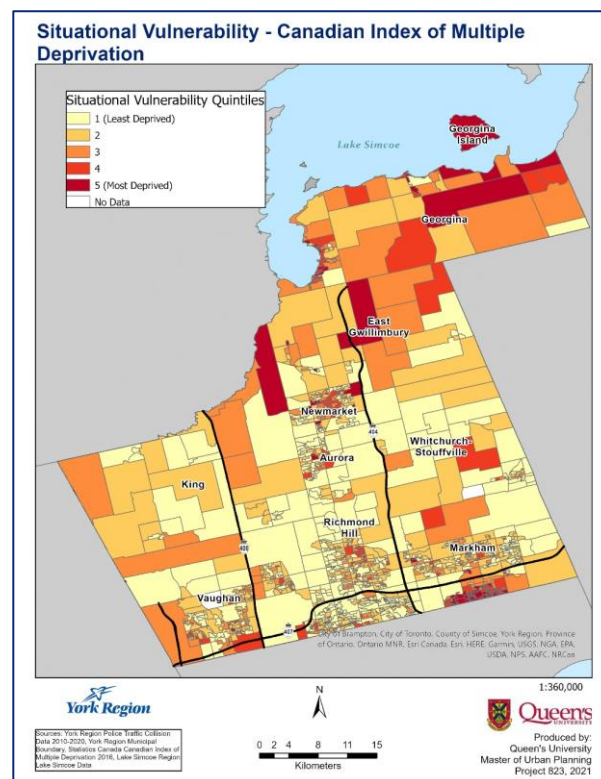
Figure 5.9. 2016 CIMD - Situational Vulnerability Quintiles, York Region.

Multiple Deprivation Analysis of Pedestrian and Cyclist Collisions

Given the lack of differentiation between vulnerable road users and motorists in the York Regional Police collision data, the most frequent locations for collisions involving pedestrians and cyclists were mapped with the CIMD to better understand the connections between neighbourhood-level vulnerability and collision risks to vulnerable road users. These locations were plotted and visually compared to the average CIMD quintiles, which is the average of the four dimensions of deprivation, to better understand if areas that are highly affected by multiple dimensions have higher frequencies of pedestrian and cyclist collisions.
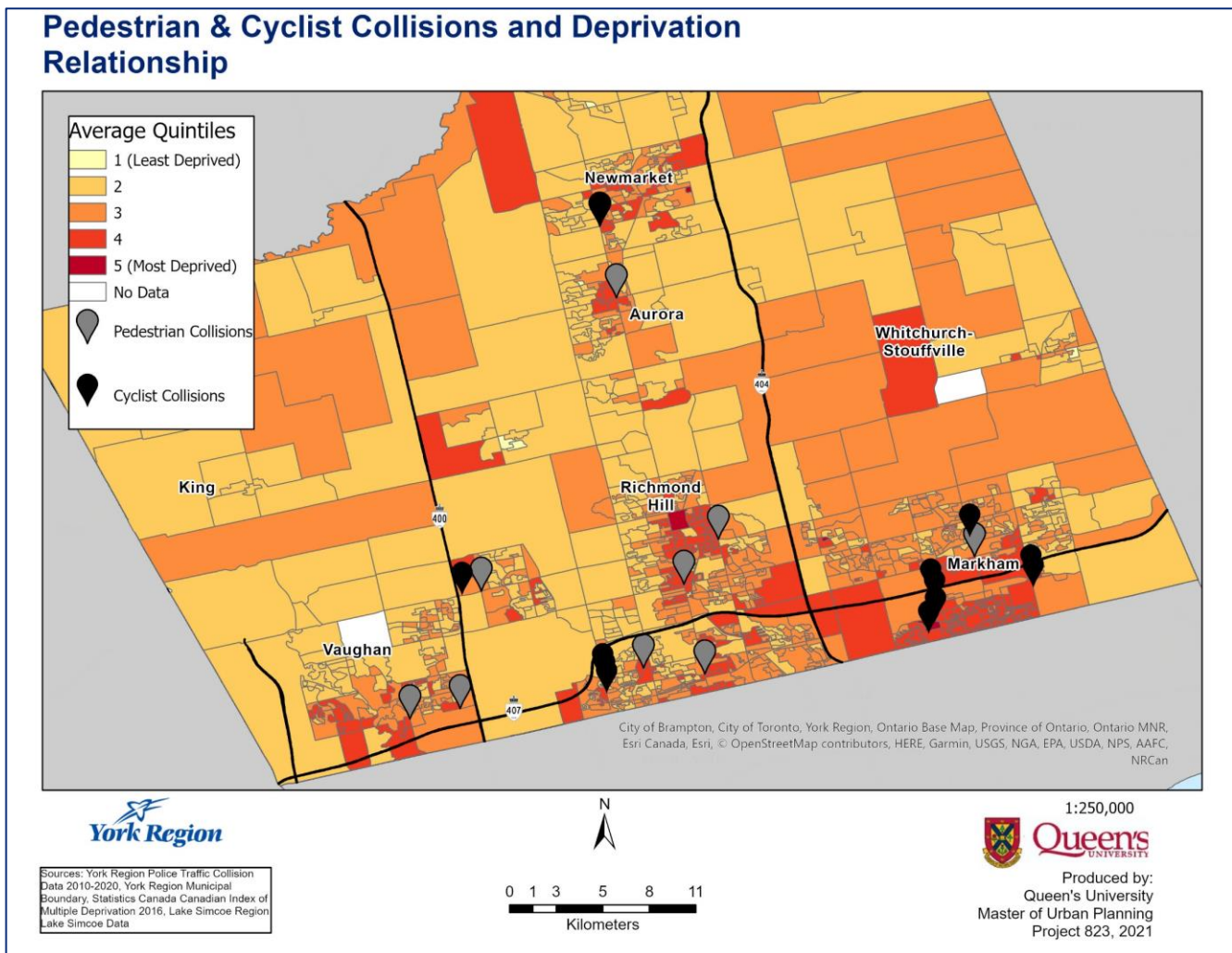
Figure 5.10. Relationship between deprived areas and the most frequent locations of pedestrian and cyclist collisions.

Overall, there is a spatial relationship between neighbourhood-level deprivation and high frequency cyclist and pedestrian collision locations. Specifically, all 22 high frequency cyclist and pedestrian collision locations are in urban areas and at a street intersection immediately next to or within areas that have a deprivation score of 3 or greater. Table 5.3 and Table 5.4 provide further information on the deprivation quintiles of all the CIMD dimensions for the plotted locations of pedestrian and cyclist collisions.

Table 5.3. Deprivation quintile scores for the 11 intersections with the highest frequency of pedestrian collisions in York Region.

Most Frequent Pedestrian Collision Locations						
Municipality	Street Intersection	Average Deprivation Quintile	Economic Dependency Quintile	Ethnocultural Composition Quintile	Residential Instability Quintile	Situational Vulnerability Quintile
Richmond Hill	Yonge St & Carville Rd	4	4	5	5	3
Markham	Highway 7 & McCowan Rd	4	5	5	3	3
Vaughan	Major Mackenzie Dr W & Jane St	3	2	5	3	3
Aurora	Wellington St E & Yonge St	4	4	4	5	4
Markham	Yonge St & Clark Ave W	4	5	5	5	4
Vaughan	Highway 7 & Weston Rd	4	5	5	4	4
Vaughan	Highway 7 & Pine Valley Dr	4	5	5	1	3
Newmarket	Yonge St & Mulock Dr	4	5	4	5	5
Vaughan	Centre St & North Promenade	4	5	5	5	1
Richmond Hill	Major Mackenzie Dr E & Bayview Ave	4	3	5	5	4

Table 5.4. Deprivation quintile scores for the 11 intersections with the highest frequency of cyclist collisions in York Region.

Most Frequent Cyclist Collision Locations						
Municipality	Street Intersection	Average Deprivation Quintile	Economic Dependency Quintile	Ethnocultural Composition Quintile	Residential Instability Quintile	Situational Vulnerability Quintile
Markham	14th Ave & Markham Rd	4	5	5	2	4
Vaughan	Dufferin St & Centre St	3	4	5	3	4
Vaughan	Dufferin St & Clark Ave W	3	4	5	2	4
Vaughan	Dufferin St & Glen Shields Ave	4	4	5	3	2
Markham	Kennedy Rd & 14th Ave	4	4	5	5	4
Markham	Kennedy Rd & Clayton Dr	5	4	5	4	5
Markham	Kennedy Rd & Denison St	5	5	5	5	5
Markham	Kennedy Rd & Highway 407 (Eb Off-Ramp)	4	4	5	5	3
Markham	Kirkham Dr & Highglen Ave	4	3	5	3	4
Vaughan	Major Mackenzie Dr W & Highway 400 (NB Off-Ramp)	3	2	5	1	3
Markham	McCowan Rd & Carlton Rd	4	5	5	4	4

Overall, most pedestrian and cyclist collisions occurred in a deprived community with a quintile of 3 to 5. In total, there were 22 locations spatially analyzed over the 4 dimensions of CIMD deprivation as well as the average CIMD quintiles. Of this, there are only three occurrences of a plotted collision location being in a dissemination area with a CIMD dimension score of 1. These locations are Major Mackenzie Drive West & Highway 400 (NB Off-Ramp), Centre Street & North Promenade, and Highway 7 & Pine Valley Drive. Five locations were in a dissemination area with a CIMD dimension of 2, these are Major Mackenzie Drive West & Highway 400 (NB Off-Ramp), Dufferin Street & Glen Shields Avenue, Dufferin Street & Clark Avenue West, 14th Avenue & Markham Road and Major Mackenzie Drive West & Jane Street. The percentage of collision locations within each of the quintiles (1 through 5) are shown in the table below.

Table 5.5. Percentage of pedestrian and cyclist collisions occurring in each of the deprivation dimensions by quintile.

Quintile	Average Deprivation	Economic Dependency	Ethnocultural Composition	Residential Instability	Situational Vulnerability
1	0%	0%	0%	9%	5%
2	0%	9%	0%	9%	5%
3	18%	9%	0%	23%	27%
4	73%	36%	14%	14%	45%
5	9%	46%	86%	45%	18%

Socio-economic and Demographic Analysis of Pedestrian and Cyclist Collisions

The CIMD analysis showed that there is a spatial relationship between neighbourhood-level deprivation and high frequency cyclist and pedestrian collision locations. However, the CIMD dimensions combine multiple variables such as ethno-cultural composition, which includes immigrants and visible minorities. This leads to inability to further investigate specific demographic trends. Through the academic literature review and news media review, other socio-economic and demographic determinants proved to have an influence on a road users' overall level of risk.

To determine if the vulnerable groups that were identified (youth, older adults, racialized individuals, and immigrants) are at a greater risk in York Region, further analysis was conducted using 2016 census data retrieved from the Canadian Census Analyser (CHASS). Using census data, the variables: age 0-19, age 65+, immigrant status (recent and total), and visible minority status, were analyzed against York Region's top 22 pedestrian and cyclist collision locations, seen in Figure 5.11-Figure 5.15. The maps in Figure 5.11-Figure 5.15 compare the percentage of the dissemination area's population who identify in one of the at-risk groups with York Region's top 22 pedestrian and cyclist collision locations.

Youth (0-19 years of age)
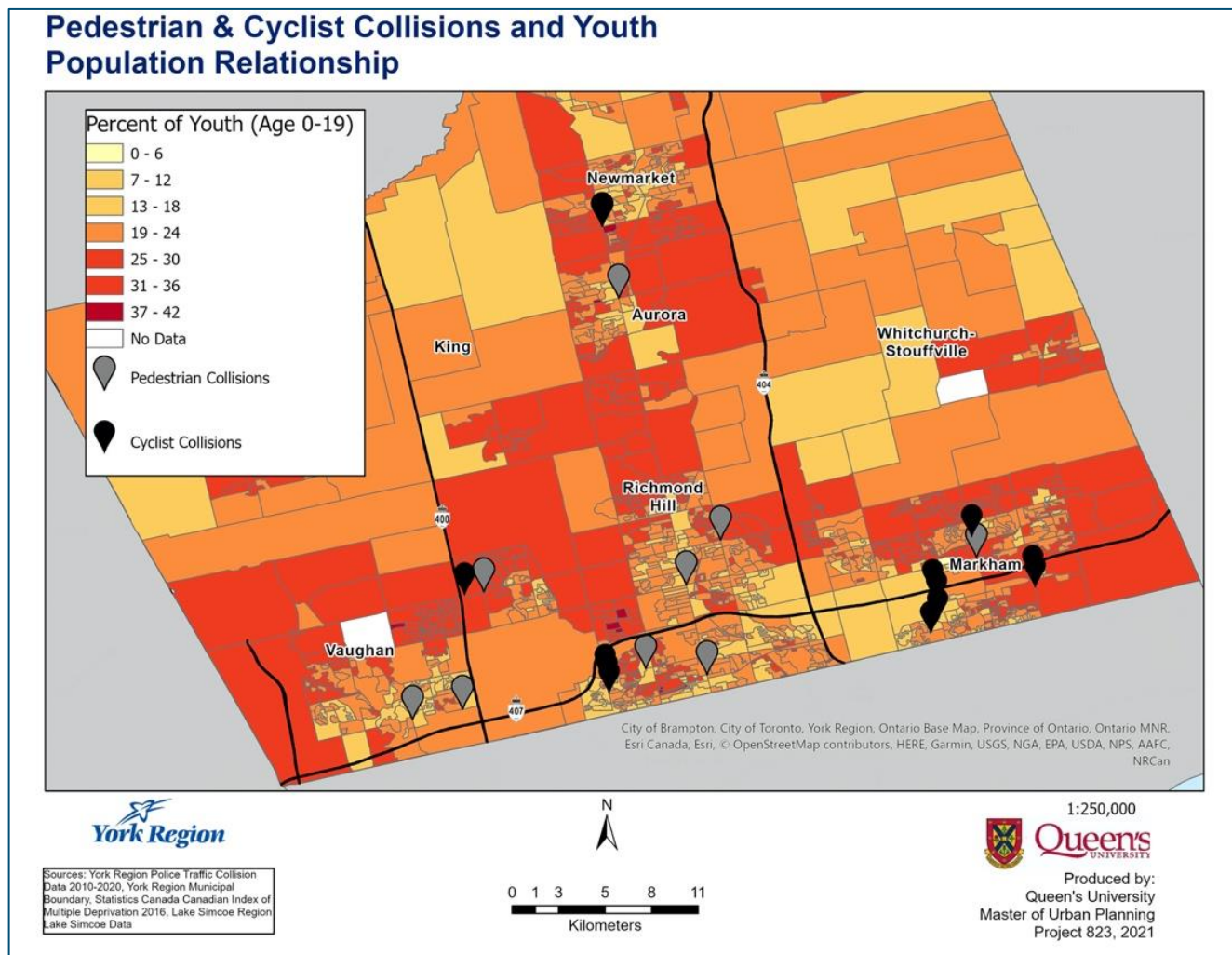
Figure 5.11. Percent of each dissemination area's population who are between the ages 0-19 with the highest pedestrian and cyclist collision frequency intersections.

As seen in Figure 5.11, most of the highest frequency pedestrian and cyclist collision locations (fifteen out of twenty-two) occur in dissemination areas where youth make up at least 19-24% and up to 36% of the population. The location in Newmarket has one of the highest cyclist collision locations, Yonge Street and Mulock Drive, near a dissemination area where youth represent 37-42% of the population. Eight of the total twenty-two high frequency collision locations were located in or directly beside a dissemination area where youth represented over 25% of the population.

Older Adults (65+)
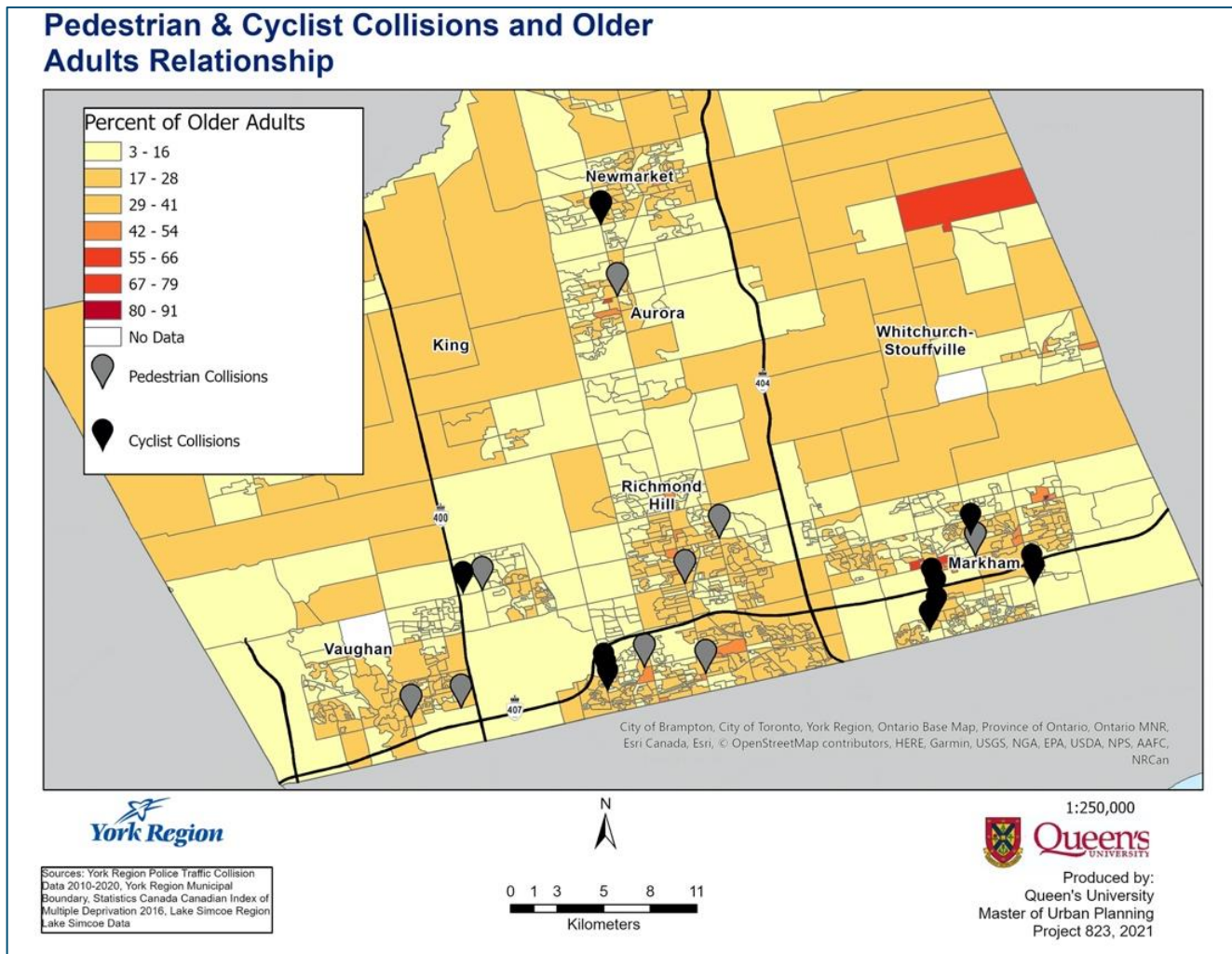
Figure 5.12. Percent of each dissemination area's population who are aged 65 and over with the highest pedestrian and cyclist collision frequency intersections.

As seen in Figure 5.12, older adults represent between 3-41% of the population in most of York Region's dissemination areas. The dissemination areas where older adults represent over 55% of the population are not concentrated in a specific area and are mostly dispersed across the Region. These dissemination areas with over 55% of the population do not have any of the top collision locations. Fourteen of the collision locations are within or beside dissemination areas where older adults represent only 3-16% of the population. The location with the highest frequency of cyclist collisions, 14th Avenue and Markham Road,[14] is in a dissemination area where older adults only represent 3-16% of the population.

Visible Minorities
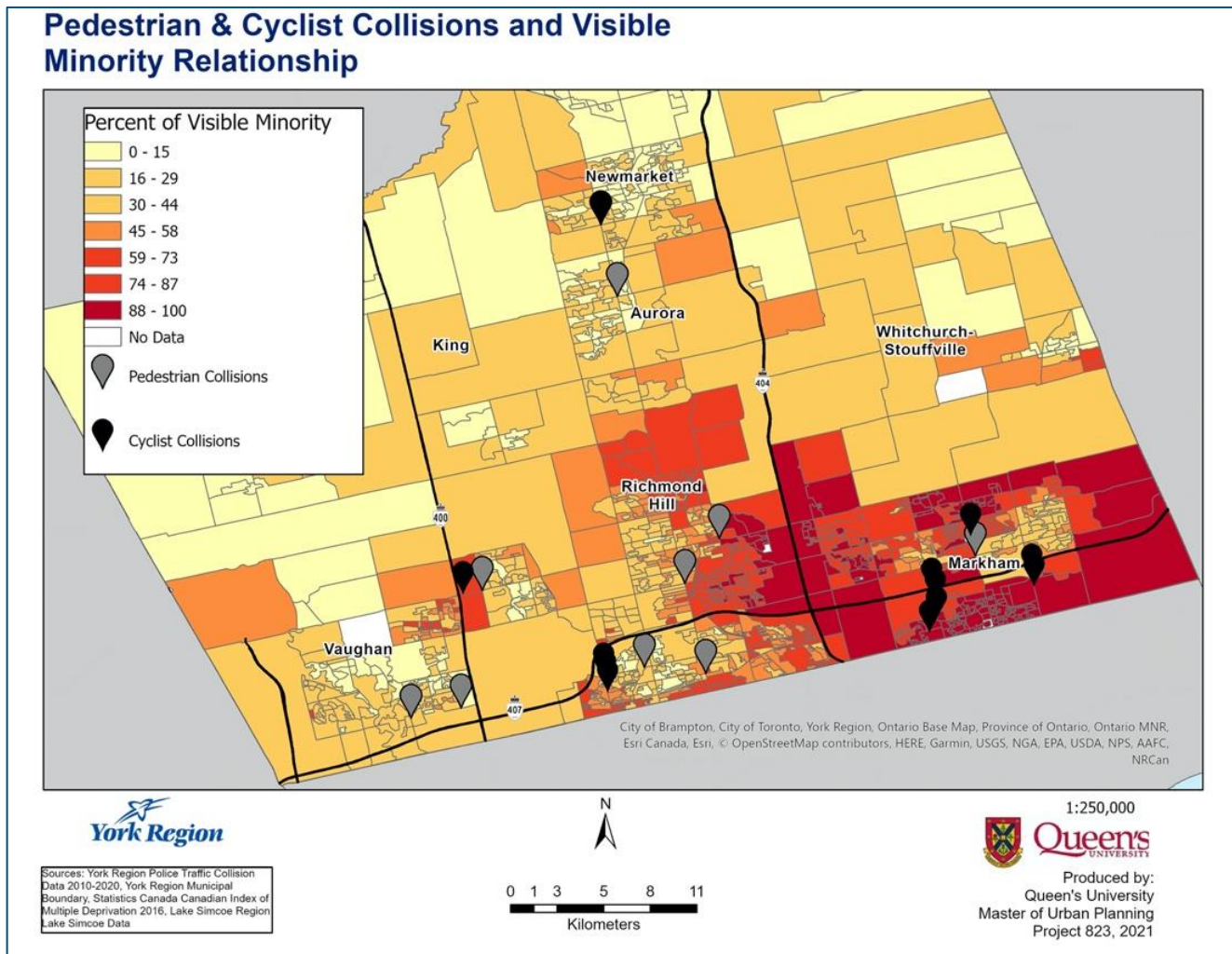
Figure 5.13. Percent of each dissemination area's population who identifies as a visible minority with the highest pedestrian and cyclist collision frequency intersections.

Figure 5.13 shows that a substantial number of people who identify as visible minorities reside in the urban, southeastern areas of York Region. Many of Markham's, and some of Richmond Hill's, dissemination areas are represented by 59-100% visible minority populations; these areas also contain the locations with the highest frequency of pedestrian and cyclist collisions. Overall, fourteen of the twenty-two high frequency pedestrian and cyclist collision locations in York Region occurred in or near dissemination areas with a visible minority population of 59% or greater, showing a potential relationship between visible minority status and traffic collisions.

Recent Immigrants
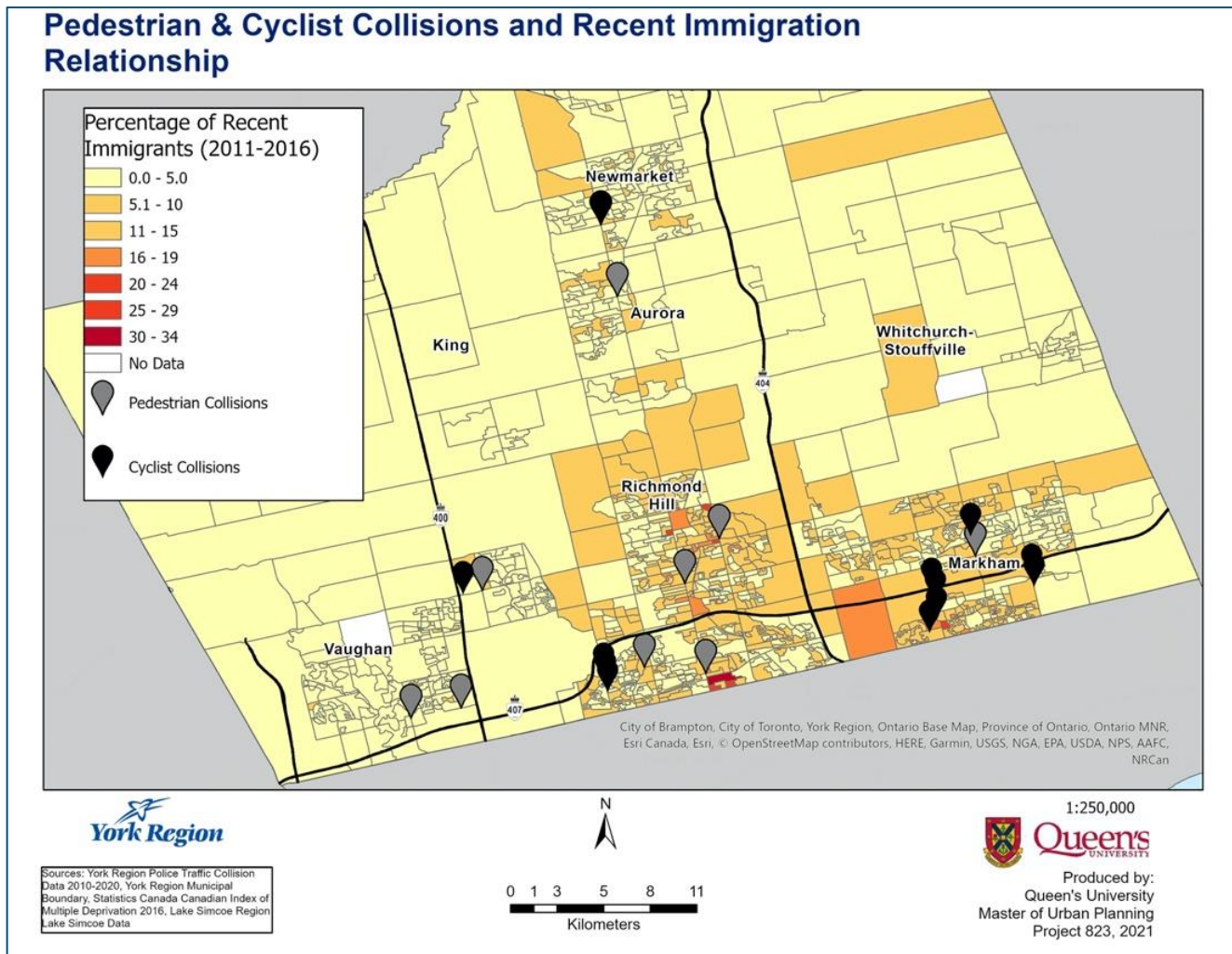
Figure 5.14. Percent of each dissemination area's population who are recent immigrants (2011-2016) with the highest pedestrian and cyclist collision frequency intersections.

As seen in Figure 5.14, many recent immigrants are located in York Region's southern, more urban, locations. Most pedestrian and cyclist collision locations (seventeen out of twenty-two) are either in or directly beside dissemination areas where recent immigrants represent between 5.1-15% of the population. In Richmond Hill and Markham however, pedestrian and cyclist collisions mostly occurred in or adjacent to dissemination areas that are represented by 16-19% and 20-24% recent immigrant populations.

Immigrants
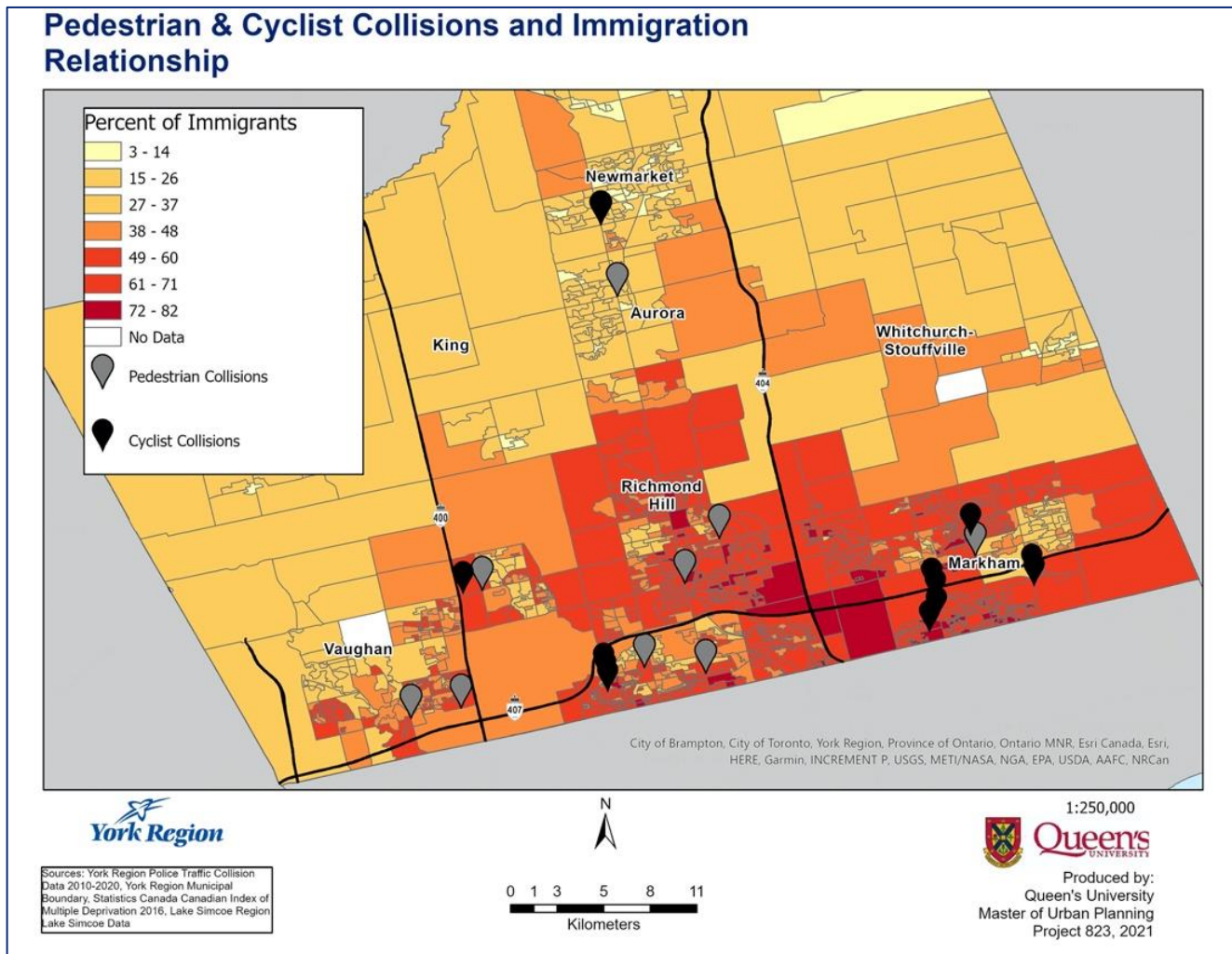
Figure 5.15. Percent of each dissemination area's population who have immigrated to Canada in their lifetime with the highest pedestrian and cyclist collision frequency intersections.

Figure 5.15 shows that the areas with the highest percent of the population who are immigrants are clustered in the southern municipalities of Markham and Richmond Hill. This variable accounts for both recent immigrants and individuals who may have lived in Canada for several years but immigrated within their lifetime. Nineteen of the twenty-two collision locations are either in or directly beside a dissemination area where immigrants represent over 49% of the population. The location with the highest frequency of pedestrian collisions, Yonge Street and Carrville Road,[14] is on the boundary of four dissemination areas. Within three of these areas, immigrants make up 61-71% of the population, and the fourth area, immigrants make up 72-82% of the population. The location with the highest frequency of cyclist collisions, 14th Avenue and Markham Road, is located between dissemination areas where immigrants represent 61-71% of the population.

In total, there were 22 locations spatially analyzed using the 2016 census demographic variables: youth (0-19), older adults (65+), visible minority status, recent immigrant status (2011-2016), and immigrant status. From this analysis, it appears that many of the collision locations were in areas with high portions of the population who self-identified as a visible minority or are immigrants, both recent and total. Interesting to note, the areas with the highest percent of the population over 65 are not the sites with high collision intersections. Additionally, almost all of the high frequency collision locations are within dissemination areas where youth represent over 19% of the population. Overall, it is difficult to make conclusions using only 22 collision locations, however high frequency pedestrian and cyclist collision locations are disproportionately located in areas with higher representation of visible minorities, immigrants, and youth.

When

Motorists

The highest frequency of motorist collisions occur in the winter months, as road conditions are worse, which reduces traction and braking for motorists. However, this also causes motorists to act more cautiously and drive slower, leading to less injuries and fatalities. By contrast, the highest number of injuries and fatalities in 2020 occurred in June, when vehicle volumes are high and driving conditions are favourable. The months of July and August, which are largely vacation season in Canada, generate the lowest daily vehicle volumes as well as collisions. Most collisions occur on Friday and during rush hour times, corresponding with peak vehicle volumes

Pedestrians

The highest frequency of pedestrian collisions occur in the winter months due to poor visibility. Similar to motorists, the highest number of collisions occur on Friday and during morning and evening rush hours, corresponding with peak vehicle volumes. On weekends, most collisions occur at night due to poor visibility. York Region has responded to these trends by initiating the fall 'Be visible, Be seen' campaign, aimed at educating vulnerable road users about the increased risk they face with the changing weather and daylight hours.

Cyclists

The highest frequency of cyclist collisions occurred in the summer months when weather conditions are more favourable for cycling. While most collisions involving cyclists also occur on Friday and during morning and evening rush hours, the relationship to vehicle volume hours is not as strong as it is for pedestrians. On weekends, the highest frequency of cyclist collisions occurs at peak vehicle volumes.

Why

Motorists

Motorist collisions are most often caused by motorists following too close, leading to rear-ending. Another significant cause is failing to yield in the right-of-way; such behaviour causes more angle collisions, and account for the most injuries among any collision type. Failing to yield in the right-of-way, including disobeying traffic controls and making improper turns, is a major contributor to intersection collisions.

In the majority of collisions, the at-fault motorist is in normal condition (no impairment, fatigue, or disability), however, inattentive driving is a factor in 22% of collisions. This has led to York Region's 'Pledge to Ignore' campaign, which is aimed at reducing inattentive driving.

Pedestrians

The majority of pedestrian collisions (71%) are the result of improper driving actions, placing the motorist at-fault. Of all motorist at-fault collisions, 71% were caused by motorists failing to yield, often while a pedestrian is crossing with the right-of-way. Of the pedestrian at-fault collisions, 39% were pedestrians crossing mid-block without a marked crosswalk or crossing against the flow of traffic at a signalized intersection. Figure 5.16 illustrates the driving actions that lead to pedestrian collisions.

Cyclists

The majority of cyclist collisions (73%) are a result of improper driving actions, placing the motorist at-fault. Of all motorist at-fault collisions, 61% were caused by motorists failing to yield to the right-of-way, while 17% were caused by motorists making improper turns. Of the cyclist at-fault collisions, the top cause (26%) was cyclists failing to yield in the right-of-way. Figure 5.17 illustrates the driving actions that lead to cyclist collisions.
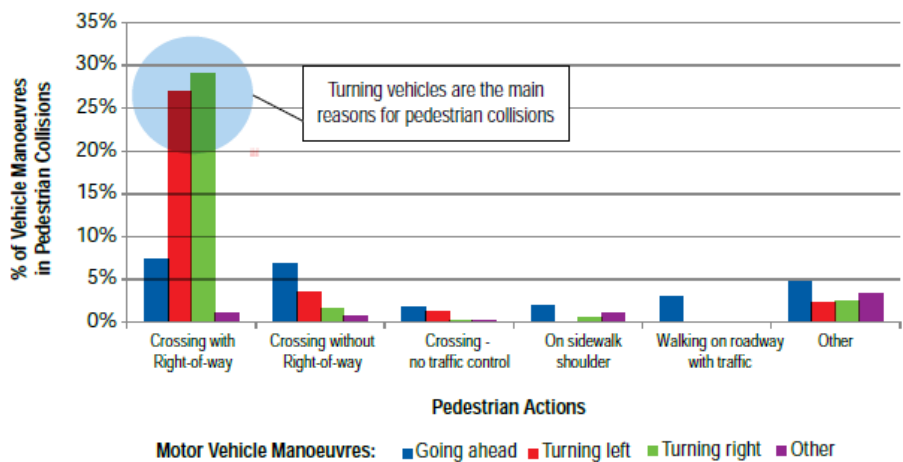
Figure 5.16. Motor vehicle actions leading to pedestrian collisions (Source: York Region).[14]
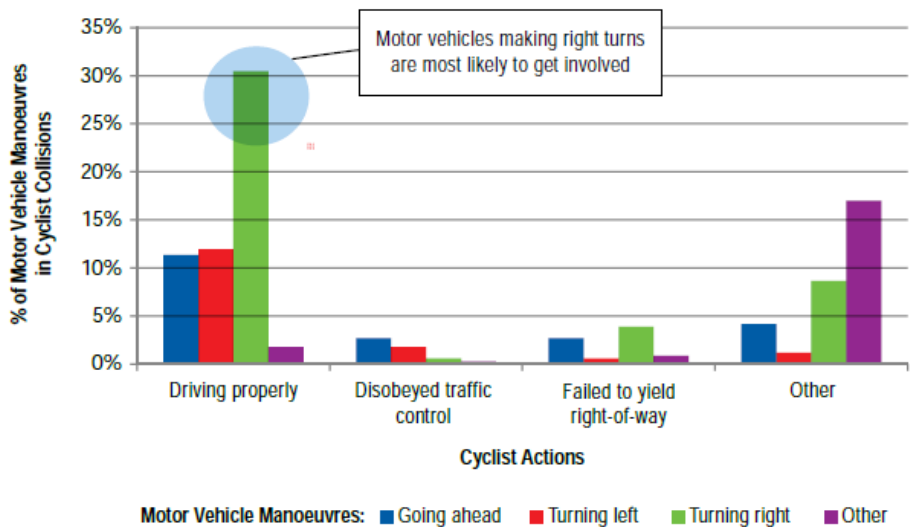
Figure 5.17. Motor vehicle actions leading to cyclist collisions (Source: York Region)[14]

5.4 Limitations

The most significant limitation of this analysis was the lack of differentiation between collision type (i.e., vehicle, pedestrian, or cyclist) in the spatial data provided by York Regional Police. Supplemental information was obtained to identify high frequency collision locations for pedestrians and cyclists, but this does not account for all collision locations involving vulnerable road users. Additionally, other than age, the collision data did not include important demographic or socio-economic data, such as gender, education, income, or racial identity of the victims, nor did it include vehicle type involved in the collision. This information is critical to a fulsome understanding of the inequities in traffic injuries and fatalities in York Region.

To supplement the lack of demographic and socio-economic data in the spatial data, 2016 census data was used with the top 22 pedestrian and cyclist collision locations that were derived from data collected between 2011-2020. Within this 9-year period, demographic patterns could have changed affecting any associations found in the analysis. Additionally, although the census and CIMD data provide insight into the location of specific variables, the CIMD and census data also have limitations. First, the CIMD deprivation scores and census variables are displayed by dissemination area – a geographic unit used to identify an area for census data. When travelling for work or school, residents often move across dissemination areas and, as such, they may be involved in collisions in dissemination areas outside the ones in which they reside. This spatial mismatch makes it difficult to draw strong conclusions about the spatial relationship between collision location and the vulnerability of residents. However, as pedestrians and cyclists travel shorter distances to work, school, and public transit nodes than motorists, collisions involving vulnerable road users are more likely to be close to where they live compared to collisions involving motorists.[127]

Another limitation of census and CIMD data is that it does not include those experiencing homelessness. In the context of traffic injury and fatality, this is an important demographic that should be considered as their increased tendency to occupy space in or near rights-of-way increases their level of risk and exposure.

5.5 Conclusion

The collision data analysis revealed several key trends which are summarized in Table 5.6.

Table 5.6. Who, where, when, and why summary.

Who	Younger motorists are prone to speeding and dangerous driving, leading to higher injury/fatality rate
	Cyclists and pedestrians are at much greater risk of injury or fatality when involved in a collision
	Younger pedestrians are most prone to injury, senior pedestrians are most prone to fatality
	Younger cyclists are most prone to injury and fatality
Where	Majority of collisions occur in urban areas where there are higher volumes of traffic and larger arterial road networks
	Average CIMD scores, representing deprivation, did not result in a significant correlation between total collisions and spatial deprivation
	The majority of cyclist and pedestrian collision locations are occurring in or in close proximity to areas scoring higher on the deprivation
	The majority of cyclist and pedestrian collision locations were in or beside areas with higher representation of visible minorities, immigrants and youth
When	Motorist, cyclist, and pedestrian collisions correspond with peak vehicle volumes
Why	The majority of pedestrian collisions are caused by motorists, specifically motorists making turns
	The majority of cyclist collisions are caused by motorists, specifically failing to yield to the right-of-way

6.0 Observations

6.0 Observations

6.1 Introduction

The academic literature review (Chapter 2) and news media review (Chapter 3) both offered valuable insights regarding the spatial determinants of road safety. To better understand how these spatial determinants manifest in York Region, the team conducted direct observations of intersections with the highest frequencies of collisions, as identified in the York Region *Traveller Safety Report*.[128]

6.2 Methodology

The team conducted direct observations of 11 intersections in York Region. The intersections were selected based off of collision frequency from the *2020 York Traveler Safety Report*.[128] The top three most frequent collision locations from 2017-2019 were selected, as well as the top two most frequent cyclist and pedestrian collision locations from 2010-2019. Additionally, four intersections with recent pedestrian safety improvements were selected. These four intersections were a part of a pilot program initiated by York Region in 2019, in which several safety measures were added to select intersections, including pedestrian head-starts, no-right turns on red, protected left turns, and warning signage. Table 6.1 shows the specific condition of each intersection observed.

Table 6.1. Intersections observed during the site visits and their current conditions.

Intersection Name	Condition
Major Mackenzie Dr and Bayview Ave	Pedestrian Safety Improvements
14th Ave and Markham Rd	Highest Frequency of Cyclist Collisions
Bathurst St and Clark Ave	Pedestrian Safety Improvements
Yonge St and Carrville Rd/16th Ave	Highest Frequency of Pedestrian Collisions
Yonge St and Clark Ave	Pedestrian Safety Improvements
Bathurst St and Carrville Rd/ Rutherford Rd	Pedestrian Safety Improvements
Highway 7 and Weston Rd	Highest Collision Frequency
Yonge St and Green Ln	Third Highest Collision Frequency
Highway 7 and Keele St	Second Highest Collision Frequency
Dufferin St and Glen Shields Ave	Second Highest Frequency of Cyclist Collisions
Major Mackenzie Dr W and Jane St	Second Highest Frequency Pedestrian Collisions

The four intersections that received pedestrian safety improvements were selected based off of a safety index which used a weighted score considering several indicators including total

collisions, road characteristics, road user volume, crossing distance, speed limit and environment.[129] The measures have so far been successful, as they have resulted in a 60% decline in total collisions. These results are most likely attributable to the decrease in conflict rates at each intersection. Conflict rates are calculated based on volumes and conflicts observed through video analysis. Furthermore, the data was collected during irregular travel patterns, including winter months of the COVID-19 pandemic, possibly affecting the results. The before and after conflict rate for each intersection with pedestrian safety improvements is provided in Table 6.2.

Table 6.2. Conflict rates for the intersection with improvements, before and after the implementation of improvements.

Intersection	Vehicle-Pedestrian/Cyclist Conflict		Vehicle-Vehicle Conflict	
	Before	After	Before	After
Bathurst Street and Carrville Road/ Rutherford Road	12	1	14	0
Bathurst Street and Clark Avenue	35	3	78	0
Major Mackenzie Drive and Bayview Avenue	222	18	32	0
Yonge Street and Clark Avenue	27	2	4	0

The observations were conducted on two different days: five intersections were observed on September 24th and the remaining six were observed on October 7th. Two checklists entitled 'All Season's Age-Friendly Pedestrian Safety and Walkability'[130] and 'How Walkable is your Community'[131] were used at each intersection, found in Appendix D.

Two observers went to each intersection and scored the checklists individually and took the average of the two scores for each indicator. The 'How Walkable is your Community' checklist, produced by the U.S. Department of Transportation, is scored out of 30 points, with the absolute minimum possible score of 5. The checklist considers any score above 26 a walkable area. An intersection with a score of 21-25 is considered "pretty good" for walking, scores of 16-20 means the intersection "needs work", scores of 11-15 "need a lot of work", and 5-10 is considered "a disaster for walking". The checklist was composed of five indicators for evaluation including an assessment of room for pedestrians, ease of crossing streets, motorist behaviour, clarity of safety rules and pleasantness of the walk.

The second checklist, 'All Season Age-Friendly Pedestrian Safety' developed by the Council on Aging of Ottawa, was significantly longer than the previous checklist and had 38 evaluation indicators divided into four subcategories: safety, accessibility, convenience, and comfort and attractiveness. Observers answered Yes or No for each of the 38 indicators, and all yes responses were coded as 1 point and all no responses were coded as 0 points to give

quantitative scores that could easily be compared across intersections. Therefore, the highest possible score for this checklist was 38, and the lowest possible score was 0.

Additionally, qualitative observations and photos of intersection conditions and pedestrian/motorist behaviour were used to supplement the checklists. It should be noted that several intersections were observed to have recent 'built environment upgrades', such as street trees and new sidewalk finishings. This differs from the pedestrian safety improvements undertaken on the four intersections of the pilot program. These pedestrian safety improvements were operational adjustments aimed specifically at reducing conflict points between motorists, pedestrians, and cyclists.

6.3 Observation Findings

"How Walkable is Your Community?" Results

Table 6.3 compares the walkability scores calculated from the 'How Walkable is your Community Checklist' across the 11 intersections observed. Figure 6.1 shows the intersections observed numbered from highest walkability score to lowest. The scores ranged from 9/30 to 25/30, and four of the intersections scored higher than 20/30, suggesting good levels of walkability. Given that all the observed intersections are known for being busy with vehicular traffic and high rates of collisions, the walkability scores of these intersections do not adequately account for the hidden dangers that these intersections pose.
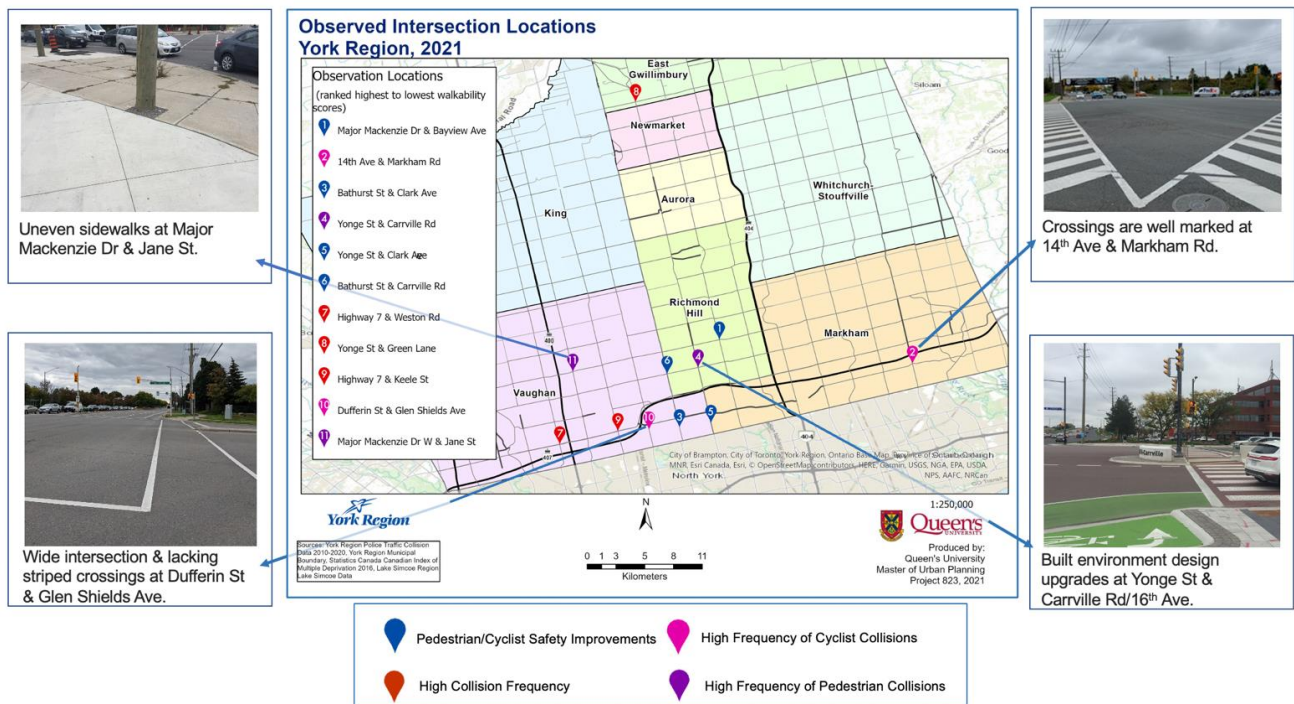
Figure 6.1. Observed intersections with high frequencies of collisions or pedestrian safety improvement in York Region.

All the intersections with pedestrian safety improvements scored higher than 15/30 for walkability. In particular, the intersection with the highest walkability score (25/30), Major Mackenzie Drive and Bayview Avenue, has the recently pedestrian safety improvements, specifically the restrictions of no-right on red and protected left turns. Meanwhile, the intersections of 14th Avenue and Markham Road, and Yonge Street and Carrville Avenue also received high walkability scores, despite having the highest frequencies of cyclist and pedestrian collisions, respectively. These high walkability scores may be attributed to built environment upgrades, seen in Figure 6.1, that have been made to the intersections, including new sidewalks and the addition of street trees, contributing to their high scores on the "pleasantness" indicator. Since intersection upgrades may attract more pedestrian and cyclist activity, and collision frequencies tend to be higher at intersections with high concentrations of pedestrians and cyclists, it is advised that traffic signal-based improvements to be made prior to, or in tandem with, built environment upgrades to minimize collisions.

Table 6.3. Walkability scores out of a total of 30 points for intersections of interest.

Intersection Name	Municipality	Walkability Score Based on Observations (Out of 30)
Major Mackenzie Dr and Bayview Ave	Richmond Hill	25
14th Ave and Markham Rd	Markham	23
Bathurst St and Clark Ave	Vaughan	22
Yonge St and Carrville Rd/16th Ave	Richmond Hill	21
Yonge St and Clark Ave	Markham and Vaughan	17
Bathurst St and Carrville Rd/ Rutherford Rd	Vaughan	17
Highway 7 and Weston Rd	Vaughan	15
Yonge St and Green Ln	East Gwillimbury	13
Highway 7 and Keele St	Vaughan	12
Dufferin St and Glen Shields Ave	Vaughan	12
Major Mackenzie Drive West and Jane Street	Vaughan	9

'All Season Age-friendly Pedestrian Safety' Results

Table 6.4 summarizes the findings from the 'All Season Age-Friendly Pedestrian Safety Checklist'. None of the intersections achieved a perfect score in any of the subcategories indicating room for improvement at all intersections observed. The following sections will review the subcategories of the checklist.

Table 6.4. Intersection walkability results using the 'All Season Age-friendly Pedestrian Safety Checklist'.

Intersection Name	Safety Score (Out of 15)	Accessibility Score (Out of 7)	Convenience and Connected-ness Score (Out of 6)	Comfort and Attractive-ness Score (Out of 10)	Total Score Based on Observations (Out of 38)
Yonge St and Carrville Rd/16th Ave	10	5	4	4	23
Major Mackenzie Dr and Bayview Ave	10	4	3	5	22
Bathurst St and Carrville Rd/ Rutherford Rd	8	4	4	6	22
14th Ave and Markham Rd	9	3	3	5	20
Major Mackenzie Dr W and Jane St	7	1	4	8	20
Highway 7 and Weston Rd	11	4	2	3	20
Bathurst St and Clark Ave	10	1	3	4	18
Yonge St and Green Ln	7	2	2	3	15
Highway 7 and Keele St	7	4	2	2	15
Dufferin St and Glen Shields Ave	8	1	2	4	15
Yonge St and Clark Ave	4	1	2	4	11

Safety

This checklist evaluated safety through 15 indicators asking observers about their perception of sidewalk quality, separation from the road, traffic calming and crossing times, among other indicators. The lowest safety score was at Yonge Street and Clark Avenue, with a score of 4/15. Observers indicated inadequate separation distance from the road and noted that sidewalks were in poor repair as seen in Figure 6.2. Observers also noted poor street lighting, and that crossing times were too short at this intersection.

The intersection with the highest safety score, of 11/15 was Highway 7 and Weston Road, which also had the highest frequency of total collisions. The intersection recently had built environment upgrades, as seen in Figure 6.3, including new sidewalks, newly painted crossings and bike lanes, likely increasing the safety score.

The intersections with pedestrian safety improvements installed by York Region had the highest safety scores in the All Season Age-Friendly Checklist, other than Highway 7 and Weston Road. Interestingly, indicator 9 asked "Do pedestrian lights allow enough time for older people and young children to cross safely?" despite, these four intersections having pedestrian head starts installed, observers noted that pedestrians did not have enough time to cross at Bathurst Street and Carrville Road/Rutherford Road and Yonge Street and Clark Avenue. Observers noted at Bathurst Street and Carrville Road/ Rutherford Road an adult woman had to pick up and carry a child to ensure they could cross in time. This may indicate that pedestrian head starts still do not provide enough time for pedestrians of all ability levels to cross major intersections.

Figure 6.2. Sidewalk quality at Yonge Street and Clark Avenue in Markham.
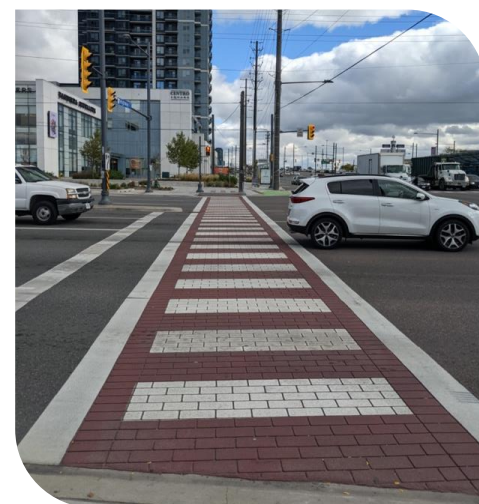
Figure 6.3. Newly painted striped crossings installed at Highway 7 and Weston Road.

Accessibility

Major areas of concern for accessibility are the intersections that scored a 1 out of 7 on this subcategory which includes, Dufferin Street and Glen Shields Avenue, Major Mackenzie Drive West and Jane Street, Yonge Street and Clark Avenue, and Bathurst Street and Clark Avenue. These intersections only had one of the following accessibility parameters: audible signal devices at crosswalks, wide sidewalks for passing, sidewalks clear from obstructions, public toilets nearby, smooth curb ramps, safe and accessible construction areas, and sidewalks that are smooth and easy to wheel on. The only intersections that had audible signal devices at crosswalks were, Major Mackenzie Drive and Bayview Ave, Yonge Street and Carrville Avenue, Yonge Street and Clark Avenue, and Bathurst Street and Clark Avenue, however, observers noted the audible signals were difficult to hear over traffic noise.

The highest scored intersection on accessibility was Yonge Street and Carrville Road, with a score of 5/7. This intersection recently had built environment upgrades including the installation of wide and smooth sidewalks that led to the higher score. All the intersections could improve accessibility through the implementation of more public washrooms. These results show there is an understanding of how to improve accessibility as more updated intersections have higher accessibility scores, however, more accessibility measures need to be implemented across the Region to ensure pedestrians of different ability levels can safely navigate intersections.

Convenience and Connectedness

Since all the selected sites were major arterial intersections, two of the indicators regarding cul-de-sacs and dead-end roads, and separated off-leash dog parks were not applicable, resulting in low convenience and connectedness scores. Most intersections did not have pedestrian signage identifying nearby services, thus reducing their score in this subcategory. Minimal pedestrian signage was present at the following locations: Major Mackenzie Drive West and Jane Street, Yonge Street and Clark Avenue, Bathurst Street and Carrville Road/ Rutherford Road and Yonge Street and Green Lane. Within the convenience and connectedness subcategory, observers also noted that all intersections evaluated were on a public transit route.

Figure 6.4. Inaccessible street furniture at Bathurst Street and Carrville Road.

Figure 6.5. Lack of continuously linked sidewalks at Yonge Street and Green Lane.

The intersections with the lowest scores for convenience and connectedness were Highway 7 and Keele Street, Dufferin Street and Glen Shields Avenue, Yonge Street and Clark Avenue, and Yonge Street and Green Lane all with a score of 2/6. Observers flagged that at Yonge Street and Green Lane sidewalks were not continuously linked seen in Figure 6.5. The lack of connected sidewalks is a major safety hazard for pedestrians.

Comfort and Attractiveness

Finally, comfort and attractiveness scores were determined based on 10 indicators. The intersections with the lowest scores were Highway 7 and Keele Street with a score of 2/10. This intersection also scored low on comfort and connectedness and safety likely due to the poor connectivity of sidewalks and bike lanes which is seen in Figure 6.6. Observers noted this intersection did not have street furniture, adequate street trees, places to shelter from bad weather and was also not well-maintained.

Figure 6.6. Bike lanes at Highway 7 and Keele St that are between two lanes of high-speed traffic and not continuously linked to other bike lanes.

None of the intersections had drinking fountains and only about half of the intersections had benches or other street furniture—aside from the benches associated with public transit stops. The intersections that had adequate benches and places to rest were 14th Avenue and Markham Road, Major Mackenzie Drive West and Jane Street, Bathurst Street and Carrville Road/Rutherford, Dufferin Street and Glen Shields Avenue, and Yonge Street and Clark Avenue. Observers also noted that street frontages were not interesting and attractive and there was a lack of points of interest at most intersections. The only intersections that observers indicated there were points of interest were at Major Mackenzie Drive West and Jane

Figure 6.7. View of Canada's Wonderland at Major Mackenzie Drive West and Jane Street.
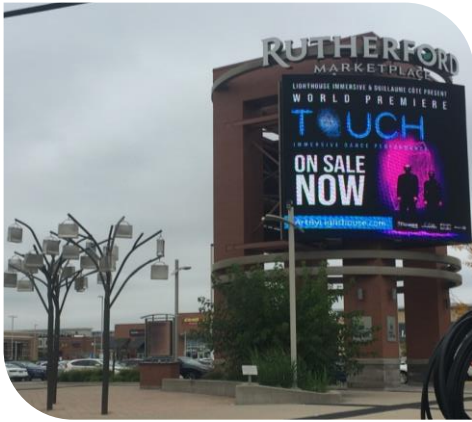
Figure 6.8. View of Rutherford Marketplace at Bathurst Street and Carrville Road.

Street, and Bathurst Street and Carrville Road. The points of interest at these intersections can be seen in Figure 6.7 and Figure 6.8.

Overall, all intersections evaluated scored poorly on comfort and attractiveness, excluding Major Mackenzie Drive West and Jane Street. The poorly scored intersections could be improved through enhancing landscaping, adding street furniture and pedestrian-oriented street frontages. Additional recommendations for the overall improvement of these intersections will be discussed in the engineering recommendations in Chapter 9.

6.4 Limitations

There are a few limitations of the observations that are worthy of note. First, as the research team was based in Kingston, they were only able to conduct observations on two days. Being closer to York Region would have enabled a great number of observation periods, and potentially better insights about the spatial determinants of road safety at these high collision intersections. Secondly, the reliability of the walkability tools was not tested prior to their application in York Region, and the team did note discrepancies in scores between individual observers on the team. In these instances, average scores were used. Another limitation is that all observations were taken only once, during the middle of a weekday, during daylight hours, and with clear, dry roads; this approach limits the team's understanding of how pedestrian safety may be compromised in periods of different traffic patterns, limited visibility due to daylight, or hazardous driving conditions.

Observers mostly relied on predetermined checklists to evaluate the intersections, which may not have included other identified built environment factors, such as separation of bike lanes from traffic and the absence of tactile sidewalk markings. The checklists used were also not specific to evaluating intersections which is a limitation to our approach. Additionally, since the walkability checklists were not designed specifically for intersections, certain parameters, such as the availability of off-leash dog areas and the presence of cul-de-sacs were not relevant to our analysis. This occurred specifically in the connectedness scores in the 'All Season's Age-Friendly Pedestrian Safety'. Lastly, despite the checklists attempting to account for different ages and abilities, all the observers were young able-bodied individuals and therefore the observations may not have captured the perceived safety and accessibility for other ages and ability levels.

6.5 Conclusion

Intersections with built environment upgrades including new sidewalks, striped crossings, and street trees scored highly on walkability despite some having high frequencies of collisions. This may likely be due to their attractiveness to pedestrians, therefore increasing pedestrian activity at these sites. These are particularly important considerations at several York Region intersections that have been made more attractive and comfortable to pedestrians, such as Yonge Street and Carrville Road, Highway 7 and Weston Road, and Highway 7 and Keele Street. While built environment upgrades can improve pedestrians' and cyclists' safety and confidence with engaging in active transportation, the York Region collision data analysis (Chapter 5) revealed that most pedestrian-involved collisions at intersections were a result of improper motorist behaviour; conflicts that are unlikely be resolved by these built environment upgrades. Instead, improvements that prioritize pedestrian safety (e.g., no-right on red, protected left turns and pedestrian head starts) need to be prioritized, or implemented in tandem with, built environment changes to accommodate for the potential increase in pedestrian activity and to maximize the safety of vulnerable road users at these locations.

7.0 Key Informant Interviews

7.0 Key Informant Interviews

7.1 Introduction

Five semi-structured interviews were conducted with key informants to gain insight into the current perspectives regarding road safety and vulnerable populations. The key informants, mostly from Ontario, were invited to participate based on their expertise in road safety initiatives and/or working with vulnerable populations. They range from police officers, public servants, urban planners, and active transportation activists. Most key informants were already identified as willing to participate before this project began, however, the research team also identified several potential key informants based on preliminary research in news media review and the case study analysis.

7.2 Methodology

Eleven potential key informants were recruited through email with a request to participate in an interview. A letter of information was provided outlining the scope of the project and ethical considerations. Follow-up emails were sent within one week to those who did not reply to the original email. Confirmation emails were sent outlining the interview date and time, and a copy of the interview question guide was provided in advance.

Four out of the five key informants explained existing conditions within York Region. The interviews focused on the key informants' understandings of the connections between vulnerability and road safety, with specific questions tailored towards each key informant's role and experience (see Appendix E: Interview Guide for interview questions). Ethics approval for the interviews was obtained from the Queen's General Research Ethics Board, and all participants provided consent before the interviews took place. Interviews were facilitated through video conferencing with the use of Zoom. Each interview was approximately 30 to 45 minutes in length and was conducted by two team members to ensure quality and consistency. All interviews were transcribed using the Zoom transcription function.

7.3 Key Themes

Based on the qualitative data obtained through the interview process, the following common themes emerged:

1.
The greatest barriers to road safety are current road designs that favour motorists, the two-tiered government system, and lack of funding

First, the key informants were asked to identify and describe the greatest barriers to road safety. All key informants who work within the realm of urban planning identified that the current road design in Canada focuses on the needs of motorists by prioritizing traffic speed and volumes, leaving pedestrians and cyclists as secondary users of the space. This reinforces that personal vehicles are the most prioritized mode of transportation. Key informants also identified York Region's aging population as a growing demographic, noting that current transportation networks are not designed with older adults in mind. Transportation systems are costly to build and have long lives; key informants expressed the difficulty in updating current roads to accommodate new best practices in built environment standards. Moreover, the lack of funding allocated towards improving road safety and retrofitting roads was also identified as a barrier. Political support is present across the region; however, it was suggested that the main barrier to implementing safety measures across the Region was the lack of funding or the exclusion of safety measures as a budget priority.

Another barrier discussed was the political structure of the two-tiered government within York Region. Despite the claim that the Region and individual municipalities collaborate on road safety, the division of responsibility of regional roads versus local roads causes confusion and difficulty coordinating safety measures. For instance, the Region may implement built environment improvements at major arterial roads such as marked cycling lanes, which are the responsibility of the Region. However, the Region may not continue the marked cycling lanes on local roads that are the responsibility of the lower-tier municipality leaving cyclists to merge into motorized traffic as they travel between areas, thereby increasing exposure and risk. To apply a systems-based approach, as advocated for in Vision Zero strategies, the political structure of the two-tiered system may be a barrier to road safety unless cross-collaboration is improved.

2. Cyclists and pedestrians are the most commonly identified vulnerable population, however holding other "at-risk" identities further exacerbates cyclists and pedestrians' risk

The following table lists populations that were identified by key informants as the most at-risk due to road safety issues, and the factors contributing to their level of risk and exposure.

Table 7.1. Vulnerable Populations as Identified and Explained by Key Informants.

Vulnerable population most at risk	Contributing factors
Pedestrians and cyclists	Not protected from impacts sustained from vehicles and there is not always appropriate active transportation infrastructure available for their use
Older adults	More likely to have age-related mobility and cognitive limitations and/or impairments
People with lower incomes	More likely to walk, cycle or take public transit as their primary mode of transportation. More likely to be working multiple jobs or shift work and experience cognitive fatigue, reducing reaction times and general awareness
People with mental illness and/or addictions	More likely to be unaware of their surroundings and potential dangers in the right-of-way
Newcomers to an area	May be unfamiliar with local road conditions, motorist behaviours, and road safety practices
School-aged children	Limited life experience that may limit their awareness of their surroundings and/or their understanding of road safety practices
People experiencing homelessness	More likely to spend longer portions of their day within and adjacent to busy right-of-way, such as arterial and collector roads
Individuals with mobility impairments	It may take longer to cross large intersections, slower reaction times and less visibility for individuals who use wheelchairs

The vulnerable populations outlined in Table 7.1 are populations affected by road safety issues in general and were not identified as population-specific to York Region. Cyclists and pedestrians are the most mentioned vulnerable group, followed by older adults and children. There was little discussion on the influence of holding multiple at-risk identities, however, it is known that these different identities interact in many ways and individuals are not siloed into singular vulnerability categories. Furthermore, it is crucial to note that key informants from York Region highlighted the region's rapid growth, primarily from newcomers to Canada, many of whom speak English as a second language.

3. The neighbourhoods where individuals live also influences risk of traffic injury and fatality

An individual's identity influences risk, however, the communities where individuals live also impact their level of risk due to diverse spatial determinants. Discrepancies in the Region's various built environments create pockets of more dangerous areas. Lower-income neighbourhoods were identified as sites of higher collision frequencies in the Region due to the lack of safe pedestrian and cyclist infrastructure such as wider sidewalks, street illumination, or bike lanes. This claim was also supported by findings from both the academic literature review and the news media review that found collisions were occurring at higher frequencies in lower-income neighbourhoods and neighbourhoods with predominant newcomer populations.

4. Current approaches to road safety include built environment improvements, educational campaigns, and safe systems strategies

Key informants detailed that specific built environment improvements lead to the increased safety of vulnerable populations. Through improvements such as pedestrian head starts in urban areas, red light cameras, and eliminating right turns on red for motorists, vulnerable road users can move through intersections at a variety of speeds to accommodate a range of physical abilities. Further, improvements such as providing an advanced left turn signal for vehicles have led to reduced pedestrian and cyclist collisions.

Campaigns such as the 'Be Seen and Be Safe' initiative and the 'Share the Road Approach' were provided as examples of current educational programs. The 'Be Seen and Be Safe' campaign emphasizes the importance of pedestrians and cyclists wearing reflective clothing to increase their visibility for motorists. The 'Share the Road' approach was also identified as an educational program that focuses on rural communities and emphasizes the importance of motorists sharing the road with cyclists, and only passing when it is safe to do so. The 'Share the Road' approach attempts to improve motorists' awareness of vulnerable road users, specifically cyclists.

Lastly, safe systems strategies were discussed, such as the Vision Zero approach, that focuses on the larger structural factors leading to collisions. It was noted that the Vision Zero principles are useful to apply to communities that have not officially adopted the policy but are seeking to improve conditions for all road users. Additionally, adopting a Vision Zero Strategy also provokes education among residents around traffic collisions and pushes people to re-think traditional approaches to road safety that prioritize the vehicle. The implementation of built

environment improvements, educational campaigns, and safe systems strategies that prioritize vulnerable populations are the main road safety approaches being implemented by the key informants and their departments.

5. Using a proactive approach to road safety that shifts decision-making into a shared responsibility

Proactive transportation planning was also identified as a current approach to road safety to recognize potential safety issues such as poor lighting and short crossing times, before any traffic injuries or fatalities occur. There is also a need to incorporate vulnerable populations into decision-making as opposed to relying on 'experts' or standards created by experts who are unaware of local contexts. Advisory committees made up of residents were one approach mentioned that incorporates these perspectives into proactive road safety planning. Another approach emphasized was community partnerships which gives power to those most vulnerable. However, many vulnerable populations are hard to reach through current public engagement strategies and there is a shortage of staff skilled in this area who can lead outreach campaigns or understand how to capture lived experience data.

6. Staff commitment to road safety is a major strength in the current approaches to Vision Zero

The key informants identified several strengths of the existing road safety initiatives within the communities that they work or reside in. The most commonly identified strength was the commitment of municipal staff to ensuring the safety of all road users through the implementation of road safety initiatives. The political support from municipal council members is a major determinant for the successful implementation of Vision Zero and other road safety initiatives. York Region's dedication to road safety was specifically mentioned as a strength and key informants cited the *Traveller Safety Reports* and the Region's willingness to collaborate with various stakeholders as examples of this commitment.

7. Collaborating across stakeholders is a main shortcoming in current approaches to road safety

Shortcomings discussed in interviews included responses such as the difficulty of retrofitting existing roads, the lack of socio-economic data, and the shortage of trained staff with skillsets in engaging with vulnerable populations. However, the main shortcoming discussed among key informants was the lack of coordination and collaboration across key stakeholders and various levels of government. Although the two-tiered system is not a barrier or weakness in itself, key informants discussed the difficulty of implementing safety improvements when different levels of government have control over the roads that fall under their respective jurisdiction. The two-tiered system also requires greater efforts for collaboration and consensus amongst many different municipal and regional departments. This can be a difficult and lengthy process. Additionally, by involving multiple stakeholders in decision-making, it is difficult to set up meetings and meet deadlines when more people are needing to provide feedback. These shortcomings were considered for the creation of recommendations at the end of this report.

8. There is no consistent approach among experts to incorporate vulnerability in Road Safety Initiatives

The last key theme emerged from the final interview question which asked, "**what more could be done to ensure that the needs of populations at risk are fully addressed?**"

Almost every key informant provided an entirely different response.

There was also tension between responses as one key informant stressed the importance of ensuring that road safety is everyone's responsibility, while others reinforced the need to redirect the onus of collisions onto systems, as opposed to the road users. Initiatives that focus on improving pedestrians' and cyclists' visibility were mentioned as successful initiatives to reduce the risk of injury and fatality. However, literature findings indicated that initiatives focused on placing the onus on the vulnerable road user to avoid being struck inherently contributes to the overall systemic issue of road safety and is against the core values of Vision Zero.

Two key informants mentioned that vulnerability is also accounted for in the proactive transportation planning approach, by identifying areas that offer inadequate protection for vulnerable road users in the right-of-way before they are identified through injury and fatality data. Forming partnerships with vulnerable road users has been the focal point of centering

vulnerability in road safety to ensure that the design of future roadways addresses real safety needs faced by the community. Two key informants stressed the need for incorporating 'harder to reach' populations in road safety decision-making such as collaborating with school boards to engage with school-aged children on road safety. Concurrently, another key informant suggested the solution lies in hiring external consultants who are experts in road safety solutions. Overall, there are tensions between the strategies to address vulnerability, where some key informants suggested the redistribution of decision-making to vulnerable users while others favoured the use of established experts. Therefore, there needs to be greater agreement among professionals on how to centre vulnerability and establish a better understanding of the core tenant of Vision Zero as a safe systems approach to road safety to ensure consensus amongst stakeholders.

7.4 Limitations

The breadth of insights that were gleaned from the key informants was limited by the small sample size. The research team contacted eleven prospective key informants to inform this project, but only five individuals agreed to be interviewed, reducing the potential findings. Interviews were also limited to a short timeframe, which did not allow key informants to share more of their experience.

7.5 Conclusion

The key informant interviews provided critical insights for this report and a basis for the development of recommendations for York Region. The key informants identified specific populations at greatest risk of traffic injuries and/or fatalities, that were consistent with populations that were identified in previous chapters, including older adults, children, lower-income individuals, and individuals with mobility impairments. The key informants also identified that there is supportive political climate for Vision Zero in York Region, however, some responses suggested that 'support' for Vision Zero was based on the misconception that road safety is "everyone's responsibility". This perpetuates the idea that vulnerable road users, motorists, and system designers have an equal level of risk when using transportation networks. Moreover, the overall lack of consensus among key informants on how to approach road safety and protect vulnerable road users reflects the different understandings and interpretations of who holds the greatest responsibility for collisions. This is likely shaped by key informants' own positionality and place of work. Overall, to adopt a safe systems approach to road safety, there needs to be greater education for those in key decision-making positions to lead with a united front.

8.0 Discussion

8.0 Discussion

8.1 Introduction

This chapter synthesizes key insights from the preceding chapters. The analysis of who and why people are vulnerable to traffic-related injuries and fatalities was informed by the team's academic literature review (Chapter 2), news media review (Chapter 3), York Region collision data analysis (Chapter 5), and key informant interviews (Chapter 7). Several populations were identified as being vulnerable due to spatial, socio-economic, and individual-level determinants. The observations of high frequency collision intersections (Chapter 6) supported this analysis, by offering insights on the locations and built environment context of collisions in York Region. Lastly, the case study analysis (Chapter 4) illustrated how various jurisdictions are currently addressing road safety, and how vulnerability is being considered in those approaches.

8.2 Key Insights

✱ Pedestrians and cyclists are well established vulnerable road users who face greater risk of traffic injuries and fatalities

The academic literature review, news media review, and key informant interviews identified pedestrians and cyclists as vulnerable road users who face disproportionate risk of traffic injuries and fatalities. When compared to motorists, the lack of protection that comes from being within an enclosed vehicle with features such as seatbelts and airbags is a reason why pedestrians and cyclists face a greater risk of injury and fatality in traffic collisions. Meanwhile, the operating speed coupled with the mass of different vehicle types determines the severity of traffic collisions. Other factors that contribute to increasing pedestrians' and cyclists' risk include the spatial, socio-economic, and individual-level determinants that emerged from the academic literature and news media review.

The findings from the traffic collision data analysis are consistent with the academic literature: pedestrians and cyclists in York Region are at a much higher risk of being injured or killed when involved in a collision. In 2020, pedestrians were the most vulnerable road users in York Region, where nearly all pedestrian collisions (94%) resulted in pedestrians' injury or fatality, followed by 88% of all cyclist collisions resulted in injury or fatality.[128]

Contributing factors to pedestrian and cyclist collisions that were identified in the *York Region 2021 Traveller Safety Report i*nclude daylight levels and conflicts occurring at intersections.[14]

Comparably, the academic literature also noted that intersections were sites that experienced increased frequencies of collisions involving pedestrians and cyclists.[39,40] Common risks from the academic literature review that were associated with intersection design included wide, multi-laned intersections and multi-laned roundabouts where there was a lack of pedestrian or cyclist infrastructure.[31,32,41] As well, collisions at intersections were commonly attributed to motorists failing to yield or see vulnerable road users due to their poor visibility.[33]

✱ Vulnerable populations at greatest risk: Children and Youth, Older Adults, Racialized Individuals, Immigrants and Newcomers, Individuals Experiencing Homelessness

Children and Youth

Children's vulnerability to traffic injuries and fatalities is often attributed to their inexperience and limited awareness of their surroundings and road safety practices.[14] This common explanation for children's vulnerability and their increased risk to traffic collisions is problematic as it places the responsibility of road safety onto a child and demands that they conform to the established norms of road safety without critically asking why children face disproportionate traffic-related risks. For instance, the academic literature found that a common cause for collisions with children was a lack of designated play spaces.[26,30,43,45,48] With a lack of designated play spaces, a child who is unaware of the dangers associated with the road may dart into unsafe traffic to retrieve a ball they were playing with.[43] Rather than placing the blame on the lack of designated play spaces for the children, most news and media sources would place the blame on the individual child for darting into traffic.

Additionally, the further a child must travel to attend school also increases their risk of traffic injury and fatality.[45,46] Children who travel farther distances to school must cross a greater number of roads, therefore increasing the amount of traffic that the child is exposed to. When compounding distance to school with trends in types of vehicle models that are being manufactured, children that travel longer distances are also facing more SUV's which are larger, heavier, and more likely to inflict severe injuries or fatalities due to their high front-end profile.[110] Together these factors place children and youth, specifically those who rely on active transportation, in extremely vulnerable positions.

The increased risk faced by children as identified in the academic literature review reflects current trends in York Region. Young pedestrians 15 to 19 experience higher injury rates compared to pedestrians aged 20 and over. Similarly, young cyclists between 15 to 19 years of age experience the highest injury rate and those aged 20 to 24 have the highest fatality rate.[14] Furthermore, the socio-economic and demographic analysis that was compared to York

Region's top pedestrian and cyclist collisions in Chapter 5 revealed that eight of the twenty-two dissemination areas with higher youth populations also had more pedestrian and cyclist collisions. For example, Newmarket's Yonge Street and Mulock Drive intersection is one of the highest locations for cyclist collisions. This intersection is also adjacent to a dissemination area where youth represent 37-42% of the population, showing a possible relationship between youth and traffic collisions. These higher injury and fatality rates among younger adults likely reflect their limited access to a personal vehicle, and their increased reliance on walking and cycling are their primary modes of transportation.

Older Adults

For many older adults, walking is their primary mode of choice and provides the benefits of maintaining physical activity and remaining connected to their communities. Consequently, older adults are recognized as disproportionately vulnerable to traffic injuries and fatalities. Indeed, in York Region, the pedestrian fatality rate generally increases with age, such that older pedestrians have the highest fatality rate of all age groups.[14] According to the socio-economic and demographic analysis that was compared to York Region's top pedestrian and cyclist collisions in Chapter 5, most dissemination areas did not have a strong relationship between older adults and traffic collisions. However, as York Region has an aging population, this group should be recognized such that they are not disproportionately affected by traffic collisions in upcoming years.

Differences in crossing behaviour due to age-related factors, such as reduced mobility and visual and cognitive decline, are often cited as reasons for the increased risk of traffic collisions involving older adults.[14,52,53,55,70] However, solely focusing on their individual-level behaviours takes away from understanding how the built environment is not designed for their needs and abilities. For instance, roads designed for high-traffic speeds and volumes, too few opportunities for crossing, and intersection timings that are too short to enable safe crossing all place older adults at greater risk.[40,102] Making improvements at intersections that accommodate the mobility needs of older adults improves safety conditions for road users of all ages and abilities.

Racialized Individuals

Racialized individuals are more likely to reside in areas with inadequate active transportation infrastructure, poor lighting, and a high concentration of busy arterial roads, all of which increase their risk of traffic injuries and fatalities.[28,53] This pattern is due, in part, to fewer investments for road safety initiatives, such as traffic calming, in these neighbourhoods.

According to the 2016 census, 49% of York Region's population identified as a visible minority.[13] In York Region, Markham is the most diverse municipality with 78% of the population identifying as a visible minority. Markham is also home to the most cyclist collisions with each hotspot location appearing in a dissemination area that has a visible minority population of 59% or greater. Most pedestrian and cyclist collisions outside of Markham similarly occurred within or adjacent to a dissemination area with a high proportion of visible minorities suggesting that there is likely a relationship between people who identify as a visible minority and traffic collisions.

Immigrants and newcomers

Immigrants and newcomers to an area are expected to immediately adapt to the road safety culture of the community in which they have settled. Meanwhile, studies have found that immigrants and newcomers are more likely to reside in high density neighbourhoods that have more bus stops, intersections, and high-traffic roads.[26,48,63] These spatial determinants have all been identified as factors that can increase a road users' level of risk. The expectation of immigrants and newcomers to simply adapt to the "safety culture" of their new community to avoid injury or fatality places the onus of road safety on the individual, often in the absence of critical information and infrastructure that is required to keep themselves safe.

According to the 2016 census, 47% of York Region's residents were born outside of Canada - the third highest in Ontario behind Peel Region and Toronto.[13] The data analysis in Chapter 5 between visible minority status and traffic collisions showed that recent immigrant populations and total immigrant populations are affected by traffic collisions. When comparing total immigration to pedestrian and cyclist collisions in York Region, nineteen of twenty-two total collisions occurred in or near a dissemination area that was composed of an immigrant population of 49% or more, again suggesting that there is likely a relationship between immigrants and traffic collisions.

People experiencing homelessness

People experiencing homelessness are also disproportionately victimized by traffic collisions and fatalities because of their frequent proximity to the right-of-way relative to housed residents. People experiencing homelessness are also more likely to be suffering from addictions and/or mental illness that may compromise their capacity to assess or react to traffic-related risks. However, since these individuals are not captured in censuses, and collisions with motorists are more likely to go unreported, there is a lack of data that tracks their experiences of collisions. Indeed, homeless people were not profiled within the academic literature review, news or media review, case studies, or the York Region collision analysis, indicating that this vulnerable group is consistently overlooked in the road safety discourse

At the time of the 2016 census, which informed the team's data and results, the homeless population in York Region had not been accounted for. Since then, York Region began an initiative in 2018 called the *Homeless Count*. This identified 389 individuals experiencing homelessness. While these 389 individuals make up less than 1% of York Region's population, they are still a vulnerable population that should be recognized in the discussion of traffic collisions in York Region.[132] As people experiencing homelessness are not captured in census data, injuries and fatalities often go unreported. This highlights the necessity of collecting data that is all-encompassing which includes information about the people who are most at risk.

✳ Lower-income individuals are at higher risk of traffic injuries and fatalities because of transportation inequity

Lower-income individuals were consistently identified as a vulnerable population throughout the academic literature review, news media review, case studies, key informant interviews, and the collisions data analysis. This sub-section outlines why lower-income populations are more exposed to traffic, the spatial determinants that put this population at greater risk, and how lower-income individuals relate to York Region. York Region's existing and future road safety initiatives need to be developed such that they do not perpetuate transportation inequity in the region.

Exposure to traffic

Lower-income individuals are more likely to walk, cycle, or take public transit as their primary mode of transportation, as these are all lower-cost transportation options compared to private vehicles. However, municipal and regional governments tend to spend far less on infrastructure per capita to support these low-cost modes of transportation, resulting in disproportionately unsafe journeys by these modes. For instance, infrequent pedestrian crossings that promote unsafe mid-block crossing, painted bike lanes that do not offer protection from passing motorists, and poorly located bus stops that are difficult to access, all increase the risk to these lower-income individuals who are more reliant on these modes of travel.[98]

Spatial determinants that commonly affect lower-income individuals

While increased exposure places lower-income individuals at a greater risk, the built environment exacerbates lower-income individuals' risk levels. Lower-income neighbourhoods are frequently located in or near areas that are designed for high-traffic speeds and volumes, such as multi-lane arterial roads. Lower-income areas are more likely to have poor infrastructure, including broken or missing sidewalks and inadequate lighting. Additionally,

lower-income areas have a higher density of public transit stops and routes, and public transit use is positively associated with the number of pedestrian collisions.[98] Meanwhile, the case studies and academic literature revealed that higher-income neighbourhoods are often prioritized for receiving active transportation infrastructure and traffic calming upgrades.[30,60] This pattern has been attributed to higher citizen engagement and influence over where infrastructure and traffic calming upgrades are implemented.

Traffic collisions and fatalities in the York Region context

Spatial analysis revealed that pedestrian and cyclist collision hotspots in York Region are predominantly located in or adjacent to areas of moderate to high deprivation. While the location of a collision does not necessarily reflect the area in which a victim resides, the chances that a victim lives in a deprived area are higher for pedestrians and cyclists, since they tend to travel shorter distances than motorists.

Observational data of York Region's high frequency collision intersections showed that many intersections regardless of their quintile of deprivation are receiving improvements such as new sidewalks and clearer crossings (Figure 8.1). And yet, numerous locations in high deprivation areas, including Yonge Street & Green Lane, still require improvements (Figure 8.2).

Given the elevated risk that lower-income individuals face in terms of road safety, lower-income areas should be prioritized for these improvements.

Figure 8.1. Intersection at Weston Road and Highway 7. Located near a dissemination area with a deprivation score of 4 but has sidewalk improvements.

Figure 8.2. Sidewalk in poor condition near Yonge Street and Green Lane intersection. The area is located near a dissemination area with a deprivation score of 4.

✳ Individuals holding multiple at-risk identities face higher risk of traffic injuries and fatalities

Individuals with multiple at-risk identities are more likely to be involved in traffic-related collisions and fatalities because of their combined exposure to various socio-economic and spatial determinants. This was found in the academic literature review and confirmed in the key informant interviews.

For instance, children in lower-income households frequently reside in high-density neighbourhoods near high-traffic areas, thus exposing them to greater risk due to the associated high speed and volume of vehicles.[26,30] Residing in high-traffic areas means that children in lower-income households are forced to cross busier streets to travel to and from school.[47]

Immigrant children is another population that holds multiple at-risk identities. Immigrants are more likely to reside in high density neighbourhoods that have poor pedestrian and cycling infrastructure. When children live in these neighbourhoods that lack pedestrian and cyclist infrastructure, they are more likely to walk and play in undesignated areas exposing them to more traffic.[63] Many sources note that immigrants and immigrant children undergo a period where they must adapt to their new environment and the road safety culture. However, without systems being designed in a uniform and comprehensive manner this population is placed at a disadvantage when trying to adapt to their new environment and safety culture. As previously stated, according to the 2016 census, 47% of York Region's residents were born outside of Canada and child pedestrians between the ages of 15-19 are most at risk of being in a collision or injury.[13] This turns the onus on York Region's system designers to ensure road systems are provided and designed in a uniform way for their varying vulnerable populations.

✳ The language used to describe and frame traffic collisions is important

Currently, there is not a consistent term that is used to describe traffic collisions amongst different sources ranging from the news media, academic literature, to various policy documents. The choice of vocabulary to depict and frame traffic collisions reflects the source's approach and understanding of road safety issues, as well as how solutions are conceived.

News media has a vital role in shaping the general public's perception and understanding of road safety. The news media frequently describes traffic collisions as "accidents," implying that

no one is at fault. This allows motorists and the larger system that creates these unsafe road environments to be free from any form of accountability. Media reporting often blames victims of traffic collisions by referring to their lack of personal protective equipment, such as high-visibility clothing or helmets, or inattentiveness through the usage of hand-held electronic devices during the time of collision, suggesting these factors would have prevented them from being involved in a collision. This reinforces the idea that traffic collisions are only preventable through personal responsibility and individual action alone, ignoring the larger systemic conditions that already place people at risk.

The academic literature, governments, and policymakers often use neutral terms such as "traffic collisions", "traffic crashes", and "traffic injuries and fatalities" to describe road-incidents. While this is an improvement from using language that frames road-incidents as unavoidable mistakes, neutral language can understate the severity of the issue at hand.

Vision Zero advocates for the use of language such as "road violence" and "traffic violence" to bring attention to how these road-incidents are violent and have become normalized and acceptable in everyday life. These terms are a departure from language that is neutral and broad, as "violence" implies that there is a perpetrator who must be held responsible for the unacceptable harm that has been caused. Some news media articles have started to use these terms as well, indicating a potential shift in how the reporting of traffic collisions is starting to change and affect public perceptions of this important issue. However, the academic literature uses "road violence" to describe motorist aggression and road rage.[133] Motorist aggression and road rage is common amongst motorists and is usually a result of external factors such as work or family pressures. Motorist aggression and road rage is usually towards other motorists and can result in an increase of driving speeds, more dangerous driving patterns, and at times increase the likelihood of collisions.[69] Thus, instead of reflecting the severe impact systems and vehicles have on vulnerable road users, "road violence" in the academic literature reflects the aggression and increase of risk for motorists. Using more active language can reframe this issue to highlight the reality of traffic collisions.

* Reimagining traditional approaches to road safety

Traditional approaches to road design have prioritized updates that centre around motorists. These new road design updates are implemented to increase the speed and efficiency of driving between locations as well as minimizing traffic congestion. With traditional approaches that prioritize the motorist, this results in the pervasiveness of dangerous road environments that are often designed with vulnerable road users as an afterthought.

Education and enforcement have been the two main tools used in traditional road safety approaches, where the blame of traffic collisions is assigned to human factors and the responsibility is placed principally on the individual road user.

Conventional road safety initiatives are centred around educational campaigns that focus on changing the individual behaviours of road users. While these programs may come from a place of good intention to protect road users from the realities of unsafe road environments, this singular approach can be harmful as it reinforces the idea that the only solution to road safety rests on changing individual behaviours. Instead, people in positions of power should be questioning the root of the issue as to why the onus is placed on vulnerable road users to increase their visibility to avoid being struck. These programs are only short-term, short-sighted solutions, to the long-term abiding problem of continuing to design unsafe road environments.

Enforcement measures such as ticketing pedestrians for crossing outside of marked crosswalks or fining cyclists for riding on sidewalks fails to address the larger issues of road safety such as poor pedestrian infrastructure, minimal traffic calming measures, and an absence of quality cycling infrastructure.[134,135]

Metrics such as the number of collisions, traffic volumes, and risk of exposure are used in conventional engineering decision-making processes to prioritize which areas and sites receive pedestrian and cyclist enhancements. In addition to these data points, using or developing additional indicators that consider socio-economic determinants of traffic collisions can begin to address the disproportionate traffic-related risks among vulnerable populations.

Engaging with vulnerable populations can provide insight into their lived experiences, and highlight themes and areas of concern that may not be captured in quantitative data. In principle, public engagement allows for communities to voice their opinions and concerns, and advocate for their needs; however, barriers to participation among vulnerable groups is often not considered in public engagement strategies as they are designed for a "general" public. This oversight results in the uneven distribution of resources and infrastructure as well as the use of unsuitable road safety "solutions" that are not reflective of communities' most urgent safety concerns.

Centering vulnerability in road safety initiatives means a complete re-evaluation of the current system approaches to first understand *how* the system has continued to fail the most vulnerable populations. Those who are in positions of power, including key decision-makers and system designers, city planners, policymakers, traffic engineers, public health officials, and police officers, carry the greatest responsibility to ensure that roads are safe for our communities.

Policies such as Vision Zero call for a paradigm shift in approaches to road safety by demanding a total rethinking of who is ultimately responsible for preventing traffic collisions, injuries, and fatalities: calling for greater action from system designers and those who hold decision-making power. While Vision Zero aims to redistribute responsibility into the hands of system designers this can lead to the further concentration of power and decision-making into those who are already in leadership roles. Beginning to consider and implement Vision Zero policies and other safe mobility strategies is a step towards re-distributing the burden of road safety and centring on vulnerability to make roads safer.

8.3 Conclusion

This chapter synthesized the research findings from previous sections by answering who are the most vulnerable populations that face disproportionate levels of traffic-related risks and why.

The vulnerable populations identified are as follows:

- Vulnerable road users, inclusive of pedestrians and cyclists
- Children and youth
- Older adults
- Visible minorities
- Immigrants and newcomers
- People experiencing homelessness

Lower-income individuals were determined to be a highly vulnerable population as they appeared frequently across the different chapters. Since walking and cycling are more cost-efficient modes of transportation, lower-income individuals are more likely to walk, cycle, or take public transit. This exposes them to traffic more frequently as well as to the systems that receive less public investment (pedestrian, cycling, public transit infrastructure).

Individuals who hold multiple at-risk identities are also extremely vulnerable due to the compounding exposure to multiple socio-economic and/or spatial determinants.

The language used to characterize traffic collisions is important because it establishes how the public perceives and understands road safety issues, which can influence the level of action that needs to be taken.

Conventional approaches to road safety have not done enough to make roads safer for vulnerable populations. There needs to be a total rethinking of who is ultimately responsible for preventing traffic collisions, injuries, and fatalities. More responsibility and actions to address road safety should come from the system designers who hold decision-making power.

9.0 Recommendations

9.0 Recommendations

9.1 Introduction

The following chapter will recommend the next steps for York Region to work towards achieving Vision Zero, along with a proposed implementation strategy and timeline for implementation. These recommendations are based on the findings from all previous chapters and an analysis of York Region's road safety and transportation documents. Using literature from York Region, the team performed a gap analysis of current road safety and transportation-related initiatives and will present recommendations based on the identified gaps. Recommendations for initiatives, tools, and programs are categorized using the START (implementing new ideas), CONTINUE (supporting current efforts), and STOP (cease doing in York Region) approach. The implementation strategy then sorts the recommendations into priority status (Low, Medium and High) and timeline for implementation using Short Term (0-6 months), Medium Term (6 months-2 years) and Long Term (2-6 years).

All recommendations are categorized under the Five E's of Road Safety framework: Engagement, Education, Engineering, Evaluation, and Enforcement. The Five E's framework is commonly used in Vision Zero strategies. One of the shortcomings of this framework is in its implication that all five E's are of equal importance. When road safety is viewed through an equity and intersectionality lens, it is apparent that Engagement, Evaluation, and Engineering should carry more weight, as they focus on how and from whom road safety priorities and collision data are gathered, as well as the inadequacies of the built environment in reducing exposures that vulnerable populations disproportionately face. By contrast, the E's of Enforcement and Education tend to place the onus for safety on victims of road violence, approaches that do little to address the reasons why people are vulnerable to road violence in the first place. Additionally, strategies that effectively address Engagement, Evaluation, and Engineering will translate to less reliance on Enforcement and Education in the long term.

Evaluation   **Engagement**   **Engineering**

Enforcement   **Education**
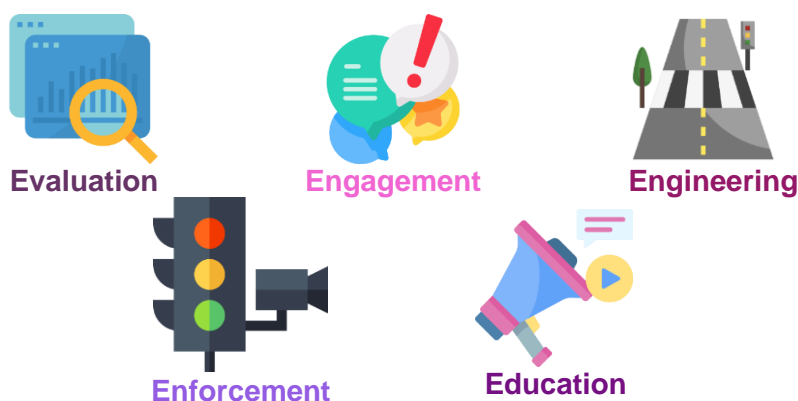
9.2 Recommendations

Evaluation

Evaluation refers to data collection, reporting, and analysis to ensure evidence-based road safety initiatives. The recommendations provided under evaluation were developed using an equity framework that demands a rigorous evaluation of collision data to centre vulnerability in road safety initiatives. The key findings from the academic literature review and news media review highlighted the influence that socio-economic status and spatial design have on pedestrians' and cyclists' risk for traffic injury and fatality. However, these variables were missing from the available York Region data, making it difficult to analyze the influence of these variables in the York Region context. Without quantifying the increased risk that vulnerable populations face, 'data-driven' solutions fail to recognize the need to tailor solutions to specific vulnerable populations. These recommendations call on York Region to address gaps in their data collection to ensure an equitable approach to Vision Zero implementation.

START

A.1 Collecting additional socio-economic and socio-demographic data to clearly identify those most at-risk.

- Collect data on the gender, racial identity, education, income, time since immigration, and presence of mobility impairments, if data is not already being collected.
- Establishing a partnership between the York Regional Police and the Health departments' hospital datasets may link further details on collisions and the individuals involved. This information provides further perspective on any notable correlation between socio-economic status and traffic collisions.

A.2 Collecting data on vehicle make, model, year, and after-market modifications to determine if there is a pattern in the types of vehicles involved in collisions in York Region.

A.3 Collecting temporal volume of cyclists and pedestrians.

- Vehicle volumes are currently recorded, however, including cyclist and pedestrian volumes would allow for an analysis of the rates of cyclist and pedestrian collisions relative to their respective volume.

A.4 Including severity of injury in collision reports.

- This will allow for more comprehensive collision data, as collisions are currently defined as either an injury or fatality.
- Locations with a higher frequency of severe injuries can be prioritized for further investigation and improvements.

A.5 Analyzing the spatial relationship between traffic related-inquiries and reports and high collision areas to investigate whether there is a discrepancy between collisions and inquires.

- This will allow for an analysis of the public's willingness to interact with authorities and provide insight into whether stronger engagement is needed in certain communities

A.6 Centralizing collision data and make it publicly available.

- This can promote the completion of research surrounding the collision data to further understand the nature and causes of crashes.
- For example, external bodies, such as non-profit organizations and road safety advocates, to lead data-driven initiatives that aim to improve road safety

Table 9.1. Proposed implementation strategy for evaluation recommendations.

Recommendations	Priority			Implementation Timeline		
	High	Medium	Low	Long-term	Medium-term	Short-term
A.1 Collect additional socio-economic and socio-demographic data	■				■	
A.2 Collect data on vehicle make, model, year, and after-market modifications		■			■	
A.3 Collect temporal volume of cyclists and pedestrians	■					■
A.4 Include severity of injury in collision reports	■					■
A.5 Analyze the spatial relationship between traffic-related inquiries/reports and high collision areas		■			■	
A.6 Centralize collision data and make it publicly available	■					■

Engagement

Engagement refers to the inclusion of road users in road safety decision-making, strategies and campaigns. Many Canadian municipalities that have implemented a Vision Zero strategy often either exclude engagement as one of the 5 E's entirely or consider it as an extension of education campaigns. Additionally, public engagement and consultation have been excluded from the traffic design and planning process as road design has been dictated by traffic manuals prescribed by Ontario Traffic Council. To this point, road design has been largely delegated to engineers and considered the work of experts. Despite the acknowledgement of the necessity of public engagement in urban planning projects, this sentiment has not applied to road design and safety, leading to singular solutions for diverse users.

The recommendations provided in this section attempt to apply the same public engagement practices used in other planning projects to road safety initiatives. To centre the needs of vulnerable populations in road safety, policies, strategies, and initiatives need to be guided by the voices of these populations. Therefore, the following recommendations focus on eliminating barriers to engagement and enhancing the effectiveness of current engagement strategies.

START

B.1 Partnering with non-profit organizations and community groups that understand and are more familiar with target communities.

- Organizations familiar with the target communities can improve recruitment for engagement events as they may have larger networks and are trusted by target communities.
- Local organizations should be fairly compensated for the assistance they provide to the Region.

B.2   Applying a Gender-Based Analysis Plus (GBA+) lens to design public engagement strategies and events on road safety initiatives and policy.

- Public engagement staff should complete the Government of Canada's free GBA+ course to understand how to effectively apply this lens.
- Using the GBA+ lens to design public engagement events will help staff consider barriers to participation and aspects of road safety they are unaware of based on their own positionality.
- Staff must ensure gender diversity in public engagement participants and consider if one gender identity is under or over-represented in engagement sessions.
- Ensure language, symbols, and images used in engagement material are appropriate and represent diverse gender identities.

B.3   Prioritizing the collection of lived experience data at public engagement events.

- For instance, engaging with vulnerable populations to gain insight surrounding the strengths and weaknesses of the Region's transportation network.
- Lived experience data can capture the burden traffic collisions place on those who are missed in collision reports, census and hospital data such as individuals experiencing homelessness

B.4   Using a participatory planning approach to create road safety policy and new road safety interventions that allow capacity building and ensure the changes are appropriate for the community.

- For example, the 'Stepping It Up' program by Metrolinx that engages with elementary school children to develop and implement road safety solutions around their schools.

B.5   Prioritizing engagement with those in lower-income areas where active transportation is more likely to be relied upon and populations are harder to reach.

- This could include offering honorariums for participation or free childcare during engagement sessions to remove barriers to participation

B.6   Ensuring diversity amongst staff working in public engagement and that all staff understand their own positionality prior to the engagement process.

B.7 Reducing barriers for newcomers to participate in public engagement.

- Utilize paid community ambassadors who are familiar with community members and are multi-lingual themselves

B.8 Using multi-lingual recruitment materials and ensuring translators are available at public engagement events.

B.9 Hiring external consultants who specialize in certain engagement techniques in road safety planning projects if there are no York Region employees who have the expertise.

- Hire engagement consultants that specialize in dignity-infused engagement.
- Hire external consultants that specialize in youth engagement (i.e., Urban Minds, Emerging Youth Consultancy) and engagement with older adults (i.e., Lura Consulting).

B.10 Holding public engagement sessions to determine the best approach for traffic reporting that adequately meets the needs of vulnerable populations.

CONTINUE

B.11 Engaging with pedestrians, transit users, and cyclists at places that they most frequently use (i.e., transit stops and stations, trails).

B.12 Using multiple interactive methods to collect feedback in public engagement to account for the different ways participants may feel comfortable contributing.

- For example, using anonymous electronic polls, roundtable discussions, collaborative mapping, drawing activities, written feedback, and gathering input from social media.

B.13 Using collaborative mapping tools where residents can add pins at any time to places where they have observed or experienced unsafe conditions.

B.14 Using annual educational and enforcement initiatives run by the Region and municipalities (i.e., 'Cross Smart', 'Cycle Smart', 'Seniors Safe Driving') as an opportunity to engage with residents and collect feedback on road safety initiatives

STOP

B.13 Generalizing public engagement events and instead use tailored, "dignity-infused" engagement.

B.14 Relying solely on virtual engagement sessions
- These sessions can be difficult to access for vulnerable populations

Table 9.2. Proposed implementation strategy for Engagement recommendations.

Recommendations	Priority			Implementation Timeline		
	High	Medium	Low	Long-term	Medium-term	Short-term
B.1 Partner with non-profit organizations and community groups to lead public engagement	■				■	
B.2 Apply a Gender-Based Analysis Plus (GBA+) lens to design public engagement strategies and events	■					■
B.3 Prioritize the collection of lived experience data at public engagement events		■		■		
B.4 Use a participatory planning approach to create road safety policy		■			■	
B.5 Prioritize engagement with those in low-income areas	■					■
B.6 Ensuring diversity amongst staff working in public engagement	■			■		
B.7 Reduce barriers for newcomers to participate in public engagement	■				■	
B.8 Use multi-lingual recruitment materials and ensuring translators are available at events	■				■	
B.9 Hire external consultants who specialize in certain engagement techniques	■				■	

Recommendations	Priority			Implementation Timeline		
	High	Medium	Low	Long-term	Medium-term	Short-term
B.10 Hold public engagement sessions to determine the best approach for traffic reporting		■			■	
B.11 Engage with pedestrians, transit users, and cyclists at places that they frequently use	■					
B.12 Use multiple interactive methods to collect feedback in public engagement		■				■
B.13 Use collaborative mapping tools where residents can add pins at unsafe conditions		■			■	
B.14 Use annual educational and enforcement initiatives as an opportunity to engage with residents			■			■
B.15 Stop generalizing public engagement events	■			■		

Engineering

Engineering strategies aim to improve upon the built environment, whether that is enhancing existing infrastructure or introducing new measures. Central to engineering strategies is ensuring a safe environment for cyclists, pedestrians, and other vulnerable populations. Throughout the academic literature and news media, we identified several built environment factors that contribute to collision risk for vulnerable road users. To ensure that York Region's roads and communities can meet the needs of the entire population, the following section will provide a variety of engineering recommendations. These recommendations are based on best practices uncovered throughout our research and are framed around the prioritization of pedestrian and cyclist safety over maximizing traffic speeds and volumes.
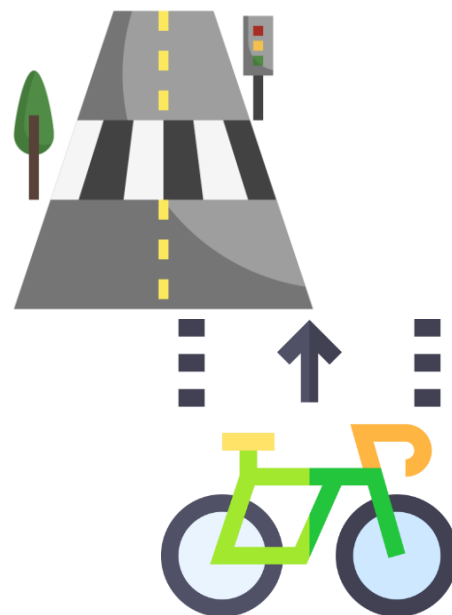
START

C.1	Increasing investment in pedestrian and cyclist infrastructure beyond the Municipal Streetscape Partnership Program (MSPP) and the Pedestrian/Cycling Municipal Partnership Program (PCMPP).
C.2	Enhancing street illumination on blocks surrounding high pedestrian activity locations.
C.3	Expanding the implementation of traffic calming devices.
	• Example: street trees, concrete planters, speed humps, and roundabouts.
C.4	Implementing traffic signal-based safety improvements concurrently with improvements to the built environment.
	• Pedestrian head starts, protected left turns, age-friendly signal timing should be installed at intersections receiving new sidewalks and upgrades public transit stops

CONTINUE

C.5 Maintaining communication and collaboration with municipalities regarding safety initiatives and plans.

- Due to the divisions of responsibility between municipalities and the Region regarding roadway and sidewalk maintenance, issues with consistency can, and will, arise. Developing and maintaining collaborative plans and channels of communication can help offset any inconsistencies.

C.6 Developing consistent wayfinding networks.

- *The York Region Pedestrian and Cycling Planning and Design Guidelines* provide clear and detailed instructions for designing accessible and safe streets. Enforcing and updating these guidelines is essential.

C.7 Reducing speed limits across regional and local roads.

- The Region has recently reduced speeds on several roads throughout the area. Speed limits should also be reduced in the problem areas identified in the collision data analysis.

C.8 Implementing York Region's most up-to-date guidelines.

- Following the *Designing Great Streets*' guidelines to ensure crossing distance is reduced, medians are implemented in wide intersections, longer crossing times, are prioritized, and pedestrian head starts are introduced.
- Following the OTM Book 18 for cycling facilities design

C.9 Implementing traffic signal-based intersection improvements and safety enhancements.

- Exclusive left turn signals, no-right turn on red signals, pedestrian and cyclist right-of way signage, and providing pedestrian head starts.

STOP

C.10 Adding bike lanes on arterial roads without separation from vehicles and/or lowering vehicle speeds.

C.11 Designing intersections without protected left turns and pedestrian head starts.

Table 9.3. Proposed implementation strategy for Engineering recommendations.

Recommendations	Priority			Implementation Timeline		
	High	Medium	Low	Long-term	Medium-term	Short-term
C.1 Increase investment in pedestrian and cyclist infrastructure.	■				■	
C.2 Enhance street illumination on blocks surrounding high pedestrian activity locations		■				
C.3 Expand the implementation of traffic calming devices	■			■		
C.4 Implement traffic signal-based safety improvements concurrently with improvements to the built environment		■			■	
C.5 Maintain communication and collaboration with municipalities regarding safety initiatives and plans			■			■
C.6 Develop consistent wayfinding networks			■		■	
C.7 Reduce speed limits across regional and local roads	■				■	
C.8 Implement York Region's 'Designing Great Streets' Guidelines	■			■		
C.9 Continue implementing traffic signal-based intersection improvements and safety enhancements	■				■	
C.10 Stop adding bike lanes on arterial roads without separation from vehicles	■					■
C.11 Stop designing intersections without protected left turns and pedestrian head starts	■					■

Enforcement

Vision Zero strategies define enforcement as the strong communication and partnership between municipalities and police services to reduce collisions through the improvement of compliance with traffic laws. Indeed, enforcement of traffic laws is an important mechanism for changing motorists' behaviour. However, policy makers should be wary, as the over-emphasis on enforcement in Vision Zero policies can incorrectly place blame on individual road users despite proponents' emphasis on a systems approach. Vision Zero's systems approach acknowledges that the responsibility for road violence lies with the actors (i.e., traffic engineers, city planners, elected officials) who create the conditions that enable collisions with pedestrians and cyclists in the first place. Thus, enforcement strategies have a role to play in the preliminary phases of Vision Zero, but they are not meaningful long-term solutions.
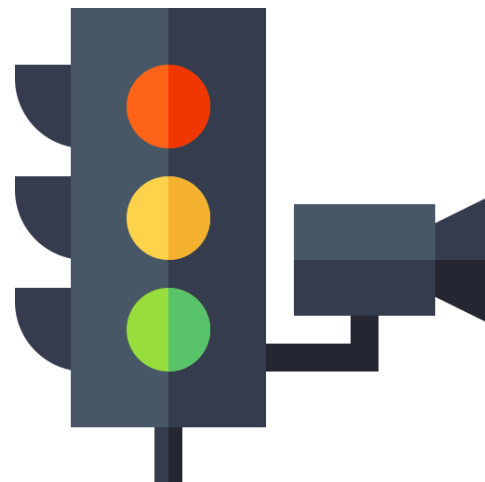
The following recommendations do not aim to encourage increased police presence or police budget allocations, given the problem of racial profiling in traffic enforcement.[112,134,136]The report did not uncover evidence of racial profiling in York Regional Police specifically, however, this has been identified issue in police forces across North America. Overall, these recommendations encourage a stop to punitive strategies that target pedestrians, cyclists, and vulnerable populations, and instead emphasize the importance of enforcement surrounding at-fault motorists.

START

D.1   Expanding the regional red light camera program by focusing on high frequency collision intersections, as identified in the York Region Traveller Safety Report (2020).

D.2   Increasing safety initiatives around school zones.
- For example, temporary road closures adjacent to schools, road-side cameras around schools, reduced speed limits, increased enforcement of parking infractions

D.3   Increasing enforcement on inattentive driving.

- Specifically targeting the use of electronics while driving.

- Using stationary road-side cameras that automatically issue tickets similar to a speed camera.

D.4   Targeting enforcement at intersections with new traffic regulations to ensure motorist compliance with changes.

- For example, increasing enforcement at intersections with recent no-right on red restrictions added.

CONTINUE

D.5   Programs that target high-traffic areas and high collision areas for inattentive motorists.

- For instance, 'Operation Stay Focused' initiative run by the York Regional Police.

STOP

D.6   Ticketing cyclists and pedestrians for disobeying traffic rules and instead use it as an opportunity to raise awareness about the risks of not following traffic rules.

- Ticketing pedestrians and cyclists enforces the idea that pedestrians and cyclists are equally at fault for collisions compared to motorists, which is inaccurate.

D.7   Programs that place police officers on public transit as this can create public distrust.

- The police program YRT/VIVA places police officers on transit buses to provide a different vantage point for catching inattentive motorists, however vulnerable groups who are more likely to face police brutality are often frequent public transit riders.

- Having police officers present, in uniform or in plainclothes, can cause stress, discomfort, and trauma for transit riders.

Table 9.4. Proposed implementation strategy for Enforcement recommendations.

Recommendations	Priority			Implementation Timeline		
	High	Medium	Low	Long-term	Medium-term	Short-term
D.1 Expand the regional red light camera program by focusing on high frequency collision intersections.	■				■	
D.2 Increase safety initiatives around school zones	■				■	
D.3 Increasing enforcement on distracted driving	■					■
D.4 Target enforcement at intersections with new traffic regulations			■		■	
D.5 Maintain communication and collaboration with municipalities regarding safety initiatives and plans			■			■
D.6 Stop ticketing cyclists and pedestrians for disobeying traffic rules	■					■
D.7 Re-evaluate programs that place police officers on public transit	■					■

Education

Education strategies aim to change the behaviour of road users and influence public perception through raising awareness of safety risks and traffic laws. Many Vision Zero and road safety strategies prioritize education campaigns for pedestrians and cyclists, perpetuating the notion that individual pedestrians and cyclists are responsible for avoiding collisions. Additionally, educational programs often focus on the promotion of active modes of transportation prior to providing environmental conditions that are conducive to safe cycling, effectively placing pedestrians and cyclists in precarious situations. Therefore, rather than placing the onus on pedestrians and cyclists, the following recommendations focus on redirecting the education burden onto motorists and system designers.

START

E.1 Reviewing and updating current programming to ensure that messaging surrounding road safety is up to date.

- Ensuring education programs focus on the behaviours of motorists, rather than placing the responsibility of traffic collision prevention on non-motorists.

E.2 Educating the public on the implementation of new safe street designs and providing guidance on how to use them through social media campaigns, and automatic responses to those using collaborative mapping tools mentioned in **C.14**.

E.3 Expanding existing population-specific strategies for road safety initiatives.

- Creating programs for newcomers to learn about road safety rules and traffic signs, specific to the local York Region context.
- Accounting for cultural differences and approaches to road safety.
- For instance, making sure program materials are available in multiple languages.
- Involving parents as a target group in school-based education initiatives.

E.4   A York Region Task Force dedicated to education-based initiatives aimed at reducing traffic injuries and fatalities.

- This could include a dedicated plan which establishes objectives and actions to reduce injuries with monitoring and evaluation indicators.

E.5   Re-evaluate education programs that target pedestrians including 'Be Visible Be Seen' and 'Cross Smart', that perpetuate the idea that vulnerable road users are responsible for avoiding collisions.

CONTINUE

E.6   Developing road safety initiatives using an inter-organizational approach, involving various departments and organizations.

E.7   Road safety education campaigns targeted at motorists.

- For example, the 'Pledge to Ignore Campaign' on inattentive driving, and 'Slow Down Campaign' to change motorist behaviour under York Region's Traffic Safety Program.
- Reframe programs to focus on vulnerable populations.

E.8   Seasonal road safety initiatives for motorists and motorcyclists.

- For example, the 'Winter Driving Safety Campaign' and 'Motorcycle Safety Awareness Campaign' led by the York Regional Police.

STOP

D.6   Disproportionately placing the educational burden on pedestrians and cyclists.

D.7   Using fear tactics in educational programming and outreach materials that place the blame on individual-level behaviours of active transportation users.

- The current York Region Pedestrian Campaign videos for teenagers imply that inattentive pedestrians are at-fault for traffic collisions.

Table 9.5. Proposed implementation strategy for Education recommendations.

Recommendation	Priority			Implementation Timeline		
	High	Medium	Low	Long-term	Medium-term	Short-term
E.1 Review and update current programming to ensure that messaging surrounding road safety is up to date.	■				■	
E.2 Educate the public on the implementation of new safe street designs.			■		■	
E.3 Expand existing population-specific strategies for road safety initiatives.		■			■	
E.4 Start A York Region Task Force dedicated to education-based initiatives aimed at reducing traffic injuries and fatalities.		■				■
E.5 Re-evaluate education programs that target pedestrians	■					■
E.6 Develop road safety initiatives using an inter-organizational approach.		■			■	
E.7 Continue road safety education campaigns targeted at motorists.		■				■
E.8 Continue seasonal road safety initiatives for motorists and motorcyclists.		■				■
E.9 Stop disproportionately placing the educational burden on pedestrians and cyclists.	■					■
E.10 Stop using fear tactics in educational programming and outreach materials.	■					■

10.0 Project Limitations & Considerations

10.0   Project Limitations

This report has several limitations. First, no policy analysis was conducted. However, an internal review of documents was conducted to understand existing road safety initiatives in York Region.

These documents include the following:

- York Region Transit-Oriented Design Guidelines (2006)
- York Region Official Plan (2010)
- York Region Built Environment and Health Action Plan Primer (2015)
- York Regional Police Traffic Management Strategy (2015)
- York Region Transportation Master Plan (2016)
- York Region Transportation Mobility Plan Guidelines (2016)
- York Regional Police Road Safety Strategy (2017)
- York Region Sustainable Mobility Wayfinding Guidelines (2018)
- York Region Designing Great Streets Guidelines (2019)
- York Region Traveller Safety Plan (2019, 2020, 2021)
- York Region Pedestrian and Cycling Planning and Design Guidelines (2020)
- York Region Access Guidelines (2020)
- York Region Road Design Guidelines (2020)

The review of these documents provided the foundation to our understanding of current road safety initiatives and were incorporated into how we developed our recommendations. However, producing a more comprehensive analysis of York Region's policies and initiatives in comparison to other provincial and municipal policies and initiatives would have been beneficial. External policy documents and guidelines such as the Ontario Traffic Manual were not reviewed for this report. In addition, only the current York Region Official Plan (2010) was reviewed.[137] As of December 2021, York Region is currently in the process of updating their Official Plan. A policy analysis of external relevant documents for York Region in relation to road safety would have been beneficial to understand the current policy context of the region.

Second, there were only a small number of case studies conducted, which limits the universality and concreteness of our findings. Our chosen case studies may not be representative or directly applicable to York Region due to differences in legislative, regulatory, and geographic contexts.

Lastly, the recommendations were established for a broader regional context and are not specific to municipalities. However, we recognize that York Region is a large geographic area that is composed of nine municipalities varying in different urban and rural contexts and populations.

11.0 Conclusion

11.0   Conclusion

The primary objective of this report was to provide recommendations for York Region to effectively improve road safety for vulnerable populations and provide a foundation for incorporating an equity lens for future road safety initiatives.

The report was guided by an intersectional framework which aimed to understand and analyze the complexity of human experiences through historical and social context. In addition to recognizing an individual's unique experiences, it is crucial to understand positionality and the interconnectivity of social categorisations. These principles were reflected in the research methodologies and the recommendations of our report.

Key findings emerged from our various research methods: academic literature review, news media review, key informant interviews, observational analysis, case study analysis, and collision data analysis. The findings revealed that there are several vulnerable populations who face a higher risk of injury in York Region. The research also uncovered additional vulnerable populations within a broader context, however, gaps in York Region's data collection limited the team's ability to assess the vulnerable populations including visible minorities, lower-income individuals, newcomers, and people experiencing homelessness in the York Region context. The gaps in data limited the teams to ability to determine where and how individuals holding multiple at-risk identities are potentially at a greater risk of being involved in a traffic collision. The recommendations aim to close this gap and allow for York Region to identify additional vulnerable populations.

The research findings also emphasized the importance of language when discussing road safety, as words frame how we understand and perceive topics. The news and media often describe collisions as "accidents", implying no one is at fault. This allows motorists and the larger system that creates unsafe road environments to be free from any form of accountability. Furthermore, data collection and government language can understate the severity of road violence, exemplified by the term 'injury' which offers no level of severity. Additionally, there is a shift towards using the term 'violence' when describing collisions. This reframes the conventional notion of collisions and implies that there is a perpetrator who must be held responsible for the unacceptable harm that has been caused.

Lastly, it was determined that current approaches to road safety need to be reimagined. Traditional approaches to road design have prioritized the vehicle and address measures such as vehicle speed and traffic congestion, resulting in the pervasiveness of dangerous road environments that increase the risk of traffic collisions, particularly among vulnerable road

users. The recommendations emphasized using different approaches that reframe road safety issues.

Moving Forward

Centering vulnerability in road safety is crucial in creating equitable safety and access to York Region's residents. This involves reimagining approaches to road safety and holding that any road fatality is unacceptable. Conventional approaches often focus on the behaviour of individuals; however, a shift is required to view road safety as a larger picture. Responsibility cannot be put solely on the users but must fall to the system designers as well. Applying the report's recommendations will allow York Region to design more equitable safety initiatives, providing a safer place for residents and visitors to travel.

Glossary

Glossary

Active Transportation: Using your own power to get from one place to another. This includes walking, biking, skateboarding, rollerblading, etc.

Arterial Road: Arterial roadways are regional roads that connect the nine York Region municipalities to one another.

Authentic Engagement: Engagement strategies that prioritize equity and inclusivity on the path to safe mobility. This type of community engagement requires a shift in power from institutional leaders to those who are affected by decisions.

Built Environment: The human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or green space to neighbourhoods and cities that can often include their supporting infrastructure, such as water supply or energy networks.

The Canadian Index of Multiple Deprivation (CIMD): An area-based index that is composed of four dimensions of deprivation and marginalization: residential instability; situational vulnerability; economic dependency; and ethno-cultural composition.

Deprived Community: A disadvantaged community that does not have the basic needs of life in comparison to other communities. For this report, indicators of a deprived community are: economic dependency, ethno-cultural composition, residential instability, and situational vulnerability.

Dissemination Area: A small, relatively stable geographic unit composed of one or more adjacent dissemination blocks with an average population of 400 to 700 persons based on data from the previous Census of Population Program.

Diversity: The presence of a wide range of human qualities and attributes within an individual, group or organization. Diversity includes such factors as age, sex, race, ethnicity, physical and intellectual ability, religion, sexual orientation, educational background, and expertise.

Economic Dependency: The second dimension of deprivation in the CIMD relates to reliance on the workforce, or a dependence on sources of income other than employment income.

Equity: Fairness, impartiality, even-handedness. A distinct process of recognizing differences within groups of individuals and using this understanding to achieve substantive equality in all aspects of a person's life.

Equity-Centered Planning: Planning policy and action that directly confront structural inequities and power imbalances by empowering individuals and groups who experience marginalization to improve their equality of life while also pushing for organizational/structural changes to

prevent the systemic disadvantaging of peoples.

Equity, Diversity, and Inclusion Planning: A planning practice that seeks to confront and address systematic racism and discrimination in the governance systems, practices, and policies that planners implement, create, and influence.

Equity Lens: A framework that includes a set of questions to be considered when making decisions regarding policies, programs, or initiatives. The lens acts as a guide to help understand how decisions and actions either break down or reinforce barriers that disproportionately affect vulnerable populations.

Ethnocultural Composition: The third dimension of Canadian Index of Multiple Deprivation that refers to the community make-up of immigrant populations, and at the national-level. For example, this takes into consideration factors such as the proportion of population who are recent immigrants, the proportion of the population who self-identified as a visible minority, the proportion of the population born outside of Canada, and the proportion of the population with no knowledge of either official language (linguistic isolation).

Exposure: Being in a situation which has some risk of involvement in a road traffic collision.

Gender-Based Analysis Plus (GBA+): An analytical process used to assess how different women, men, and gender diverse people may experience policies, programs, and initiatives.

Inclusion: Appreciating and using our unique differences – strengths, talents, weaknesses and frailties – in a way that shows respect for the individual and ultimately creates a dynamic multi-dimensional organization.

Individual-Level Determinants: A range of individual characteristics and behaviours that are determinants of one's exposure to traffic collisions and risk of traffic injuries and fatalities.

Intersectionality: Seeks to understand and analyze the complexity of human experiences and the interconnectivity of social categorizations.

Linguistic Minority: Groups of people who's maternal or chosen official language is not the majority language in their province or territory.

Lived Experience: Personal knowledge of the world gained through direct participation and involvement in an event or phenomenon.

Local traffic: Traffic that originates in a neighbourhood.

"**Looked-but-Failed-to-See" Errors**: Refers to when car drivers are looking in the direction where the other parties were but have not seen (i.e., perceived the presence of) the other road user.

Marginalized Persons: Groups and communities that experience discrimination and exclusion (social, political, and economic) because of unequal power relationships across economic, political, social, and cultural dimensions.

Non-Local traffic: Traffic that flows through or arrives in a different neighbourhood than where it originated.

Participatory Planning: Participatory planning is a form of public engagement that advocates for empowerment of marginalized groups and the creation of 'participatory structures able to work with conflict in productive ways. Participatory planning promotes bottom-up solutions by putting decision-making power into the hands of residents

Positionality: Positionality examines how differences in social position and power shape identities and access in society.

Recent Immigrants (also known as newcomers): Refers to landed immigrants who came to Canada up to five years prior to a given census year.

Residential Instability: One of the four dimensions of the Canadian Index of Multiple Deprivation. It refers to the tendency of neighbourhood inhabitants to change over time, while taking into consideration characteristics such as housing and family. Indicators contributing to this dimension include: the proportion of dwellings that are apartment buildings, the proportion of people living alone, the proportion of dwellings that are owned, and

the proportion of population who moved within the last five years.

Risk: A factor that raises the probability of adverse outcomes.

Road Safety: Measures such as improvement to road system, infrastructure, and vehicles used to prevent road users from being killed or seriously injured.

Road Violence: The epidemic of deaths and serious injuries that occur on roadways and in our transportation systems.

Safety Culture: The everyday attitudes, values, norms, and beliefs that leaders and staff share about risk and safety. The perceived social norms that newcomers have toward risky traffic behavior as pedestrians and cyclists, as well as habits and expectations of motorist behavior.

Safety in Numbers: The phenomenon by which the per-walker or per-bicyclist frequency of being struck by motorists declines as the amount of walking or bicycling on a street or in a region increases.

School-Aged Children: Children aged 5-19 years.

Situational Vulnerability: The fourth dimension represented in the Canadian Index of Multiple Deprivation, speaks to variations in socio-demographic conditions in the areas of housing and education, while considering other demographic characteristics.

Social Determinants: The conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life.

Socio-economic Determinants: Refer to a specific group of social and economic factors within the broader determinants of health. These relate to an individual's place in society, such as income, education, or employment. Experiences of discrimination, racism and historical trauma are important social determinants for certain groups such as Indigenous Peoples, LGBTQ+, and Black Canadians.

Spatial Determinants: A variable that may increase or detract from the suitability of a location for the presence of a particular land-use or land-cover category.

Traffic Calming: Commonly associated with physical features such as: speed humps, raised intersections, and roundabouts. They are installed on a road to reduce the speeds at which vehicles travel, to discourage through traffic, to improve road safety, and to improve comfort levels for all road users.

Traffic Collisions: (inclusive of injuries and fatalities) For this report, this is the involvement of a vehicle that collides with another vehicle, pedestrian, or cyclist and may result in injury, fatality, or property damage.

Transportation Inequality: The unequal distribution of travel between social groups, particularly related to transportation

resources such as car ownership, access to public transport, and/or all forms of transportation more generally.

Vision Zero: A strategy to eliminate all traffic fatalities and serious injuries, while increasing safe, healthy, equitable mobility for all.

Vulnerable Road User: Refers to pedestrians and cyclists who are easily injured and killed in a car-dominated road space.

Vulnerability: An internal risk factor of the subject or a system that is exposed to a hazard and corresponds to its intrinsic tendency to be affected, or susceptible to damage.

3-leg Intersection: Also called a T-intersection, which is used to terminate one road.

4-leg Intersection: Often called a crossroads or four-way intersection – this is where two roads meet, usually at a right angle.

References

References

[1]   York Region Public Health. "Built Environment and Health Action Plan". 2015, www.york.ca/wps/portal/yorkhome/yorkregion/yr/plansreportsandstrategies/healthybuiltenvironment.

[2]   Vamvaka-Tatsi, Ourania. "Intersectionality." Sociology of Race and Ethnicity 7.1 (2021): 142-43. Print.

[3]   Ontario Human Rights Commission. "An Introduction to the Intersectional Approach." 2021, www.ohrc.on.ca/en/intersectional-approach-discrimination-addressing-multiple-grounds-human-rights-claims/introduction-intersectional-approach.

[4]   The University of British Columbia (UBC). "Positionality and Intersectionality." 2021, www.indigenousinitiatives.ctlt.ubc.ca/classroom-climate/positionality-and-intersectionality/

[5]   Barr, Victoria. "What Is an Equity Lens? A Primer for Local Governments.": LevelUp Planning & Consulting., 2019. Print.

[6]   City of Ottawa. "Equity and Inclusion Lens Handbook Third Edition." City of Ottawa and City for All Women Initiative (CAWI), 2018. Print.

[7]   World Health Organization (WHO). "Health Equity." 2021, www.who.int/health-topics/health-equity.

[8]   Paul, Shitangsu. "Vulnerability Concepts and Its Application in Various Fields: A Review on Geographical Perspective." Journal of Life and Earth Science, vol 8, 2013, pp. 63-81.

[9]   Government of Canada. "Canadian Motor Vehicle Traffic Collision Statistics: 2019." 2019, www.tc.canada.ca/en/road-transportation/statistics-data/canadian-motor-vehicle-traffic-collision-statistics-2019.

[10]   Pirdavani, Ali, et al. "Socioeconomic and Sociodemographic Inequalities and Their Association with Road Traffic Injuries." Journal of Transport & Health, vol. 4, 2017, DOI:10.1016/j.jth.2016.12.001.

[11]   Brubacher, Jeffrey R., et al. "The Association between Regional Environmental Factors and Road Trauma Rates: A Geospatial Analysis of 10 Years of Road Traffic Crashes in British Columbia, Canada." PLoS One 11.4. 2016. Print.

[12]   The Regional Municipality of York. "York Region 2016 Census Release Report." York Region 2018. Print.

[13]   York Region. 2016 Census Release Report-Immigration and Ethnocultural Diversity: York Region, 2016. Print.

[14]   Regional Municipality of York. "2021 Traveller Safety Report." Ed. Corridor Control and Safety, Communications, Community Engagement and Marketing, Transportation Services 2021. Print.

[15]   York Regional Police. "2018 to 2023 York Regional Police Road Safety Strategy". 2017. Web, www.yrp.ca/en/about/road-safety-bureau.asp.

[16]   Parachute. "Making a Vision Zero␣Commitment in Canada 2020." Web, www.parachute.ca/wp-content/uploads/2020/02/Making-a-Vision-Zero-Commitment-in-Canada-UA.pdf.

[17]   Centre for Active Design. "Vision Zero: Learning from Sweden's Successes." Vision Zero: Learning from Sweden's Successes, 2021, www.centerforactivedesign.org/visionzero.

[18] World Health Organization (WHO). "Global Status Report on Road Safety 2018." 2018, www.who.int/publications/i/item/9789241565684.

[19]   World Health Organization and the United Nations Regional Commissions. "Global Plan: Decade of Action for Road Safety 2021-2030". www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030.

[20]   Canadian Council of Motor Transport Administrators (CCMTA). "Canada's Road Safety Strategy 2025". 2015, www.roadsafetystrategy.ca/en/strategy.

[21]   Ukkusuri, Satish & Miranda-Moreno, Luis & Ramadurai, Gitakrishnan & Isa-Tavarez, Jhael. "The Role of Built Environment on Pedestrian Crash Frequency." Safety Science - SAF SCI, vol. 50, 2012, DOI:10.1016/j.ssci.2011.09.012.

[22]   Miranda-Moreno, Morency, & El-Geineidy. "The Link Between Built Environment, Pedestrian Activity And Pedestrian–Vehicle Collision Occurrence at Signalized Intersections" Accident; Analysis and Prevention, vol. 43, no. 5, 2011, DOI:10.1016/j.aap.2011.02.005.

[23]   Ukkusuri, Satish, Hasan, S. and Aziz, A.H. " Random parameter model used to explain effects of built environment characteristics on pedestrian crash frequency." Transportation Research Record: Journal of Transportation Research Board, vol. 2237, pp. 98-106, 2011, DOI:10.3141/2237-11.

[24]   Pulugurtha, Srinivas S., et al. "Traffic Analysis Zone Level Crash Estimation Models Based on Land Use Characteristics." Accident Analysis & Prevention, vol. 50, 2013, pp. 678–87. ScienceDirect, DOI:10.1016/j.aap.2012.06.016.

[25]   Chen, Peng, & Qing Shen. "Identifying High-Risk Built Environments For Severe Bicycling Injuries." Journal Of Safety Research, vol. 68, 2019, pp. 1-7, DOI:10.1016/j.jsr.2018.11.002

[26]   Chakravarthy, Bharath, et al. "A Geographic Analysis of Collisions Involving Child Pedestrians in a Large Southern California County." Traffic Injury Prevention, vol. 13, no. 2, Mar. 2012, pp. 193–98. DOI:10.1080/15389588.2011.642034.

[27]   Lee, Jaeyoung, et al. "Demographic And Socioeconomic Factors Associated With Traffic Crash Involvement In Florida." 16th International Conference Road Safety on Four Continents. Beijing, China (RS4C 2013). 15-17 May 2013. Statens väg-och transportforskningsinstitut.

[28]   Marshall, Wesley E., and Nicholas N. Ferenchak. "Assessing Equity and Urban/Rural Road Safety Disparities in the US." Journal of Urbanism: International Research on Placemaking and Urban Sustainability, vol. 10, no. 4, Oct. 2017, pp. 422–41, DOI: 10.1080/17549175.2017.1310748.

[29]   Marshall, Wesley E., and Nicholas N. Ferenchak. "Why Cities with High Bicycling Rates Are Safer for All Road Users." Journal of Transport & Health, vol. 13, June 2019, p. 100539, DOI:10.1016/j.jth.2019.03.004.

[30]   Rothman, Linda, et al. "Recent Trends in Child and Youth Emergency Department Visits Because of Pedestrian Motor Vehicle Collisions by Socioeconomic Status in Ontario, Canada." Injury Prevention, vol. 25, no. 6, Dec. 2019, pp. 570–73, DOI:10.1136/injuryprev-2018-043090.

[31]   Mohan, Dinesh et al. "Urban Street Structure And Traffic Safety." Journal Of Safety Research, vol. 62, 2017, Pp 63-71. Doi:1016/J.Jsr.2017.06.003.

[32]   Stipancic, Joshua Et Al. "Pedestrian Safety At Signalized Intersections: Modelling Spatial Effects Of Exposure, Geometry And Signalization On A Large Urban Network." Accident; Analysis And Prevention, vol. 134, 2020, pp. 105265. DOI:10.1016/j.aap.2019.105265.

[33]   Stoker, Philip, et al. "Pedestrian Safety and the Built Environment: A Review of the Risk Factors." Journal of Planning Literature, vol. 30, no. 4, SAGE Publications Inc, Nov. 2015, pp. 377–92, DOI:10.1177/0885412215595438.

[34]   Dai, Dajun & Derek Jaworski. "Influence Of Built Environment On Pedestrian Crashes: A Network-Based GIS Analysis." Applied Geography, vol. 73, 2016, pp. 53-61. DOI:10.1016/j.apgeog.2016.06.005.

[35]   Aceves-González, Carlos et al. "The Role Of Perceived Pedestrian Safety On Designing Safer Built Environments." Traffic Injury Prevention, vol. 21, sup1 , 2020, pp. S84-S89. DOI:10.1080/15389588.2020.1812062.

[36]   Naderi, J. R. Landscape Design In The Clear Zone: The Effects Of Landscape Variables On Pedestrian Health And Driver Safety. 82nd Annual Transportation Research Board, 2013. Print.

[37]   Cushing, Matthew et al. "Vision Zero in the United States Versus Sweden: Infrastructure Improvement for Cycling Safety." American Journal Of Public Health, vol. 106 no.12, 2016, pp. 2178-2180. DOI:10.2105/AJPH.2016.303466.

[38]   Shanshal, Dalia, et al. "Prediction of Fatal and Major Injury of Drivers, Cyclists, and Pedestrians in Collisions." Promet - Traffic&Transportation, vol. 32, no. 1, Feb. 2020, pp. 39–53. DOI.10.7307/ptt.v32i1.3134.

[39]   Presser, Maxwell et al. "Roadway Features Associated With Elderly Drivers In Motor Vehicle Crashes." The Journal Of Trauma And Acute Care Surgery, vol. 90, no. 2, 2021, pp. 313-318. DOI:10.1097/TA.0000000000003034.

[40]   Kim, Dohyung. "The Transportation Safety of Elderly Pedestrians: Modeling Contributing Factors to Elderly Pedestrian Collisions." Accident Analysis & Prevention, vol. 131, Oct. 2019, pp. 268–744, DOI:10.1016/j.aap.2019.07.009.

[41]   Reynolds, Conor C O et al. "The Impact Of Transportation Infrastructure On Bicycling Injuries And Crashes: A Review Of The Literature." Environmental Health : A Global Access Science Source, vol. 8, no. 47, Oct. 2009, DOI:10.1186/1476-069X-8-47.

[42]   Fuentes, Cesar Mario, and Vladimir Hernandez. "Spatial Environmental Risk Factors For Pedestrian Injury Collisions In Ciudad Juárez, Mexico (2008-2009): Implications For Urban Planning." International Journal Of Injury Control And Safety Promotion vol. 20, 2013, pp. 169-78, DOI:10.1080/17457300.2012.724690.

[43]   Calderon-Rodriguez, Rubi. "The Relationship Between Low Socioeconomic Status and Mortality Rates of School Age Children Related to Motor Vehicle Accidents." Dominican University of California. 1 May 2020, DOI: 10.33015/dominican.edu/2020.NURS.ST.03.

[44]   Wheeler-Martin, Katherine C., et al. "Trends in School-Age Pedestrian and Pedalcyclist Crashes in the USA: 26 States, 2000–2014." Injury Prevention, vol. 26, no. 5, Oct. 2020, pp. 448–55, DOI:10.1136/injuryprev-2019-043239.

[45]   Rothman, Linda, et al. "Motor Vehicle-Pedestrian Collisions and Walking to School: The Role of the Built Environment." Pediatrics, vol. 133, no. 5, May 2014, pp. 776–84, DOI:10.1542/peds.2013-2317.

[46]   Yiannakoulias, Nikolaos, and Darren M. Scott. "The Effects of Local and Non-Local Traffic on Child Pedestrian Safety: A Spatial Displacement of Risk." Social Science & Medicine, vol. 80, Mar. 2013, pp. 96–104, DOI:10.1016/j.socscimed.2012.12.003.

[47]   Macpherson, A., et al. "Children's Exposure to Traffic and Pedestrian Injuries." American Journal of Public Health, vol. 88, no. 12, Dec. 1998, pp. 1840–43. DOI:10.2105/AJPH.88.12.1840.

[48]   Davison, Colleen M et al. "Bicycle Helmet Use And Bicycling-Related Injury Among Young Canadians: An Equity Analysis." International Journal For Equity In Health, vol. 12, no. 48, 2013, DOI:10.1186/1475-9276-12-48.

[49]   DiMaggio, Charles et al. "National Safe Routes To School Program And Risk Of School-Age Pedestrian And Bicyclist Injury." Annals Of Epidemiology, vol. 26, no. 6, 2016, pp. 412-7. DOI:10.1016/j.annepidem.2016.04.002.

[50]   Li, Qingfeng, et al. "Children and Road Traffic Injuries: Can't the World Do Better?" Archives of Disease in Childhood, vol. 101, no. 11, Nov. 2016, pp. 1063–70. DOI:10.1136/archdischild-2015-309586.

[51]   Embree, Tania E., et al. "Risk Factors for Bicycling Injuries in Children and Adolescents: A Systematic Review." Pediatrics, vol. 138, no. 5, Nov. 2016, pp. e20160282. DOI:10.1542/peds.2016-0282.

[52]   Harmon, Katherine J et al. "Selected Characteristics And Injury Patterns By Age Group Among Pedestrians Treated In North Carolina Emergency Departments." Traffic Injury Prevention, vol. 21, sup1, 2020, pp. S157-S161. DOI:10.1080/15389588.2020.1829912.

[53]   Brussoni, Mariana, et al. "Hospitalizations Due to Unintentional Transport Injuries among Aboriginal Population of British Columbia, Canada: Incidence, Changes over Time and Ecological Analysis of Risk Markers." PLOS ONE, edited by Jahan Fahimi, vol. 13, no. 1, Jan. 2018, pp. e0191384, DOI:10.1371/journal.pone.0191384.

[54]   O'Toole, Sarah E., and Nicola Christie. "Educating Parents to Support Children's Road Safety: A Review of the Literature." Transport Reviews, vol. 39, no. 3, May 2019, pp. 392–406. DOI:10.1080/01441647.2018.1499678.

[55]   Fang, C. W., et al. "Differences in Road-Crossing Decisions between Healthy Older Adults and Patients with Alzheimer's Disease." Journal Safety Reearch, vol. 66, 2018, 81-88. Print.

[56]   Vanlaar, Ward, et al. "Fatal and Serious Injuries Related to Vulnerable Road Users in Canada." Journal of Safety Research, vol. 58, Sept. 2016, pp. 67–77. ScienceDirect, DOI:10.1016/j.jsr.2016.07.001.

[57]   Noland, Robert B., and Maria Luz Laham. "Are Low Income and Minority Households More Likely to Die from Traffic-Related Crashes?" Accident Analysis & Prevention, vol. 120, Nov. 2018, pp. 233–38, DOI:10.1016/j.aap.2018.07.033.

[58]   Morency, Patrick, et al. "Neighborhood Social Inequalities in Road Traffic Injuries: The Influence of Traffic Volume and Road Design." American Journal of Public Health, vol. 102, no. 6, June 2012, pp. 1112–19, DOI:10.2105/AJPH.2011.300528.

[59]   Haghighi, Mohammad Reza Rahmanian, et al. "Social, Economic, and Legislative Factors and Global Road Traffic Fatalities." BMC Public Health, vol. 20, no. 1, Dec. 2020, pp. 1413, DOI:10.1186/s12889-020-09491-x.

[60]   Alphonsus, Khrisha B., et al. "Examining the Association between Area Level Deprivation and Vehicle Collisions That Result in Injury." Canadian Journal of Public Health, vol. 109, no. 1, Feb. 2018, pp. 43–51, DOI:10.17269/s41997-018-0036-7.

[61]   Saeednejad, Mina, et al. "Association of Social Determinants of Health and Road Traffic Deaths: A Systematic Review." Bulletin of Emergency and Trauma, vol. 8, no. 4, Oct. 2020, DOI:10.30476/beat.2020.86574.

[62]   Doulabi, Saba, et al. "Exploring the Determinants of Older Adults' Susceptibility to Pedestrians' Incidents." Accident Analysis & Prevention, vol. 155, June 2021, pp. 106100. DOI:10.1016/j.aap.2021.106100.

[63]   Chen, Cynthia, et al. "Exploring the Impacts of Safety Culture on Immigrants' Vulnerability in Non-Motorized Crashes: A Cross-Sectional Study." Journal of Urban Health, vol. 89, no. 1, Feb. 2012, pp. 138–52, DOI:10.1007/s11524-011-9629-7.

[64]   Kulharni, Jaspreet. "Public Health Issue Related To Road Traffic Crashes (Rcts)." International Journal Of Collaborative Research On Internal Medicine And Public Health, vol. 13.2, 2020): 1-6. Print.

[65]   Dezman, Zachary, et al. "Hotspots and Causes of Motor Vehicle Crashes in Baltimore, Maryland: A Geospatial Analysis of Five Years of Police Crash and Census Data." Injury vol. 47.11, 2016, pp. 2450-58. Print.

[66]   Lichenstein, Richard, et al. "Headphone Use and Pedestrian Injury and Death in the United States: 2004–2011." Injury Prevention, vol. 18.5, 2012, pp. 287-90. Print.

[67]   Ethan, D., et al. "An Analysis of Technology-Related Distracted Biking Behaviors and Helmet Use among Cyclists in New York City." Journal of Community Health, vol. 41.1, 2016, pp. 138-45. Print.

[68]   Stelling-Konczak, A., et al. "Mobile Phone Conversations, Listening to Music and Quiet (Electric) Cars: Are Traffic Sounds Important for Safe Cycling?" Accident Analysis & Prevention, vol. 106, 2017, pp. 10-22. Print.

[69]   Wickens, Christine M., et al. "Do Driver Anger and Aggression Contribute to the Odds of a Crash? A Population-Level Analysis." Transportation Research Part F: Traffic Psychology and Behaviour, vol. 42.2016, 2016, pp. 389-99. Print.

[70]   Dommes, Aurélie, and Viola Cavallo. "The Role of Perceptual, Cognitive, and Motor Abilities in Street-Crossing Decisions of Young and Older Pedestrians." Ophthalmic and Physiological Optic, vol. 31.3, 2011, pp. 292-301. Print.

[71]   Wilmut, K., and C. Purcell. "The Nature of the Risk Faced by Pedestrians with Neurodevelopmental Disorders: A Systematic Review." Accident Analysis & Prevention, vol. 149, 2021, pp. 105886. Print.

[72]   Kraemer, J. D., and C. S. Benton. "Disparities in Road Crash Mortality among Pedestrians Using Wheelchairs in the USA: Results of a Capture-Recapture Analysis." BMJ Open, vol. 5.11, 2015, pp. e008396. Print.

[73]   Herriges, Daniel. "Pedestrian Deaths Are up 45% in the Last Decade. When Is Enough Enough?" 2021, www.reddit.com/r/StrongTowns/comments/m3gjrk/pedestrian_deaths_are_up_45_in_the_last_decade/.

[74]   Crist, Carolyn. "Pedestrian-Friendly Road Design Law Tied to Fewer Traffic Deaths." 2018, www.reuters.com/article/us-health-pedestrians-safety/pedestrian-friendly-road-design-law-tied-to-fewer-traffic-deaths-idUSKCN1GR361.

[75]   Spurr, Ben. "Why Are So Many Pedestrians Killed in Scarborough? Advocates Point to Poor Street Design as City Appears to Reach New High for Road Deaths." 2018. Print.

[76]   Buck, Naomi. "Why did our Children Stop Walking to School?" The Globe and Mail. 2019, www.theglobeandmail.com/opinion/article-why-did-our-children-stop-walking-to-school/.

[77]   Shahum, Leah. "We Know How to Fix Deadly Streets." (2021). Web.

[78]   The Canadian Press. "Reducing Speed Limits Has a Big Impact on Accidents: Quebec Study." 2021. Print.

[79]   Huard, Maxime, and Martin Robert. "Higher Speed Limits Don't Mean Safer Roads, Researcher Says." CBC News. 2019.

[80]   Hartill, Mary Beth. "Bracebridge Neighbours Implore District of Muskoka to Put in Traffic-Calming Measures." Muskoka Region, 2021. Print.

[81]   Briggs, Stephen. "Call for Traffic Calming Measures on Peterborough City Centre Road after Bmw Crashes into Theatre Steps." Peterborough Telegraph, 2021. Print.

[82]   Riedner, Heidi. "Markham Cyclist's Death after Collision with Vehicle 'Accident Waiting to Happen'." Markham Economist & Sun, 2020. Print.

[83]   Elliott, Hannah. "Most Dangerous Times to Drive." Forbes, 2009, www.forbes.com/2009/01/21/car-accident-times-forbeslife-cx_he_0121driving.html?sh=555751706fc0.

[84]   City of Toronto. "City of Toronto Urges Drivers to Slow Down and Stay Alert Ahead of Time Change." City of Toronto News Release, 2021.

[85]   Queen, Lisa. "Fatal Collisions up Despite Overall Drop in Accidents on York Region Roads." Simcoe, 2015,   www.simcoe.com/news-story/5678581-fatal-collisions-up-despite-overall-drop-in-accidents-on-york-region-roads/.

[86]   National Safety Council. "The Most Dangerous Time to Drive." NSC, 2020. Print.

[87]   Asmelash, Leah. "Pedestrian and Cyclist Deaths Are Rising Even as Overall Traffic Fatalities Are on the Decline." CNN, 2019. Print.

[88]   Blair, Taylor &. "Main and Terminal: Vancouver's Most Dangerous Intersection." Taylor & Blaire Blog, 2018, www.taylorandblair.com/blog/2018/09/26/main-and-terminal-most-dangerous-intersection/.

[89]   Watson, Bridgette. "Here Are Metro Vancouver's Most Dangerous Pedestrian Intersections." CBC News,   2019,   www.cbc.ca/news/canada/british-columbia/here-are-metro-vancouver-s-most-dangerous-pedestrian-intersections-1.5385333.

[90]   Woods, Michael. "These Are the 10 Most Dangerous Intersections in Ottawa." CTV News Ottawa, www.ottawa.ctvnews.ca/these-are-the-10-most-dangerous-intersections-in-ottawa-1.5274720.

[91]   Draaisma, Muriel. "Toronto Speed Cameras Prompting Drivers to Slow Down, Research Shows." CBC News, 2021. Print.

[92]   Queen, Lisa. "York Region to Double Red-Light Cameras over 5 Years." Newmarket Era, 2016. Print.

[93]   "Red Light Cameras Lead to Drops in Collisions in Ontario Municipalities." CBC News Thunder Bay, 2021, www.cbc.ca/news/canada/thunder-bay/red-light-cameras-ontario-1.5944412.

[94]   Martin, Simon. "Red-Light Cameras Help Reduce T-Bone Collisions 72 Per Cent in York Region." Stoufville Sun-Truibune, 2018. Print.

[95]   Cook, Lindsey. "The Inequality of Who Gets Hit by Cars." US News, 2015, www.usnews.com/news/blogs/data-mine/2015/10/19/the-inequality-of-who-gets-hit-by-cars.

[96]   Mohn, Tanya. "Dying in a Traffic Crash: It's More Likely If You Are Black or Indigenous." Forbes, 2021. Print.

[97]   Simpson, Brett. "Why Cars Don't Deserve the Right of Way." The Atlantic, 2021. Print.

[98]   Schmitt, Angie, & Davis-Overstreet, Yolanda. "Op-Ed: People of Color Are Dying from Traffic Violence at a Much Higher Rate. Here's Why." Los Angeles Times, 2 Sept. 2021, www.latimes.com/opinion/story/2021-09-02/schmitt-davis-overstreet-pedestrian-deaths.

[99]   Murray, Brittany. "Black People Are More Likely to Die in Traffic Accidents. Covid Made It Worse." NBC News, 2021, www.nbcnews.com/news/nbcblk/black-people-are-more-likely-die-traffic-accidents-covid-made-n1271716.

[100]   Centre for Disease Control and Prevention (CDC). "Pedestrian Safety."   2017, www.cdc.gov/transportationsafety/pedestrian_safety/index.html.

[101]   Ballingall, Alex. "Toronto Streets More Dangerous for Seniors; People 65 and Older Account for About 60% of Pedestrian Traffic Deaths, Officer Says." Toronto Star, 2016, Print.

[102]   Pelley, Lauren. "80% of Pedestrian Deaths So Far in 2019 Are Older Adults, Seniors." CBC News, 2019. Print.

[103]   Bolotnikova, Marina. "America's Car Crash Epidemic." Vox, 2021, www.vox.com/22675358/us-car-deaths-year-traffic-covid-pandemic.

[104]   Siekierska, Alicja. "Canada among Only Seven Countries to See Rise in Pedestrian Deaths, Oecd Study Reveals." Financial Post, 2018, www.financialpost.com/transportation/canada-among-only-seven-countries-to-see-rise-in-pedestrian-deaths-oecd-study-finds.

[105]   York Region Staff. "Pedestrian Safety Task Force Launched in Vaughn" 2010, www.yorkregion.com/news-story/1460875-pedestrian-safety-task-force-to-launch-in-vaughan.

[106]   Snyder, Tanya. "Study: People in Low-Income Areas More Likely to Be Killed While Walking." Streets Blog USA. 2014, www.usa.streetsblog.org/2014/08/05/study-people-in-low-income-areas-more-likely-to-be-killed-while-walking/.

[107]   Creatura, D., et al. "Ontario Children Getting Hit by Cars Less Frequently, yet Children in Low-Income Areas Are Still at Higher Risk, Study Finds." IC/ES, 2019, www.ices.on.ca/Newsroom/News-Releases/2019/Ontario-children-getting-hit-by-cars-less-frequently-yet-children-in-low-income-areas-are-still.

[108]   Sun, Yang. "Pedestrians in Low-Income Areas Face Higher Risk of Getting Killed or Injured in Collisions." CBC News, 2019, www.cbc.ca/news/canada/toronto/pedestrians-collisions-1.5158415.

[109]   Rowe, Daniel. "Stay Off Your Phone: Quebec Police Hand out over 1,900 Tickets for Distracted Driving in Operation." CTV News 2021. Print.

[110]   Fox 2 Detroit. "Is October the Most Dangerous Month for Pedestrians? What Drivers and Walkers Need to Know." Fox 2 Detroit, 2021. Print.

[111]   Picheta, Rob. "Texting More Dangerous for Pedestrians Than Listening to Music or Speaking on the Phone." CNN, 2020. Print.

[112]   Canadian Broadcasting Corporation (CBC). "Ontario MPP Proposes Law to Fine Distracted Pedestrians." Canadian Broadcasting Corporation (CBC). 2017. Print.

[113]   The Canadian Press. "Milton Pedestrian Killed in Collision Was Wearing Dark Clothing." Reporter:The Canadian Press, 2011. Print.

[114]   Grimaldi, Jeremy. "Pedestrians Often at Fault in Collisions." Era-Banner, 2013. Print.

[115]   Queen, Lisa. "Report Finds Car Crashes Involving Pedestrians and Cyclists Are Increasing in York Region." The Toronto Star, 2019. Print.

[116]   Canada NewsWire. "Inattentive Driving Deadliest Behaviour on Opp-Patrolled Roads for Fifth Consecutive Year." 2018. Print.

[117]   The Hamilton Spectator. "Inattentive Driving the Leading Factor in Fatal Hamilton Crashes." The Hamilton Spectator 2017. Print.

[118]   Government Offices of Sweden. "Renewed Commitment to Vision Zero – Intensified efforts for transport safety in Sweden", 2016, www.government.se/4a800b/contentassets/b38a99b2571e4116b81d6a5eb2aea71e/trafiksakerhet_160927_webny.pdf.

[119]   New York City Mayor's Office of Operations. "Vision Zero Action Plan". 2014, www1.nyc.gov/content/visionzero/.

[120] City of Edmonton. "Safe Mobility Strategy 2021-2025". 2020, www.edmonton.ca/transportation/PDF/SafeMobilityStrategy_Changing-Conversation-Traffic-Safety_Nov2020.pdf.

[121] Region of Peel. "Vision Zero Road Safety Strategic Plan 2018-2022". 2017, www.peelregion.ca/pw/transportation/residents/vision-zero.

[122] New York City Mayor's Office of Operations. "Vision Zero Year 6 Report". 2020, www1.nyc.gov/assets/visionzero/downloads/pdf/vision-zero-year-6-report.pdf

[123] City of New York. "Initiatives: Vision Zero Scorecard." 2021, www1.nyc.gov/content/visionzero/pages/vision-zero-scorecard.

[124] Government of Canada. "Gender-based Analysis Plus". 2021, www.women-gender-equality.canada.ca/en/gender-based-analysis-plus.html.

[125] Region of Peel. "Vision Zero Road Safety Strategic Plan Update - Year Two". 2020, www.peelregion.ca/pw/transportation/_media/2019-vision-zero-road-safety-strategic-plan-update-year-two.pdf.

[126] Statistics Canda. "The Canadian Index of Multiple Deprivation." Ed. 45-20-0001., Statistics Canada Catalogue, 2019. Print.

[127] Gatersleben, Birgitta, & David Uzzell. "Appraisals of the Daily Commute - Comparing Perceptions of Drivers, Cyclists, Walkers, and Users of Public Transportation." Sagepub, Environment and Behavior vol. 39.3, 2007, pp. 416-29. Print.

[128] Regional Municipality of York. "2020 Traveller Safety Report." Ed. Corridor Control and Safety, Communications, Community Engagement and Marketing, Transportation Services. 2021. Print.

[129] Regional Municipality of York. "Pedestrian and Cyclist Safety Improvements." Ed. Services, Transportation. 2019. Print.

[130] U.S. Department of Transportation. "How Walkable is your Community". www.nhtsa.gov/document/walkability-checklist.

[131] Council on Aging of Ottawa. "All Season Age Friendly Pedestrian Safety and Walkability Checklist." 2015, www.coahamilton.s3.amazonaws.com/uploads/2017/01/Pedesterian-Safety-and-Walkability-Checklist.

[132] "York Region's 2018 Homeless Count: Working Together to Prevent, Reduce, and End Homelessness: York Region". 2019. Print.

[133] Rakotonirainy, Andry, Frank Feller, & Narelle Haworth. "Using in-Vehicle Avatars to Prevent Road Violence." Springer-Verlag.Adjunct Proceedings of Pervasive 2008: the Sixth International Conference on Pervasive Computing. 2008. Print.

[134]   Bowen, Andrew. "Despite Racial Disparities in Tickets, Jaywalking Will Remain a Crime in California." KPBS Public Media, 2021. Print.

[135]   City News. "Cyclists Continue to Use Sidewalks despite Danger to Pedestrians, Risk of Fines." CityNews Toronto, 6 Nov. 2017, www.toronto.citynews.ca/2017/11/06/cyclists-continue-to-use-sidewalks-despite-danger-to-pedestrians-risk-of-fines/.

[136]   Novak, Kenneth J., & Mitchell B. Chamlin. "Racial Threat, Suspicion, and Police Behavior". Crime & Delinquency, vol. 58.2, 2012, pp. 275–300. DOI:10.1177/0011128708322943.

[137]   Regional Municipality of York. "York Region Official Plan.". 2019. Print.

Appendices

Appendix A: News Media Search Terms

To ensure relevant articles were included, a wide variety of keywords were utilized. The search strategy used a combination of the following terms:

- Locations in North America
- Traffic fatalities
- Road injuries
- Road traffic morbidity
- Road traffic collisions
- Road safety
- Transport injuries
- Transport collisions
- Injuries
- Vulnerable populations
- Social determinants
- Economic determinants
- Socio-economic determinants
- Spatial determinants
  - Urban design
  - Road design
- Land use
- Marginalized groups
- Equity
- Equity lens
- Vision Zero
- Marginalized
- Low-income / low income
- Disabilities
- Person(s) with disabilities
- Person(s) with a disability
- Senior
- Older adult
- Children
- Child
- Cyclist
- Pedestrian
- Road user(s)
- Infrastructure
  - Sidewalk
  - Curb
  - Intersection
  - Crosswalk/Crossing
  - Stop sign / stop light
  - Pedestrian infrastructure
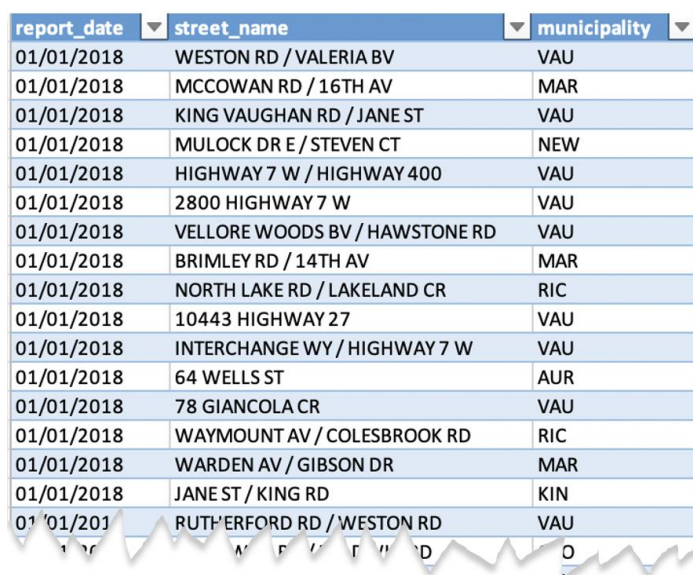 - Cycling infrastructure

Appendix B: Spatial Analysis Methodology

The spatial analysis utilized Motor Vehicle Collision (MVC) data from 2018-2020 provided by the York Regional Police. From this data, locational information for each reported collision in York Region was obtained. This was used for the "where" analysis within the York Region Data Analysis chapter. The Canadian Index of Multiple Deprivation (CIMD) was used, from which socio-economic data was obtained. Comparing these two datasets allowed for an investigation into the relationship between collision frequency and socio-economic status. Additionally, the Canadian Census Analyser (CHASS) was used to retrieve 2016 census data to further review socio-economic and demographic determinants and their relationship with traffic collisions. The determinants analyzed were: youth (age 0-19), older adults (age 65+), immigrant status (both total immigrants and recent immigrants from years 2011-2016), as well as visible minority status.

Datasets

York Regional Police Motor Vehicle Collision Data

This dataset provided the location (street intersection) of all motor vehicle collisions reported to the York Regional Police from 2018-2020. This dataset allowed for the analysis of past traffic collisions trends to pinpoint the high frequency traffic collision locations.

report_date	street_name	municipality
01/01/2018	WESTON RD / VALERIA BV	VAU
01/01/2018	MCCOWAN RD / 16TH AV	MAR
01/01/2018	KING VAUGHAN RD / JANE ST	VAU
01/01/2018	MULOCK DR E / STEVEN CT	NEW
01/01/2018	HIGHWAY 7 W / HIGHWAY 400	VAU
01/01/2018	2800 HIGHWAY 7 W	VAU
01/01/2018	VELLORE WOODS BV / HAWSTONE RD	VAU
01/01/2018	BRIMLEY RD / 14TH AV	MAR
01/01/2018	NORTH LAKE RD / LAKELAND CR	RIC
01/01/2018	10443 HIGHWAY 27	VAU
01/01/2018	INTERCHANGE WY / HIGHWAY 7 W	VAU
01/01/2018	64 WELLS ST	AUR
01/01/2018	78 GIANCOLA CR	VAU
01/01/2018	WAYMOUNT AV / COLESBROOK RD	RIC
01/01/2018	WARDEN AV / GIBSON DR	MAR
01/01/2018	JANE ST / KING RD	KIN
01/01/2018	RUTHERFORD RD / WESTON RD	VAU

Figure A.0.1. The collision data provided by York Regional Police.

Canadian Index of Multiple Deprivation (CIMD)

CIMD is an area-based measure –by Dissemination Area –of socio-economic conditions, that is commonly used to evaluate community inequalities. It is composed of four deprivation dimensions, all of which a score of 1 (least deprived) to 5 (most deprived) is assigned to a dissemination area. The four dimensions are:

1. **Economic dependency**

   "Relates to reliance on the workforce, or a dependence on sources of income other than employment income. For example, the indicators included in this dimension, at the national-level, measure concepts such as the proportion of the population aged 65 and older, the dependency ratio (the population aged 0-14 and population aged 65 and older divided by the population aged 15-64), and the proportion of the population not participating in the labour force".

2. **Ethno-cultural composition**

   "This dimension refers to the community make-up of immigrant populations, and at the national-level, for example, takes into consideration factors such as the proportion of population who are recent immigrants, the proportion of the population who self-identified as visible minority, the proportion of the population born outside of Canada, and the proportion of the population with no knowledge of either official language (linguistic isolation)".

3. **Residential instability**

   "Speaks to the tendency of neighbourhood inhabitants to fluctuate over time, taking into consideration both housing and familial characteristics. For example, the indicators in this dimension at the national-level measure concepts such as the proportion of the population who have moved in the past five years, the proportion of persons living alone, and the proportion of occupied units that are rented rather than owned".

4. **Situational vulnerability**

   "Speaks to variations in socio-demographic conditions in the areas of housing and education, while taking into account other demographic characteristics. For example, the indicators in this dimension at the national-level measure concepts such as the proportion of the population aged 25 to 64 without a high-school diploma, the proportion

of the population identifying as Aboriginal, and the proportion of dwellings needing major repairs".

Methodology

The preparation of data was completed using Microsoft Excel and Google Sheets. The spatial analysis was completed using ArcGIS.

Preparing Data for Analysis

The MVC data was sorted using Microsoft Excel in order to remove any collisions recorded outside of York Region (i.e., Peel Region, Toronto). The locational information was then altered to include symbology (& instead of /) and abbreviations (St for Street) that GIS recognizes. The abbreviated municipalities were also changed to provide the expanded name of the municipality, the province, and the country (e.g., MAR = Markham, Ontario, Canada). The data was then uploaded into Google Sheets to be geocoded in order to provide the geographical coordinates of all the collisions to be used for the spatial analysis in GIS.

Using ArcGIS Pro, the geographic information was analyzed in relation to the CIMD data. Since all the dimensions of the CIMD data displayed a similar spatial trend, a new column was created that calculated the average (or summary score) of CIMD quintiles for each Dissemination Area.

GIS Analysis

Hot Spot Maps

Hot spot maps were created by using the "Point Density" tool in ArcGIS for the collision data. This tool calculates the magnitude-per unit area of point features around each raster cell. This was used to identify areas of significantly high clustering of traffic collisions.

Relationship Between Motor Vehicle Collisions and Deprivation

The collision data and the CIMD were compared to identify any significant relationship. First, the MVC data and the CIMD data were spatially joined to match all rows of collisions data to their geographic locations in the CIMD data. Next, the "Local Bivariate Relationship" tool was used on this joined data layer. This created a new column in the attribute table that counts the number of collisions in each Dissemination Area. This tool allows you to quantify the relationship between two variables on the map and determine if one of the variables is dependent or influenced by another variable. In this case, the dependent variable is the count of collisions in each Dissemination Area and the independent variable is the CIMD deprivation

dimension. This tool was used for each of the deprivation dimensions (economic dependency, ethno-cultural composition, residential instability, and situational vulnerability) as well as for the averaged CIMD calculation based on all 4 dimensions. Overall, no significant relationship was identified for any of the dimensions.

Relationship Between Pedestrian and Cyclist Collisions and Deprivation

Based on other methods of research, specifically in the literature review, it was determined that pedestrian and cyclist collisions are more likely to involve vulnerable/deprived populations. The MVC data did not differentiate between cyclist, pedestrian, or motor vehicle collisions, hence it was decided another method would be used to further investigate this relationship. The most frequent cyclist and pedestrian locations were plotted and then compared to the averaged CIMD data. In total, 22 locations (10 highest pedestrian collision locations and 12 highest cyclist collision locations) were plotted against the CIMD data. It was found that all these collision locations were located within or on the edge of dissemination areas with a deprivation score of at least 3 and up to 5. This led to the conclusion that there could potentially be a relationship between pedestrian and cyclist collisions and more deprived communities.

Socio-economic and Demographic Analysis of Pedestrian and Cyclist Collisions

For this section of the analysis, census data was compared to the highest pedestrian and cyclist collision location data. The census socio-economic and demographic variables (youth, older adults, immigrant status, and visible minority status) were downloaded as a dBase database file (.dbf) that was then uploaded into GIS. This file included codes for the dissemination areas which is comparable to the previously used CIMD data used in this analysis. This file was then joined to the collision and CIMD data based on the dissemination areas in order to spatially define the census data. Next, population rates for each dissemination area were calculated for each of the variables (e.g., age 0-19 / total population). Each of these newly calculated fields were then plotted visually and compared to the top 22 pedestrian and cyclist collision locations in order to determine if there were any relationships between collision location and demographic and socio-economic variables.

Appendix C: Maps

C.1. Traffic Collision Hot Spot Map, 2018.
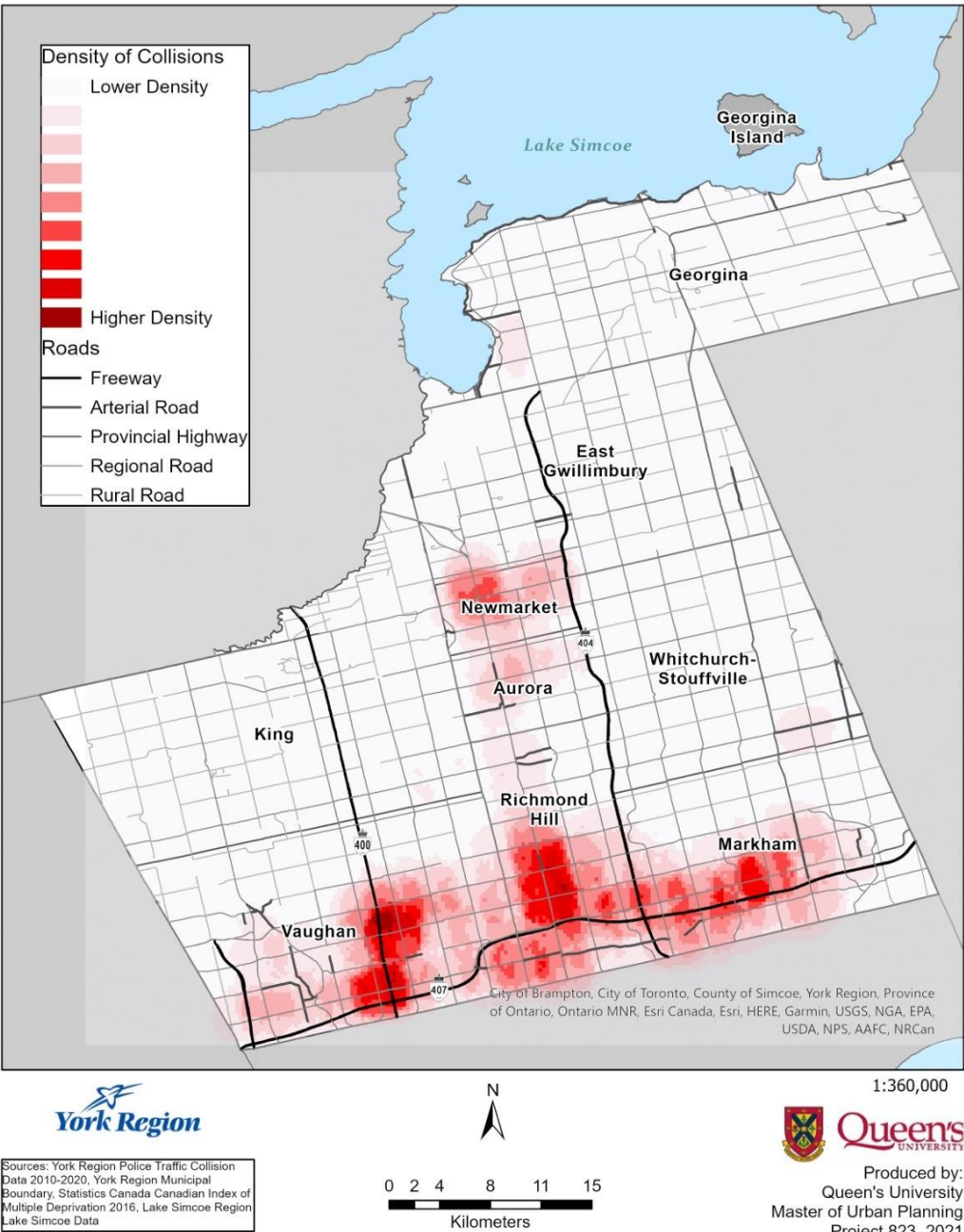
C.2 Traffic Collision Hot Spot Map, 2019

2019 Traffic Collision Hot Spot Locations
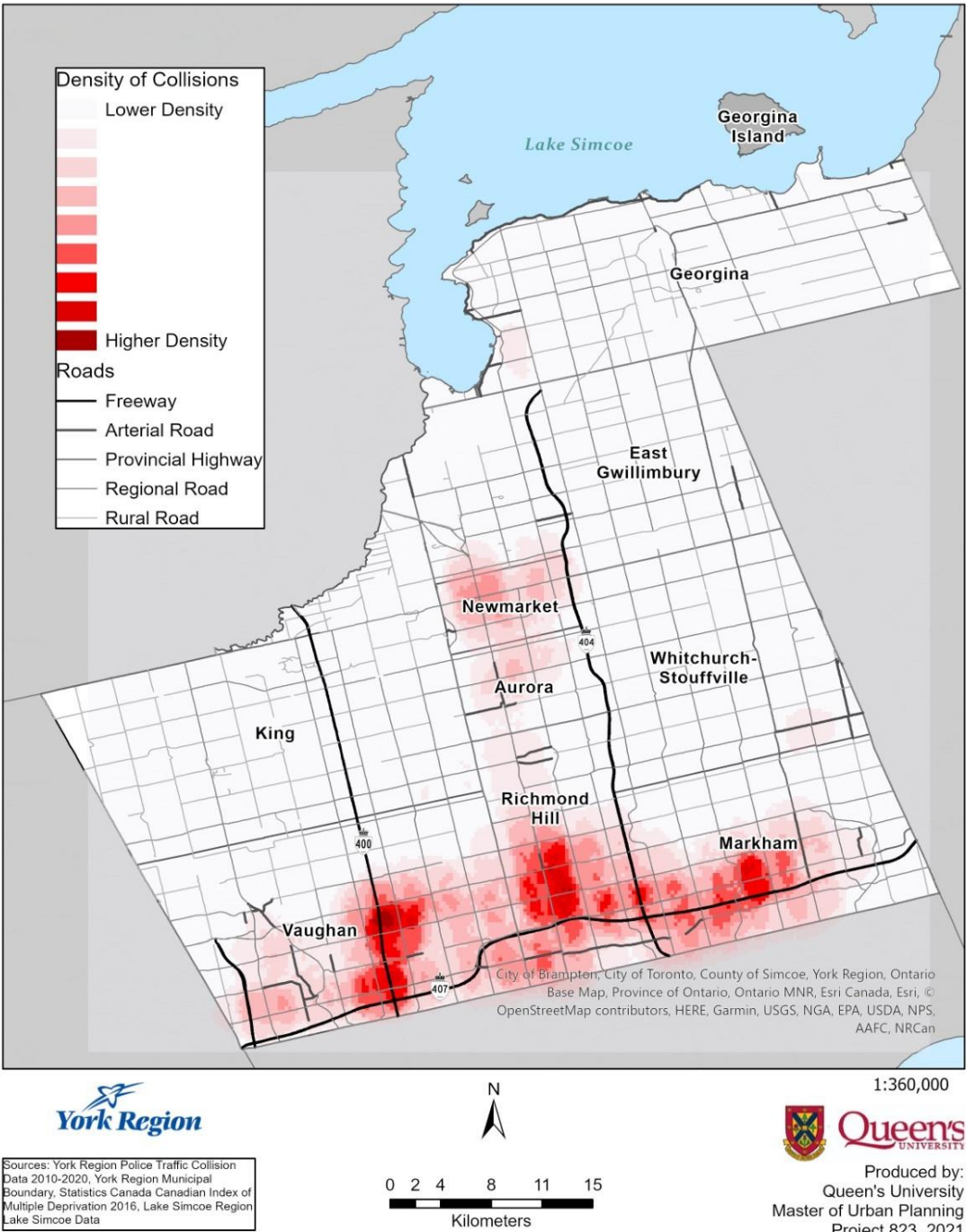
C.3 Traffic Collision Hot Spot Map, 2020

2020 Traffic Collision Hot Spot Locations
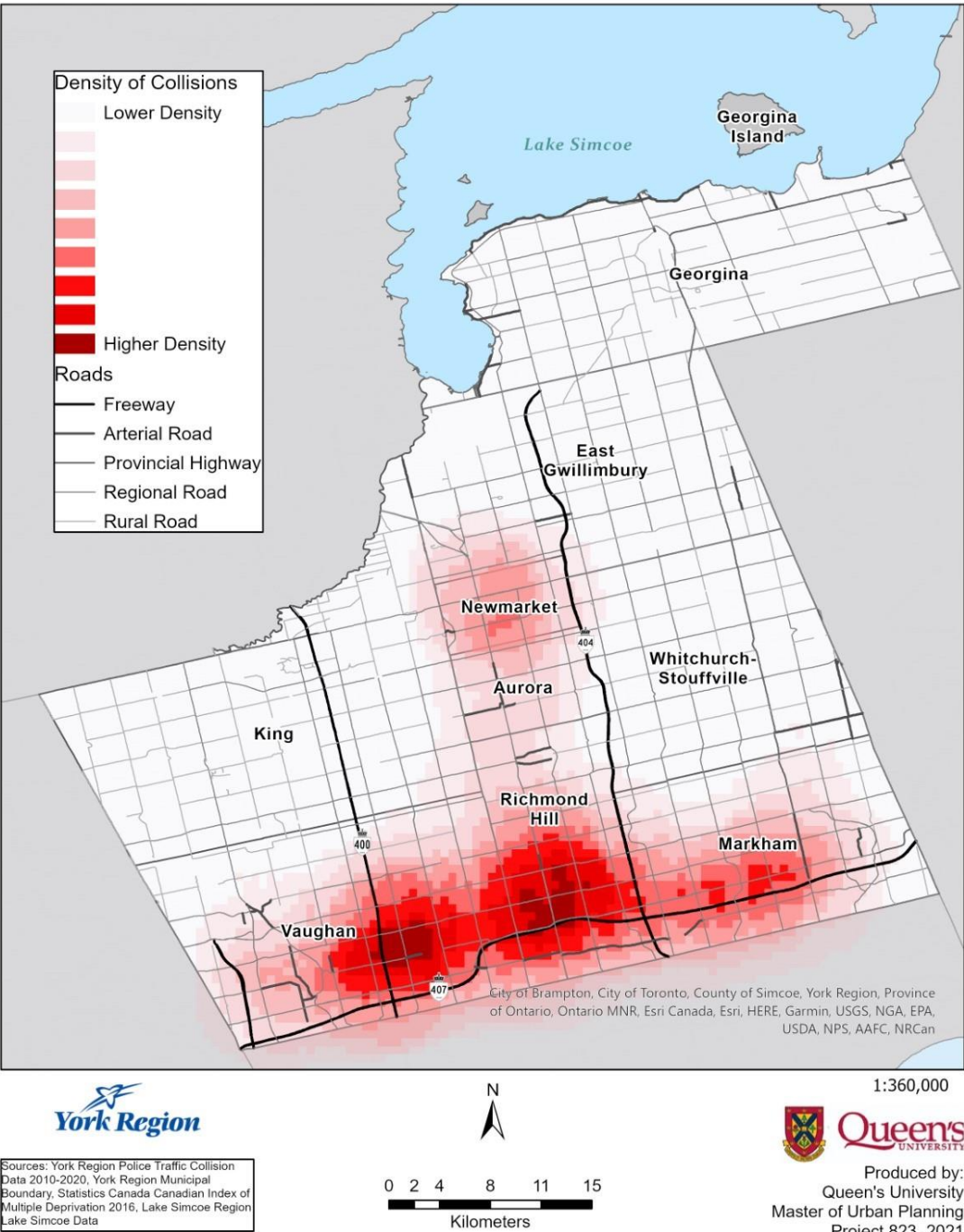
C.4 2016 CIMD – Economic Dependency Quintiles, York Region

Economic Dependency - Canadian Index of Multiple Deprivation

Economic Dependency Quintiles
1 (Least Deprived)

5 (Most Deprived)
No Data

Lake Simcoe

Georgina Island

Georgina

East Gwillimbury

Newmarket

Whitchurch-Stouffville

Aurora

King

Richmond Hill

Markham

Vaughan

City of Brampton, City of Toronto, County of Simcoe, York Region, Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

1:360,000

York Region

Sources: York Region Police Traffic Collision Data 2010-2020, York Region Municipal Boundary, Statistics Canada Canadian Index of Multiple Deprivation 2016, Lake Simcoe Region Lake Simcoe Data

N

0 2 4   8   11   15
Kilometers

Queen's UNIVERSITY

Produced by:
Queen's University
Master of Urban Planning
Project 823, 2021

C.5. 2016 CIMD – Ethnocultural Dependency Quintiles, York Region

Ethnocultural Composition - Canadian Index of Multiple Deprivation
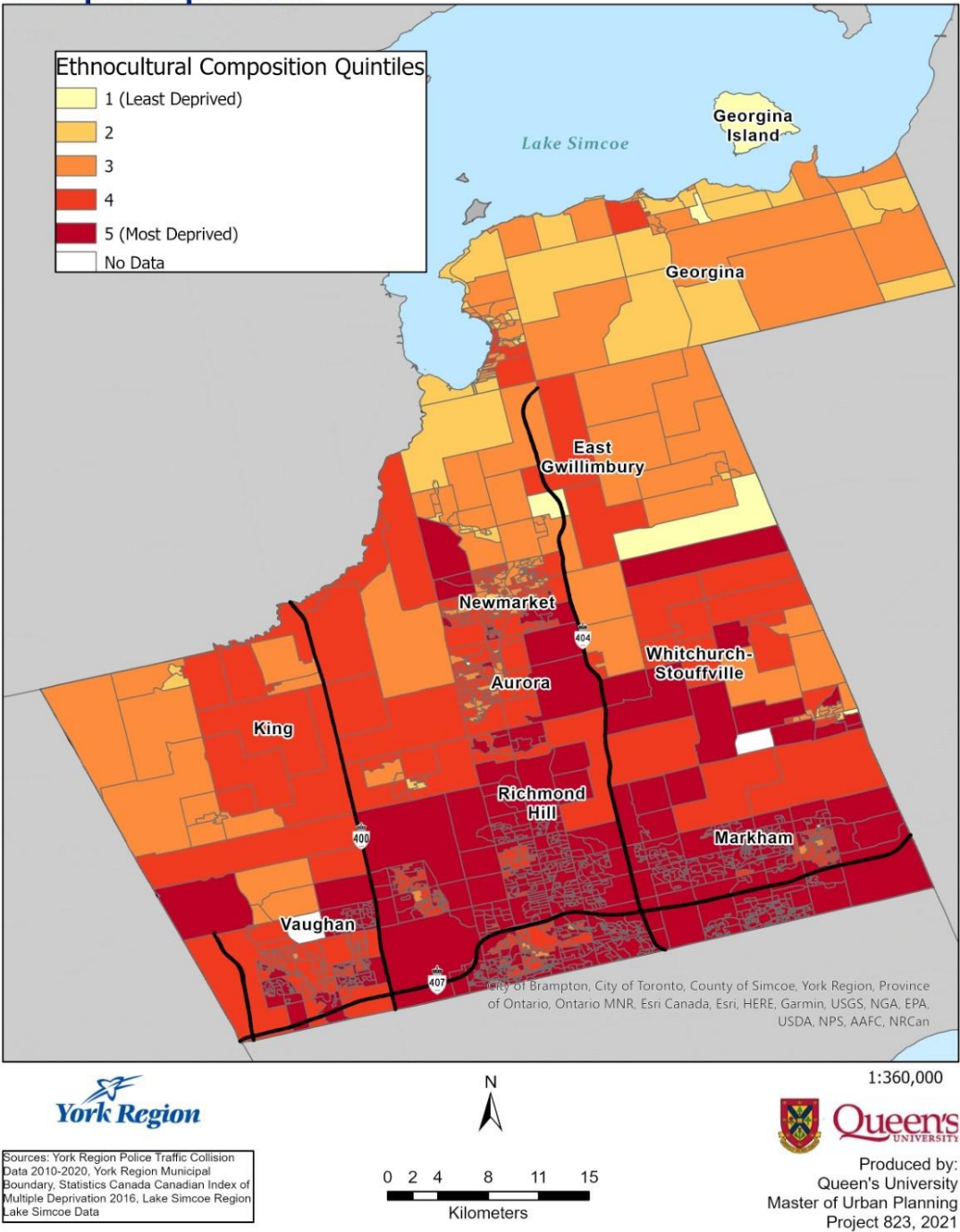
C.6. 2016 CIMD – Residential Instability Quintiles, York Region

Residential Instability - Canadian Index of Multiple Deprivation, 2016
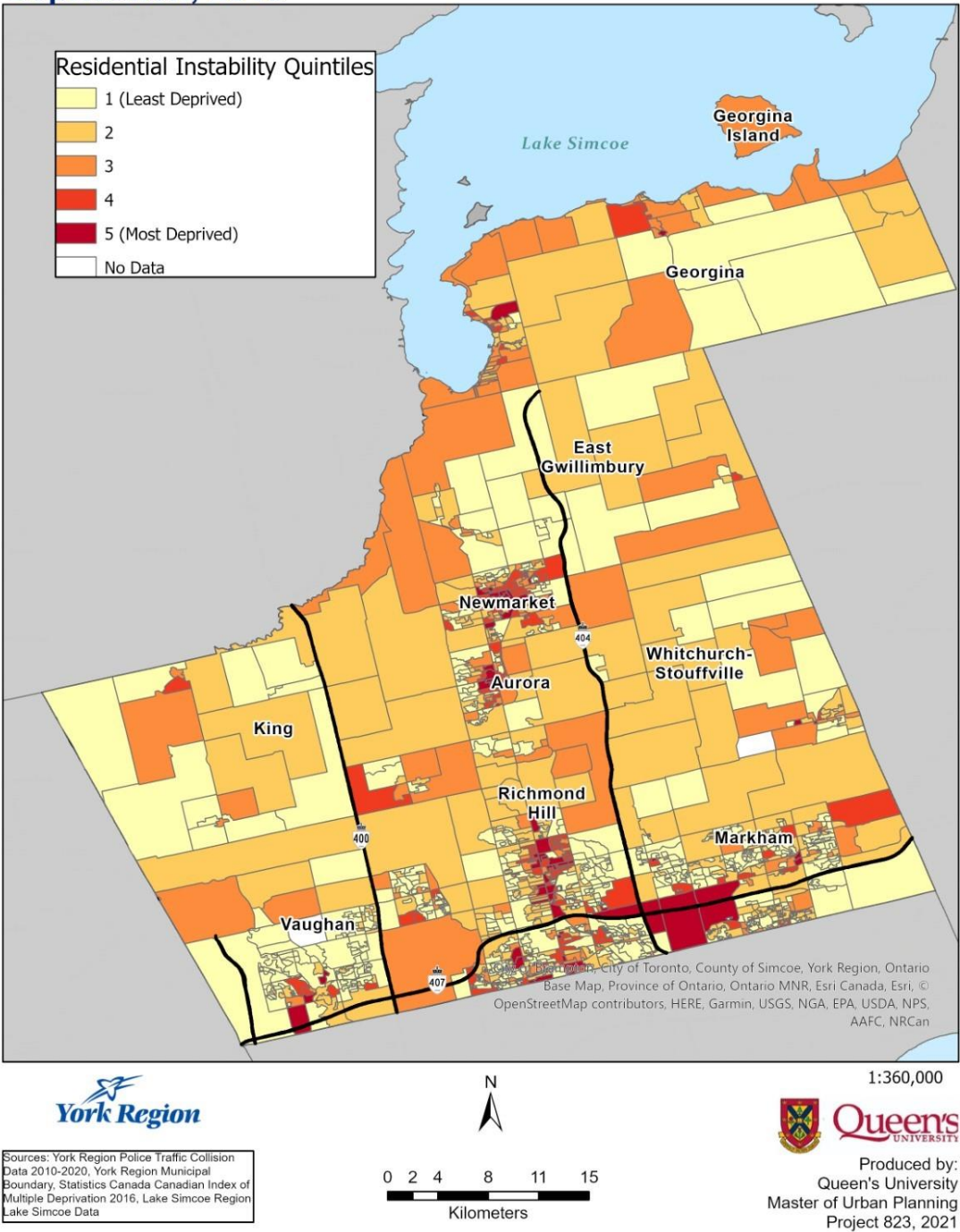
C.7. 2016 CIMD – Situational Vulnerability Quintiles, York Region

Situational Vulnerability - Canadian Index of Multiple Deprivation
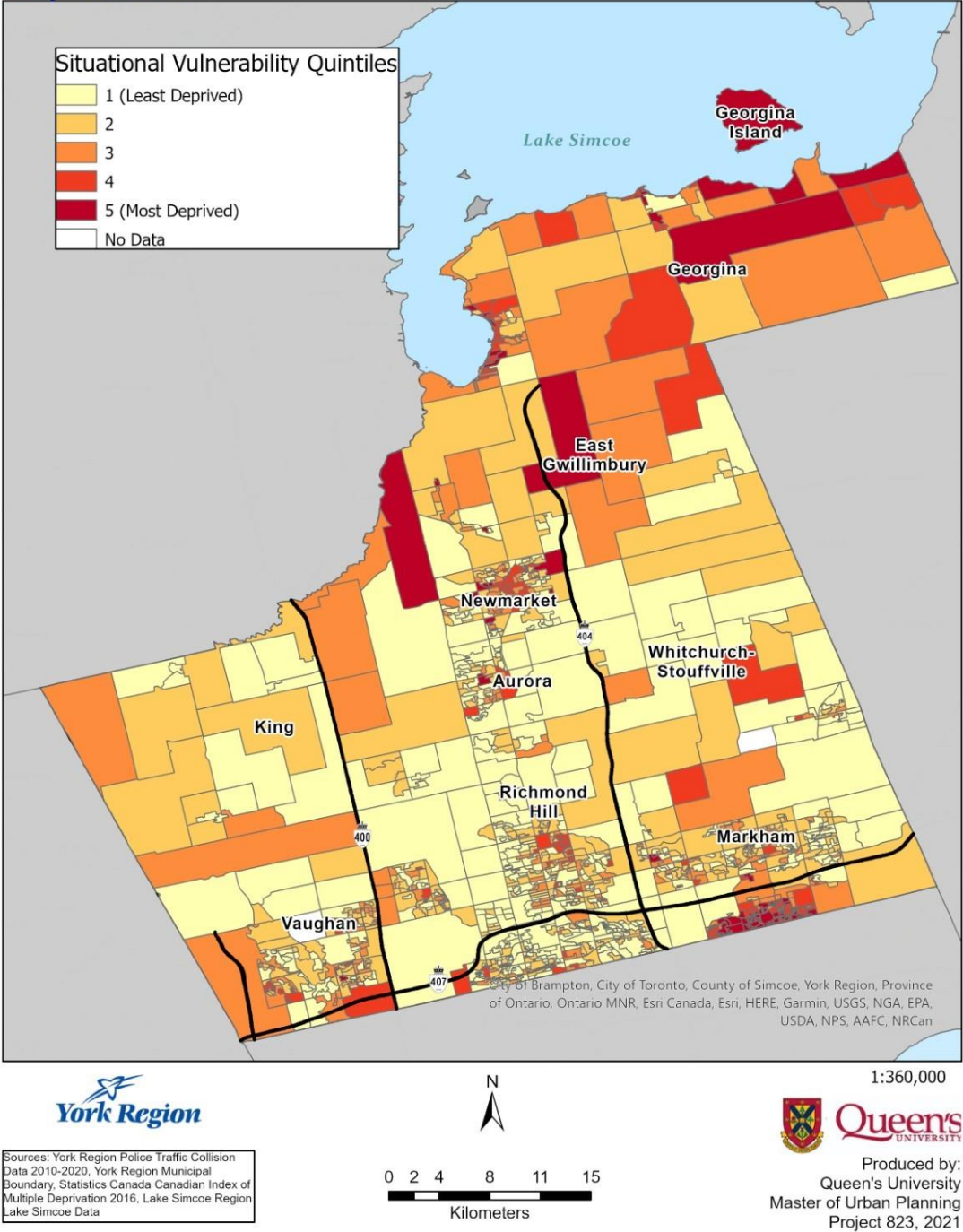
Situational Vulnerability Quintiles
- 1 (Least Deprived)
- 2
- 3
- 4
- 5 (Most Deprived)
- No Data

Sources: York Region Police Traffic Collision Data 2010-2020, York Region Municipal Boundary, Statistics Canada Canadian Index of Multiple Deprivation 2016, Lake Simcoe Region Lake Simcoe Data

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Queen's University
Master of Urban Planning
Project 823, 2021

C.8. Relationship Between Deprived Areas and the Most Frequent Locations of Pedestrian and Cyclist Collisions
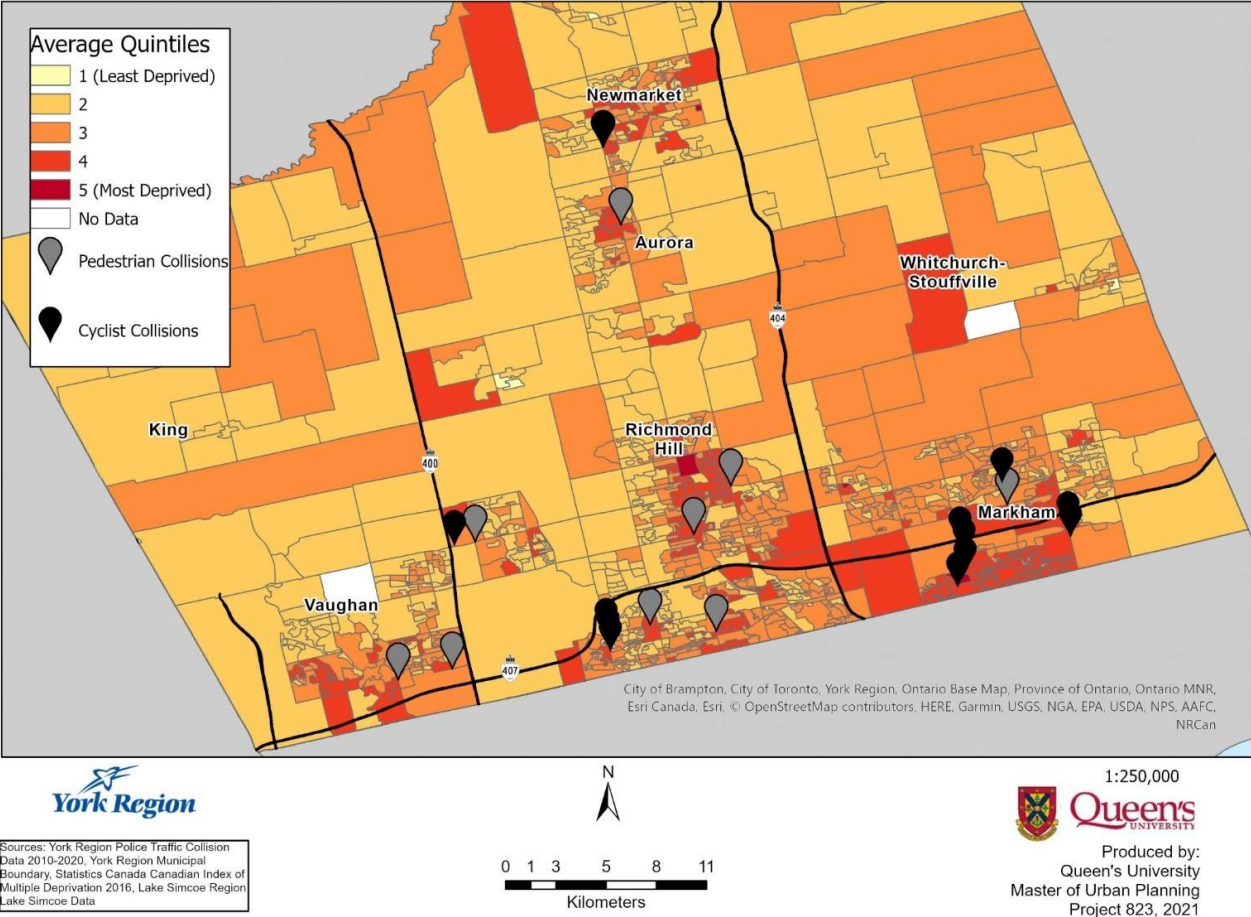
C.9. Percent of Each Dissemination Area's Population who are Between the Ages of 0-19 with the Highest Pedestrian and Cyclist Collision Frequency Intersections
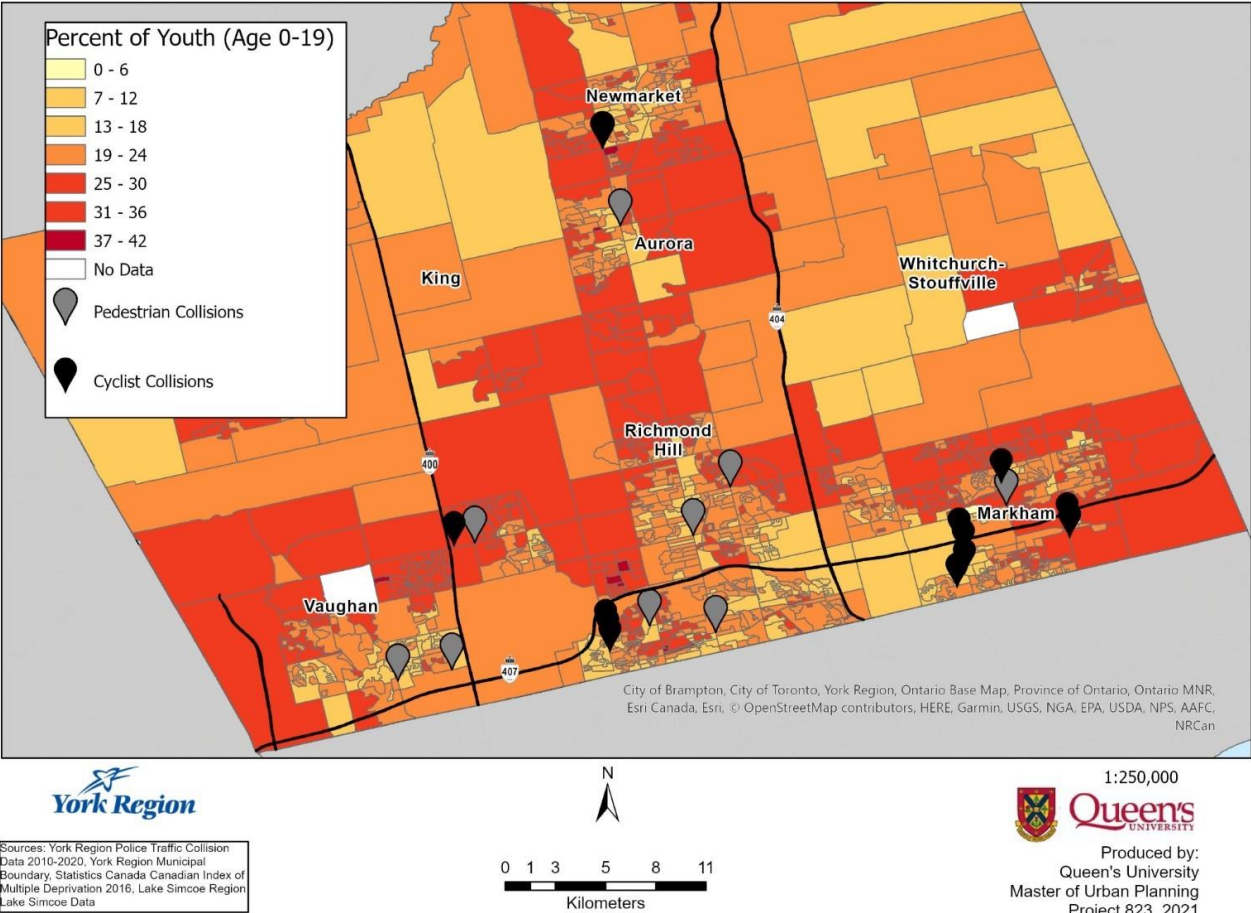
C.10. Percent of Each Dissemination Area's Population Who Are Aged 65 and Over with the Highest Pedestrian and Cyclist Collision Frequency Intersections

Pedestrian & Cyclist Collisions and Older Adults Relationship
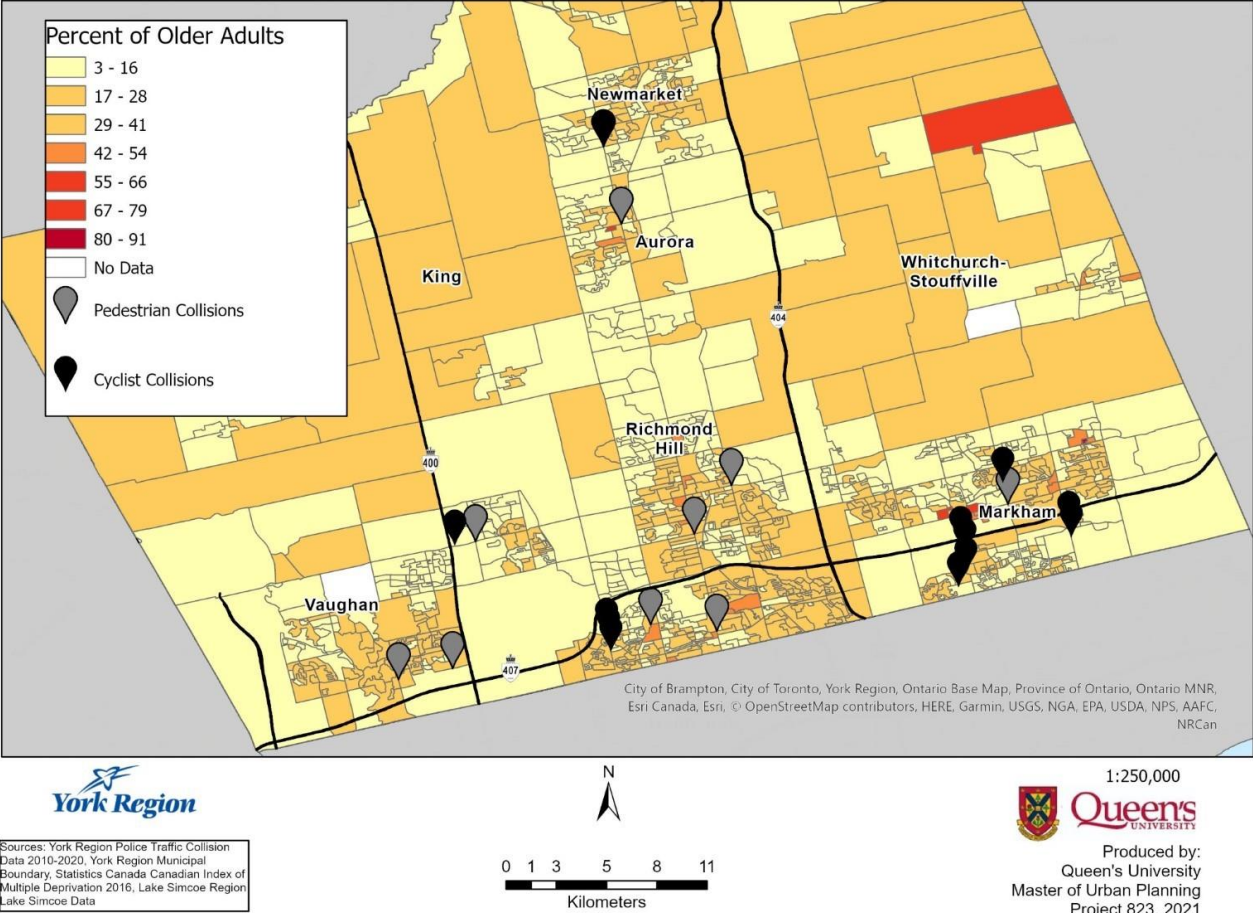
C.11 Percent of Each Dissemination Area's Population Who Identifies as a Visible Minority with the Highest Pedestrian and Cyclist Collision Frequency Intersections

Pedestrian & Cyclist Collisions and Visible Minority Relationship
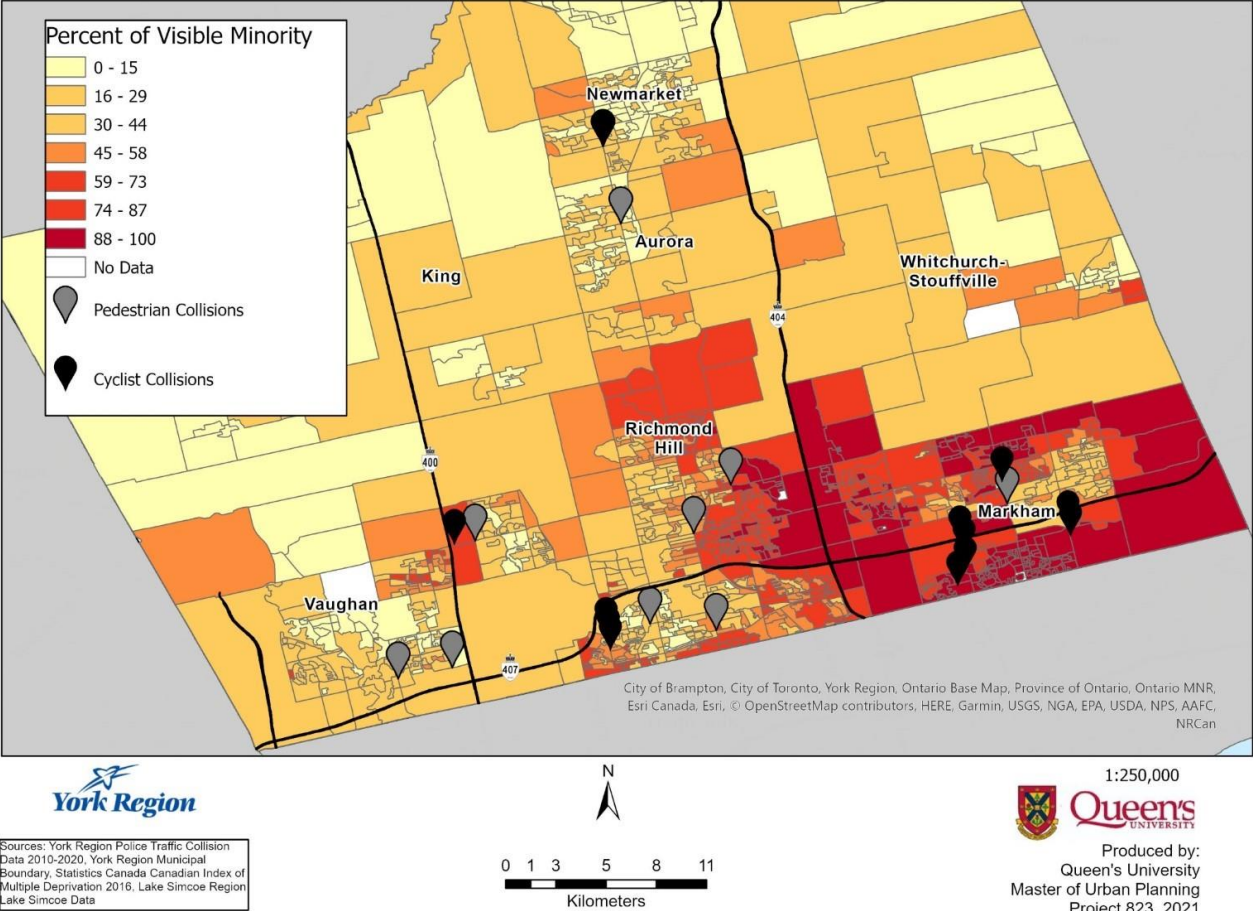
C.12 Percent of Each Dissemination Area's Population Who Are Recent Immigrants (2011-2016) With the Highest Pedestrian and Cyclist Collision Frequency Intersections

Pedestrian & Cyclist Collisions and Recent Immigration Relationship
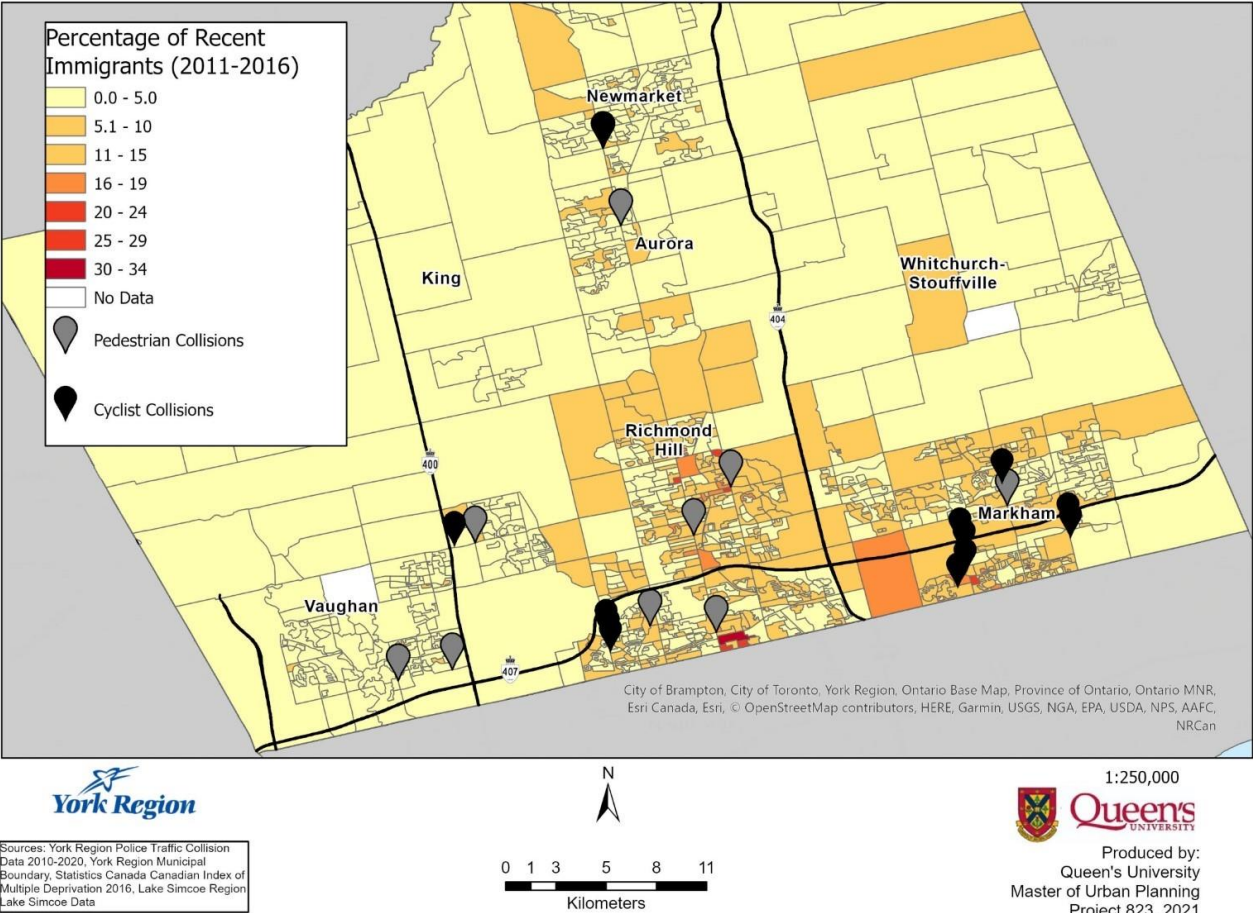
C.13. Percent of Each Dissemination Area's Population Who Have Immigrated to Canada in Their Lifetime with the Highest Pedestrian and Cyclist Collision Frequency Intersections

Pedestrian & Cyclist Collisions and Immigration Relationship
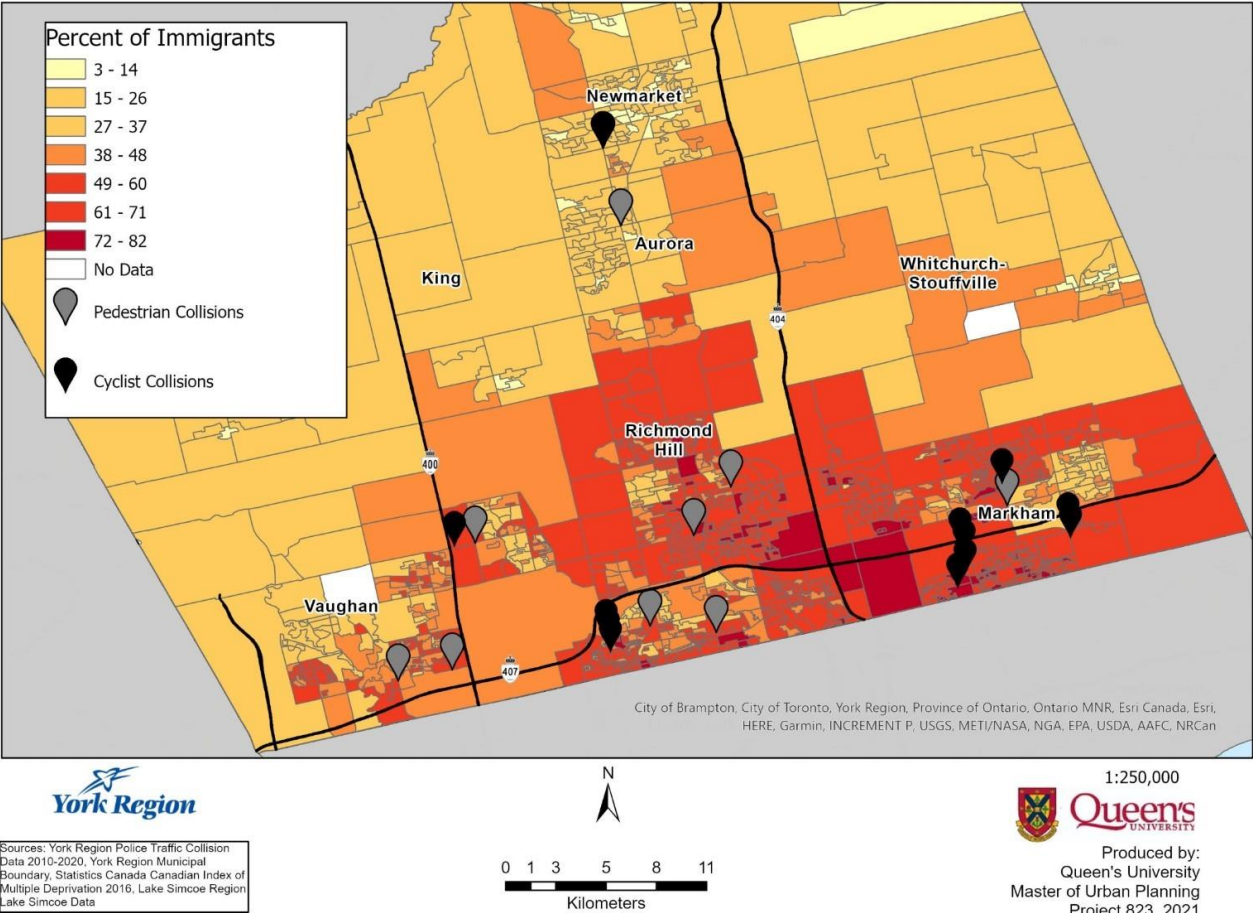
C.14. Observed Intersections with High Frequencies of Collisions or Pedestrian Safety Improvement in York Region

**Observed Intersection Locations
York Region, 2021**

Observation Locations

1. Major Mackenzie Dr & Bayview Ave
2. 14th Ave & Markham Rd
3. Bathurst St & Clark Ave
4. Yonge St & Carrville Rd
5. Yonge St & Clark Ave
6. Bathurst St & Carrville Rd
7. Highway 7 & Weston Rd
8. Yonge St & Green Lane
9. Dufferin St & Glen Shields Ave
10. Highway 7 & Keele St
11. Major Mackenzie Dr W & Jane St

City of Brampton, City of Toronto, York Region, Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

York Region

Sources: York Region Police Traffic Collision Data 2010-2020, York Region Municipal Boundary, Statistics Canada Canadian Index of Multiple Deprivation 2016, Lake Simcoe Region Lake Simcoe Data

N

0 1 3   5   8   11
Kilometers

1:250,000

Produced by:
Queen's University
Master of Urban Planning
Project 823, 2021

Appendix D: Walkability Checklists

D.1
Ch

About the Walk

Area / Neighbourhood: _____

Names of streets on route: _____

_____

Approximate distance of walk:

☐ less than 1 km   ☐ 1 km   ☐ 1.5 km   ☐ more than 1.5 km

Today's Date (day/ month/ year): _____

Time of day: ☐ a.m. ☐ pm

About the Walkers

Your Name _____

How to Contact You: _____

Who Went on this Safety & Walkability Audit:

Walker 1: Age: _____   Walks with a cane or mobility aid: ☐ No ☐ Yes
Walker 2: Age: _____   Walks with a cane or mobility aid: ☐ No ☐ Yes
Walker 3: Age: _____   Walks with a cane or mobility aid: ☐ No ☐ Yes
Walker 4: Age: _____   Walks with a cane or mobility aid: ☐ No ☐ Yes

We generally walk this route for [check all that apply]
☐ Transportation – to reach a specific location e.g. store, service, bus stop, etc
☐ Recreation – walking for enjoyment and/or physical activity

All-Season Age-Friendly Pedestrian Safety and Walkability Checklist   p 2

1	SAFETY	YES	NO	NA
1.1	Do you feel safe on this walk?			
1.2	If you were to walk this route at night, would it be well lit?			
1.3	Are shared-use pathways safe for both pedestrians and cyclists?			
1.4	Are sidewalks or other safe walkways available on every street on your route?			
1.5	Are sidewalks and other walkways in good repair?			
1.6	Are sidewalks/walkways and public transit stops ploughed for safe walking and wheeling in winter?			
1.7	Are there lights or pedestrian crossings at busy intersections?			
1.8	Are pedestrian lights and pedestrian crossings safely and conveniently located near schools, parks, retirement homes, shops, public transport stops, etc.?			
1.9	Do pedestrian lights allow enough time for older people and young children to cross safely?			
1.10	Do you feel safely separated from the road traffic, e.g., pedestrian islands in the middle of wide street crossings, adequate curbs, etc.?			
1.11	Are there roundabouts, speed bumps or other traffic calming measures?			
1.12	Is the neighbourhood free from debris, litter, dog waste, overflowing waste bins, and broken glass?			

	SAFETY (cont'd0	YES	NO	NA
1.13	Are crossing points free of obstructions such as plants, or parked cars that limit your view of the traffic? In wintertime, do snow banks obstruct crossing point views?			
1.14	Are speed limits for cars appropriate and clearly posted?			
1.15	Is there appropriate/adequate signage identifying the need to slow down near schools and residences for older adults?			
	TOTAL (add each column)			

Location of Identified Issues : the No's [also mark on map, if possible]

SAFETY Comments / Suggestions:

2	ACCESSIBILITY	YES	NO	NA
2.1	Can people walk or wheel side-by-side on the sidewalks and walkways, including individuals with strollers and walkers, and those using wheelchairs?			
2.2	Are sidewalks and walking areas free from obstructions such as overgrown plants, advertising boards, snow piles and ice?			
2.3	Are construction areas safe and accessible?			
2.4	Are toilets available to the public along your route?			
2.5	Are the sidewalks/ walkways easy to walk or wheel on, with even surfaces for strollers and wheelchairs?			
2.6	Are there smooth curb ramps at street crossings for people using walkers, scooters, wheelchairs and strollers?			
2.7	Are there audible signal devices at crosswalks and lights?			
	TOTAL (add each column)			

Location of Identified Issues : the No's [also mark on map, if possible]

ACCESSIBILITY Comments / Suggestions:

3	CONVENIENCE & CONNECTEDNESS	YES	NO	NA
3.1	Is there pedestrian signage on the route, identifying hospitals, recreation, libraries and public transit locations?			
3.2	Does this route link with public transit services? If yes, please circle: Bus/ Train/ Other			
3.3	Does this route lead to a destination such as a school, café, library, workplace, place of worship, sports field or recreational facility?			
3.4	Are sidewalks and pathways continuously linked?			
3.5	Is the dog off-leash area separated from children's play areas?			
3.6	If you walked into a cul-de-sac or dead end, was there a safe route connecting you through to another street?			
	TOTAL (add each column)			

Location of Identified Issues : the No's [also mark on map, if possible]

CONVENIENCE & CONNECTEDNESS Comments / Suggestions:

4	COMFORT & ATTRACTIVENESS	YES	NO	NA
4.1	Are there places to shelter from rain, hot sun, wind and snow?			
4.2	Are there benches/places to stop and rest, particularly for older people and young children?			
4.3	Are there trees along the route to provide shade and a pleasant environment?			
4.4	Are there enough garbage and recycle bins available?			
4.5	Are there transit shelters with adequate seating at key transit stops?			
4.6	Are there any points of interest (e.g. historical markers, public art, parks, community gardens)?			
4.7	Is the neighbourhood free from graffiti and vandalism?			
4.8	Are park areas well maintained?			
4.9	Are there drinking fountains in parks or in other places along the route?			
4.10	Are the street frontages interesting and attractive (e.g. landscaping, fences, shop fronts)?			
	TOTAL (add each column)			

Location of Identified Issues : the No's [also mark on map, if possible]

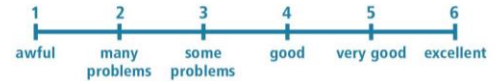COMFORT & ATTRACTIVENESS Comments / Suggestions:

How walkable is your community?

D.2

Location of walk _____

_____

Rating Scale:

1	2	3	4	5	6
awful	many problems	some problems	good	very good	excellent

1. Did you have room to walk?

☐ Yes ☐ Some problems:
- ☐ Sidewalks or paths started and stopped
- ☐ Sidewalks were broken or cracked
- ☐ Sidewalks were blocked with poles, signs, shrubbery, dumpsters, etc.
- ☐ No sidewalks, paths, or shoulders
- ☐ Too much traffic
- ☐ Something else _____
  Locations of problems: _____

Rating: (circle one) _____
1 2 3 4 5 6   _____

2. Was it easy to cross streets?

☐ Yes ☐ Some problems:
- ☐ Road was too wide
- ☐ Traffic signals made us wait too long or did not give us enough time to cross
- ☐ Needed striped crosswalks or traffic signals
- ☐ Parked cars blocked our view of traffic
- ☐ Trees or plants blocked our view of traffic
- ☐ Needed curb ramps or ramps needed repair
- ☐ Something else _____
  Locations of problems: _____

Rating: (circle one) _____
1 2 3 4 5 6   _____

3. Did drivers behave well?

☐ Yes ☐ Some problems: Drivers...
- ☐ Backed out of driveways without looking
- ☐ Did not yield to people crossing the street
- ☐ Turned into people crossing the street
- ☐ Drove too fast
- ☐ Sped up to make it through traffic lights or drove through traffic lights?
- ☐ Something else _____
  Locations of problems: _____

Rating: (circle one) _____
1 2 3 4 5 6   _____

4. Was it easy to follow safety rules? Could you and your child...

☐ Yes ☐ No Cross at crosswalks or where you could see and be seen by drivers?

☐ Yes ☐ No Stop and look left, right and then left again before crossing streets?

☐ Yes ☐ No Walk on sidewalks or shoulders facing traffic where there were no sidewalks?

☐ Yes ☐ No Cross with the light?
  Locations of problems: _____

Rating: (circle one) _____
1 2 3 4 5 6   _____

5. Was your walk pleasant?

☐ Yes ☐ Some unpleasant things:
- ☐ Needed more grass, flowers, or trees
- ☐ Scary dogs
- ☐ Scary people
- ☐ Not well lighted
- ☐ Dirty, lots of litter or trash
- ☐ Dirty air due to automobile exhaust
- ☐ Something else _____
  Locations of problems: _____

Rating: (circle one) _____
1 2 3 4 5 6   _____

How does your neighborhood stack up? Add up your ratings and decide.

1. _____
2. _____
3. _____
4. _____
5. _____

Total _____

26–30 Celebrate! You have a great neighborhood for walking.

21–25 Celebrate a little. Your neighborhood is pretty good.

16–20 Okay, but it needs work.

11–15 It needs lots of work. You deserve better than that.

5–10 It's a disaster for walking!

Now that you've identified the problems, go to the next page to find out how to fix them.

Now that you know the problems, you can find the answers.

Improving your community's score...

	What you and your child can do immediately	**What you and your community can do with more time**
1. Did you have room to walk?		
Sidewalks or paths started and stopped Sidewalks broken or cracked Sidewalks blocked No sidewalks, paths or shoulders Too much traffic	• pick another route for now • tell local traffic engineering or public works department about specific problems and provide a copy of the checklist	• speak up at board meetings • write or petition city for walkways and gather neighborhood signatures • make media aware of problem • work with a local transportation engineer to develop a plan for a safe walking route
2. Was it easy to cross streets?		
Road too wide Traffic signals made us wait too long or did not give us enough time to cross Crosswalks/traffic signals needed View of traffic blocked by parked cars, trees, or plants Needed curb ramps or ramps needed repair	• pick another route for now • share problems and checklist with local traffic engineering or public works department • trim your trees or bushes that block the street and ask your neighbors to do the same • leave nice notes on problem cars asking owners not to park there	• push for crosswalks/signals/ parking changes/curb ramps at city meetings • report to traffic engineer where parked cars are safety hazards • report illegally parked cars to the police • request that the public works department trim trees or plants • make media aware of problem
3. Did drivers behave well?		
Backed without looking Did not yield Turned into walkers Drove too fast Sped up to make traffic lights or drove through red lights	• pick another route for now • set an example: slow down and be considerate of others • encourage your neighbors to do the same • report unsafe driving to the police	• petition for more enforcement • request protected turns • ask city planners and traffic engineers for traffic calming ideas • ask schools about getting crossing guards at key locations • organize a neighborhood speed watch program
4. Could you follow safety rules?		
Cross at crosswalks or where you could see and be seen Stop and look left, right, left before crossing Walk on sidewalks or shoulders facing traffic Cross with the light	• educate yourself and your child about safe walking • organize parents in your neighborhood to walk children to school	• encourage schools to teach walking safely • help schools start safe walking programs • encourage corporate support for flex schedules so parents can walk children to school
5. Was your walk pleasant?		
Needs grass, flowers, trees Scary dogs Scary people Not well lit Dirty, litter Lots of traffic	• point out areas to avoid to your child; agree on safe routes • ask neighbors to keep dogs leashed or fenced • report scary dogs to the animal control department • report scary people to the police • report lighting needs to the police or appropriate public works department • take a walk wih a trash bag • plant trees, flowers in your yard • select alternative route with less traffic	• request increased police enforcement • start a crime watch program in your neighborhood • organize a community clean-up day • sponsor a neighborhood beautification or tree-planting day • begin an adopt-a-street program • initiate support to provide routes with less traffic to schools in your community (reduced traffic during am and pm school commute times)
A Quick Health Check		
Could not go as far or as fast as we wanted Were tired, short of breath or had sore feet or muscles Was the sun really hot? Was it hot and hazy?	• start with short walks and work up to 30 minutes of walking most days • invite a friend or child along • walk along shaded routes where possible • use sunscreen of SPF 15 or higher, wear a hat and sunglasses • try not to walk during the hottest time of day	• get media to do a story about the health benefits of walking • call parks and recreation department about community walks • encourage corporate support for employee walking programs • plant shade trees along routes • have a sun safety seminar for kids • have kids learn about unhealthy ozone days and the Air Quality Index (AQI)

Appendix E: Interview Guide

1. Can you briefly introduce yourself and explain your work with road safety and/or vulnerable populations?

2. What do you see as the biggest barriers to road safety?

3. Which populations in the communities you've worked with are at greatest risk due to road safety issues?

   a. What factors contribute to their level of risk or exposure?

4. Please describe the current approach to road safety initiatives in your community.

5. What are the strengths and shortcomings of the existing road safety initiatives?

6. In what ways are the needs of populations at greatest risk of road safety issues accounted for in existing road safety initiatives in your community?

7. What more could be done to ensure that the needs of populations at risk are fully addressed? (i.e., any initiatives, tools or policies that could assist).

Appendix F: Letter of Information for Key Informants

**Centering Vulnerability in Road Safety Initiatives in York Region:
Applying an Equity Lens to Vision Zero and Safe Mobility Initiatives**

*Department of Geography and Planning, Queen's University
SURP 823 – Health and Social Planning Project Course (Fall 2021)*

This research is being conducted by a team consisting of students in the project course
SURP 823 – Health and Social Planning Project Course through the Department of Geography
and Planning at Queen's University in Kingston, Ontario. The course instructor is Dr. Patricia
Collins (Queen's University), and the project is being led by Sonia Sanita from The Regional
Municipality of York.

What is this study about?

This research is being conducted by eight students in the Master of Urban and Regional
Planning program. This year, our project is focused on centering vulnerability in road safety
initiatives in the Regional Municipality of York, Ontario. To that end, our
team is researching socio-spatial disparities in road safety in the region, as well as
identifying best practices and recommendations for The Regional Municipality of York to
enable the establishment of road safety initiatives that support health and social equity.

You are invited to participate in a semi-structured interview with members of the project team
to share your professional knowledge. There are no known physical, psychological,
economic, or social risks associated with this study. The input from your interview will
inform our final report and recommendations.

Is my participation voluntary?

Yes. Although it would be greatly appreciated if you would answer all questions as frankly as
possible, you should not feel obliged to answer any question that you find objectionable or
that makes you feel uncomfortable. You may also withdraw from the project at any time.
Should you choose to withdraw from the project at any point, including during or following the
interview session, please inform the project team manager, Gabi Scollon, a
g.scollon@queensu.ca, or our course instructor, Dr. Patricia Collins, at
patricia.collins@queensu.ca. You will not have not waived any legal rights by consenting to
participate in this study.

What will happen to my responses?

The interview will be audio-recorded and transcribed verbatim. If you decline the use of an audio recorder, then the interviewer will take written notes only. Only the research team will have access to the information. Interview participants speaking in their professional capacity may consent to having their name attribute to their statements OR request to have their confidentiality protected as noted in attached consent form. If you choose the latter option, we will strip your name and any information from the transcript that we suspect could indirectly identify you to ensure your responses are kept confidential. However, given the small number of participants, it is possible that you could be identified from a quotation that we use from your interview, and you're your confidentiality cannot be guaranteed. The Queen's General Research Ethics Board (GREB) may request access to study data to ensure that the researcher(s) have or are meeting their ethical obligations in conducting this research.

For the duration of this study, all interview transcripts will be securely stored on team members' password-protected computers and in an encrypted cloud-based data management platform. By January 2021, after the study is complete, all raw data from this study will be destroyed. The final report from the study will be made available on the Queen's School of Urban and Regional Planning website (https://www.queensu.ca/geographyandplanning/surp/project-courses). The findings may also be published in professional journals or presented at academic or professional planning conferences.

Will I be compensated for my participation?

You will not be compensated for your participation in this project.

What if I have concerns?

If you have any complaints, concerns or questions about this research, please feel free to contact Dr. Patricia Collins at patricia.collins@queensu.ca (613-533-6000x77060) or the Chair of the General Research Ethics Board at chair.greb@queensu.ca (1-844-535-2988) at Queen's University.

Again, thank you. Your interest in participating in this research is greatly appreciated.