

**Cycle City: Generating a Cycling Culture in Toronto**

by

Stephen Michael Wenzel

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## **Author's Declaration Page**

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.



# Abstract

As Toronto's population continues to grow, the city is faced with many new challenges related to the quality of urban life. Central to overcoming these challenges is a rethinking of urban mobility. As the region's population grows, city streets have become ever more congested, and commute times have increased exponentially. The city and the region's governments have called for an end to sprawling development and initiated a policy of densification. This new paradigm allows the bicycle to play a key role in making Toronto a better place in which to live and travel, assisting in overcoming the limitations of the current automotive-dominated transportation network.

Often, the Toronto cyclist feels like an outsider, wrestling for space amongst the automobiles. In order for cycling to have a major influence on the quality of life in the city, a cycling culture must become much more prevalent amongst Torontonians. This culture can only be achieved through a redefinition of the cycling experience, transforming bicycling into the most efficient and exciting mode of transportation within the city.

How can Toronto build upon the cycling support, which has developed in the downtown core, to make cycling a fundamental part of the transportation network throughout the city? As illustrated in the attempted implementation of Toronto's 2001 bike plan, a uniform strategy for cycle promotion across all reaches of the city is ineffective in generating the support necessary to instigate significant infrastructural and behavioural change. In contrast, this thesis seeks to understand cycling patterns and preferences in Toronto and to use this information to target the design of strategically selected cycling projects. The role of design is explored as a catalyst for behavioural change and the rise of a cycling culture.

A new cycling corridor is proposed, linking the forthcoming Eglinton cycle track with the downtown core, making cycling much more accessible for midtown Toronto residents. This corridor seeks to combine infrastructure and amenities, creating new programmatic pairings which elevate the image of cycling within the city. The route acts as a catalyst for the growth of a cycling culture and expansion of the city-wide cycling network.



# Acknowledgments

My idea for this thesis stems from my love of bikes and my belief that their use can make our cities better places to live. I must first thank my uncle who gave me my first road bike, a 1970's Sekine. It is on this bicycle that I discovered the true joy of cycling and realized the amazing potential of these simple machines.

I must also thank my friends Daniel, Zak and Brent for being crazy enough to join me on an amazing 3200 kilometer Canadian cycling adventure from Toronto to Cape Spear, Newfoundland, the easternmost point in North America. This journey taught me a great deal about traveling by bicycle and allowed me the unique experience of getting to know many of Canada's cities and towns from the seat of my bicycle.

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Finally, I want to thank my parents for always supporting me, encouraging me to follow my passions, and for being so enthusiastic about my work.

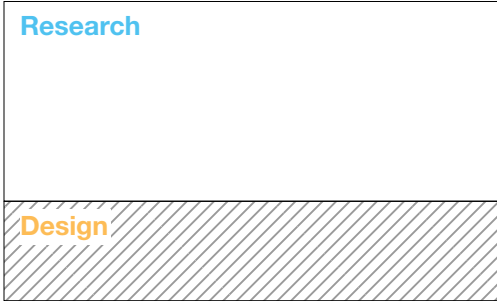
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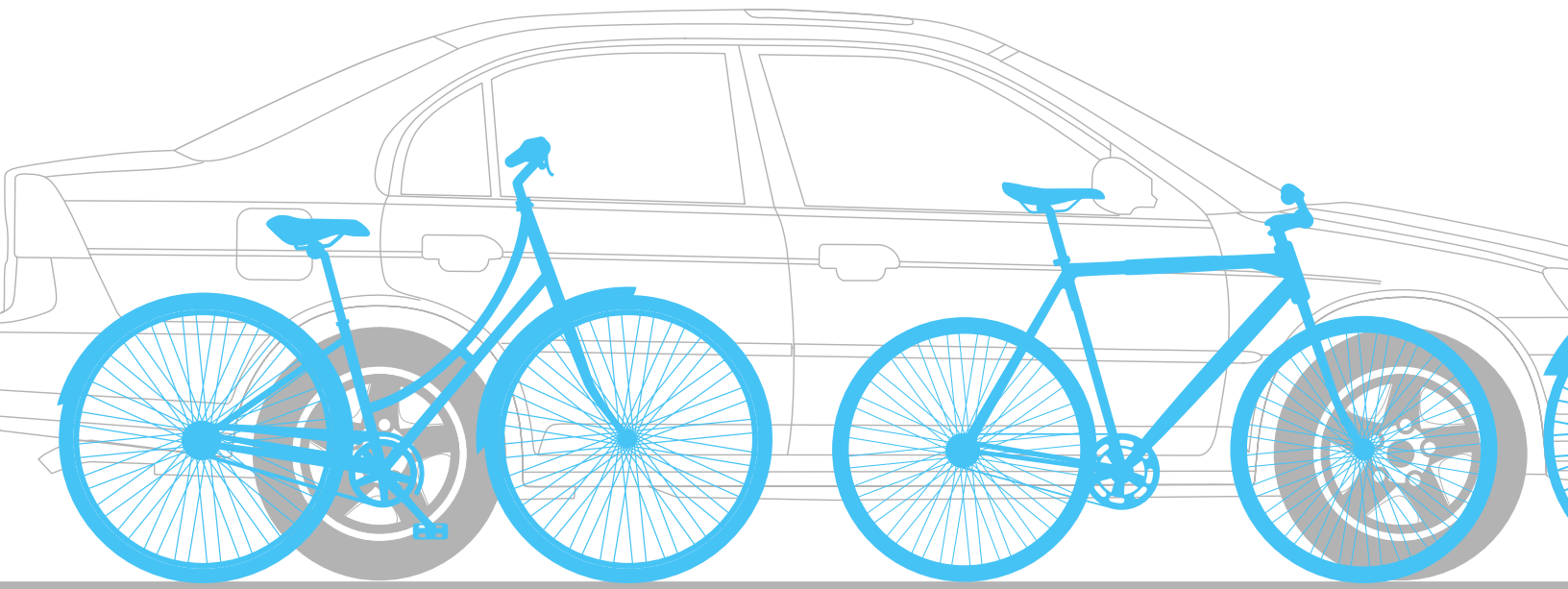
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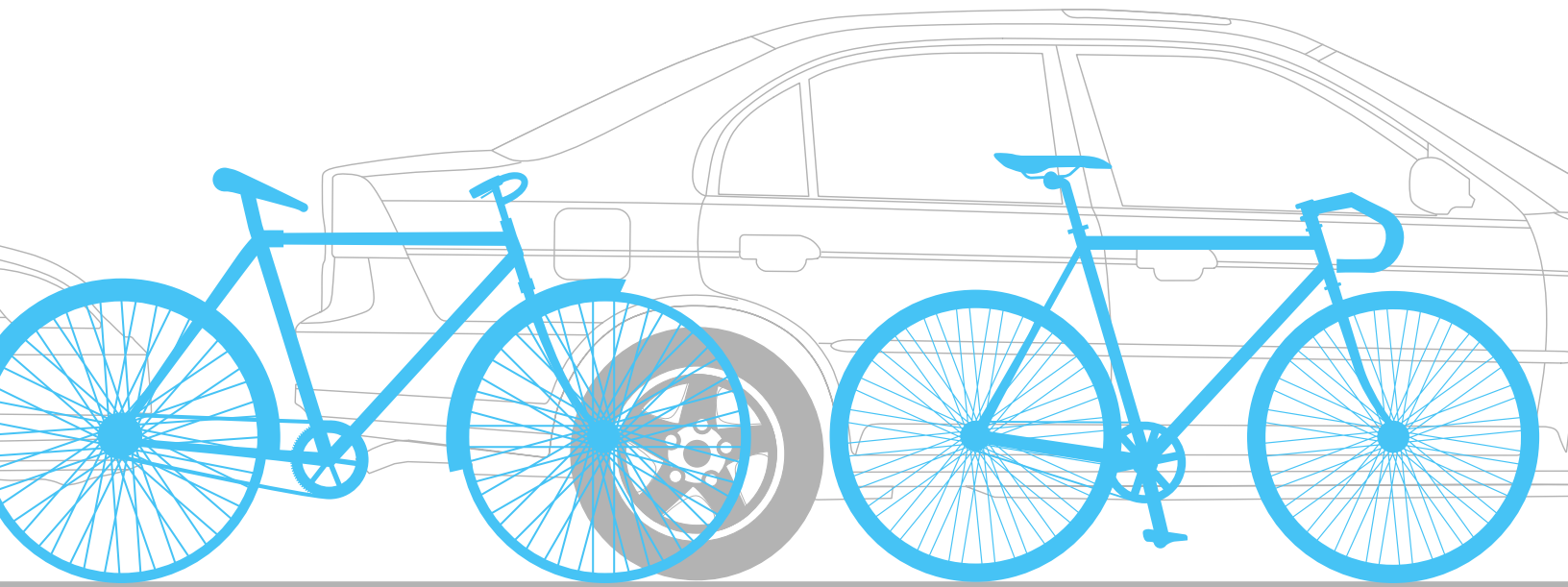
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01

# Introduction



## Why Cycling?

A cycling boom has been spreading rapidly across the world throughout the past decade. Many cities across North America, South America, Europe and Australia are beginning to realize the value that cycling can bring to a city. The past 100 years of automotive development have left many of our cities in a state of traffic gridlock, pollution, and uncontrolled sprawl as commute times grow ever longer. The automobile, which was envisioned to save time and shrink space, has proven to cost more than it saves. Automobile-centric nations are faced with the economic costs of fuel and infrastructure, the spatial cost of land consumed by transportation and the psychological costs of time lost in transit.

The bicycle is an important, yet often overlooked, element of the urban transportation network, allowing for swift and independent travel within the urban core and well into the inner suburbs. Since the 1960's, architects and urban planners have realized that car-inspired city planning does not easily lend itself to the bicycle and began to acknowledge the importance of the bicycle within urban centers.<sup>1</sup> In 1966, British Architect, Paul Ritter wrote, "As with public transportation, so with cycles: a great deal of thinking and innovating is required as the need becomes more and more obvious"<sup>2</sup>. Despite these realizations, mainstream North American planning has largely ignored the immense potential which the bicycle holds, rather, preferring to respond to the needs of the car. Streets designed for the automobile encouraged consumers to purchase cars, while increased car ownership further encouraged planners and politicians to plan cities for the automobile. This trend is finally changing as North Americans come to realize the limits of the automobile in the dense urban environment.

In Toronto, cycling has a great untapped potential to take some of the load off the private automobile and public transportation systems, both of which are currently running over capacity. Bicycling holds only 1.2% of Toronto's modal share compared to 23.3% by public transportation and 79.9% by the private automobile.<sup>3</sup>

Not only can cycling help improve transportation flow, but it also indirectly addresses many other concerns of modern urban life. The bicycle contributes zero emissions towards air pollution, promotes a healthy, active lifestyle and contributes to a more vibrant civic life. Cycling can have a profound effect on the individual spirit and by association, the quality of life which a society enjoys. Studies have linked the level of cycling in a city to the overall happiness of its citizens. According to the *European Cycling Foundation*, the countries which rank highest in their *Cycling Barometer* also rank highest in the UN's *World Happiness Index*. The four happiest countries according to the index are Denmark, The Netherlands, Sweden and Finland. These countries hold identical rankings on the ECF Cycling Barometer.<sup>4</sup>



*Figure 1-1 Space needed to transport 50 people by Bike, car and bus*

While car drivers move about isolated in their own world, bound by a soundproof steel and glass box, cyclists are full participants in urban life. They have an increased awareness of their surroundings, can interact with fellow citizens on the street and are more likely to stop and enjoy the many amenities of the urban environment. While drivers often find their commutes to be a great source of stress, commuters who participate in active transportation, such as cycling, often report their commute to be one of the most enjoyable parts of their day.<sup>5</sup> Rather than leaving them drained, their journey actually increases their energy levels.

In addition to the numerous positive effects on the individual, at the civic level, the power of cycling comes from its efficiency. The bicycle takes up far less space than the private automobile on city streets, nearly reaching the efficiency levels of public transit as seen in Figure 1-1. Additionally, the cost of bicycle lanes and other bicycle infrastructures falls far below the costs of building infrastructure required for automobiles and public transportation. Considering all the benefits, there is no doubt that cycling has the potential to make major positive changes within today's cities.

The leaders of most major cities in the developed world have realized a future based on past practices is not a sustainable one. Toronto is no different; change must occur in order to make the city more livable once again. Key to a livable city is the efficient flow of people. When citizens can easily get where they need to go, they have more time to spend both at work and at leisure. The city at once becomes a happier and a more productive place. As the population of Toronto has grown and more people commute into the city from around the Greater Toronto and Hamilton Area, experience has shown that a single-mode transportation model does not have the capacity to move people efficiently through the city. The only way to effectively solve Toronto's, and many other similar cities', traffic congestion is through a multi-modal approach to transportation.

In this chapter, municipal and provincial policies for Toronto and Ontario are examined in order to understand cycling's position within the regions' urban vision of a future that focuses on densification and multi-modal transportation. Next, types of potential cyclists are identified and their motivations are examined. Finally a method is proposed for encouraging these potential cyclists to become daily cyclists.

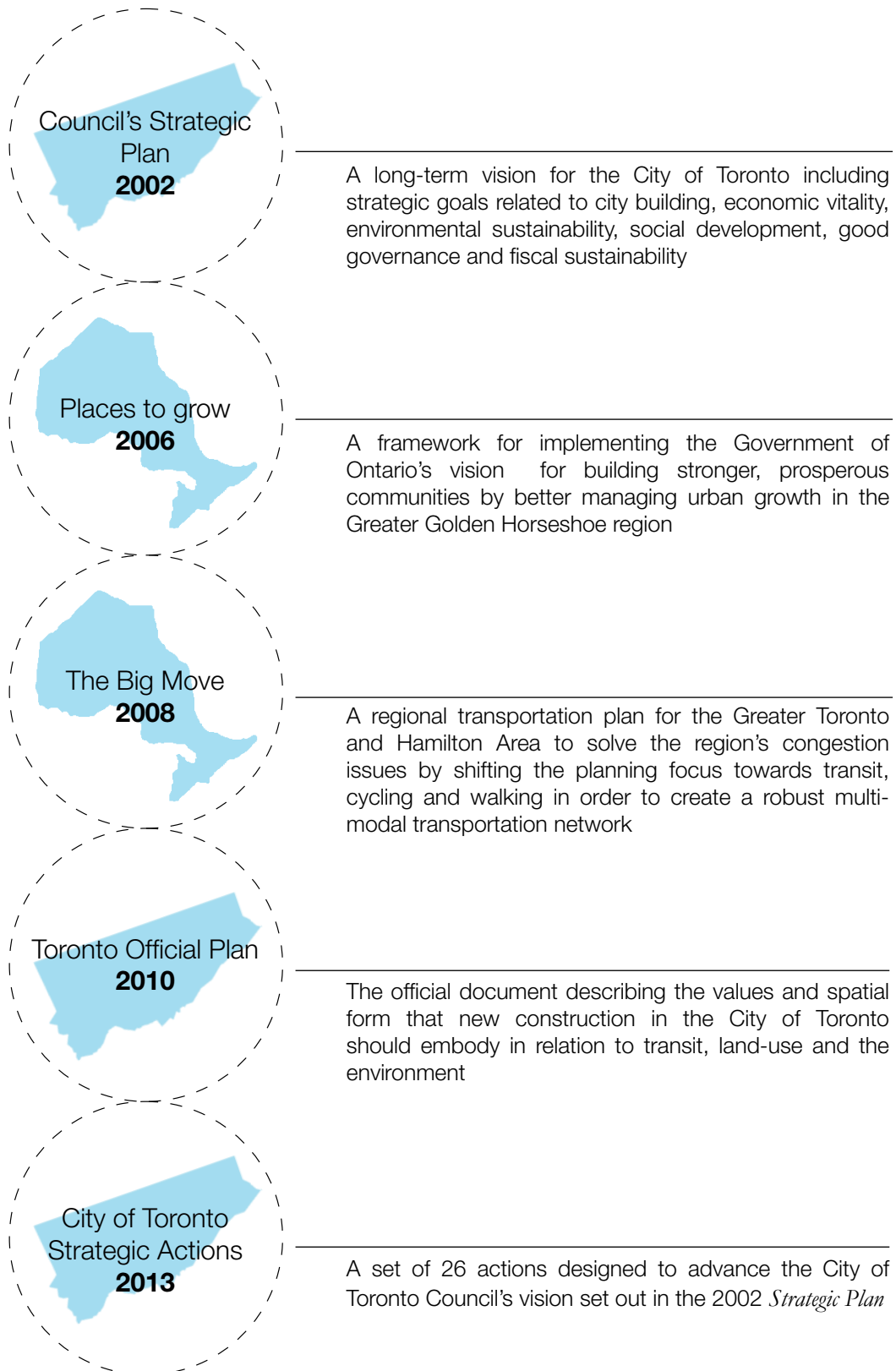


Figure 1-2 Municipal and provincial urban development and transportation plans



## A New Vision for Toronto and the GTAH

The massive growth in the Great Lakes Mega-Region over the past several decades has caused serious transportation problems within the region's urban areas. Particularly in the Greater Toronto and Hamilton Area (GTHA), road and transit infrastructure have not been able to keep pace with the commuting lifestyles of the region's 6 million residents. Increasing population has led to unprecedented levels of congestion, while sprawl has increased commute times by locating residents ever further from their places of employment.

Leaders in Toronto, the GTAH and Ontario have come to the realization that the region must reinvent the way in which its people commute. In order for Toronto and surrounding areas to continue to prosper and maintain a high quality of life, their residents must live more sustainably. To promote and support this new lifestyle, the government of Ontario as well as the City of Toronto have invested a great deal in developing a long-term vision and strategy for the future of urban development and transportation. With Toronto being the most populous city in the region, the city's own plans are tightly linked to those of the province.

The bicycle, both implicitly and explicitly, plays an important role in these strategies. Examining *Toronto Council's Strategic Plan*, *Toronto's Official Plan*, and *The City of Toronto's Strategic Actions*, as well as the Government of Ontario's *Places to Grow Act*, and the *Big Move*, reveals the increasing importance placed on the bicycle in the future of Ontario's urban areas.

Beginning in 2002, Toronto City Council developed *Council's Strategic Plan* to outline a vision for Toronto and a strategy by which this vision can be achieved. The plan strives for a city that is:

1. Caring and friendly
2. Green and sustainable
3. Dynamic
4. Invests in quality of life<sup>6</sup>

As a sustainable mode of transportation that encourages people to engage in their community, the bicycle can clearly contribute to all four objectives. Some directions laid out by Council in the *Strategic Plan* include enhancing the livability of the city by reducing automobile dependency, distributing employment nodes across the city in order to reduce commute times, and maximizing infrastructure efficiency by working with regional partners to limit sprawl and develop more growth within urban centers<sup>7</sup>. The encouragement of compact living creates an ideal environment in which the bicycle can thrive. Together with transit and walking, cycling can claim much of the domain currently held by the private motor vehicle.

In 2006, the government of Ontario embraced this vision of compact living as a strategy for the entire Greater Golden Horseshoe region with the release of the *Growth Plan* and implementation of the *Places to Grow Act*. With the goal of building compact, vibrant and complete communities, the plan emphasizes intensification of already built areas rather than new greenfield development. These communities are designed to reduce the need for the automobile by creating an enticing environment for cycling, walking and transit. This effect is accomplished by building mixed use developments that allow people to live affordably, close to their places of work and in close proximity to all the necessary amenities of daily life. A more compact lifestyle creates dynamic, lively communities while also reducing home-work commute times. Development is to be focused in specified *Urban Growth Centres* (seen in Figure 1-3) including downtown Toronto and along intensification corridors which exist along public transportation lines. The plan describes a 35-year vision for the region's cities and communities with a new approach to mobility,

*Getting around will be easy. An integrated transportation network will allow people choices for easy travel both within and between urban centres throughout the region. Public transit will be fast, convenient and affordable. Automobiles, while still a significant means of transport, will be only one of a variety of effective and well-used choices for transportation. Walking and cycling will be practical elements of our urban transportation systems.<sup>8</sup>*

Cycling is clearly an integral part of this new paradigm. An emphasis is also put on connectivity between different modes of transportation to reduce dependence on any singular mode. The emphasis shifts from moving vehicles, primarily private automobiles, to moving people in the most efficient and enjoyable way possible.

The transportation aspect of the 2006 *Growth Plan* is further elaborated on in *The Big Move*, a regional transportation plan published by the government of Ontario in 2008. The plan, produced by the *Greater Toronto Transportation Authority* known as *Metrolinx*, focuses on an interconnected transit system allowing efficient connections across the GTA in order to foster a high quality of life, a sustainable approach to the environment, and a prosperous economy. Despite the focus on public transit when dealing with regional connectivity, the plan fully acknowledges the importance of the bicycle in contributing to the complete transportation network. Rob Maclaas, the chair of *Metrolinx* writes,

*The Big Move will help to revitalize our communities into the kinds of places where residents can take transit, ride a bicycle or walk to fulfill their day's activities, and where children can once again walk to school. Over 7,000 km of new lanes, trails and pathways for pedestrians and cyclists will make walking and cycling safe and encourage healthy lifestyles. Greenhouse gas*



Figure 1-3 Places to Grow: Urban Growth Centres in the GTHA

*emissions per resident will decline dramatically and our air will be cleaner.*<sup>9</sup>

In 2010, the city of Toronto released its new *Official Plan* which builds upon the lessons of *Places to Grow* and *The Big Move* to outline a strategy for building the city of the future. An emphasis is placed on making sustainable growth choices to leave a better city for future generations. The plan calls for reurbanization within the existing urban fabric, specifically on *Centers, Avenues, Employment Districts* and the *Downtown*.<sup>10</sup> This form of development will reduce the amount of congestion on Toronto's streets, "every home built within the *Downtown* area offsets the need for in-bound commuting each day. Mixed use is a key ingredient to the successful functioning of *Downtown* and by creating "accessibility through proximity", shows that moving less is clearly achievable".<sup>11</sup> If Torontonians can indeed succeed in moving less on a daily basis, then cycling can become a convenient and practical solution for the majority of urban trips. In addition to outlining a building strategy, the plan outlines a *Progressive Agenda for Transportation Change*, which suggests methods for increasing the efficiency of our road space by moving people in a variety of ways rather than solely in the motorcar. Policies are put in place to make a safer, more comfortable cycling and walking environment, including an expanded bikeway network, required bicycle parking in new developments, provision of bicycle parking at public transit stations, and improvements to road design and traffic management.<sup>12</sup>

In 2013, the city of Toronto reiterated its *Strategic Plan* by announcing 26 strategic actions to bolster the economic, social and environmental vitality of the city, again emphasizing the importance of smart growth, sustainability and diverse, vibrant communities.<sup>13</sup>

Reviewing these five closely related visions for Toronto and the larger region, one can clearly see that the bicycle complements and contributes to the proposed new way of life. The bicycle is simultaneously able to provide a sustainable alternative to the automobile, more efficiently use the space of the street and perform as a social activator, connecting people to their communities. While the municipal and provincial governments have been slow to make actual physical progress in relationship to cycling, they acknowledge its potential. The bicycle clearly embodies many of the ideals towards which the city's and region's leaders strive. Now is the time to take the next step and instigate quantifiable change.

## The Frustrated Commuter

In order to increase the number of daily cyclists in Toronto, one must begin to understand the potential cyclist, that is the person who does not currently cycle, but may be persuaded to do so. The most obvious target group is the frustrated commuter. This is the person who is fed up with their daily commute, either because of the time wasted or the experience of their trip. If these people can be convinced that cycling can provide a faster, more comfortable way to get to work, they will be more likely to try it. Statistics Canada transportation statistics show that Toronto is full of frustrated commuters, and thus is home to a multitude of potential cyclists. The potential cyclist can be organized into 5 categories: the frustrated driver, the frustrated transit rider, the hesitant cyclist, the long distance commuter and the tourist.

**50.8 min**

National average round-trip commute time<sup>14</sup>

**65.6 min**

Toronto average round-trip commute time<sup>15</sup>

**27%** of Torontonians spend over 90 minutes commuting each day.<sup>16</sup> That is equal to 7.5 hours each week or 49 work days each year.

**26%** of urban Canadians are delayed by traffic congestion every day of the week.<sup>17</sup>

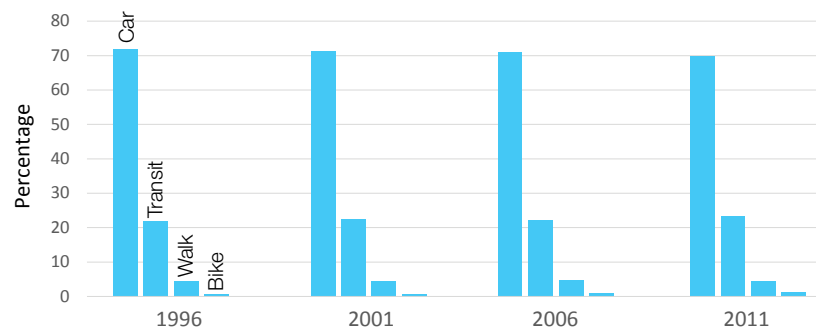


Figure 1-4 Toronto modal share 1996-2011<sup>18</sup>

Modal share has remained static in Toronto over the last 20 years.

# 1. The Frustrated Driver

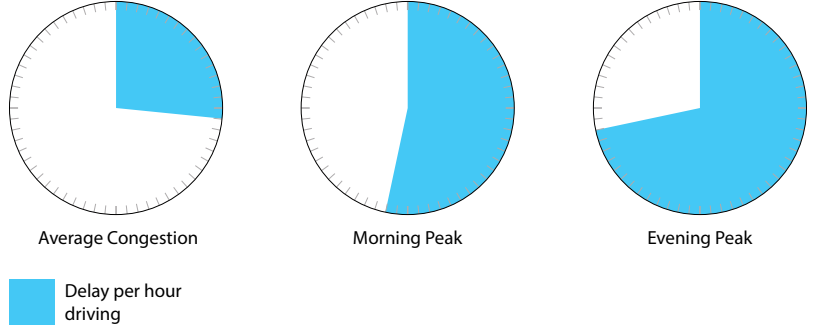
Figure 1-5 The frustrated driver



**9th** Toronto’s congestion ranking out of all North American cities<sup>19</sup> (higher ranking indicated higher congestion levels)

**2nd** Toronto’s congestion ranking among Canadian cities<sup>20</sup> (higher ranking indicated higher congestion levels)

Figure 1-6 Congestion delays per hour<sup>21</sup>



**170 hrs** per year lost to traffic congestion based on an average 60 minute round-trip commute.

## 2. The Frustrated Transit Rider



Figure 1-7 The frustrated transit rider

**4842** service outages experienced by TTC subways in 2012<sup>22</sup>

**509.5** hours of delay time from these outages<sup>23</sup>

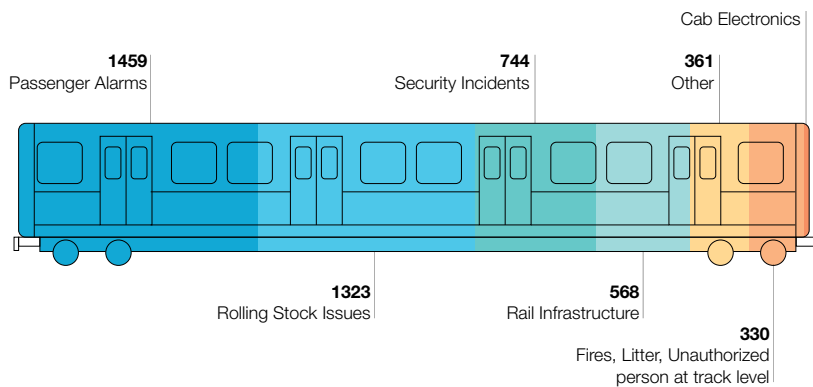


Figure 1-8 2012 TTC subway delay causes<sup>24</sup>

**28,400 people/hr**  
Current peak ridership on the Yonge subway line<sup>25</sup>

**2.2 minutes**  
Required frequency of trains to meet this demand leaves little time for delays

**35,800 people/hour**  
Predicted ridership demand by 2031 with Yonge line Subway extension<sup>26</sup>

### 3. The Hesitant Cyclist

Figure 1-9 The hesitant cyclist



**40%** of recreational cyclists could be motivated to cycle to work or school regularly, half of whom would do so if biking to work/school were safer than it is now.<sup>27</sup>

Figure 1-10 Average number of bicycles per household in Toronto<sup>28</sup>

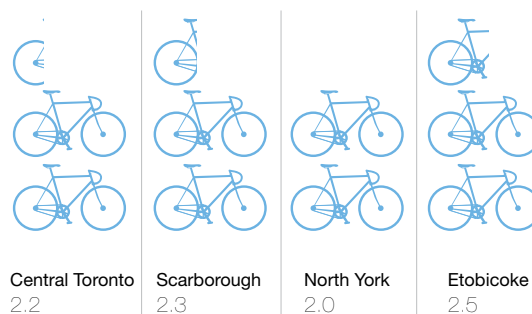
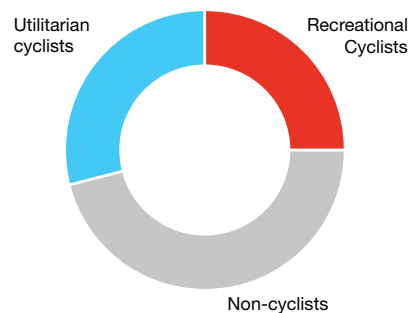


Figure 1-11 Types of cyclists in Toronto<sup>29</sup>



The largest barriers preventing recreational cyclists from using their bicycles for practical purposes are:

**Distance, inconvenience, unsafe traffic conditions, the inability to carry cargo, and the lack of bicycle lanes and paths.**<sup>30</sup>

## 5. The Long Distance Commuter



Figure 1-12 The long distance commuter

**89,650** passengers arrive at Union Station by GO train each day.<sup>31</sup> These people have to walk to their final destination or else pay for a TTC fare, or a cab.

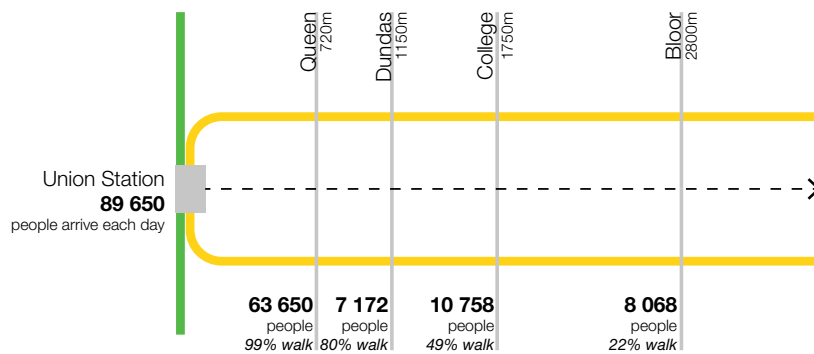


Figure 1-13 GO train commuter destination distribution<sup>32</sup>

**94,000,000** passengers per year by 2020<sup>33</sup>

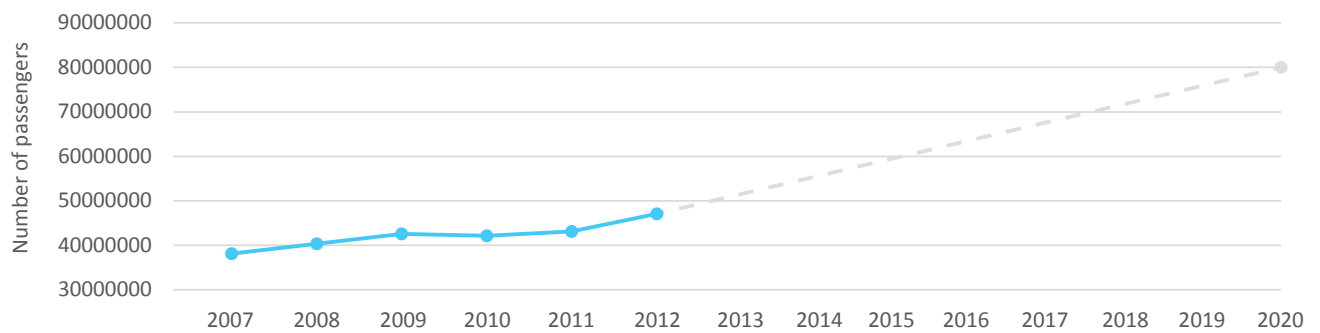


Figure 1-14 GO train ridership growth<sup>34</sup>



## 5. The Tourist

Figure 1-15 *The tourist*

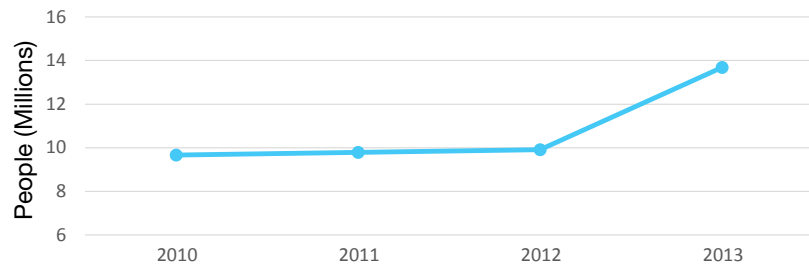


# 13,690,000

Record number of overnight visitors to Toronto set in 2013<sup>35</sup>

Bike shares can provide an excellent way for tourists to explore the city. Visitors can experience city life and not have to worry about returning their bicycles to the same location where they started. Bike shares are cheaper than taking a cab and allow for exploration along the way, unlike public transit. Additionally, guided bicycle tours can be arranged to allow visitors and locals to view the city from a new perspective. The bicycle is able to expand considerably the realm which tourists can explore.

Figure 1-16 *Overnight tourism growth in Toronto*<sup>36</sup>



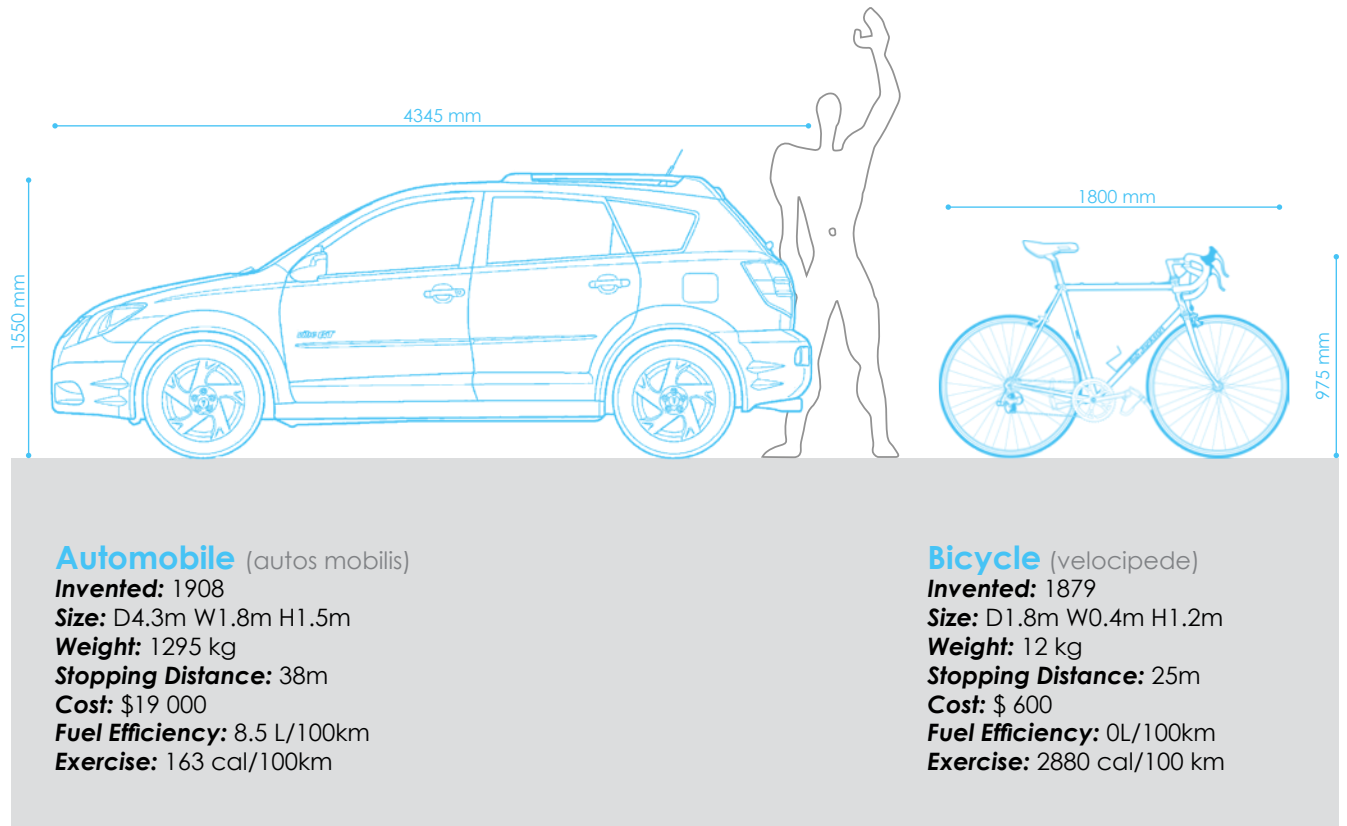


Figure 1-17 Bicycle vs Car

## Towards A Cycle City

Despite cycling’s great potential to improve urban life, and the abundance of potential cyclists living in Toronto, the city has been slow to embrace cycling as a legitimate mode of transportation. Toronto officials have generally had a no-compromise approach to cycling infrastructure, only willing to build new infrastructure once it has been proven that it will have no negative impact on any other form of transportation. As such, Toronto City Hall has mainly focused on small gestures that show a limited appreciation for the value of cycling, yet refuse to give it a prominent place in the city.

This way of thinking demonstrates a larger societal bias against the bicycle, making bicycle promotion an uphill battle. The automobile industry spends billions of dollars every year, marketing attractive lifestyles associated with their vehicles in order to attract potential consumers. In stark contrast, very little investment is put into marketing cycling to the potential cyclist. To see widespread use, the bicycle needs strong advocates who can speak as strongly for the bicycle as the auto-manufacturers do for the car. Bicycle manufacturers do not have the same financial resources or political influence as those in the automotive industry. Those who do have large advertising campaigns tend to focus on the sporting aspect of cycling above the utilitarian. Municipal

governments are in the strongest position to step up and fill this marketing gap. They can promote cycling both through marketing campaigns and through the construction of prominent new infrastructures. Advertising campaigns can promote a positive lifestyle associated with cycling by addressing the social, economic, environmental and health benefits of cycling, while simultaneously drawing attention to the current congestion in car-dominated cities. Building prominent new infrastructures also acts as a marketing tool, making cycling more visible to urban residents on a daily basis, and attracting potential cyclists through the example of existing cyclists.

Building a strong cycling culture involves a multi-faceted approach which addresses infrastructure, policy and cultural perception. A bold commitment is required from the city administration to provide the support required for potential cyclists to start a new cycling habit. In order to draw the frustrated commuter to the bicycle, city officials must look beyond the existing enthusiast cyclist, dominated by young males, and instead target strategies which make cycling appealing for the average person. A true cycling culture knows no boundaries, embracing males and females, the young and old, the rich and poor. The average person is simply not willing to bike in fast moving traffic, over long distances, or park far from their destination.

Studying other cities which have built cycling cultures over decades, researchers have been able to develop best practice guides for building cycling cultures and increasing cycling's modal share. Urban planning and policy researcher Dr. John Pucher, architect and urban design consultant Jan Gehl and Rotterdam based architects Stefan Bendiks and Aglae Degros have each published clear strategies for planners and municipal leaders to follow when developing a bicycle-conducive environment which seeks to embrace a wide cross section of society.

John Pucher emphasizes a multi-faceted infrastructure, policy and program approach with 10 key strategies for cycle promotion: <sup>37</sup>

1. Provide a comprehensive package of integrated measures
2. Build a network of integrated bikeways with intersections that facilitate cycling
3. Provide good bike parking at key destinations and public transportation stations
4. Implement bike sharing programs
5. Provide convenient information and promotional events
6. Introduce individualized marketing to target specific groups
7. Improve cyclist education and expand bike-to-school programs
8. Improve motorist training, licensing, and traffic enforcement
9. Restrict car use through traffic calming, car-free zones, and less parking
10. Design communities to be compact, mixed use, and bike-able

Jan Gehl has developed a similar strategy focusing on making cycling comfortable and convenient, so that it is inviting for all people: <sup>38</sup>

1. Develop a whole-hearted bicycle policy
2. Build a cycling network that conveniently connects to all major destinations
3. Include bicycles as part of integrated transportation thinking including public transit
4. Ensure the bicycle network is safe through separation and intersection design
5. The more cyclists on the streets, the safer cycling becomes as drivers learn to expect them
6. Ensure the cycling network is comfortable with enough space and interest, free from unnecessary irritations and disruptions
7. Introduce public bike shares
8. Host activities to promote cycling such as bike to work week and car-free days.

Stefan Bendiks and Aglaee Degros of Artgineering, a Dutch research and design firm specializing in the border between urban design and infrastructure have developed their own approach to designing successful cycling infrastructure. At a basic level, they acknowledge that bicycle infrastructure must meet certain traffic planning requirements which are outlined in the Dutch requirements for cycle infrastructure published by CROW: <sup>39</sup>

1. Cohesion
2. Directness
3. Attractiveness
4. Traffic Safety
5. Comfort

Meeting these requirements will result in efficient, safe and comfortable cycle routes, but they may still fail to entice the potential cyclist. Bendiks and Degros propose three new elements to consider in the design of successful cycling infrastructure in order to enhance the relationship between infrastructure and the experience of its context: <sup>40</sup>

1. Spatial integration
2. User experience
3. Socio-economic value

Unlike automotive freeways, which are often autonomous infrastructures, bicycle routes are much more strongly embedded in the urban context. They are not simply about getting from one place to another, but about the experience in between.

Examining these three proven and published strategies for developing strong cycling cultures, the recurring themes of **safety, convenience and**

**experience** emerge as key motivating factors in enticing people to cycle: **Safety** is concerned with *comfort*, *separation* and *visibility*.

*Comfort* deals with settling people's unease with navigating the hectic urban environment. *Separation* addresses the division of different modes of transportation to avoid conflict, and *visibility* investigates the awareness of all users where different modes of transportation come into contact.

**Convenience** is concerned with *accessibility*, *cohesion*, and *flow*.

*Accessibility* is the idea that networks and infrastructures must be available to all kinds of people and connected to major destinations including residential neighbours and employment areas. *Cohesion* calls for a unified system that is easily navigated with intuitive way finding, and *flow* accounts for the need for fast, efficient and direct movement through the network.

**Experience** is concerned with *visual impact*, *pleasure*, and *socio-economic value*. *Visual impact* refers to the prominence of cycling infrastructure within the urban environment as a form of self-promotion. *Pleasure* considers the enjoyment that comes from riding a bicycle and using cycling infrastructure, and *socio-economic value* looks at the way cycling infrastructures integrate with other aspects of urban life.

Without providing these three requirements through a combination of infrastructure, policy and programs, cycling is unlikely to be taken seriously as a daily mode of transportation in cities like Toronto. This thesis, while learning from policies and programs implemented both in Toronto and globally, focuses on the role that the design of infrastructure can play in instigating a cycling culture and fast tracking the growth of cycling rates in the city. The motivators of *safety*, *convenience* and *experience* are used throughout the thesis to examine successful cycling projects and practices in order to develop a new strategy for Toronto. All precedents in this thesis can be quickly compared using the *Cycling Motives Diagrams* an example of which can be seen in Figure 1-18. Points are used to mark the importance of each cycling motivator. When the point is located closer to the outer circle, that particular factor is either stronger, or plays a more significant role.

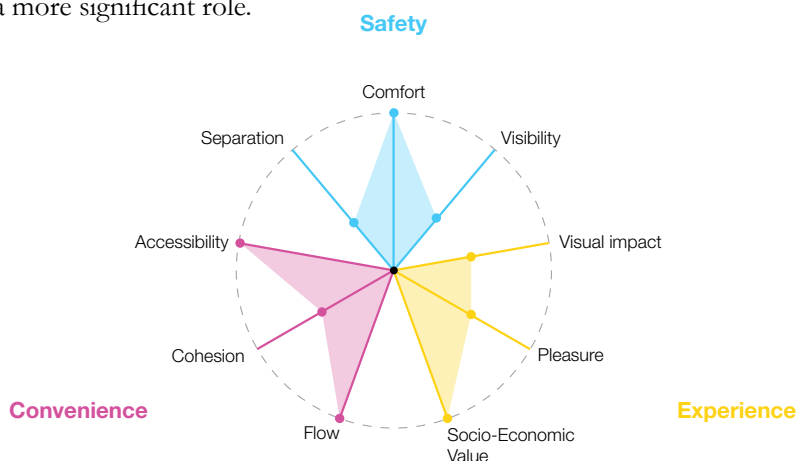


Figure 1-18 *Cycling Motives Diagram*

Urban cycling is investigated at three different scales, narrowing the view with each consecutive chapter, beginning with *Bicycle Cultures and Networks*, then zooming in to *Cycle Routes*, and finally *Supporting Bicycle Infrastructure*. Each chapter contains a case study section and a Toronto-based design-research experiment. The multi-scalar investigation allows for a contextual approach, ensuring that each infrastructure is considered in relationship to the larger cycling picture. The key to a successful cycling culture is to engage a range of different strategies which can work in synergy with each other and with their urban context.<sup>41</sup>

**Large (Ch. 2): Network and Culture** investigates factors contributing to the development of a cycling culture, the history of issues slowing the adoption of cycling in Toronto and the study of cycle flow patterns. This chapter involves case studies of cities from around the world that are prioritizing cycling, including cities such as Copenhagen and Amsterdam that have had strong cycling cultures for decades, as well as cities such as Portland and Bogotá, which have been more recently aggressively promoting cycling. This chapter ends with the design and implementation of a new GIS strategy for analyzing urban cycling patterns in Toronto in order to determine ideal locations for cycling infrastructure projects.

**Medium (Ch. 3): Cycle Route** examines how the cycling network is applied at a human scale and actualized as an urban experience. This chapter looks at innovative cycle routes from around the globe with a focus on those providing a unique, enjoyable experience to their users. A five-step route design manual is developed, which provide guidelines for implementing engaging cycle routes that are tightly integrated into the urban context. This chapter ends with the application of this manual to a proposal for a new cycle route in Toronto connecting midtown to the downtown core.

**Small (Ch. 4): Supporting Bicycle Infrastructure** focuses on building-scale cycling infrastructure in support of cycling routes. These infrastructures often act as bold statements, demonstrating the value which the city places in cycling while simultaneously providing necessary amenities. This chapter includes case studies of large-scale bicycle parking areas, inter-modal transportation hubs and cycling bridges. The chapter concludes with a design proposal for a new bicycle hub integrated with Toronto's Union Station, the highest volume transit and train station in the region.

A well-developed cycling culture goes hand-in-hand with a city-wide network of bicycle routes. An interwoven network of bicycle lanes on main streets, traffic calmed residential streets, and off-road trails can take cyclists anywhere they want to go. However, without a strong cycling

culture, the support does not exist to implement such a broad network of infrastructure. Toronto instead needs to work with a more targeted approach, focusing on individual projects located where they can have the greatest impact. As such, this thesis focuses its scope on the design of one strategically placed cycle route, carefully woven into the existing urban context and supported by prominent cycling amenities. Realizing that Toronto already has the foundation of a cycling network, this project acts as a highlight within the larger network, creating a cycling experience that transcends being merely efficient transportation. The project can act as catalyst for a larger cycling culture, proving a concept and building excitement around cycling. As people see exciting new infrastructure and witness other people enjoying cycling, they will be more inclined to try it themselves. The number of cyclists will grow exponentially until a critical mass is reached. This development encourages the city to build more infrastructure which in turn attracts even more cyclists. This natural process creates a city that values the bicycle, putting it on equal footing with other modes of transportation: a city that is cleaner, healthier, happier, more efficient and filled with vitality.





An aerial photograph of a city grid, where the streets are highlighted with glowing blue lines, creating a network pattern. The background is dark, and the overall aesthetic is modern and technical.

02

# Bicycle Cultures and Networks

L, M, S

## Urban Case Studies

Toronto can learn a great deal about the development of its own cycling culture by studying the infrastructure, policies and cultures of cities which have already taken to the bicycle. The following case studies were chosen to understand the stories of both first and second generation cycle cities. First generation cycle cities are those that have a long history of bicycle transportation, stretching back to the advent of the bicycle. Of these cities, Amsterdam was chosen for its world-renowned cycling culture and Copenhagen was chosen for the influence of strong Danish design culture on its cycling infrastructure. Second generation bicycle cities are those which have been aggressively promoting urban cycling over the past ten to twenty years. Bogotá was chosen as an example of the power of visionary leadership, and Portland was chosen for its success in increasing its cycling modal share 6 fold over 10 years to become the most cycle-friendly large city in the United States. The Cycling Motives diagrams in this chapter indicate the quality of cycling in these cities based both on their existing infrastructures and policies as well as the initiatives which are in the process of being implemented.

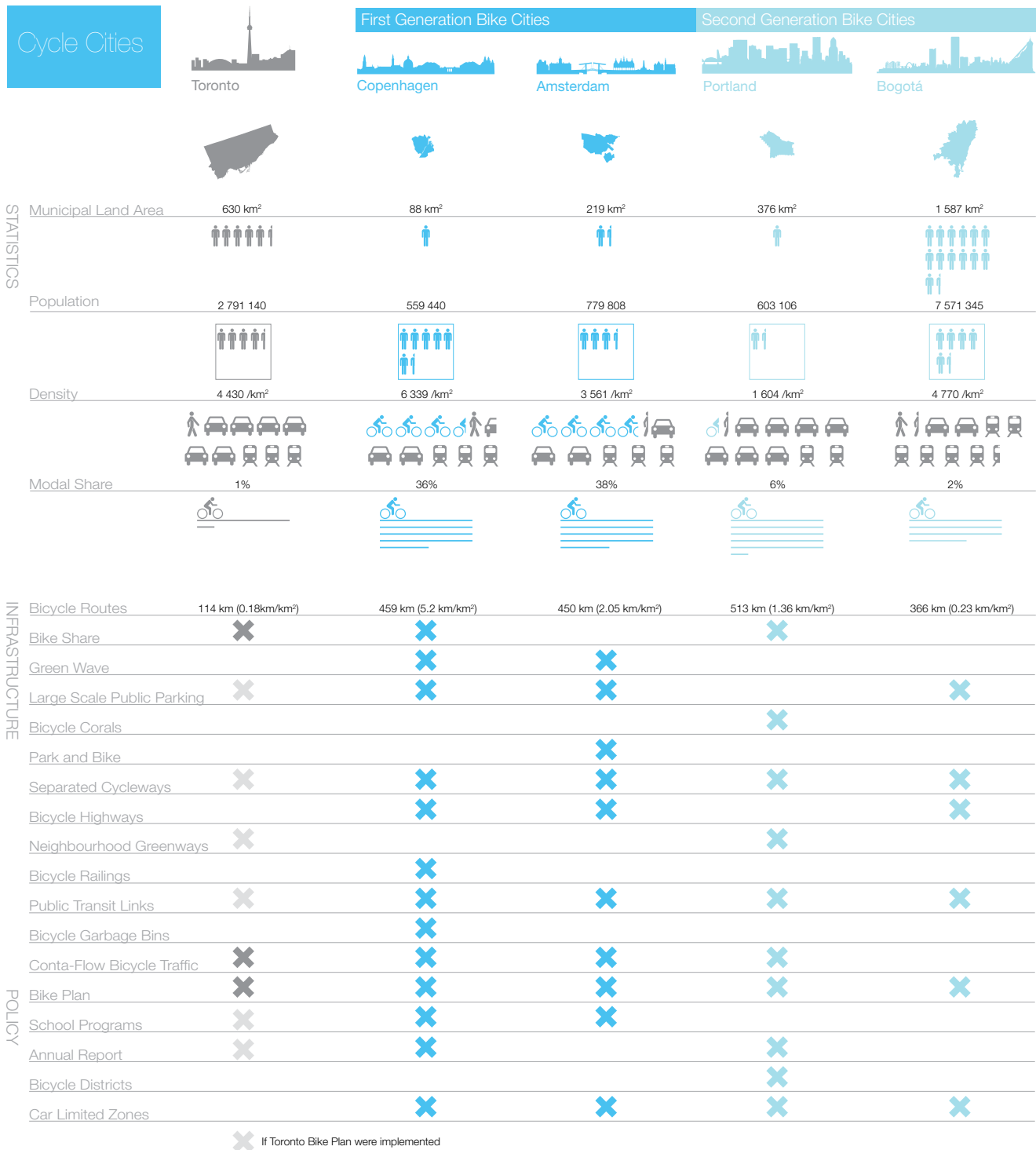


Figure 2-1 Comparison of cycle cities

# Amsterdam

Bicycle Modal Share: 38%  
 Population: 779,808  
 Age: ~900 years  
 Area: 219 km<sup>2</sup>

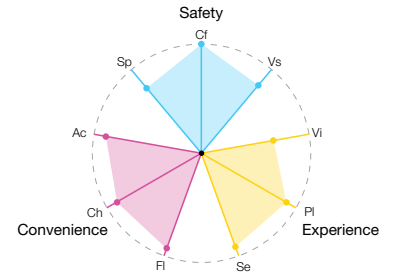


Figure 2-2 Cycling in Amsterdam: Toronto size comparison, cycle network and cycle-able radius

Amsterdam, the capital of one of the biggest cycling nations, is often viewed as the ideal cycling city. The compact layout of the historic city, combined with a flat topography and moderate climate, have created an ideal environment for cycling. 50% of all trips under 7.5 km are made on a bicycle and bicycle trips outnumber all other modes of transportation in the city. The cycling culture in Amsterdam does not discriminate; cyclists come from all age groups, genders, income groups and levels of education. Amsterdamers do not identify themselves as cyclists since the bicycle has become such an ordinary part of everyday life, like any household appliance. People just use them without having to make a conscious decision. The automobile was never able to take hold here due to the compact city form and, as a result, the bicycle is deeply ingrained in Dutch culture.<sup>1</sup>

## Strategy 1: Limit Car Use

The bicycle has been so successful in Amsterdam largely do to the inconvenience of driving. Since the 1970's, City Council has prioritized the development of cycling and public transportation while disincentivising the use of the car in the city center. These disincentives began in 1973 with car-free Sundays during the oil crisis. Today, not only is the price of gas much higher in the Netherlands than North America, but there are many more policies in place to discourage the use of cars. Parking in the city requires special permits, while existing spots are sparse and expensive. Additionally, speed limits in many areas are limited to 30 km/hr and many streets are designated one-way for cars while allowing bikes to travel in both directions. Some streets are completely off limits to cars.<sup>2</sup>

## Strategy 2: Adapt Historic Centre

The main reason for the explosion of cycling in Amsterdam can be attributed to the geometry of the city's urban fabric. The city was designed around a fine-grained canal system with roads made for horse and carriage. This structure simply did not have enough space to accommodate widespread automobile use. Bicycles, on the other hand, were perfect for fitting into small spaces and navigating the narrow bridges without adding too much congestion. The only way to make the city more accessible for cars would be to demolish many historic buildings in order to widen the roads. Instead, the people choose to bike.<sup>3</sup>

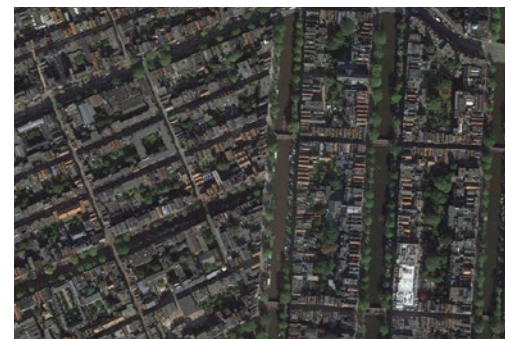


Figure 2-3 Amsterdam's tight urban fabric

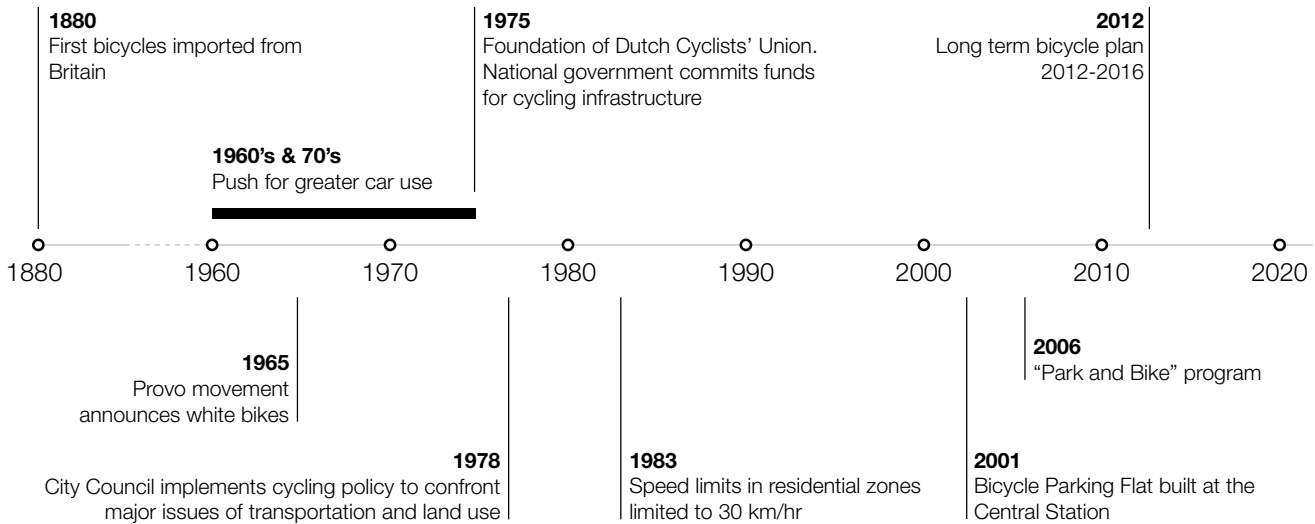


Figure 2-5 Amsterdam Cycling Timeline

### Strategy 3: Multi-modal Solutions

Recently, like many other cities, Amsterdam has experienced an increase in jobs within the city center. This phenomenon typically results in an increase of commuters driving long distances from the surrounding municipalities. Amsterdam dealt with this challenge by encouraging the multi-modal commute. As part of the park and bike program, a series of parking garages were built on the outskirts of the city where commuters can swap their cars for bicycles. Similarly, train stations across the Netherlands are equipped with bicycle parking allowing commuters to split their travels between bike and train. The Central Station in Amsterdam is equipped with a large bicycle flat with parking for over 2500 bikes.<sup>4</sup>



Figure 2-4 Bicycle Flat at Amsterdam Central Station

### Strategy 4: Listen to the Citizens

The Dutch have a history of standing up for what they believe in, and they believe that the bicycle is an important part of their culture which contributes to their high quality of life. In the 1960's the extreme Provo movement proposed to remove all motorized vehicles from the streets and launched the first bike share program called the White Bicycle Plan. Though the plan was never realized, the story of the white bicycle became a legend in cycling communities across the globe. In the 1970's, when authorities were looking to demolish parts of the city to make way for larger motorways, the people of Amsterdam said no and a new generation of young politicians rose to power standing up for a more livable city with a focus on health, safety, and accessibility for a high quality urban life.<sup>5</sup>

### Strategy 5: National Support

Cycling in Amsterdam is supported not only by the municipal government, but also at the national level. Since 1975, the Dutch government has provided funds to support urban and rural cycling infrastructure. 1975 also saw the founding of the Fietsersbond, the Dutch Cyclists' Union. The union, with its 150 local branches, campaigns for better cycling conditions throughout country. The union has been instrumental in lowering speed limits, building bicycle parking at train stations, developing route planners and identifying areas of route disrepair. The strong partnership between the municipal and national governments has been essential in streamlining improvements to the cycling network.<sup>6</sup>

# Copenhagen

Bicycle Modal Share: 37%  
 Population: 559,440  
 Age: ~900 years  
 Area: 88.25 km<sup>2</sup>

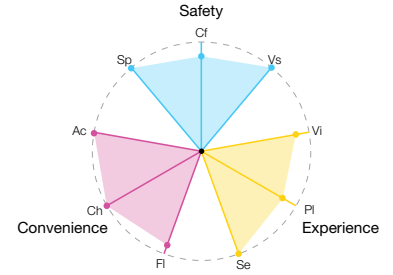


Figure 2-6 Cycling in Copenhagen: Toronto size comparison, cycle network and cycle-able radius

Copenhagen is one of the most iconic cycling cities in the world, studied by almost every other city that is trying to promote commuter cycling. Its instantly-recognizable blue separated cycle tracks are seen as the gold standard of cycling infrastructure world-wide. However, Copenhagen wasn't always this way. Despite its long cycling history, during the 1970's the city was overthrown by the automobile and space was taken away from cyclists. The city was halted by congestion, parked cars filled all public squares, and children were being injured in countless traffic accidents across the country. Copenhagen is a great example of a city which has completely turned itself around, realizing the limitations and flaws of a car dominated society and shifting it's focus to pedestrian, cycle friendly streets for a more livable city. This high quality urban life has become the city's defining characteristic and main tourist attraction.

## Strategy 1: The Power of Design

The Danish have a history of a very design oriented culture and are quite familiar with using design as a problem-solving tool. Beyond their iconic and cohesive blue cycle track network, Copenhagen has demonstrated the power of design to encourage cycling with buildings that incorporate cycling right to ones door, elaborate and exciting bicycle parking at transit stations and shopping destinations, as well as creative bridges and tunnels which create cycling shortcuts and avoid conflict with automotive traffic. The design culture also extends to the way that Copenhageners view the bicycle. While the bicycle is seen as a tool of everyday life, it is also seen as a means of self expression and a fashion statement. The blog *Cycle Chic* documents this relationship between cycling and fashion in Copenhagen and has spread to other cities all around the world.<sup>7</sup>

## Strategy 2: Cycle Highways

In order to increase the number of cyclists within the city, Copenhagen has expanded it's view beyond the traditional city limits to provide longer distance commuters with the possibility of cycling to work. To achieve this, the city had teamed up with the surrounding municipalities to build a series of direct cycle highways flowing into the city center. These cycle highways connect nodes of residential development to major employment destinations as directly as possible with few stops in between. The highways entice potential cyclists by providing a safe, and comfortable experience, while maintaining competitive commute times compared to other modes of transportation.<sup>8</sup>



Figure 2-7 One of Copenhagen's cycle highways

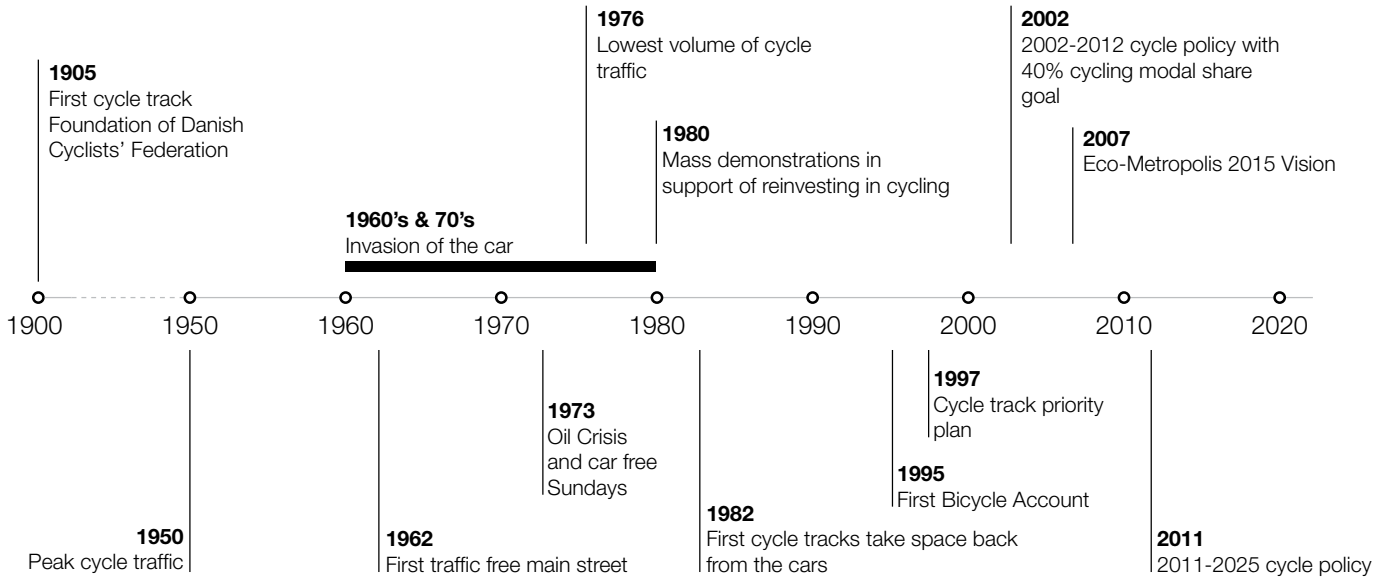


Figure 2-8 Copenhagen Cycling Timeline

### Strategy 3: The Power of Data

Copenhagen has learned the value in using data collection to validate planning and design decisions as well as to analyze their effectiveness. This strategy is often used in other cities in relation to traffic flow, but Copenhagen has, since 1968, collected and published observational data about the way pedestrians use public space and, since 1995, collected and published data related to cycling conditions. These studies began as independent research by parties such as Gehl Architects, but have since been taken on by the city. The collected data is published and given to politicians, architects and planners to inform their decisions. This data driven method has since been applied to many other cities around the globe.<sup>9</sup>

### Strategy 4: Pedestrian Only Zones

In 1962, amongst much heated debate, the city of Copenhagen closed its historic main street to traffic. People were concerned that such a street would suffer from lack of activity and did not belong in Copenhagen's culture or climate. Jan Gehl collected data to analyze the effect of this move and discovered that in fact the removal of cars enhanced the quality and use of public space. The city became more lively at all times of day, the number of cultural activities greatly increased, and the shops received more business than ever. These findings resulted in more streets being pedestrianized, growing by 400% from 1968 to 1995.<sup>10</sup>



Figure 2-9 Copenhagen's car-free Stroget district

### Strategy 5: A Comprehensive and Clear Strategy

Copenhagen's successful cycling culture has come from a clear and comprehensive bicycle planning strategy that is constantly re-evaluated and updated based on current conditions and achievements. The current bicycle modal share target has recently been increased to 50%. Copenhagen's bicycle strategy has become so iconic that the term "Copenhagenize" is often used to describe bicycle improvements to other cities. At the heart of this strategy is the strong belief that separated cycle tracks on both sides of the road are the best way to make cyclists comfortable and safe. Statistics have proven that as the total km of cycle tracks as well as the number of people cycling increases, the number of accidents and level of risk decreases. Having built a strong foundation of cycle tracks on all major roads, Copenhagen has shifted its focus to a clear strategy for refining its network that calls for increasing comfort and sense of security while decreasing travel times.<sup>11</sup>

# Bogotá

Bicycle Modal Share: 3%  
 Population: 6,778,691  
 Age: ~500 years  
 Area: 1,587 km<sup>2</sup>

**“A bikeway is a symbol that shows that a citizen on a \$30 bicycle is equally important as a citizen on a \$30,000 car.”**

Enrique Penalosa

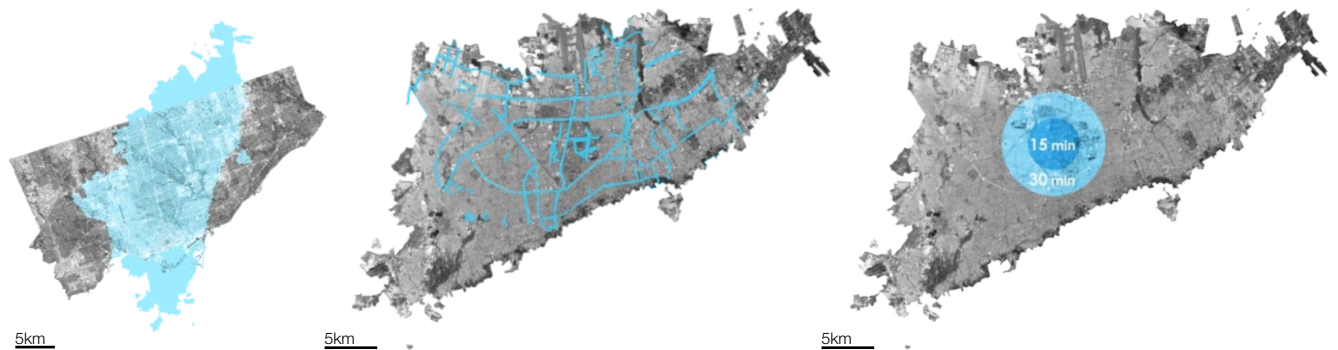
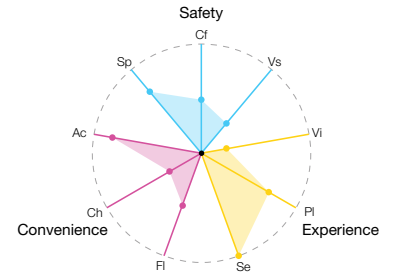


Figure 2-10 Cycling in Bogotá: Toronto size comparison, Cycle network and cycle-able radius

Bogotá is a city in Columbia whose urban form, at first glance, does not seem to suit cycling. Much like Toronto, Bogotá is a byproduct of urban sprawl, but in a very different cultural and economic context. Millions of poor rural immigrants moved into the city, creating a surge in population density. This rapid growth resulted in a divided city with a spatial separation between the rich and the poor and little quality public space. To make matters worse, the 60’s and 70’s saw a surge in motorcar use by the middle and upper classes which quickly clogged the city’s poorly designed roadways and filled the public realm with congestion and pollution. In a mere decade, beginning in the mid 90’s, the city was able to use the bicycle to kick-start a major turnaround in the city’s development and bring a new focus to the value of the street and public space.

## Strategy 1: Open the Streets

In 1974, Bogotá introduced the world’s first open streets event known as *Ciclovía*. Today, over 121 km of streets are closed to automobiles from 7am to 2pm on Sundays. These events attract millions of residents from all demographic groups to get out and safely explore their city on foot, roller blades, skateboard and bicycle. The city provides free bicycle repair, health information and other services, while impromptu street performances and food vendors line the streets and fill the public squares.<sup>12</sup>



Figure 2-11 Ciclovía

## Strategy 2: Visionary Leadership

The dramatic shift in values in Bogotá was only made possible because of a top-down visionary leadership approach. In 1991, the new constitution of Columbia provided all citizens with the “right to public space”. The preceding two mayors, Antanas Mockus, elected in 1994, and Enrique Penalosa, elected in 1997, took this right very seriously and regarded cycling promotion as an important step in providing high quality public life. Mockus implemented many programs to foster a “culture of citizenship”, while Penalosa directed substantial funding to concrete infrastructure projects including an extensive bicycle network. Unfortunately, policy and infrastructure alone, cannot make everyone want to cycle instantly; rather deeper social issues of perceived safety in the city’s neighbourhoods and the social status of car ownership need to be overcome for a cycling culture to fully blossom.<sup>13</sup>



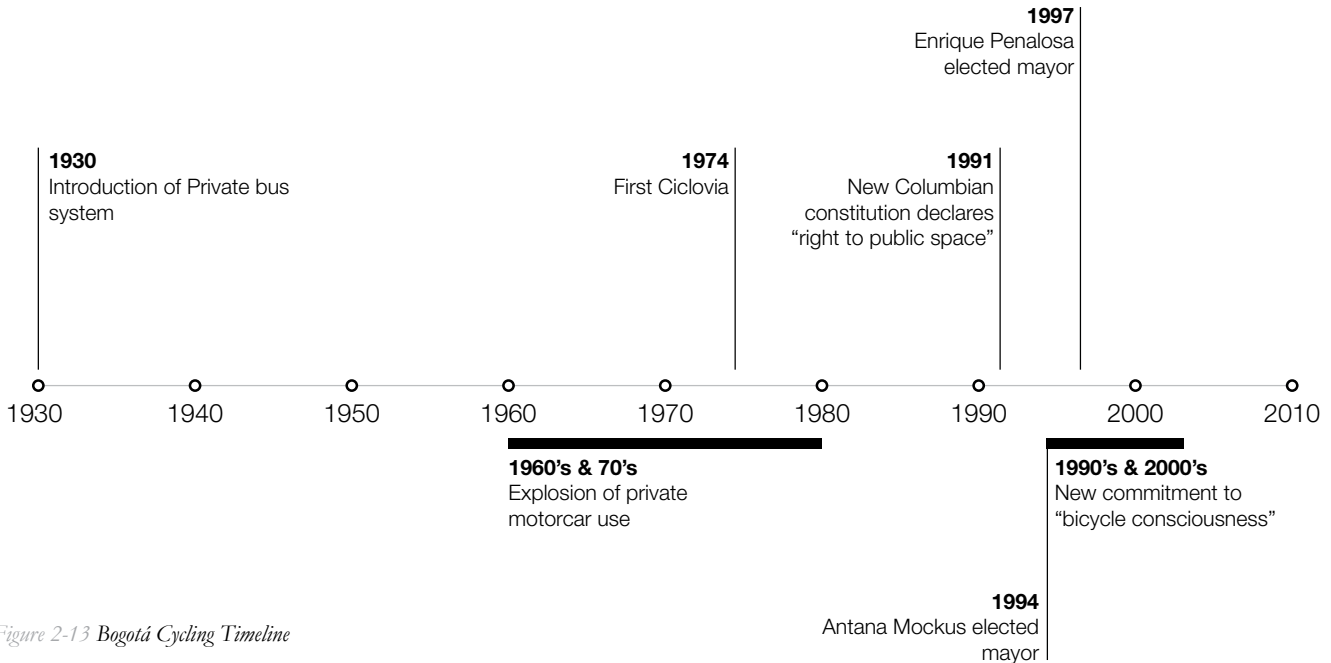


Figure 2-13 Bogotá Cycling Timeline

### Strategy 3: Curb the Automobile

Bogotá not only implemented measures to promote a “bicycle consciousness”, but also made cycling more appealing by creating disincentives towards driving. Gasoline taxes have increased, car free days such as *Ciclovía* have grown, and a restriction has been put on automobile owners that only 40% of the city’s cars can circulate the roads at certain times.<sup>14</sup>

### Strategy 4: Build a Cycling Network

Bogotá quickly built a 350 km city-wide network of dedicated cycle tracks advised by international experts from the Netherlands. These paths connect many of the city’s high density neighbourhoods to commercial and cultural centers. The routes are enhanced by a system of signage and way-finding. Unfortunately these routes are still only used by a minority of people due to the relatively long distances between destinations in the city and safety concerns where the routes intersect with chaotic streets.<sup>15</sup>



Figure 2-12 Bogotá Cicloruta

### Strategy 5: Don't Stop

Since Mockus’ tenure as mayor ended in 2003, the growth of cycling has stagnated in Bogotá at a modal share of 3-4%. This trend is in large part due to a slowing of political momentum in supporting the continued development of new infrastructure, but is also due to a cultural view that cycling is both dangerous and a symbol of poverty or inability to afford a car.<sup>16</sup> While people enjoy the many benefits of cycling, they are not ready to fully embrace it as a city until cycling is accepted as a social norm across all demographics. In order for this perception to change, the government must continue to provide support and motivation through continued infrastructure investment, new policies and social programs. Cycling has certainly improved the quality of life for Bogotans, but it has yet to reach the critical mass necessary to really take off. Toronto faces similar challenges, but appears to be in a better place in terms of cultural values to move ahead and accept the bicycle.

# Portland

Bicycle Modal Share: 6%  
 Population: 609, 456  
 Age: 163 years  
 Area: 375.8 km<sup>2</sup>

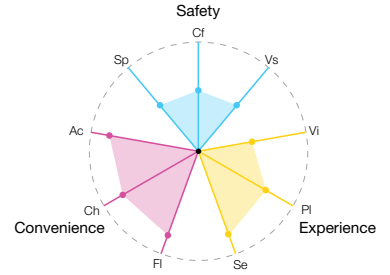


Figure 2-14 Cycling in Portland: Toronto size comparison, cycle network and cycle-able radius

Portland is considered to be the number one cycling city in the United States with over 6% cycling modal share. The city has been strongly promoting cycling since the early 1970's with the formation of a bicycle advisory council, and the publication of its first bicycle master plan. The city has been blessed with long-standing and consistent support on the political front. Portland is a unique city compared to many of its American neighbours. The people are generally quite liberal and open-minded, creating strong grassroots organizations which serve as advocates for change. It is a city with many startups, and a testing-bed for new ideas. As such, cycling fits much better with the city's mentality than it does with mainstream American culture.<sup>17</sup>

## Strategy 1: Identify your Target Groups

The city of Portland succeeded in increasing its cycling user-base by strategically targeting the potential cyclist whom it hoped to attract. The city identified four kinds of people in relation to cycling: the *Strong & Fearless*, the *Enthusied and Confident*, the *Interested but Concerned* and the *No Way No How*. The *Strong and Fearless* would cycle in almost any condition, so they are not a major concern for increasing the number of cyclists on the street. Portland's first round of bicycle infrastructure improvements addressed the *Enthusied and Confident* cyclist by adding bike lanes to major arterial roads which provide encouragement and safety for cyclists. Portland then realized that the largest group of potential cyclists actually lies in the *Interested but Concerned* people, so the city has shifted its strategy to developing quiet, low-traffic bicycle boulevards where these riders feel more comfortable.<sup>18</sup>

## Strategy 2: Build to your Strengths

In developing a bicycle planning strategy, Portland looked not only to what other cities were building, but also to the specificities of its own urban fabric. Portland was designed with a tight grid of relatively narrow streets. As such, the Netherlands' gold standard of separated cycle tracks along major streets did not fit well, and would inhibit vehicular traffic flow. The city chose instead to focus on a comprehensive network of bicycle boulevards; quiet, low-volume, bicycle priority streets running directly adjacent to major arteries and destinations.<sup>19</sup>



Figure 2-15 Portland's bicycle network with bicycle boulevards shown in green

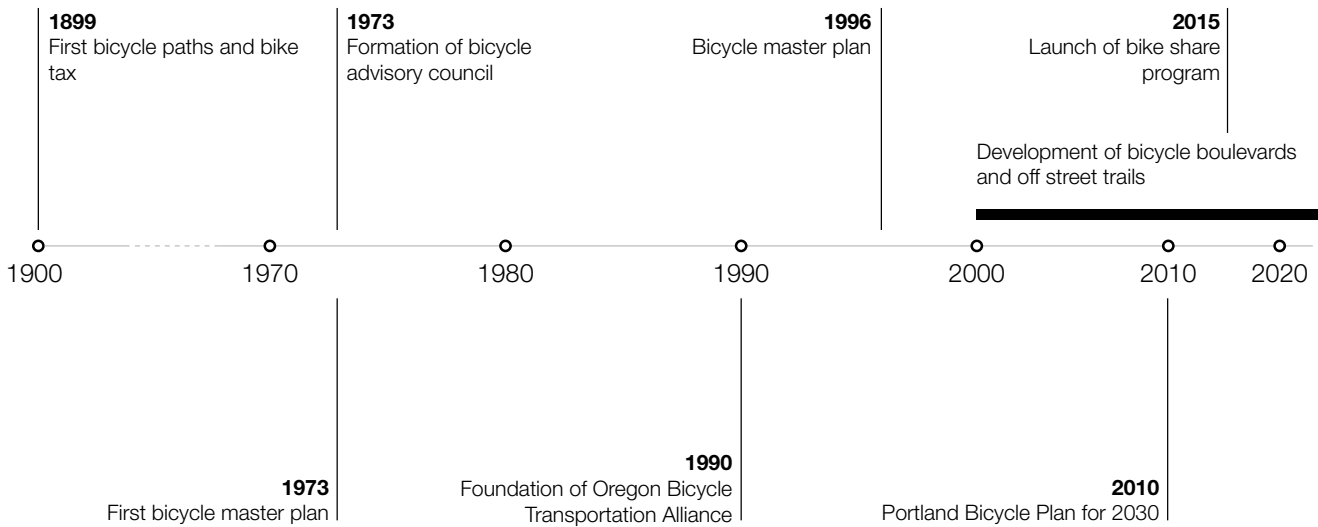


Figure 2-16 Portland Cycling Timeline

### Strategy 3: Pilot Projects

With so many stakeholders now involved in making decisions about urban infrastructure, Portland has learned that the best way to build support for cycling infrastructure is through pilot projects. This strategy has now been adopted by many other cities, including Toronto. Temporary cycling infrastructure is implemented on a portion of a proposed route, so that its effectiveness can be statistically analyzed, different strategies can be tried, and feedback can be received from its users. If successful, then the project can be improved and implemented in full.

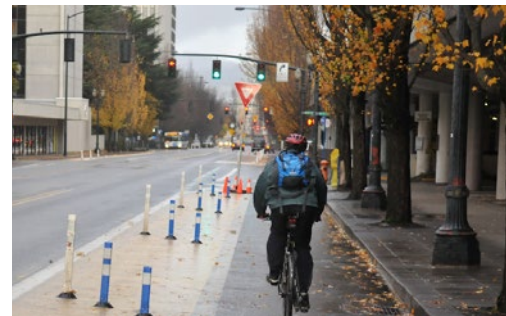


Figure 2-17 Separated cycle track pilot project

### Strategy 4: Maintain a Clear and Up-to-date Policy

Since 1973, Portland has had a strong political push to develop its cycling culture. Unlike Toronto, Portland did not just lay out a cycling plan and then fail to follow through. Instead, the city constantly reevaluates its position and goals in relationship to cycling. After the initial 1973 plan, the city developed a new plan in 1996 followed by an overhaul in 2010. The 2010 plan contains a 20 year vision with a comprehensive approach including policy, infrastructure, promotion and education that looks to boost cycling's modal share to 25%. To keep the plan on track, the city publishes detailed annual reports to track progress and results. This approach allows the plan to constantly grow and change rather than being a static, outdated vision, and ensure that strategy is turned into an achievable schedule for implementation.

### Strategy 5: Develop Beyond The Bike Path

In looking to improve cycling conditions, Portland has looked beyond the implementation of bicycle infrastructure to the bigger issue of urban structure. The city has classified new "bicycle districts" with dense mixed-use development which is conducive to cycling. Bicycle districts, chosen based on current statistics and future projections, will be developed to provide exceptional quality cycling routes on all roadways. A trend has already started in the city where developers and business owners are seeing the potential in cycling and are choosing to locate themselves based on exposure to high-quality cycle routes. These new developments are often equipped with bicycle parking, showers and other cycling amenities. Whole mixed-use communities have been developed in some areas to attract cycling residents.<sup>20</sup>

# Cycling in Toronto

## Bicycling Policy and City-led Initiatives

Toronto came to realize the importance of the bicycle revolution quite early, establishing the *Toronto City Cycling Committee* in 1975. The committee started many successful initiatives such as bike week, educational programs, bicycle friendly businesses, neighbourhood tours, bicycle art auctions, parades, demonstrations, festivals, and lectures. Between 1987 and 1993, the number of bicycle trips in the Toronto central area increased by 75%<sup>22</sup> and in 1995, the city of Toronto was named best cycling city in North America by *Bicycling Magazine*<sup>23</sup>. In 1998, major political change came to Toronto with the amalgamation of the 6 municipalities of Metropolitan Toronto into a single municipality. The more car-dominated suburban communities, which were less suited for cycling at the time, now had to share tax dollars and political decision-making with the more cycle-friendly old Toronto. Nevertheless, in 2001, the city of Toronto developed an extensive and ambitious 10 year plan to increase cycling rates throughout the city in the form of the *City of Toronto Bike Plan*. The plan outlined a comprehensive catalogue of infrastructure and initiatives to be rolled out incrementally, with the goal of doubling the number of bicycle trips in the city by 2011. Initiatives were organized around six categories: bicycle friendly streets, the bike-way network, safety and education, promotion, cycling and transit, and bicycle parking. The most impressive, yet also most costly part of the plan was a 1000 km bikeway network, stretching across the entire city as illustrated in Figure 2-20. In physical terms, “This translates into a bike-way network that is a grid of north-south and east-west routes spaced approximately two kilometers apart.”<sup>24</sup> The plan also envisioned strong and seamless connections between the bicycle and transit networks, in order to facilitate cycling for people with longer commutes. The City Council envisioned Toronto would, “become a city where many people can combine cycling and transit on their commute to and from work, and where safe and secure bicycle parking is available at all cycling destinations across the city. It will be a city that is more livable for its residents, and one that also respects and promotes the environmental, social and economic benefits that cycling can offer. It will be a leader in promoting the use of the bicycle, and also delivering traffic safety and educational programs to both motorists and cyclists of all ages. Toronto will be a city where cyclists and motorists are more respectful of each other.”<sup>25</sup>

Despite this grand vision, the city has built only 109 km of the 495 km of bike lanes which were planned to be part of the 1000 km bicycle network by 2011.<sup>26</sup> Figure 2-19 shows the actual footprint of built cycling routes compared to the routes which had been proposed to be completed by 2011 as shown in Figure 2-20. Currently, cycling rates remain quite low at 1.3% of the city’s modal share.<sup>27</sup> In addition, very few TTC or GO

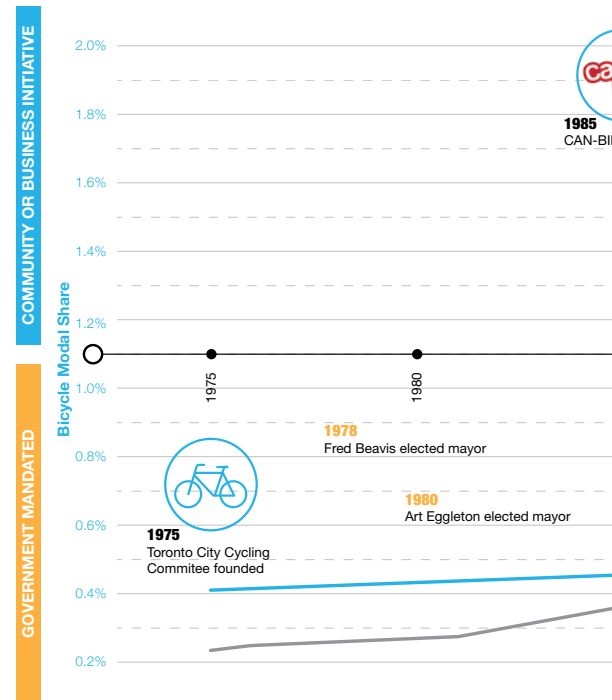
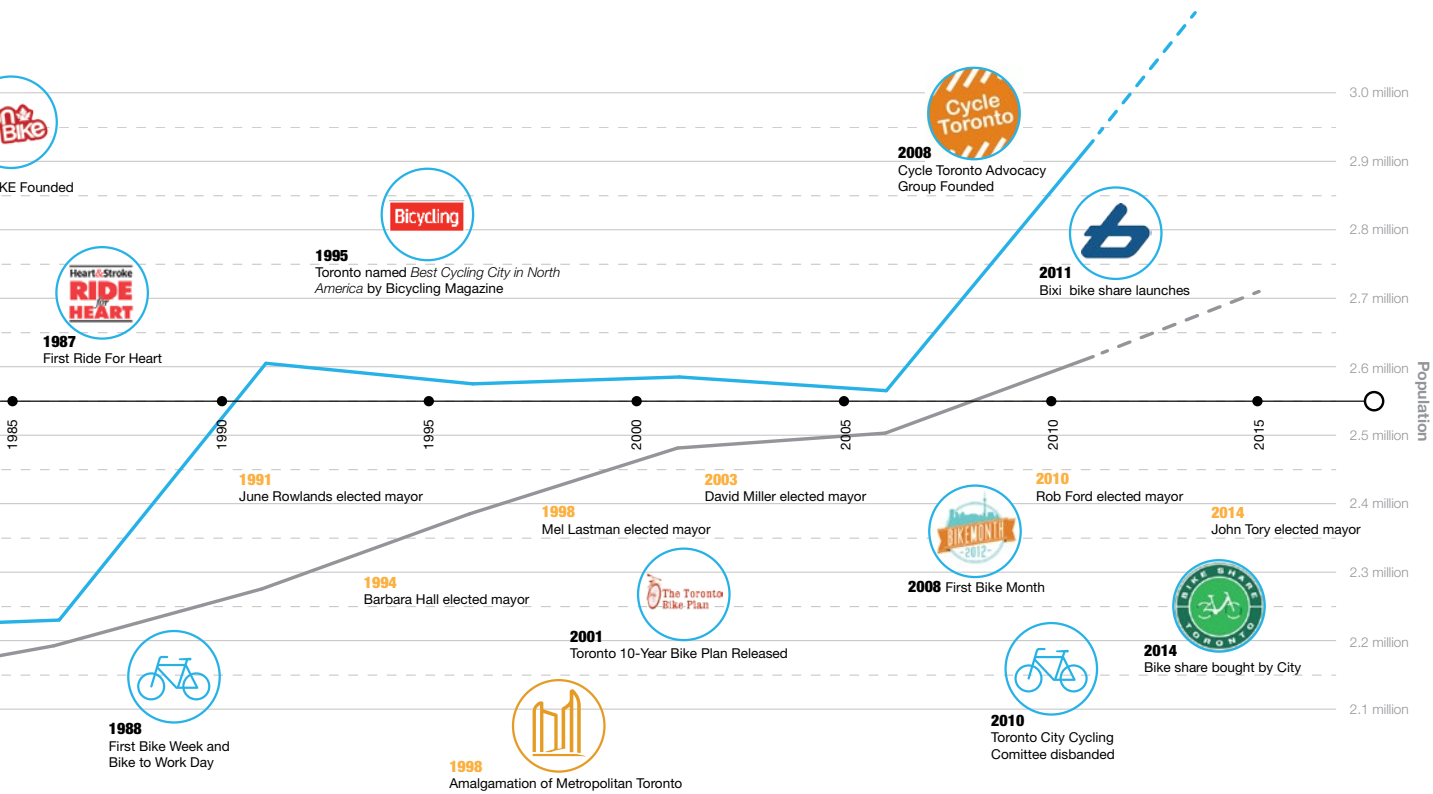


Figure 2-18 Timeline of Toronto cycling politics



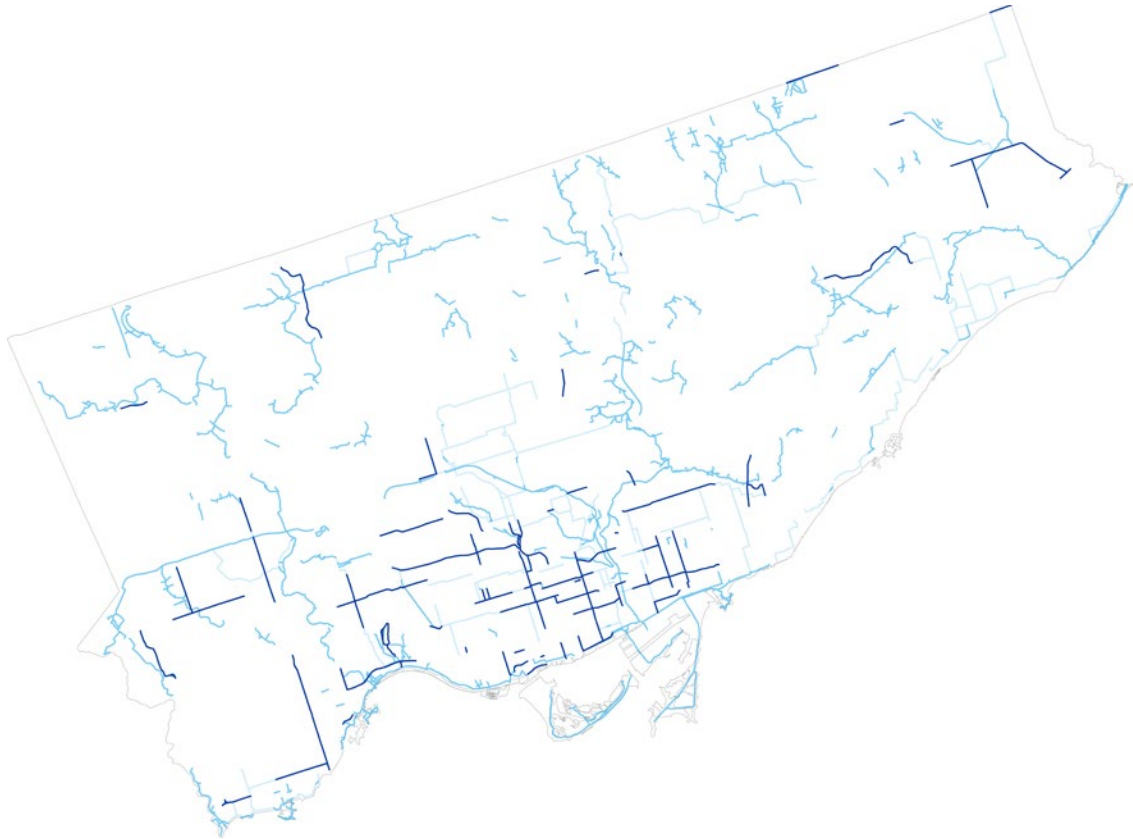


Figure 2-19 2013 City of Toronto bicycle routes

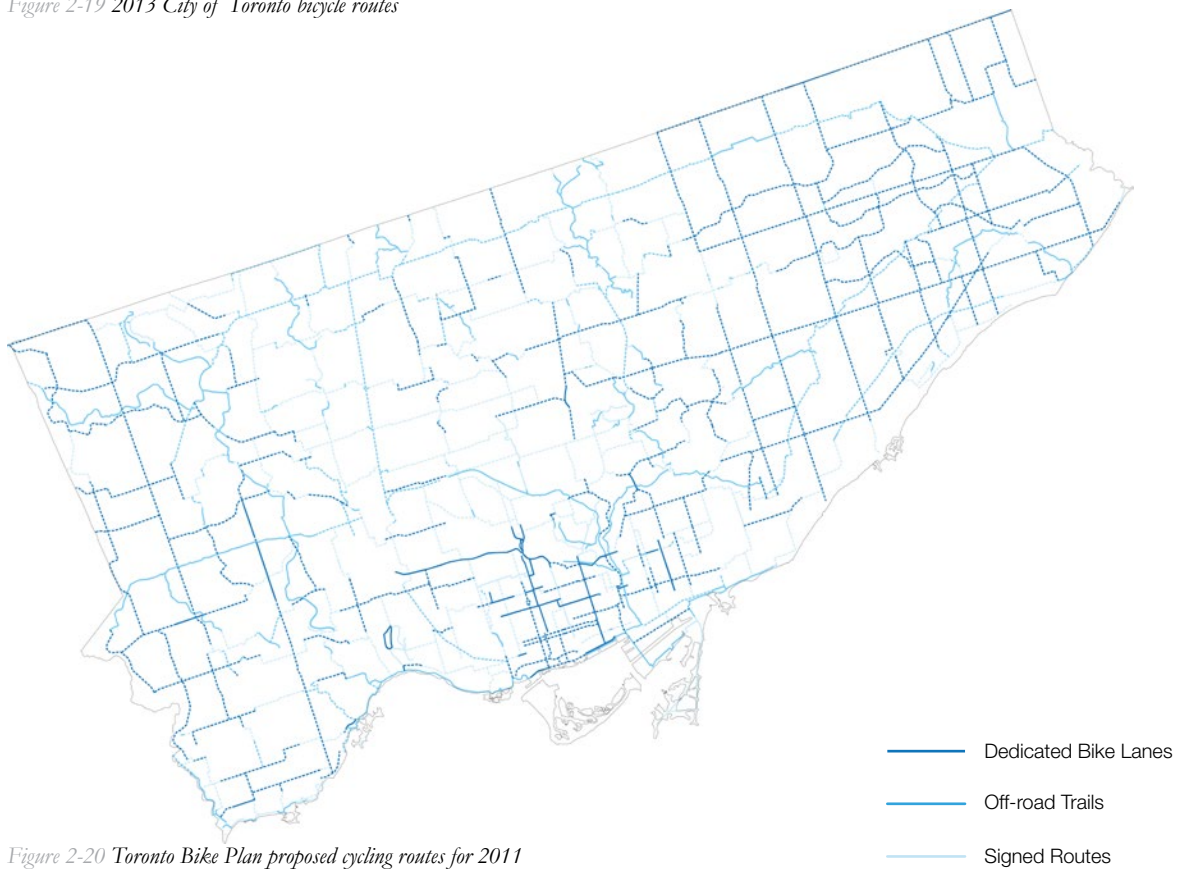


Figure 2-20 Toronto Bike Plan proposed cycling routes for 2011

stations adequately accommodate cycling, both in terms of parking and transportation. Few stations have secure bicycle parking and bicycles are only allowed on TTC vehicles during off peak hours, hardly encouraging multi-modal commuting. While advocacy groups continue to make progress in pushing for more bicycle routes, some existing routes such as the Jarvis Street bike lane have actually been removed at great expense. The city's administration disbanded the *Toronto City Cycling Committee* in 2010 when Rob Ford was elected mayor. He has since revised the city's approach to cycling in an updated plan released in 2011 as part of his overall transportation plan. The section entitled, *A Sensible Plan for Bike and Walking Trails*, outlines two strategies, neither of which prioritize cycling. The first strategy calls for 100 km of new trails along rail and hydro corridors and ravines. While beneficial to recreational cyclists and some commuters, these trails generally relegate cyclists to the periphery of the city rather than giving them space in the urban core. A cycling GIS study done in partnership with the University of Kentucky and McMaster University finds that, "off-road paths are used infrequently by the commuter cyclist...efforts to accommodate current commuter cyclists should be focused on improving cycling conditions on the road networks"<sup>28</sup>. Toronto's revised bike plan could do well to learn from these findings. Instead, the plan's second strategy involves building bicycle lanes to connect some breaks in the existing network, but only where they do not impede traffic flow and only where the community supports them. This strategy is not nearly ambitious enough and tends to favour the needs of the car.

Despite this limited approach, the potential of cycling has emerged in the downtown core. During evening rush hour on September 19th of 2013, advocacy group, *Cycle Toronto*, performed a traffic count on College Street and concluded that bikes maintained a 48% modal share over the 2 hour period<sup>29</sup>. This statistic provides hope that there is potential for cycling to reach higher levels in other parts of the city as well.

In 2011, the Bixi public bike share began operating with 800 bikes distributed across 80 stations in the downtown core. The bike share opened up the potential for cycling to a whole new segment of the population, including people who do not own bikes, tourists, and people commuting by transit from outside the city. The bike share was initially owned and operated by Bixi, the operator of Montreal's own bike share. Like most other bike shares, Toronto's program operated on a base daily, monthly, or annual fee which allowed for unlimited trips under 30 minutes in duration. The program turned out not to be financially viable for Bixi, but the city fortunately stepped in and the Toronto Parking Authority took over in March of 2014. The city has since hired Alta Bicycle Share to manage the system. Despite its relative success, the bike share's impact on cycling in the city has been limited by its narrow reach, covering only the downtown core and by its expensive pricing structure. Under the new ownership, the pricing has been made more attractive with sales for \$50 annual memberships, but the coverage is still mostly

limited to the area between Bathurst Street, Jarvis Street, Queens Quay and Bloor Street. In order for the system to expand physically, it needs a larger user base which will likely only come with increased bike lanes and other infrastructure in close proximity to the bike share stations.

Despite some efforts to realize the potential of cycling, such as starting the Toronto bike share, the question remains, why the 2001 bicycle plan was not fully implemented, and why it failed to create a widespread cycling culture among Torontonians? The direct cause of the failure for the plan can be traced to a lack of funding commitment to meet projected costs. This lack of funding stems from a lack of political will. Cycling was not seen as a priority by the majority of City Councillors, especially since the majority of Torontonians are drivers, not cyclists. While the bike plan had many promising ideas to improve cycling safety and efficiency, it ultimately did not have sufficient specific direction to ensure implementation. Most of the initiatives proposed were generic, large moves to be applied across the city, rather than targeting specific local needs of cyclists. The plan was more of a best practices guide, which never moved beyond the conceptual towards specific project proposals.

Without a clear hierarchy of projects, procuring funding required to make significant progress is difficult. The plan's strategies could never succeed holistically if a certain excitement and identity around cycling was not first built up at a smaller, more local level. Developing this excitement and identity is where the role of design can contribute, an important consideration which was not thoroughly investigated in the 2001 *Toronto Bike Plan*. Site-specific demonstration projects have the potential to build excitement and public interest, while being much more feasible than a comprehensive city-wide plan. Once one successful, well designed project is implemented, it can act as a catalyst for cycling culture within the city, spurring interest in further development, tackled piece by piece until the whole city is able to realize the potentials of cycling. The 2001 Bike Plan sets up many insightful questions and makes positive recommendations, but ultimately makes very few specific decisions.

### GPS Cycle Tracking App

Acknowledging the flaws in the current bike plan, the city has been working on an updated plan which will be released in 2015, focusing on targeting more specific areas in downtown and North York. To support this plan, the city of Toronto launched a smartphone app in May of 2014, to track the movements of the city's cyclists with the intention of using existing trends to determine where new infrastructure is most needed. The app uses an optional survey to collect data about users' personal information and cycling habits. Users have the ability to record their trips with the tap of a button. These trips are automatically uploaded to the city's database. As of November 2014, over 45,000 trips were collected from over 3000 different cyclists. The city intends to use the data to inform the expansion of the cycling network. The app will remain active in the future to evaluate and analyze the effectiveness of new infrastructure projects.<sup>30</sup>



Figure 2-21 Toronto's cycling app for iPhone and Android



## Bicycling Advocacy

Not satisfied with the progress and initiatives made by the city, citizens have organized themselves to advocate for the benefits of cycling and the infrastructure required to support its growth. These advocacy groups became even more important since City Council eliminated the *Toronto City Cycling Committee* in 2010.

In 2008, the *Toronto Cyclists Union* was founded and later rebranded as *Cycle Toronto*. The union provides a city-wide platform for co-ordinating and organizing all cycling advocacy. The union focuses its efforts both towards communicating with City Hall and working directly with the general public. The group has a goal of increasing cycling's modal share in Toronto to 5% by 2016<sup>31</sup>. *Cycle Toronto* runs a series of campaigns including: advocating for a minimum grid of bike routes as outlined in the 2001 Bike Plan, encouraging the construction of protected bicycle lanes, building support for specific new cycle routes such as the Eglinton Connects project, and improving winter maintenance for cycle routes. The union has also launched an advertising and information campaign aimed at encouraging more people to cycle, advocating that cycling is not just for the hardcore, but for people from all walks of life. Additionally, the union runs programs such as *Ward Advocacy Groups*, *Street Smarts* educational outreach, pop-up bike valet parking at special events, *Bike Month* and the *Toronto Bike Awards* for businesses, organizations and individuals. The Organization also runs a bike to school educational program, organizes a bicycle mentoring program for new Torontonians and publishes a handbook for cycling in Toronto.<sup>32</sup>

Another group working to promote cycling is the *Toronto Cycling Think & Do Tank*. This University of Toronto based research group seeks, through multi-disciplinary investigation, to find new methodologies for increasing commuter cycling. The research is funded by a two-year grant from the *Social Sciences and Humanities Research Council*. Having identified that most campaigns for increasing ridership have focused on the need for more infrastructure, the *Think & Do Tank* has chosen instead to focus on the behavioural aspect of cycle promotion, applying knowledge from the field of behavioural change to cycling. The group's work began with a series of mapping and demographic studies to find trends in cycling adoption. They have since developed a new toolkit for cycle promotion, which they have tested in a series of pilot projects, working with the members of the community.<sup>33</sup>



Figure 2-22 *Cycle Toronto's Minimum Grid Campaign*

# From Example to Implementation

After studying Toronto's history of bicycle policy, programs and advocacy, it is clear to see that the city has acknowledged and investigated the strategies for increasing bicycle use and building a cycling culture. Many of these strategies have been successful in other cities around the world. Toronto's challenge lies not so much in coming up with productive cycling initiatives, but in following through with these ideas and maintaining the political support required to turn concepts and strategies into reality. The citizens of Toronto have a strong and enthusiastic grassroots approach, but these grassroots organizations need more top-down support from the city to reach a wider audience of potential cyclists and to build much needed infrastructure. The city is at a turning point in its cycling history. Between 2010 and 2014, despite growing support for cycling among Torontonians, the city was throttled by a mayor who consistently prioritized the needs of the car over those of the bicycle. The new administration now has the opportunity to reverse the attitude of the past four years by accepting and promoting cycle and pedestrian-friendly initiatives. Additionally, on-the-boards projects such as the Queens Quay bike path and the *Eglinton Connects* complete streets project will provide some much needed East-West bicycle connections. Toronto cycling should also be positively influenced by support from the provincial government that has promised \$15 million to invest in provincial cycling infrastructure, as well as \$10 million to contribute to cost-shared municipal cycling infrastructure.<sup>34</sup> This funding could pay for over 3000 km of new bicycle lanes. The future for cycling support is looking positive, but Toronto still has a long way to come.

Learning from the examples of cities like Copenhagen, Amsterdam, Bogotá, and Portland, illuminates where Toronto has proposed positive and effective ideas, yet failed to aim high enough to fully succeed. Toronto has quite a different character, history and geography than many other cycling cities, and thus faces unique challenges in building a cycling culture. It does not have the tight urban fabric of Copenhagen, or Amsterdam, nor the clear political vision of Bogotá or the liberal attitude of Portland, yet Toronto can still learn many valuable lessons from these cities, in order to become more bold with its cycling initiatives.

## 1. Transit Connections

Toronto is severely lacking in its encouragement of the multi-modal commute. Toronto has bike racks on certain TTC buses and a handful of bicycle lockers and racks at some of its subway stations. Copenhagen and Amsterdam have shown that the most effective way to connect cycling and transit is to build ample secure bicycle parking at all major transit transfer stations.

## 2. Limit Car Use

Toronto held two car free *Open Streets* events this past summer. Bloor and Yonge street were closed from 7:30 until noon. Bogotá, on the other hand, has had much success holding such events every weekend and also on special holidays. Copenhagen and Amsterdam have gone furthest by having completely car free areas of the city. While many areas of Toronto may not be suited to such an initiative, the city could experiment with commuting corridors in which specific streets are restricted to public transit and cyclists at certain times of day.

## 3. Learn from Data

While Toronto has begun to collect cycling data with its new app, how this data will materialize into infrastructure projects has yet to be seen. Toronto has much to learn from Copenhagen in the art of monitoring the use and effects of cycling infrastructure, and then applying the results to improve its cycling strategy. In addition to quantitative data, Copenhagen also surveys cyclists about their qualitative perception of the cycling experience.

## 4. Stay On Top of the Plan

Toronto's current bike plan has sat unimplemented and without major updates for 13 years. The city can learn from Copenhagen and Portland officials who both regularly update their targets and write annual progress reports.

## 5. Longer Distance Connections

While cycling popularity has grown substantially in the downtown core, there are little amenities or incentives for people from North York, Scarborough or Etobicoke to cycle. Toronto can follow in the footsteps of cities like Copenhagen and London, building direct and uninterrupted cycle-highways connecting the inner suburbs to the urban core.

## 6. Target New Cyclists

Toronto must learn from cities like Portland that the only way to grow the modal share is to stop building infrastructure that only appeals to confident cyclists, and also address those hesitant potential cyclists who need to be separated from fast moving traffic.

Identifying this need for stronger, bolder commitment when moving from ideas to implementation, the following section develops a new strategy of GIS analysis of cycle patterns with the purpose of targeting potential locations for action. Enough time has been spent thinking about general strategies and the City of Toronto must now commit to more specific infrastructure projects. As seen, in Amsterdam, Copenhagen, Bogotá and Portland, this method is the proven way to effectively build the support for a thriving bicycle culture and to entice more people to incorporate cycling into their everyday lives.

# Analytical Tools

## Research Method

This research seeks to overcome the shortcomings of Toronto’s generic bike plan, studying specific patterns of bicycle use in order to locate potential sites and routes for cycling catalyst projects. In order to make informed decisions, street level studies must be conducted to determine the actual needs, desires and usage patterns of Toronto’s cyclists. Toronto can learn from the city of Charlottesville, Virginia, which also had trouble making significant progress in their cycling infrastructure due to a lack of specific data on cycling patterns. The city had good intentions, but, “despite this multi-modal focus, developing a cycling network has not been simple... Suggested improvements were, at most, rooted in anecdotal evidence—in part because such information was all that staff and officials had at their disposal.”<sup>35</sup> To overcome this issue, the *Metropolitan Planning Organization* decided to create a cycling-specific app for Android and iPhone which would allow them to track cyclists in order to, “help identify key cycling corridors and barriers, thus leading to a more robust and justifiable list of cycling projects”.<sup>36</sup> Access to specific data regarding bicycle use can make the difference between building underutilized cycling infrastructure, and realizing projects which can actually have a profound impact on cycling within the city.

The current research method has been developed to extract specific, detailed information about cycling patterns and habits in Toronto. The method, which is mapped out in Figure 2-23, focuses on developing a deeper understanding of cycling in Toronto in order to inform the location of sites for cycling catalyst projects. The research investigates the flows and patterns of cyclists on the city’s streets and trails through a GIS study of bicycle trips documented as part of the *Transportation Tomorrow Survey*. The research methods steps are as follows:

### **1. Analyze patterns of bicycle traffic from the Transportation Tomorrow Survey in relation to existing bicycle routes, cycling infrastructure, potential cycling territories and most dangerous intersections for cycling**

- Map cycling trip vectors from the *Transportation Tomorrow Survey* between 1986 to 2011 in order to see general cycling patterns and trends. These vectors are overlaid with key transit infrastructure and bicycle routes (see Figure 2-24)
- Run network analysis on bicycle accessible streets to simulate trip routes (see Figure 2-25)
- Run network analysis on bicycle accessible streets with route priority given to defined bicycle routes to simulate trip routes (see Figure 2-26)
- Overlay routes with existing bicycle infrastructures, routes, transit infrastructures and dangerous intersections for cyclists (see Figure 2-27)

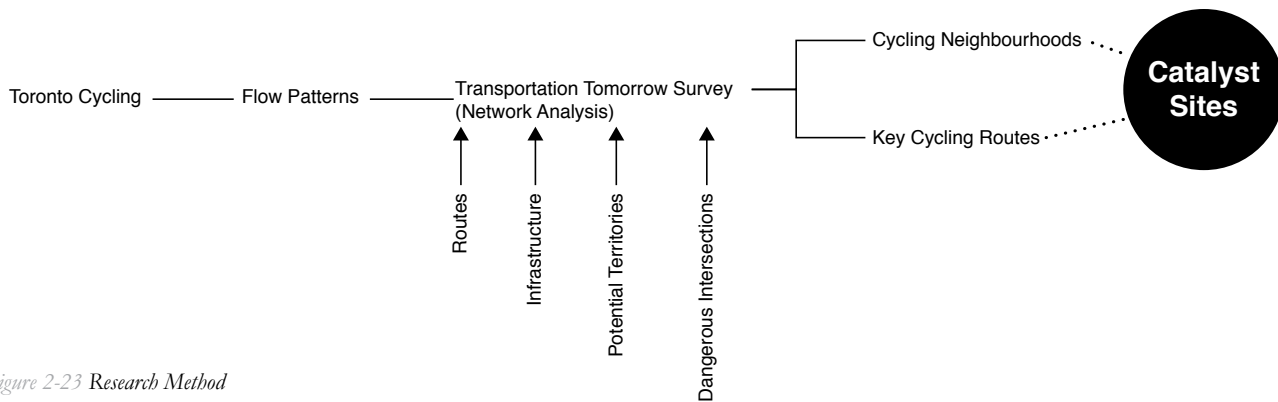


Figure 2-23 Research Method

## 2. Identify and investigate neighbourhoods in which the highest number of bicycle trips originate and terminate (see Figure 2-28)

- Use satellite imagery to analyze urban form and how it relates to volume of cycling trips and infrastructure
- Create metric by which to compare the six highlighted neighbourhoods

## 3. Identify and investigate routes with the largest volumes of cycle traffic. (see Figure 2-29)

- Identify Infrastructure, dangerous intersections and transit stations located along highlighted routes
- Determine relationship between target neighbourhoods and high volume routes
- Determine how new and proposed projects relate to these high-cycling-demand routes

# GIS Analysis

## 1. Analyze patterns of bicycle traffic

An analysis of the *Transportation Tomorrow Survey* cycling trips reveals that the majority of cycling trips take place downtown and along the Yonge subway line, likely due to higher population density and concentration of jobs and residences. Generally, the number of cycle trips has been steadily increasing from 1986 to 2014. A network analysis of specific routes reveals that shorter trips tend to use city streets, following bicycle lanes where possible, while longer trips are more likely to make use of the ravine trails, hydro corridors, and rail paths. The most dangerous intersections for cycling tend to be located in close proximity to cycling routes, especially where there are discontinuities in the cycling network. This danger is likely due to a higher volume of cyclists, and insufficient safety buffers between cars and bikes in these zones. Bike share stations are relatively evenly distributed across the downtown core with very little East-West reach. They appear to have little correlation to the specific travel paths of cyclists, beyond the fact that many cycle trips

Cycle City

pass through downtown. Bicycle shops are well distributed across the city, with a high concentration to the west of the downtown core, and generally correspond to areas with a high percentage of cyclists. Secure public bicycle parking is very sparse with only 3 locations across the entire city. These locations do not meet the needs of the volume of cyclists and, other than the undersized one at Union Station, they are not situated in optimal locations for cyclists. Additionally, the city is covered by a diverse yet disconnected network of potential cycling territories including rail and hydro corridors, laneways, local streets, ravine trails and public parks which could aid in closing many of the discontinuities found in the existing bikeway network.

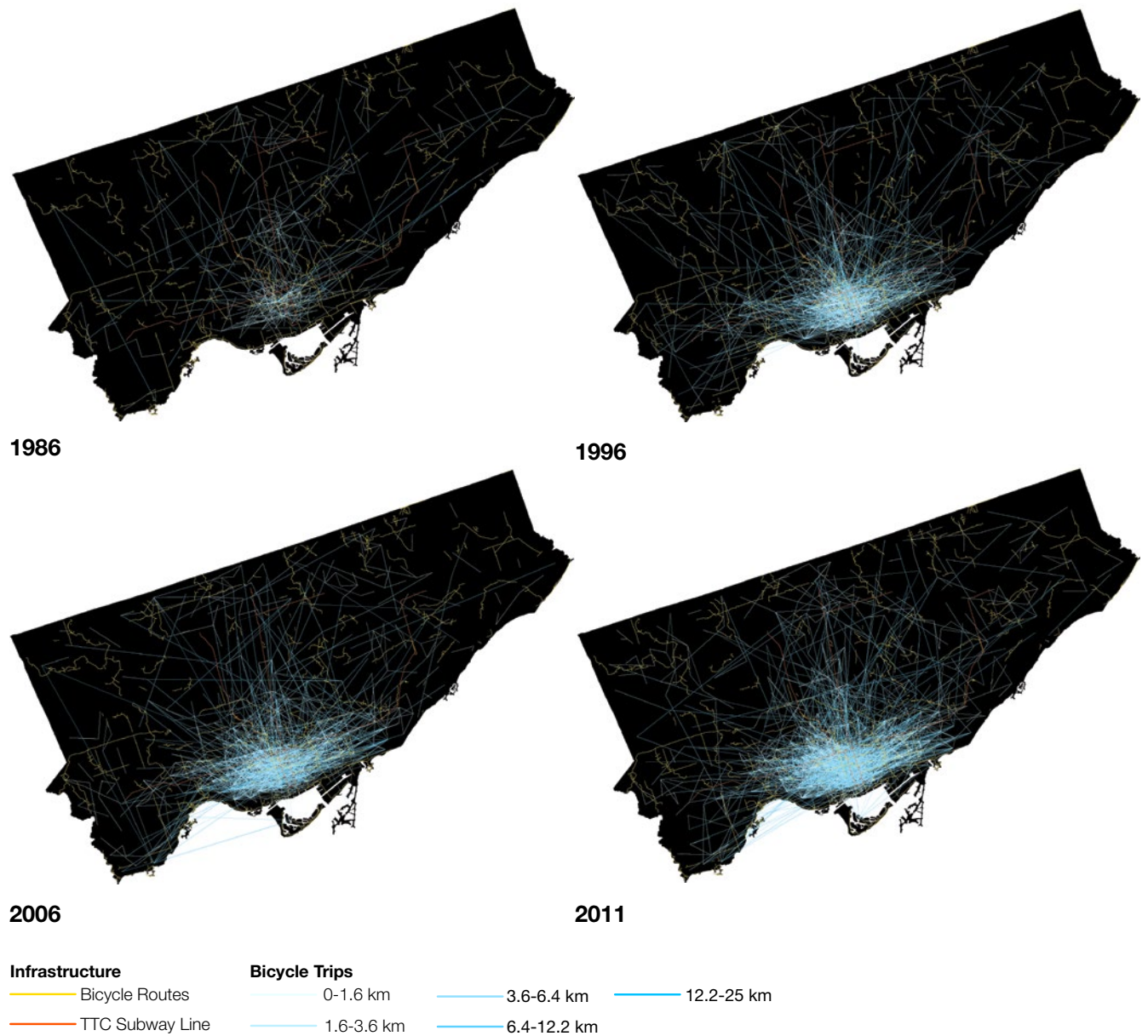


Figure 2-24 Cycling Trip Growth 1986-2011 Transportation Tomorrow Survey

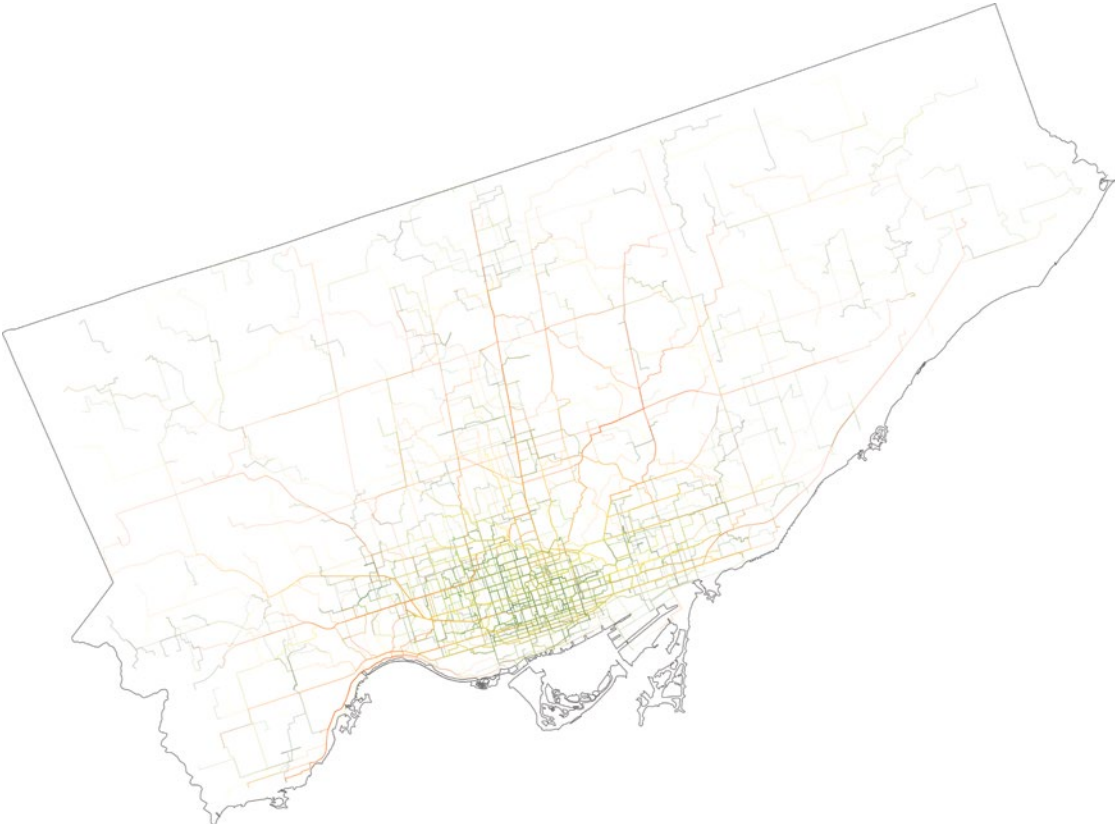


Figure 2-25 Cycling trips network analysis based on the 2011 Transportation Tomorrow Survey

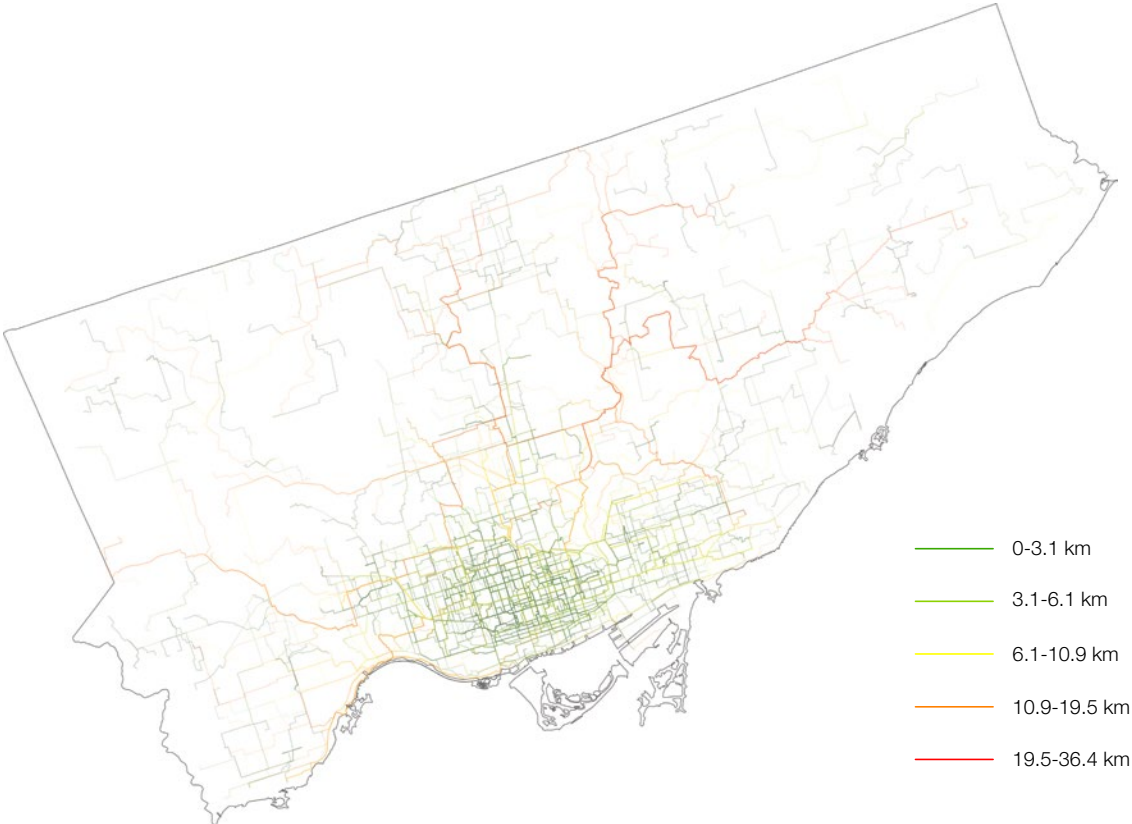


Figure 2-26 Cycling trips network analysis based on the 2011 Transportation Tomorrow Survey with bicycle route priority

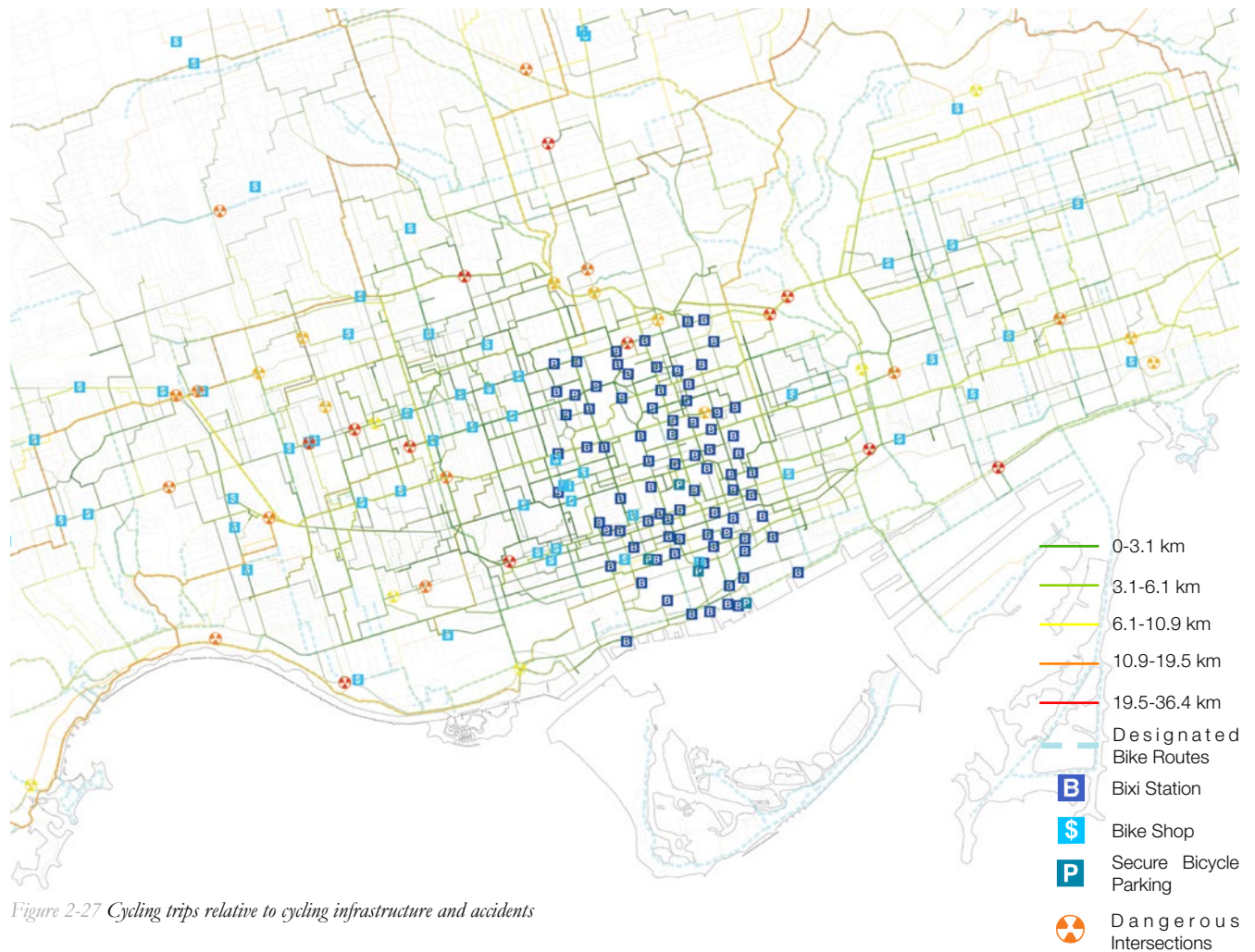


Figure 2-27 Cycling trips relative to cycling infrastructure and accidents

## 2. Identify and investigate neighbourhoods with the highest number of bicycle trips

The neighbourhoods with the greatest number of cyclists coming and going are: 1. The University of Toronto Campus, 2. The Grange Park neighbourhood, 3. The South Annex, 4. Kensington Market, and 5. St. James Town. The area of Yonge and Eglinton was also investigated as it has a high percentage of cycling trips relative to the surrounding neighbourhoods. The University of Toronto campus is home to many students who are members of the most likely demographic to cycle. In addition, the campus is located in close proximity to Queen's Park subway station, and has many bicycle share stations. Most of the campus is traffic calmed with pedestrian-friendly streets and plenty of outdoor bicycle parking. The Grange Park neighbourhood is located at the heart of the bike share network and near Osgoode and St. Patrick subway stations. It has many bike shops and side streets with bicycle lanes. Main attractions include the Art Gallery of Ontario and the Ontario Academy of Art and Design. The South Annex is a primarily residential area which has many laneways and quiet streets for safe cycling. There are many bicycle shops in this area as well as access to Bathurst and

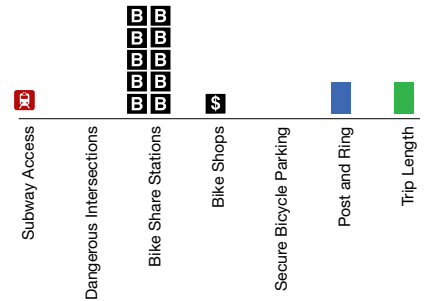
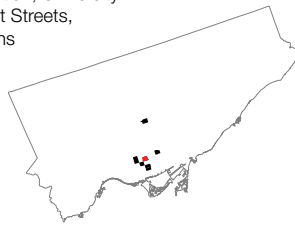
Figure 2-28 (Right) Neighbourhoods with the highest number of bicycle trips based on the 2011 Transportation Tomorrow Survey



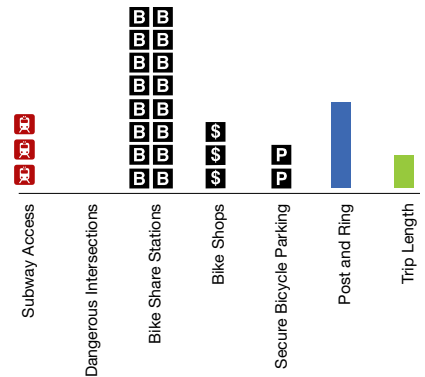
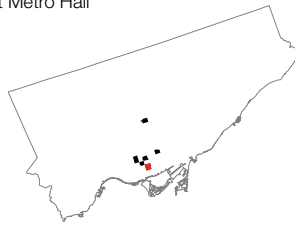
Christie subway stations. Kensington Market is a historic neighbourhood with many quiet, pedestrian-friendly streets. It is a major destination for shopping and entertainment and has five bicycle shops. St. James Town is a high-density, high-rise community located at the head of the Sherbourne Street cycle track. It is located near Sherbourne subway station and is in close proximity to a ravine trail. Finally, Yonge and Eglinton is a high density neighbourhood built around Eglinton subway station. The only cycling amenities here are post and ring locks located along the two major streets.



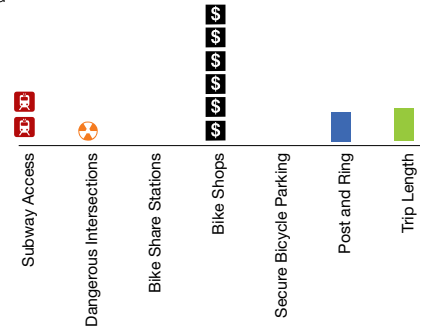
**1. U of T**  
Queen's Park subway station, University of Toronto Campus, Quiet Streets, Queen's Park, Bixi Stations



**2. Grange Park**  
St. Andrew, Osgoode and St. Patrick subway stations, Bike Shops, many Bixi Stations, Grange park, OCAD and AGO, bicycle parking at Metro Hall

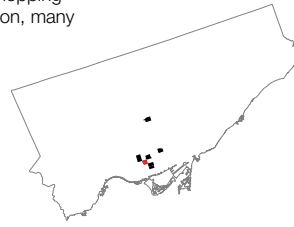


**3. South Annex**  
Bathurst and Christie subway stations, Christie pits park, many laneways, dangerous intersection at College and Crawford, many bicycle shops

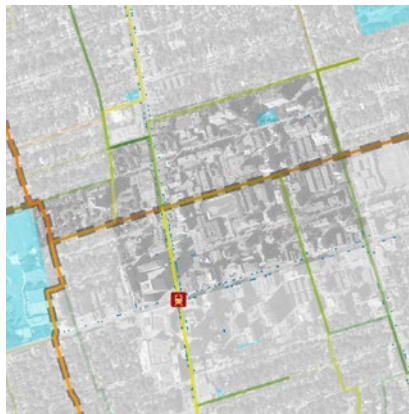
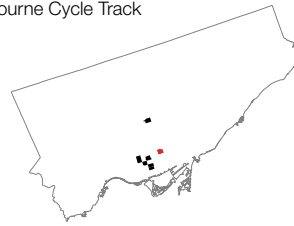




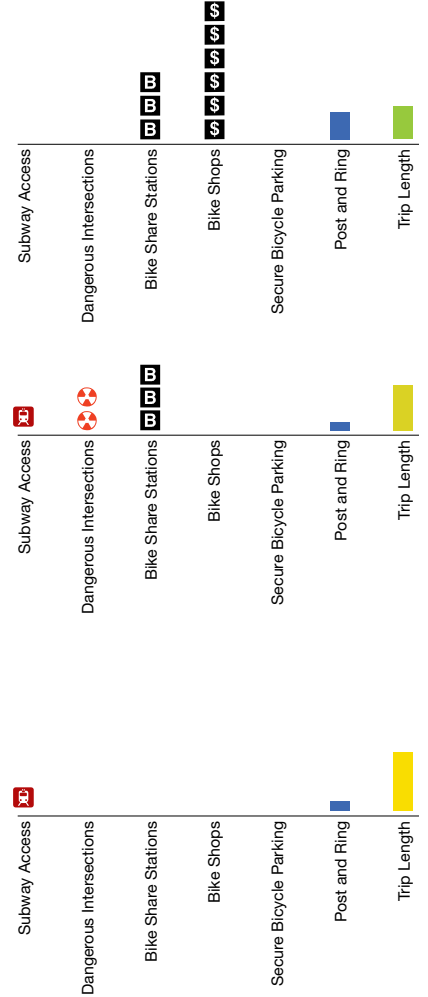
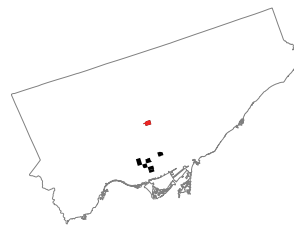
**4. Kensington Market**  
Quiet Pedestrian Streets, shopping and entertainment destination, many bike shops, bixi stations



**5. St. James Town**  
Sherbourne Station, dangerous intersection, small parks, Sherbourne Cycle Track



**6. Yonge and Eglinton**  
Eglinton subway station, Redpath Avenue Parquette, post and ring locks on major streets



### 3. Identify and investigate high volume routes

The most used cycling route in Toronto is College Street, featuring a bicycle lane between Yonge and Bathurst, and sharrows (shared lane pavement markings) as far west as Lansdowne. There are many bike shops along College's length. Three of the five identified cycling destination neighbourhoods border College Street which also crosses into the bike share area. There is much potential to transform College Street into one that really celebrates the bicycle and enhances the riding experience. The recently built *West Toronto Rail Path* is the most used off-road cycling corridor in the city, though its connection to College Street is relatively weak. More potential lies in its planned expansion down to Wellington Street. North-South routes within the city lack a strong corridor like College Street. Rather, cyclists traveling north and south tend to filter through a variety of quiet streets in order to avoid automobile traffic, the most prominent being St. George St., Beverly St. and Russel Hill

Road. The new Sherbourne cycle track provides a strong North-South connection to the east of downtown, but does not extend very far north. Davenport Road and Danforth Ave. are the most dangerous amongst the popular routes, each with multiple intersections with high rates of bicycle accidents. The new cycleway being built along 1.5 km of Queen's Quay provides pleasant connections along the Waterfront, yet does not extend far enough to be a useful commuter route. The proposed 19 km cycleway, coupled with the Eglinton LRT project has the potential to reinvent an important city-wide corridor; however, its success will depend on stronger North-South routes linking midtown to downtown.

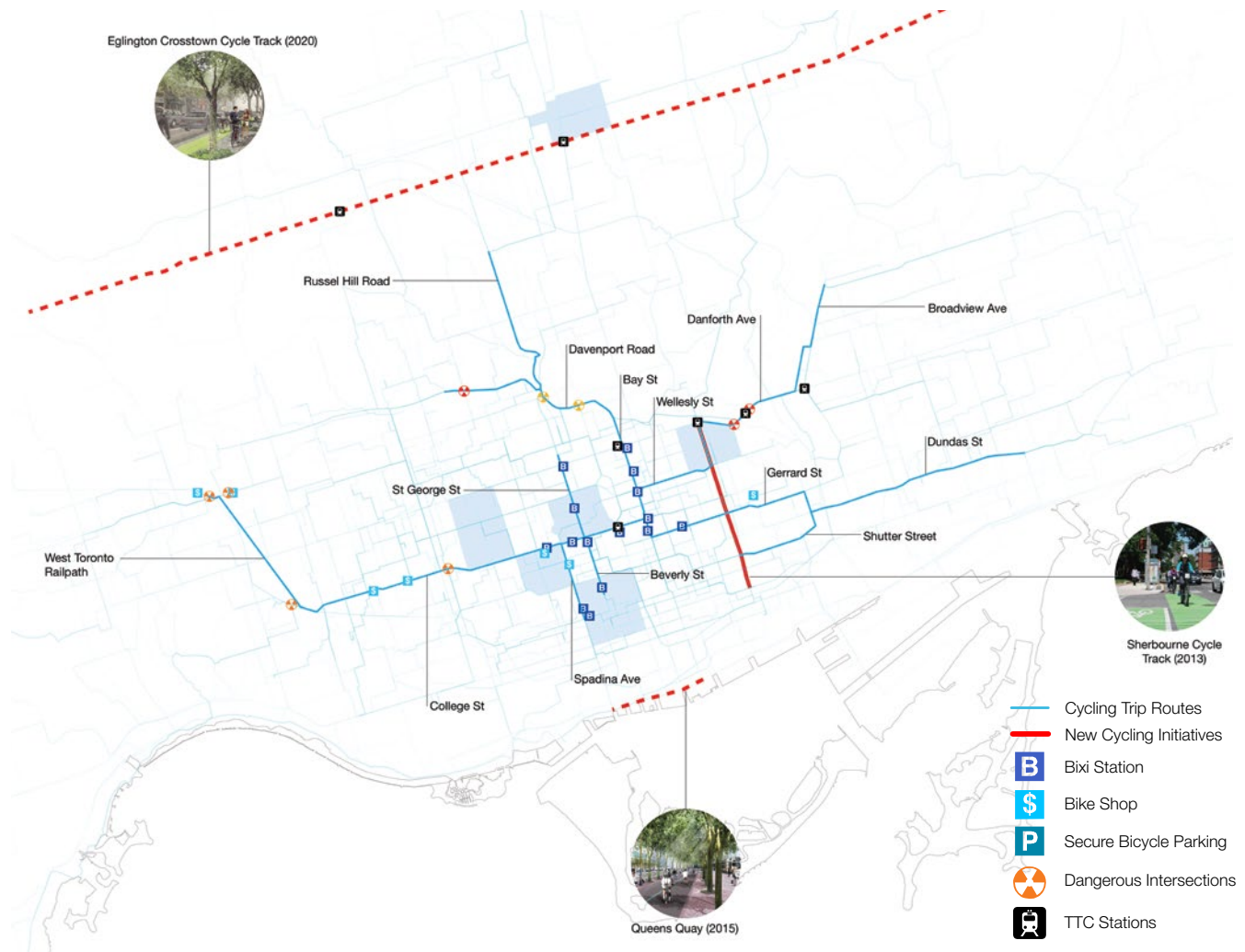


Figure 2-29 Routes with the heaviest volume of trips based on the 2011 Transportation Tomorrow Survey

## GPS Cycle Tracking App

One identified shortcoming of the GIS network analysis approach is that the cyclists' paths are generated based on a computer algorithm rather than from paths of actual cyclists. While the routes are generated based on cycling data from the *Transportation Tomorrow* website, they do not account for all the nuanced decisions that come from an intimate knowledge of the city. With years of experience, cyclists are able to learn of hidden shortcuts, discover which routes have the least traffic, find which roads have the most comfortable paving and how to best navigate the city's major hills. Additionally, scenery may play into route choice, with a cyclist choosing to ride a slightly longer route through a park or ravine trail for a more pleasurable view. Cyclists may even change their route depending on the season, either for one with better winter maintenance, or one that provides a longer route to get additional exercise on the commute home. Unfortunately, none of these more personal factors are accounted for in network analysis.

A GPS tracking study becomes valuable for addressing these deficiencies. In order to determine how accurately my findings compare to the routes that actual cyclist take, I used data acquired from the City of Toronto's bicycle tracking app. Mapping out a three week sampling of the data reveals much about where Torontonians actually cycle. Not only does this data reveal the busiest cycling routes, but it also visualizes the less obvious shortcuts and hidden routes which cyclists may take such as cutting through Mount Pleasant Cemetery, or traversing diagonally through Queen's park. Figure 2-30 shows the resulting route map.

The busiest North/South corridors in the network are:

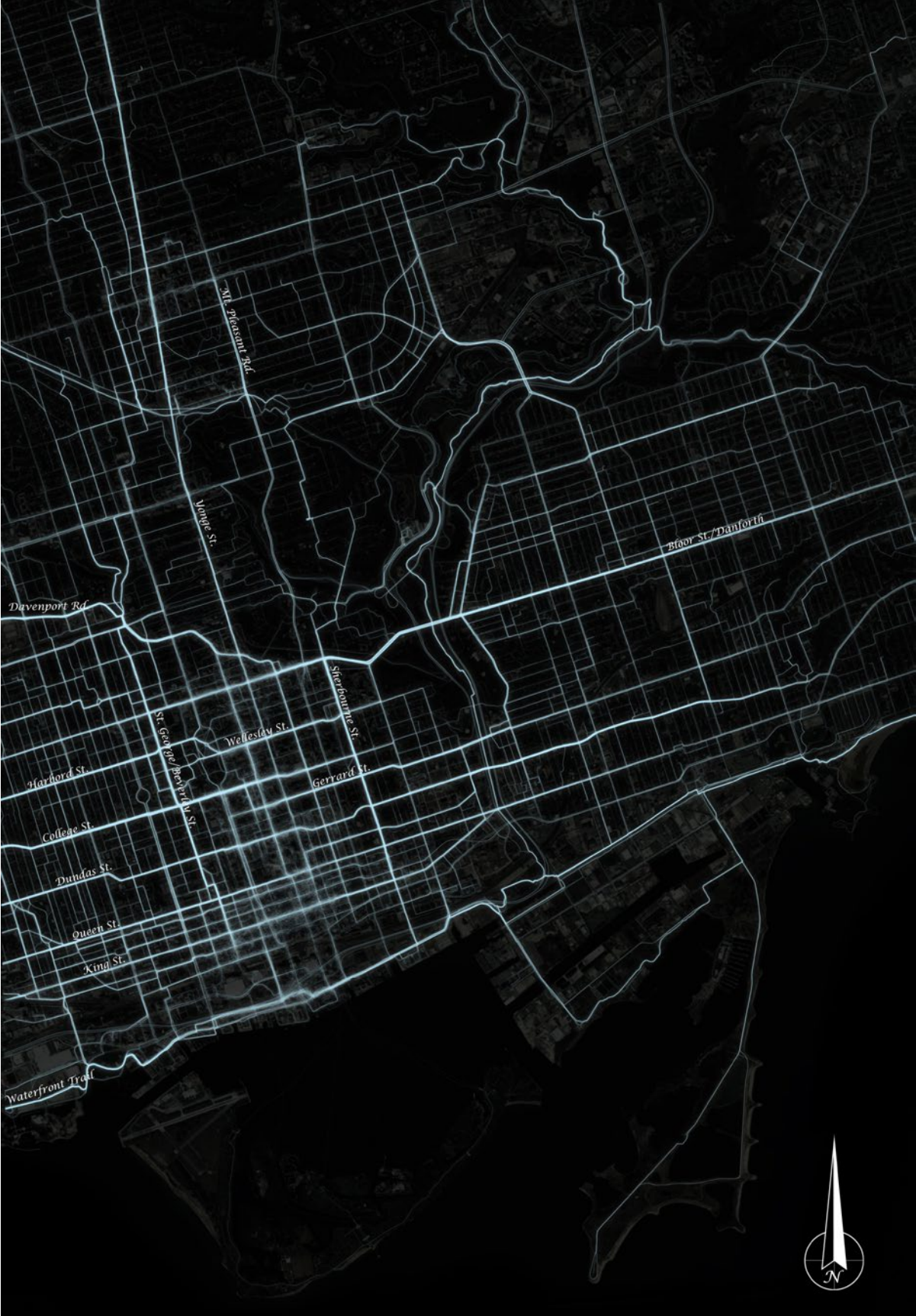
1. Sherbourne St.
2. St. George & Beverly St.
3. Yonge Street North of Bloor

The busiest East/West corridors in the network are:

1. College St.
2. Dundas St.
3. Bloor St.
4. Gerrard St.
5. Queen St.
6. Harbord & Wellesley
7. Davenport Rd.

These results are fairly consistent with my network analysis, though the app data provides some much needed precision. The network analysis identifies many of the same routes as high-traffic bicycle areas, particularly College, Sherbourne, Dundas, and Wellesley, but fails to pick up on some popular roads which do not currently have any cycling infrastructure such as Danforth Avenue and Queen Street

*Figure 2-30 (Right) Cycling trends map based on routed collected from the Toronto cycling app. Data represents trips taken between May 21st and June 11th, 2014*



The app data is not without its biases, as the demographic group who downloaded it represent a fairly narrow slice of the population. This sample group does, however, seem to be in line with the typical cyclist in Toronto. The majority of cyclists who use the app tend to be men between 25 and 49, who make a good living, who have been cycling for many years and are not afraid of cycling traffic. 40% of the Cyclists who participated in the app indicated that they cycle through the winter months, a good indicator that this data showcases the hard-core cyclist much more than the novice. In evaluating the data, consideration must be given to the variance in desires between those who are currently cycling every day and the hesitant cyclist who must be encouraged to try cycling for the first time.

### Who signed up for the app?

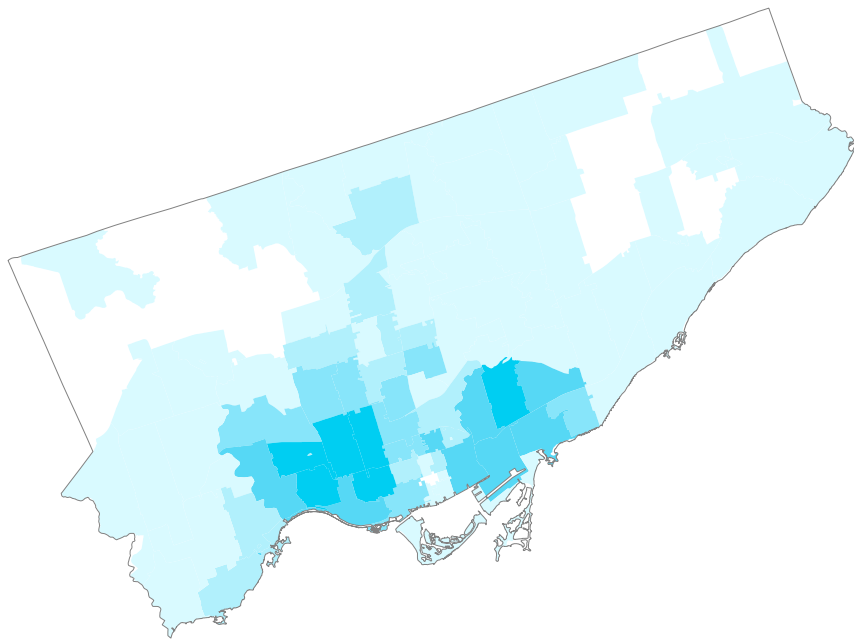


Figure 2-31 Home postal codes of participants

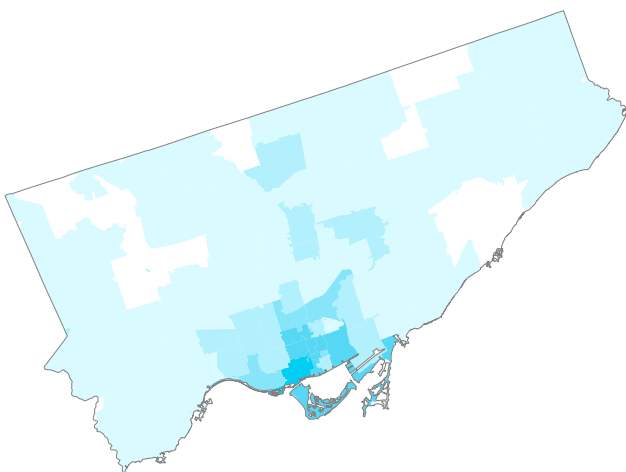


Figure 2-32 Work postal codes of participants

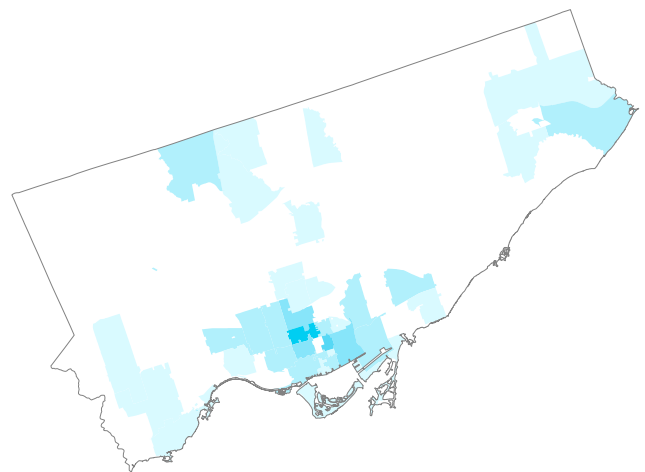
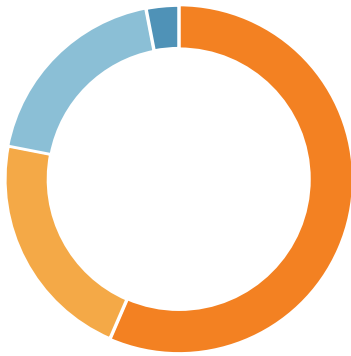


Figure 2-33 School postal codes of participants

How long have you been a cyclist?



- Since childhood
- Several years
- One year or less
- Just started/trying it out

Your comfort level on a bicycle?



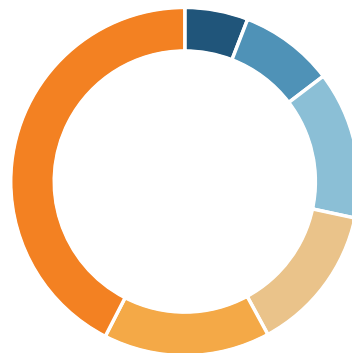
- Not comfortable sharing roadways with vehicles
- Only comfortable sharing roadways in clearly designated cycling facilities
- Comfortable cycling in most roadway conditions

Are you a winter cyclist? (Dec. - Mar.)



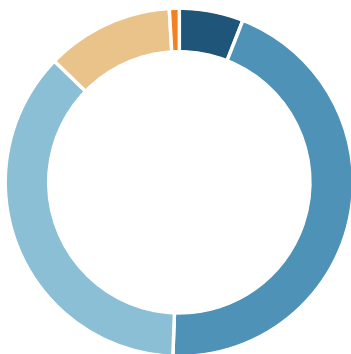
- No
- Yes

Household Income



- Under \$20,000
- \$20-39,000
- \$40-59,000
- \$60-79,000
- \$80-99,000
- \$100,000+

Age



- 18-24
- 25-34
- 35-49
- 50-64
- 65+

Gender



- Female
- Male

Figure 2-34 Statistics about app participants



Queen St.

Dundas St

College St.

Bloor St.

St. George Subway

ROM  
Gardiner Museum

Queens Park

Wellesey St. W

University of Toronto  
Ontario Legislature

College Street

Princess Margaret Hospital

Hospital for Sick Children  
Toronto General Hospital

City Hall

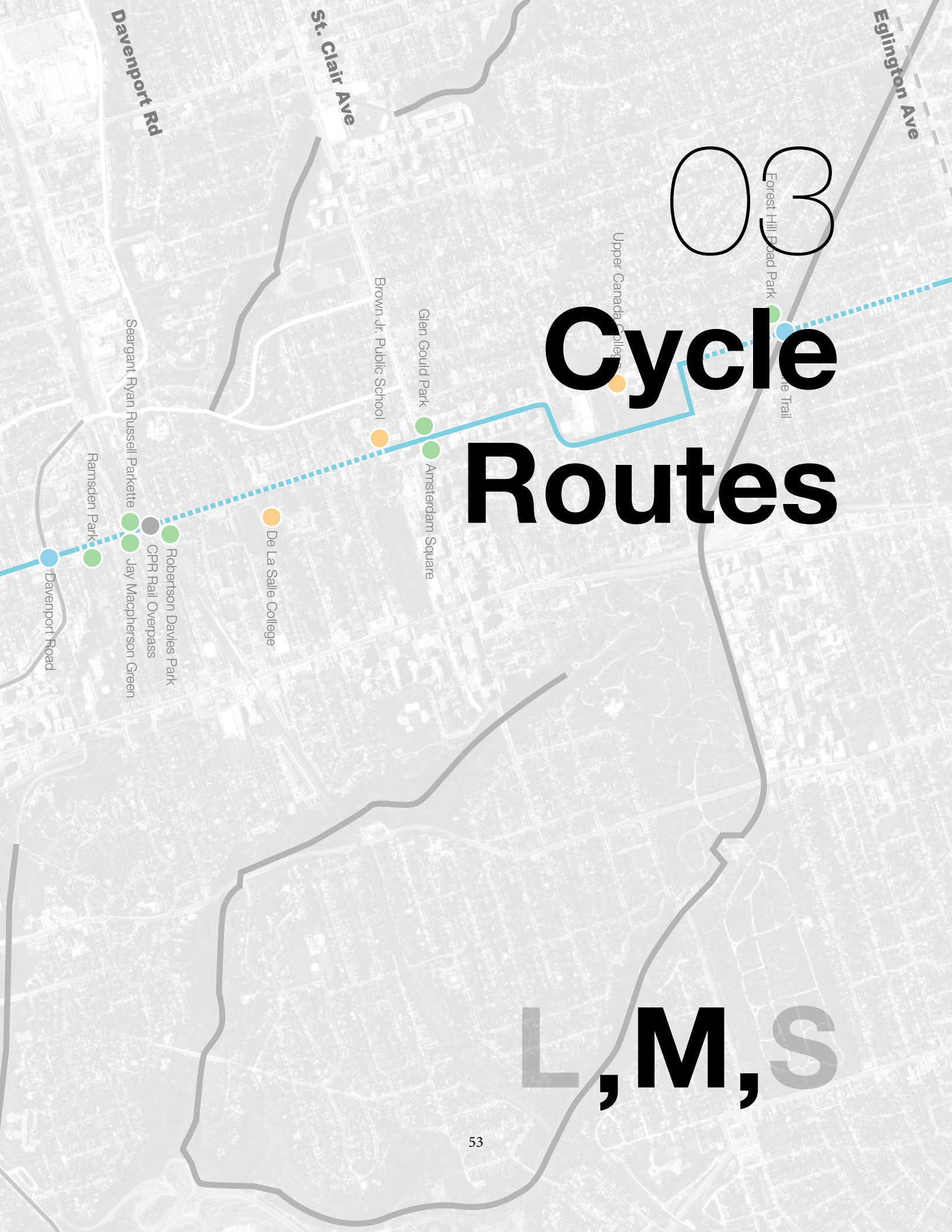
Richmond Street  
Four Seasons Centre for the performing arts

Adelaide Street

Union Bicycle Tunnel  
Go Rail Overpass

Union Station





Eglington Ave

St. Clair Ave

Davenport Rd

03

# Cycle Routes

Forest Hill Road Park

Trail

Upper Canada College

Glen Gould Park

Amsterdam Square

Brown Jr. Public School

De La Salle College

Robertson Davies Park

CPR Rail Overpass

Jay Macpherson Green

Seargant Ryan Russell Parkette

Ramsden Park

Davenport Road

L,M,S

# Finding A Route in the Network

The conclusions drawn from the GIS analysis as well as the GPS tracking study reveal a great deal about the movements of cyclists within Toronto relative to the current stock of cycling infrastructure. In order to use the design of new infrastructure as a catalyst for increasing cycling's modal share, the choice of route location becomes paramount. This thesis proposes a new cycle route on Avenue Road and University Avenue, connecting from Eglinton Avenue to the Waterfront. This choice was made through careful observation of the trends revealed by the GIS and GPS mapping studies. The following criteria were essential in choosing the location for an iconic cycling route which has the greatest potential to draw new cyclists:

## **1. Reach beyond the downtown**

Cycling has grown in the downtown core in recent years despite relatively little infrastructure expansion. Meanwhile the cycling modal share in the midtown area and beyond has remained quite low due to a lack of safe and convenient routes. The area north of Bloor Street is the next frontier of cycling growth which must be addressed. The proposed route allows for convenient, attractive cycling as far north as Eglinton, enabling cyclists to commute into the downtown core.

## **2. Terminate into other cycling routes**

The cycling network must be conceived of as continuous and interconnected. The proposed route terminates into the planned Eglinton cycle track in the North, and the Waterfront trail in the South.

## **3. Provide opportunity for multi-modal connections**

In order to expand the number of cyclists in the city, it is important to consider those who live too far from the city centre to use cycling as their sole means of commuting. The proposed route connects to Union Station allowing for connection to the GO transit network and the Yonge-University Subway line. In the North, it connects to the coming Eglinton Avenue LRT and at Bloor street, the route connects to St George Station and the Bloor-Danforth Subway Line.

## **4. Create a continuous North-South connection**

Currently there are no continuous direct cycle routes extending north of Bloor Street and entering into the downtown core. The proposed route remedies this problem by creating a direct 7.5 km path traversing from Eglinton to the Lakeshore.

## **5. Showcase cycling by occupying a prominent location within the city**

The proposed route cuts through the centre of the city on one of Toronto's most monumental streets. In this location, the route is highly visible to all users of the city and can help to raise the profile of cycling

amongst Torontonians.

**6. Tie together the many strong existing East-West routes**

The Avenue/University Route crosses many of the city's key cycling arteries including College, Harbord, Wellesley, Bloor, Queen, Davenport and the Waterfront Trail.

**7. Pass by neighbourhood with highest percentage of cycling trips**

The proposed route borders the University of Toronto and Grange Park neighbourhoods, two of the busiest cycling destinations as revealed by the *Transportation Tomorrow Survey*. The other high cycling volume neighbourhoods are easily accessed by College Street which intersects the new route.

**8. Be conscious of future planned routes**

Currently Queen's Quay is under construction which, when completed, will provide a more continuous connection along the Waterfront. Additionally, Eglinton Avenue is being revitalized with the addition of a LRT track, pedestrian oriented street design and cycle lanes. The proposed route connects to both of these projects.

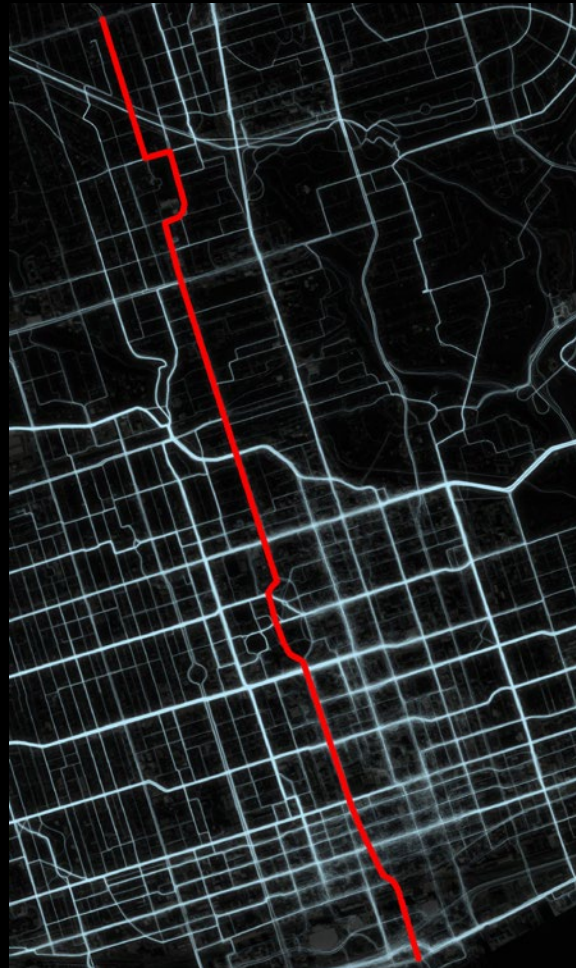


Figure 2-35 Proposed Avenue-University cycling route

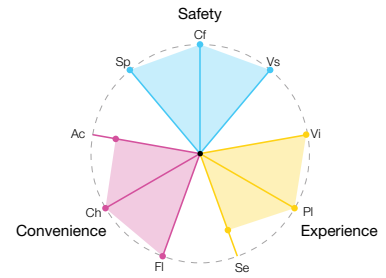
Cycle City

## Successful Cycling Routes

When designing a new cycle route for Toronto, a study of exemplary cycle paths around the world can be very useful. The following routes, including the *Lisbon Bicycle Path*, *Queens Plaza Bikeway*, *London Cycle Superhighways*, and *Minneapolis Midtown Greenway*, have all boosted cycling levels in their respective cities, while making their cities, more exciting, convenient and safer places to cycle. The *Lisbon Bicycle Path* has played a role in rejuvenating the waterfront. The *Queens Plaza Midtown Bikeway* provides a safe, enjoyable route on a once dangerous, busy street. The *London Cycle Superhighways* connect residents from the suburbs to their jobs in downtown London, and the *Minneapolis Midtown Greenway* transforms a disused rail corridor into an important commuter route.

# Lisbon Bicycle Path

Global Arquitectura Paisagista  
 Lisbon, Portugal, 2009  
 Length: 7km  
 Budget: € 600 000



The following strategies were synthesized from a variety of articles from both scholarly and popular sources.<sup>1</sup>

## Strategy 1: Make it Fun

The Lisbon bicycle route is not only a bicycle route, but also a piece of interactive graphic design. Surfaces are painted with bicycle and activity-related graphics, and quotes from Portuguese poet Alberto Caeiro are painted along the path. Even infrastructure as mundane as manhole covers are customized with simple, unique graphics.



Figure 3-1 Poetry walls

## Strategy 2: Clear Wayfinding

The graphic paint strategy not only adds to the playfulness of the path, but also serves as a useful wayfinding device. Kilometer markings are spread along the route as well as directions to key points of interest. The consistent graphics and ribbon of black asphalt facilitate navigation of the route and provide for a cohesive, well branded experience.



Figure 3-2 Kilometer markings

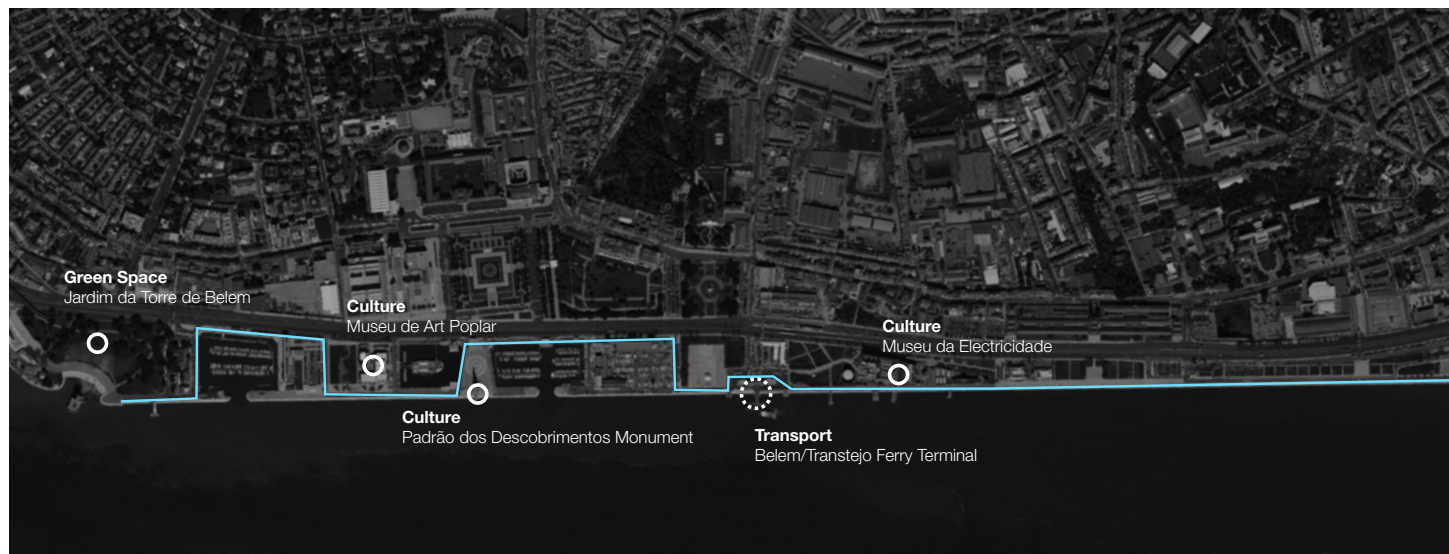


Figure 3-3 Lisbon Bicycle Path map



Figure 3-4 Integration with existing buildings

### Strategy 3: Integration

The route strategically makes use of existing structures and paving surfaces along the length of the waterfront in order to weave itself into the existing fabric. Adding just enough new material to tie together a cohesive route helps to keep costs relatively low.



Figure 3-5 River view

### Strategy 4: Connectivity

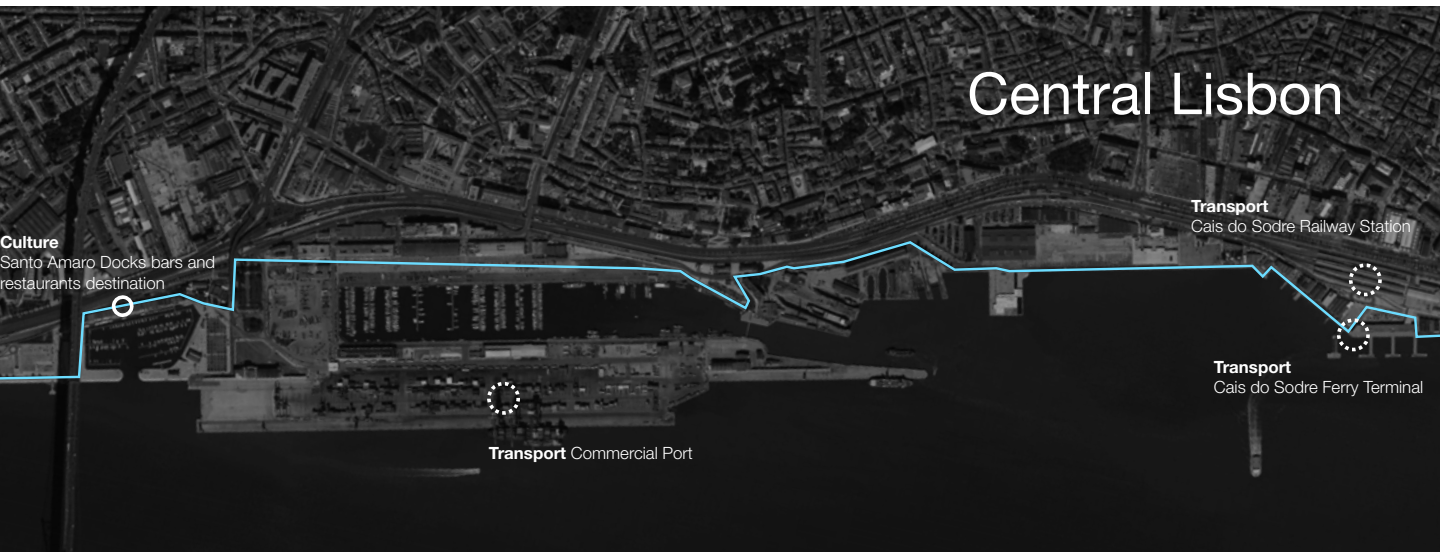
The route provides a scenic route for a weekend ride or stroll, yet also provides an important link as a commuter route. The path connects to Lisbon's main train station located in the core of the city, as well as to two ferry terminals which cross the river. Additionally, the path connects to a series of historical enclaves and cultural sites, including the *Museu de Arte Popular* and the *Museu da Electricidade*.



Figure 3-6 Trail graphics

### Strategy 5: Separation and Proximity

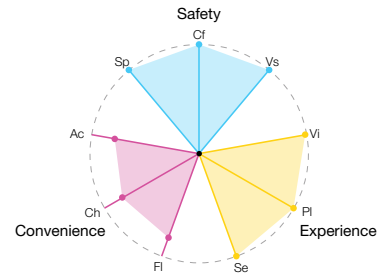
Cars, cyclists and pedestrians are safely separated from each other by simple curb cuts and graphic markings. Nevertheless, a dynamic environment is created through proximity which allows a connection between the different modes of travel as well as with the stationary activities taking place along the route.



Cycle City

# Queens Plaza Bikeway

Margie Ruddick Landscape and WRT  
 New York, NY, United States, 2011  
 Length: 1km  
 Budget: \$45 million



The following strategies were synthesized from a variety of articles from both scholarly and popular sources.<sup>2</sup>

## Strategy 1: Bundle

The Queens Plaza Bikeway is not an isolated cycling infrastructure, but is part of a much larger rejuvenation project involving a new green space and pedestrian environment. A bicycle route was easily incorporated into the larger project to improve the livability of a noisy and unpleasant street. At the heart of the project is Dutch Kills Green, a natural park built on the site of a former parking lot, creating a comfortable place to relax, walk, and cycle.



Figure 3-7 Dutch Kills Green

## Strategy 2: Connect

The bikeway and park are situated in a strategic location to stitch together a once disconnected part of the city. The project acts as a gateway to the Long Island City neighbourhood, while connecting to the Queensboro bridge and midtown Manhattan. What was once a dangerous commute for cyclists is now a comfortable journey.



Figure 3-8 Pedestrian interface

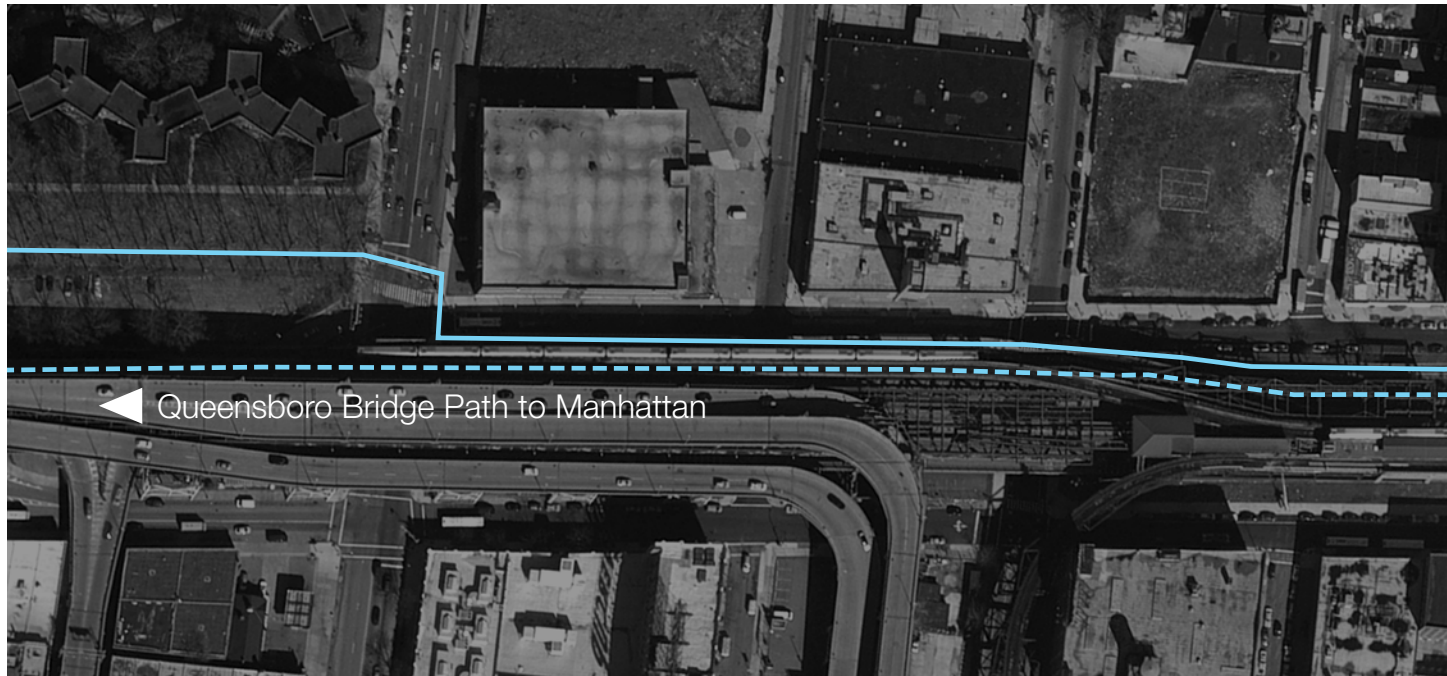


Figure 3-9 Queensboro bikeway map





Figure 3-10 Traffic crossing

### Strategy 3: Redevelopment ■

The construction of the bikeway was not seen as an end in itself, but as a catalyst for economic growth and development. The project has helped turn an area in decline into an attractive place to live and work. Long Island City is on its way to becoming a thriving mixed use community, an ideal place for cyclists. Since the opening of the park and bikeway, the area has attracted a number of new residential developments and hotels. As the population continues to grow, more businesses and shops are likely to move into the area.



Figure 3-11 Linear park

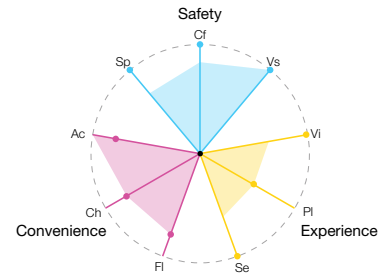
### Strategy 4: Greening ■

Queensboro Plaza has long been a bleak, inhospitable space dominated by unattractive transportation infrastructure. The designers felt that the best way to make people feel more comfortable in the space was to bring in elements of nature to act as a buffer from the noisy traffic. The hard urban infrastructures of the site have been complimented with soft, ecological infrastructures, such as the artificial wetland which helps to filter storm water, clean the air and improve public health. The result is a pedestrian and cycling oasis where people can feel safe and comfortable while experiencing nature.



# Barclay's Cycle Superhighways

Transport for London  
 London, England, 2013  
 Length: 7-15km  
 Budget: £ 30 Million



The following strategies were synthesized from a variety of articles from both scholarly and popular sources.<sup>3</sup>

## Strategy 1: Suburban Cyclists

The City of London has realized that potential cyclists have different needs depending on their proximity to the city centre. Dividing London into the central, inner and outer city, the cycling strategy was able to target the needs of these different cyclists. The Cycle Superhighways specifically target those commuting from the inner suburbs to work in central London. These 12 proposed routes radiate out from the city centre based on an analysis of potential demand in the outskirts of the city. The routes, which average in length between 10km and 15km seek to attract cyclists by creating safe, direct, and convenient connections which can be a competitive alternative to driving and transit.

## Strategy 2: Phasing

The Cycle Superhighways began with the implementation of two routes to test the effectiveness of the strategy. Phasing allowed the city to research and learn from the initial implementations and make improvements for the rest of the network. Two secondary pilot projects were implemented on the new routes, to reduce bicycle theft and encourage students to ride to school. Since the initial two routes were installed in 2010, two more routes have been built, with a number of new routes scheduled to open by 2016.



Figure 3-12 Cycle Superhighway map



Figure 3-13 Typical cycle track

## Strategy 2: Identity

The Cycle Superhighways were developed with a strong sense of branding both to ease wayfinding and also to give cycling a stronger presence within the city. The routes are all painted a continuous shade of blue, borrowed from Copenhagen’s iconic cycle tracks. The aim of this greater presence is to change the attitude of all road users towards cyclists while simultaneously attracting more cyclists. The routes have distinctively branded graphics and signage to differentiate them from other cycling routes in the city.



Figure 3-14 Bike box intersection

## Strategy 3: Intersection Design

The route designers have recognized intersections as one of the most dangerous places for cyclists and tried to eliminate the apprehension that comes from this place of interaction with motorized vehicles. Intersection strategies include painting virtual lanes through intersections, implementing advanced stop lines, traffic islands to slow traffic, and logos to warn cars that they are approaching a cycling highway intersection. Painted bike boxes are also implemented allowing bikes to stop ahead of cars where they are more visible, and also providing a place to wait while make two-stage left hand turns.

## Strategy 4: Support Programs and Infrastructure

In addition to the routes, the City of London is looking to build support for cycling at both ends of the journey by targeting the home and workplace. This support includes improvements in parking infrastructure, hosting local events supporting training and bicycle repair, and campaigns to raise awareness on the benefits of cycling. At the launch of each Superhighway, there will also be organized guided rides to familiarize residents with the routes. Businesses along the route are also provided with support to build facilities for bicycle parking and maintenance.



Figure 3-15 Cycle Superhighway CS2

# Minneapolis Midtown Greenway

City of Minneapolis  
 Minneapolis, Minnesota, 2000  
 Length: 8.9 km  
 Budget: \$ 36 Million

The following strategies were synthesized from a variety of articles from both scholarly and popular sources.<sup>4</sup>

## Strategy 1: Reclaim Infrastructure

The Minneapolis Midtown Greenway follows a trend that is catching on in countless cities across the globe, that is, finding new uses for disused industrial infrastructure. The site of the greenway was once home to a surface railroad around which many businesses were established for the convenience of direct access to shipping. Eventually, the community decided that there was too much conflict between the surface streets in the mostly residential neighbourhood and the route of the train. As a result, the track was depressed in 1916. This separation from automotive traffic happens to also be ideal for cycling, cutting a perfect commuting corridor across the city.

## Strategy 2: Community

The existence of the greenway is a direct result of community effort. Neighbourhoods, organizations and individuals teamed up to form the Midtown Greenway Coalition. This group lobbied to have the bicycle trail installed. The coalition continues to work to inform the public about the greenway and instigates potential projects to improve the route's experience and amenities. Additionally, the community has been heavily involved in building new parks and plazas along the greenway, including a community garden.

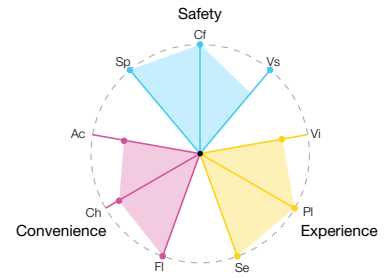


Figure 3-16 Greenway as rail corridor



Figure 3-17 Midtown Greenway Coalition

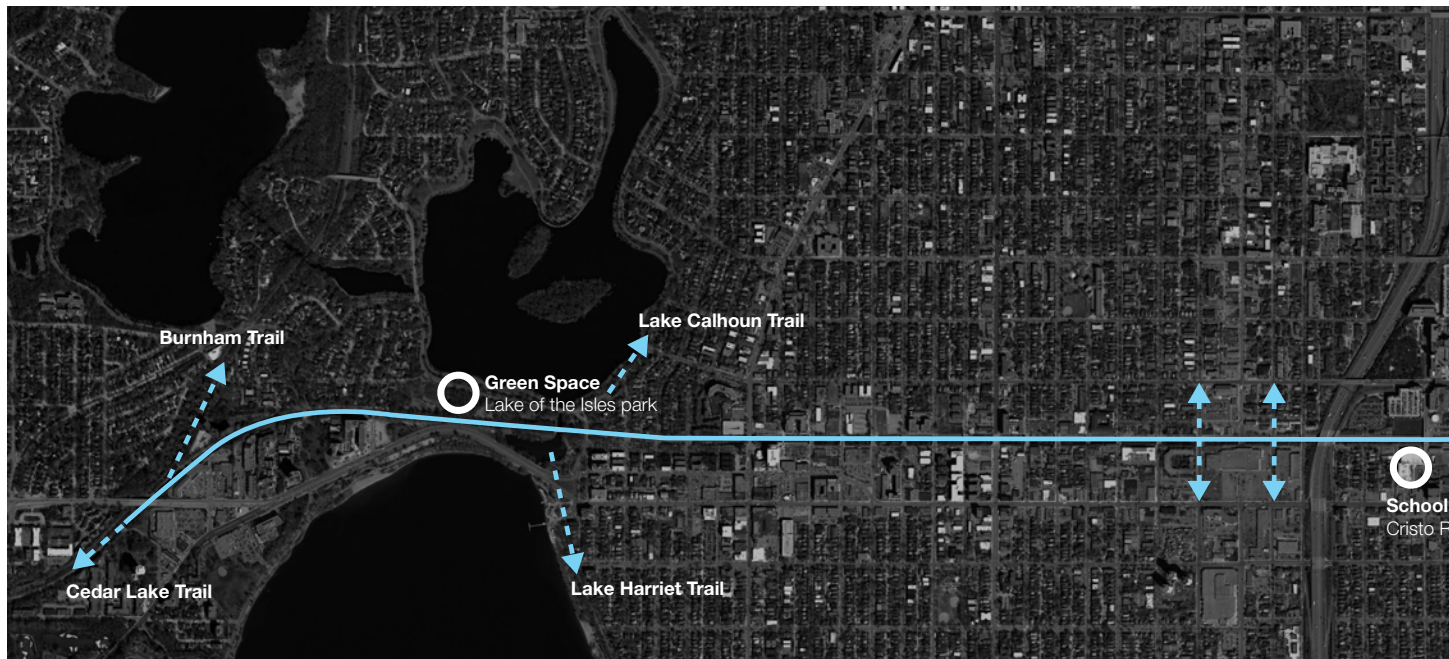


Figure 3-18 Minneapolis Midtown Greenway Map



Figure 3-19 Midtown Greenway

### Strategy 3: Connectivity

The greenway traverses the entire width of the city of Minneapolis, connecting to important business and employment nodes along Lake Street as well as two LRT lines. At either end, the route is connected to an extended trail system serving longer distance commuters. To the West, the Cedar Lake Trail connects the suburbs, while to the East, trails run through the Mississippi river park system. There has also been discussion about adding a streetcar to turn the route into a multi-modal transportation corridor.



Figure 3-20 Artistic Bridge

### Strategy 4: Public Art

The city commissioned the creation of a *Public Art Master Plan* for the greenway, recognizing the potential of public art to bring the route to life. Over time, a series of projects will be implemented along the greenway to remember its history, and bring out the character of the adjacent neighbourhoods. Art projects take on both temporary and permanent forms, ranging from event installations to functional elements, such as bicycle racks. The most influential potential lies in the 40 bridges which will gradually be replaced by new ones with artist-led design teams.

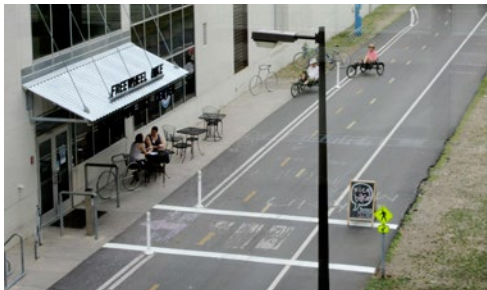
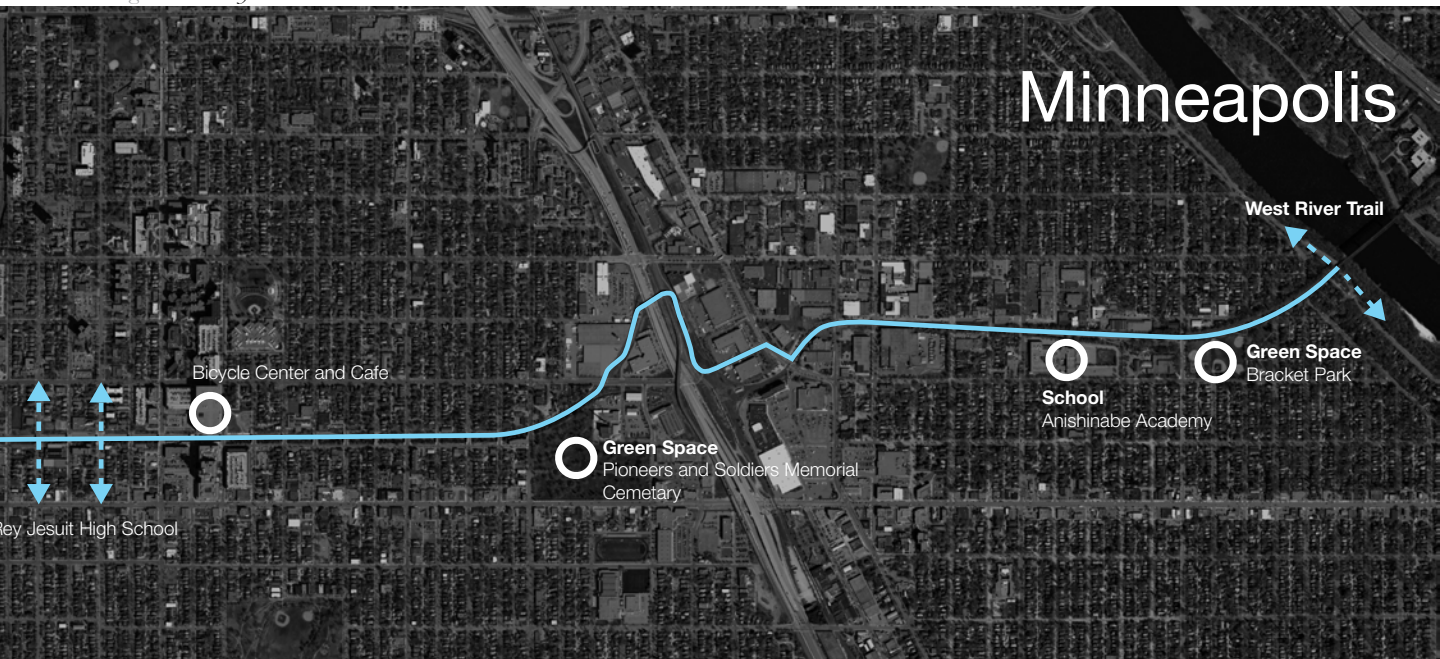


Figure 3-21 Bicycle center

### Strategy 5: Development

The greenway has spurred economic development in the neighbourhoods bordering the corridor including a 220 unit apartment complex known as the Urban Village. Additionally, the abandoned Midtown Exchange building has found new life housing a market, business incubator, apartments, and hotel. At the track level, a bicycle repair shop and café were built, providing passing cyclists with a place to fix their bikes, relax, and enjoy a drink or snack with their fellow riders.



Cycle City

## Toronto's Cycling Routes

Despite Toronto's lack of a cohesive cycling network, the city has developed a handful of successful cycling routes that should set an example for the kind of projects the city must prioritize moving forward. The *Sherbourne Cycle Track* provides an important North-South artery as Toronto's first fully separated cycle track, while the *Don Valley Trail* explores the city's beautiful ravine system. The *Waterfront Trail* begins to connect the new developments of the waterfront revitalization project, and the soon to be extended *West Toronto Rail Path* will provide a direct, car-free connection to downtown.

# Sherbourne Cycle Track

The Sherbourne Cycle Track was Toronto’s first separated cycle track. The street provides the only continuous cycle route, connecting Bloor Street to the waterfront. The route, which was completed in the spring of 2013, incorporates many best practice cycling infrastructures such as raised curbs separating cyclists from traffic, green pavement markings through intersections and bicycle boxes to assist cyclists in making two-phase left turns. In order to make room for the cycle track, on-street parking was removed from much of the street. Bus stops were integrated into the cycle track design with special pavement markings informing cyclists to yield to boarding passengers. The route provides a direct and safe North-South route through the eastern side of the downtown area where cyclists can feel comfortable traveling safely buffered from cars. Unfortunately the curb separations used are shallow and rounded, allowing cars and delivery trucks to stop in the bike lane. The city plans to study the effectiveness of the Sherbourne Cycle Track in order to inform the design of new cycle tracks elsewhere in the city.<sup>5</sup>

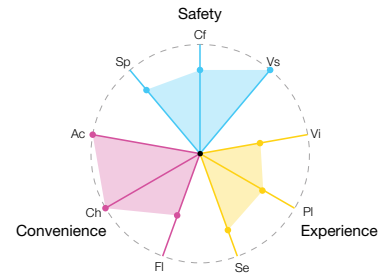


Figure 3-22 Sherbourne Cycle Track intersection

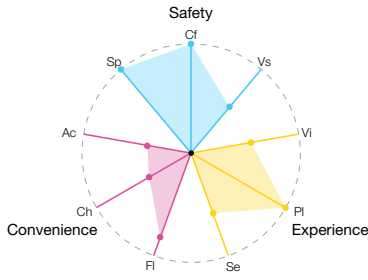


Figure 3-23 Sherbourne Cycle Track separation



Figure 3-24 Sherbourne Cycle Track plan





# Don Valley Ravine Trail

The Don Valley Trail is a byproduct of Toronto’s broad-reaching river and ravine network upon which very little development has occurred. This network has resulted in large areas of urban wilderness, untouched areas within the city’s urban boundary. This trail runs 14 km from Edwards gardens down to the lake shore, but connects to other trails which lead all the way to the northern boundary of the city at Steeles Avenue. The trail, often invisible from the street due to its location in the bottom of the river valley, provides a natural retreat in the middle of the bustling city. The multi-use pathway is used by a wide variety of people including cyclists, joggers, dog-walkers and rollerbladers, though does not see as many commuter cyclists. Due to its more remote location on the eastern edge of the downtown as well as its limited and steep access points to street level, the route, while providing a pleasant experience, is not very convenient for rushed commutes. To try and improve the use and experience of this hidden gem, the city of Toronto in conjunction with the Toronto and Region Conservation Authority commissioned a master plan for the trail to improve its environmental protection, access points, and look for opportunities for public art.<sup>6</sup> With the forthcoming development of the Lower Donlands, the Don Valley trail will become an even more important recreational and commuter corridor.



Figure 3-25 Below the Gardiner Expressway ramps



Figure 3-26 Rail Underpass near Bayview Ave. and DVP



Figure 3-27 Lower Don Trail



Figure 3-28 Don Valley Trail plan

# West Toronto Railpath

The West Toronto Railpath, which opened in 2009, follows the recent urban trend of reutilizing disused industrial infrastructures to provide new urban amenities. Perhaps the most iconic example of this kind of reuse is the Highline in New York city, in which a raised railway was transformed into a linear park, becoming one of the city’s most popular attractions. Similarly, the West Toronto Railpath appropriates an abandoned industrial rail corridor running adjacent to a GO train commuter line. The route is heavily used by commuters, taking cyclists 2.1 km from Dupont Street to Dundas, completely separated from automotive traffic. There are currently plans for a second phase which will extend the route to Wellington Avenue as well as the Waterfront Trail, providing cyclists from the northwestern region of the city with a direct commuting corridor into the downtown core. Designed by Toronto Architects Brown + Storey in collaboration with landscape architect Scott Torrance, the railpath stays true to the area’s industrial past, featuring rugged, durable materials and local, naturally occurring vegetation. The route is branded with a series of corten steel signs and bright orange paint. The path is designed not just as a place for passing through, but as a destination in itself. Beyond its transportation role, the path functions as a wild urban garden, a place to observe Toronto’s industrial past and a gallery for the artistic graffiti which juxtaposes this wild landscape. The path stitches together the neighbourhoods which it borders, creating new plazas where dead end streets intersect the trail. New development is being drawn to the area, breathing life into a long forgotten part of the city.<sup>7</sup>

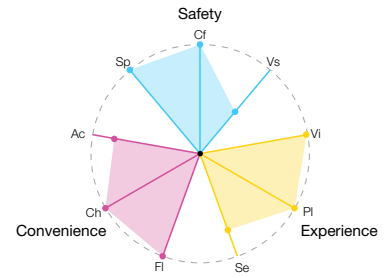


Figure 3-29 West Toronto Railpath



Figure 3-30 Bridge over Bloor St. West

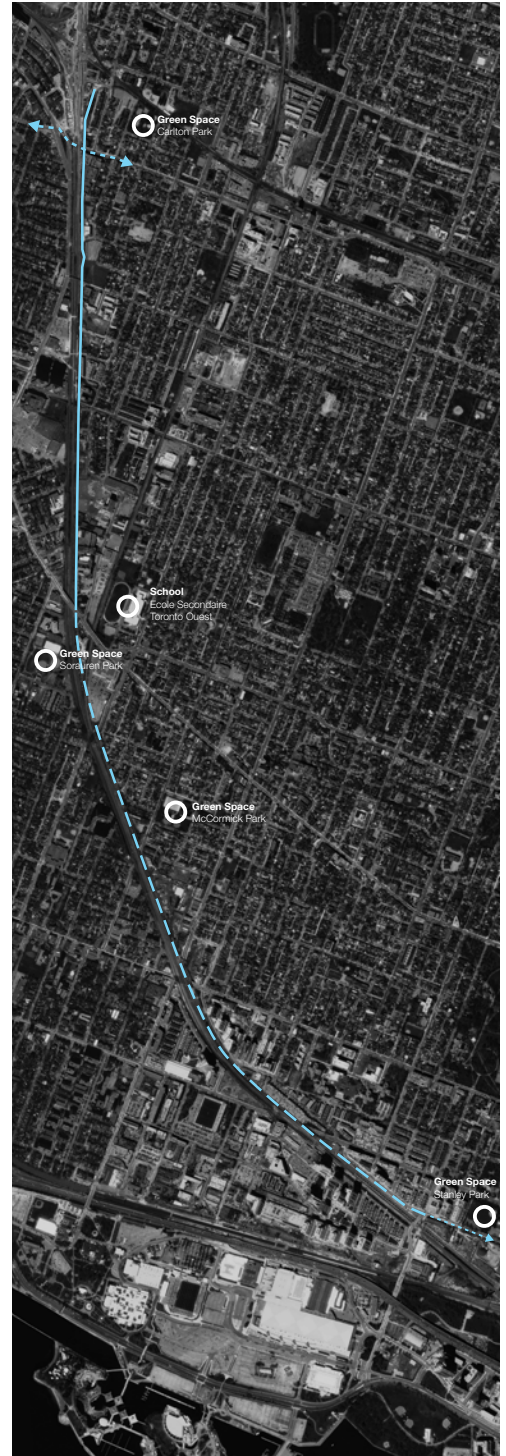


Figure 3-31 West Toronto Railpath plan

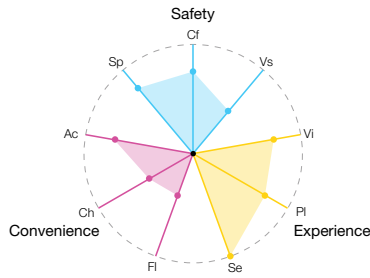


Figure 3-32 Waterfront trail plan

## Martin Goodman Trail

The Martin Goodman Trail is part of a much larger trail system stretching from Niagara, along the shores of Lake Ontario and the St. Lawrence River, to the Quebec border. This route combines sections of off-road multi-use paths with sections of signed routes on mostly quiet residential streets. The Toronto portion of the trail stretches 56 km all the way across the city from Humber Bay in Etobicoke to the Rouge River in Scarborough. The trail is used mainly as a recreational destination for Torontonians and tourists alike. For many years, the trail has suffered from disconnect and lack of continuity. Certain sections of the trail provide a pleasant experience and scenic views of the lake, yet it was difficult and somewhat dangerous to travel the entire length, often having to detour onto busy streets through the downtown core. The recent push by Waterfront Toronto to reactivate the city's waterfront has done much good for the accessibility and experience of the trail. Waterfront Toronto has worked to connect the missing links in the Trail and helped to keep cyclists away from traffic. A beautiful greenway was recently completed near Ontario Place, while construction on Queen's Quay is currently underway to make a pedestrian and cycle-friendly streetscape. Many other attractions have also been built to improve the experience of the trail and to provide attractions along the route. Some projects include HTO Park, Sugar Beach, the Spadina and Simcoe wavedecks and Harbour Square Park.<sup>8</sup> Despite these improvements, many stretches of the path remain better suited for pedestrians than cyclists, with sharp turns weaving along the harbour's edge and heavy pedestrian traffic blocking the way for cyclists.



Figure 3-34 Simcoe Wavedeck



Figure 3-33 Humber River Bridge

# From Example to Implementation

Examining successful international cycling routes from Europe, the United States and Toronto, confirms that the minimum requirements for a successful cycling route are safety and convenience, however, attentiveness to the design of the cycling experience is necessary to really set a route apart and makes it more attractive to new cyclists.

To provide a safe experience, nearly all of the studied cycle routes provide separation between bicycles and motor vehicles. This separation provides a much more comfortable and relaxed cycling experience. Additionally, many of the routes display the practice of safe intersection design including bicycle boxes, advanced lights and lane markings across intersections.

Route convenience comes mainly from proper planning, including clear wayfinding and connections between key destinations. Routes such as the London Cycle Superhighways conveniently link areas of employment with residential neighbourhoods. Other routes such as the Lisbon Bicycle Path tie together a variety of cultural destinations, parks and entertainment districts. In all cases, the routes are built near destinations where people desire to travel.

A wide variety of strategies are used to enhance the experience of the routes and provide an exciting and interesting ride for both commuters and recreational cyclists. Many of these strategies can be effectively applied to the new route proposed for Avenue Road and University Avenue in Toronto. The following strategies can help make cycling a more enticing activity while making the route stand out as an engaging experience instead of merely a mundane utility:

## 1. Creative Wayfinding

Rather than utilizing traditional street signage, more artistic and creative wayfinding provides excitement while also being bolder and more noticeable. The Lisbon Bicycle Path, for example, uses large text painted on the ground to identify distances and nearby destinations.

## 2. Connections to Neighbourhoods

A cycle route is made more exiting when it is carefully stitched into the fabric of the neighbourhoods through which it passes. Providing well marked connections to existing destinations and transforming the path's appearance to relate to the identity of the adjacent neighbourhoods, as seen in the Minneapolis Midtown Greenway, are ways to achieve these effects.

### **3. Moments of Pause**

Areas in which to sit and relax or to engage in other activities add visual stimulation to those on the cycle path while providing destinations along the route. They break up the monotony of the route while providing a connection between those who are cycling and those who are not.

### **4. United Identity**

A cohesive branding strategy can help tie together the experience of the route as seen in the London Cycle Superhighways with their consistent blue paint, or the Lisbon Bicycle Path with its repeated graphics and text painted onto the road surface and surrounding buildings.

### **5. Greenway**

Planting and greenspace have a calming effect and provide people with a contrast to the often hard textures of the urban environment. The Queensboro Bikeway and Minneapolis Greenway are both excellent examples of how a bikeway can also function as a linear park.

### **6. Value of Design**

Unique design can add a sense of novelty and thrill to a route as demonstrated by the Minneapolis Midtown Greenway and the Lisbon Bicycle Path. The value of design can be seen in the thoughtful implementation of infrastructure such as signage or bicycle racks as well as in larger scale landscapes and public art. Additionally, A new layer of design can enhance the route through temporary works installed along the path either on a seasonal basis, or coinciding with special events.

The following section demonstrates how such experiential strategies can be unified with utilitarian cycling infrastructure and implemented along the new Avenue/University cycling corridor in Toronto.

# Toronto Cycling Catalyst Corridor

This project proposes to build a new cycling corridor connecting Eglinton Avenue to the downtown core and the Waterfront Trail. The new route is intended to act as a spine in a larger network of cycleways, and bicycle boulevards spread across the entire city. The Avenue/University corridor acts as a showcase for the potential of cycling, visually increasing the presence of the bicycle within Toronto. The route acts as a catalyst for change, drawing more people to their bicycles, and thereby setting an example for future cycling infrastructure development as cycling's modal share begins to grow.

This route is able to build upon the growing cycling population in the downtown core, while also expanding the cycling user base into the midtown area between St. Clair and Eglinton where cycling user rates are at much lower levels. The route also connects to many points in Toronto's transit network, encouraging subway and train commuters to incorporate cycling into their journeys. The route begins at the proposed Eglinton crosstown LRT line, crosses the Bloor-Danforth subway line, and connects south to Union Station, the city's largest transportation hub. The route also ties together a series of existing and planned East-West cycling routes which are currently missing a strong North-South link.

Beyond its strategic location being well suited for a variety of transportation connections, the route's location also holds significant symbolic value. Constructing a prominent cycle route on this monumental civic street represents a dramatic increase in the value the city places in cycling. No longer a marginalized activity, cycling is now a prioritized mode of transportation. The route passes through Queen's Park, the home of Ontario's Legislative Assembly, tying the heart of political power to this more prominent vision for the bicycle. The route carries South, connecting the Legislature Building to the lake shore. Lake Ontario, a crucial transportation resource for the historical growth of the city, is now linked to another form of transportation which will be fundamental to the future growth of Toronto.

The route's main goal is to connect commuters from their places of residence to their places of work, as well as, to a range of other recreational and cultural destinations. Figure 3-35 illustrates the urban character along the route including neighbourhoods, land use, population density, major destinations, and intersecting cycle routes. At the south end, the route terminates at the Waterfront Trail allowing cyclists to continue their journey East or West along the lake. The North end of the route ends at Eglinton Avenue, connecting to the new crosstown LRT Station and the *Eglinton Connects* separated bike lanes which, when completed, will be the longest bike route in the city..

Figure 3-35 (Right) Context analysis of proposed cycling route

## NEIGHBOURHOODS LAND USE

Bike Routes





## Route Design Manual

The following manual outlines a five-step process for designing a cohesive and connected route with a strong ability to attract new cyclists. Such a route provides a safe, comfortable and enticing experience while, at the same time, connecting it to the urban context. Through this section, the manual is applied to the Avenue-University route. However, the same approach can be applied to other routes both within Toronto and in comparable cities.



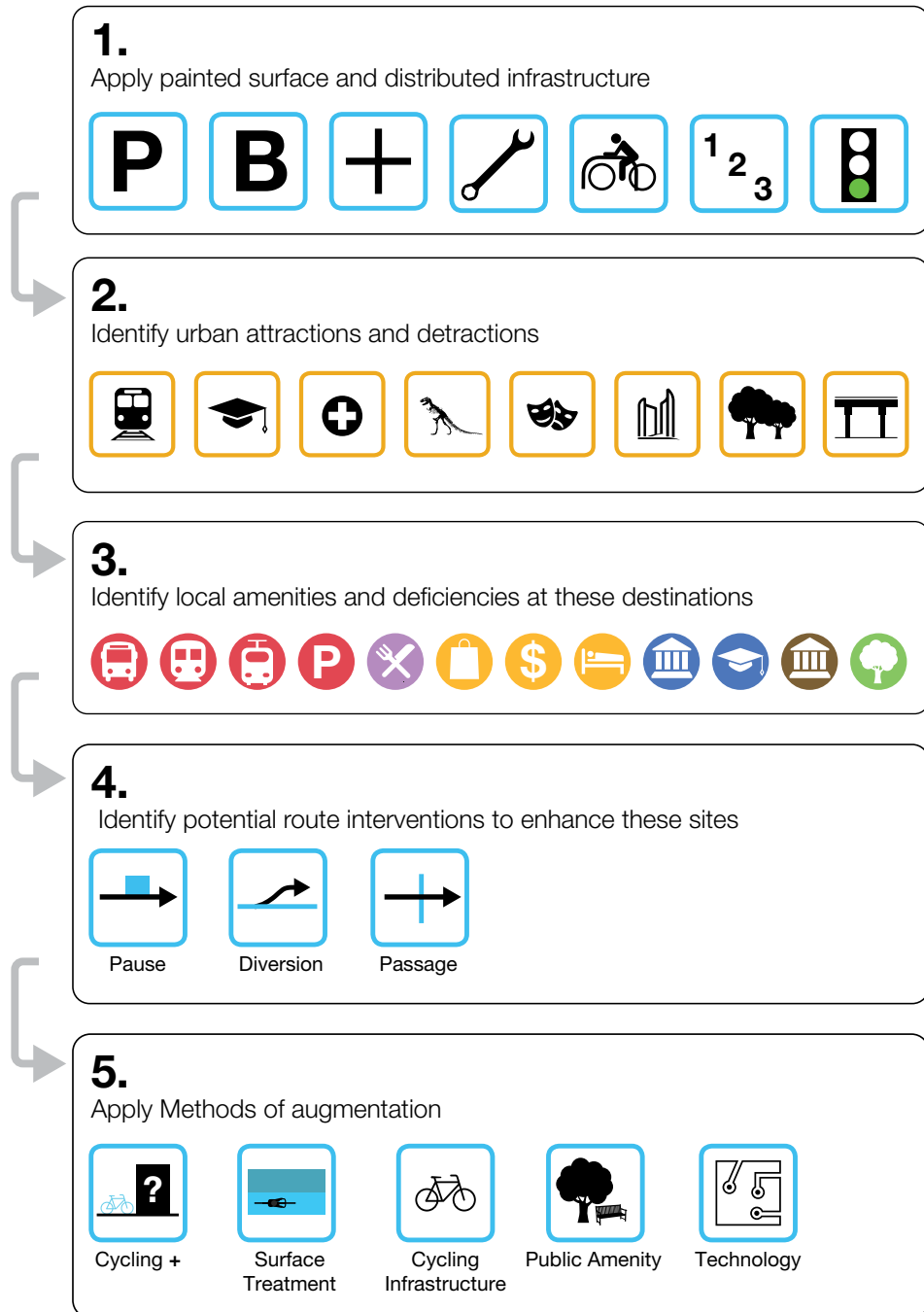


Figure 3-36 Five-step route design manual

# 1. The Painted Surface and Distributed Infrastructure

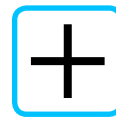
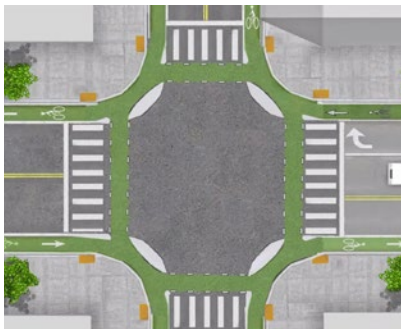
The ideal cycling route is often conceived as a unified ribbon of painted pavement. A space is defined for the bicycle, but not much thought is given to the bicycle's relationship to the neighbourhoods through which it passes. The Sherbourne Cycle Track in Toronto is a primary example of this standard approach. In the best scenario, the route is enhanced by a series of distributed cycling infrastructures such as bicycle parking and bicycle shares. Innovative cities have expanded the list of such supporting infrastructures in order to improve the safety and convenience of cycling along a given route. The regularity of these infrastructures changes in response to the needs of the community through which the route passes. For example, a community with many high-rise apartments would require more bicycle parking. Other infrastructures such as the green wave apply to the entire length of the route.



**Parking**



**Bike Shares**



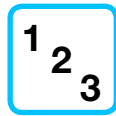
**Intersections**



**Bike Repair Station**



**Bike Railings**



**Bike Counters**



**Green Wave**

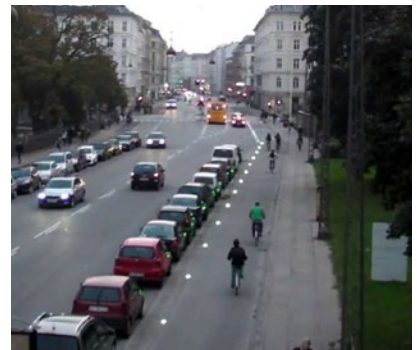


Figure 3-37 Distributed cycling infrastructures

The concept for the Avenue-University route design is founded on this idea of a painted surface supplemented with distributed infrastructures. Figure 3-38 and Figure 3-39 illustrate the potential distribution of these infrastructures throughout the route. Such infrastructures make for a safe convenient route, yet does not necessarily enhance the cycling experience, nor connect the cycling routes to other amenities within the city.

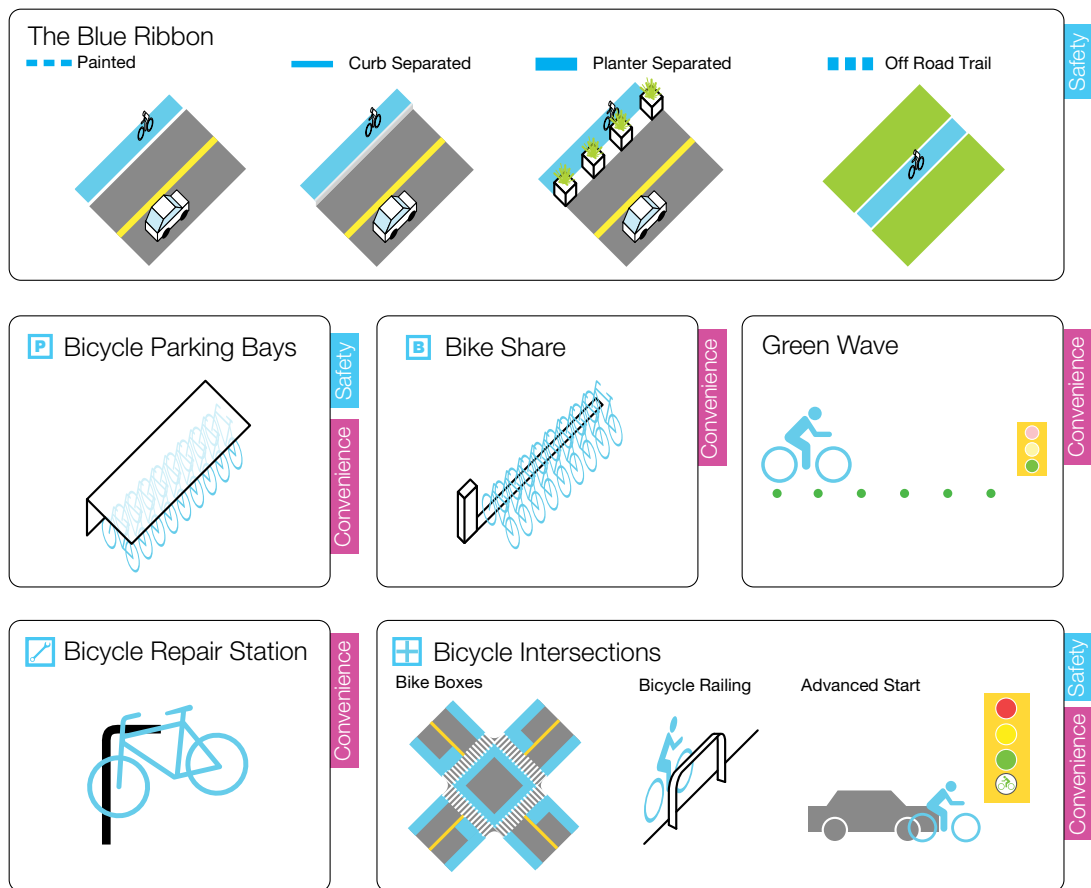


Figure 3-38 Distributed Infrastructure on Avenue-University Route

# Avenue / University Cycling Corridor

## Existing Infrastructure

- B Bike Share
- P Secure Bicycle Parking
- S Bicycle Shops
- Bicycle Trails
- Bicycle Boulevards
- Bicycle Expressways
- - - Proposed Bicycle Expressways

## New Infrastructure

- Path
  - Painted
  - Curb Separated
  - Planter Separated
  - Off Road Trail
- Distributed Infrastructure
  - P Bicycle Parking Bay
  - B Bike Share
  - + Bicycle Intersection
  - 🔧 Bicycle Repair Station

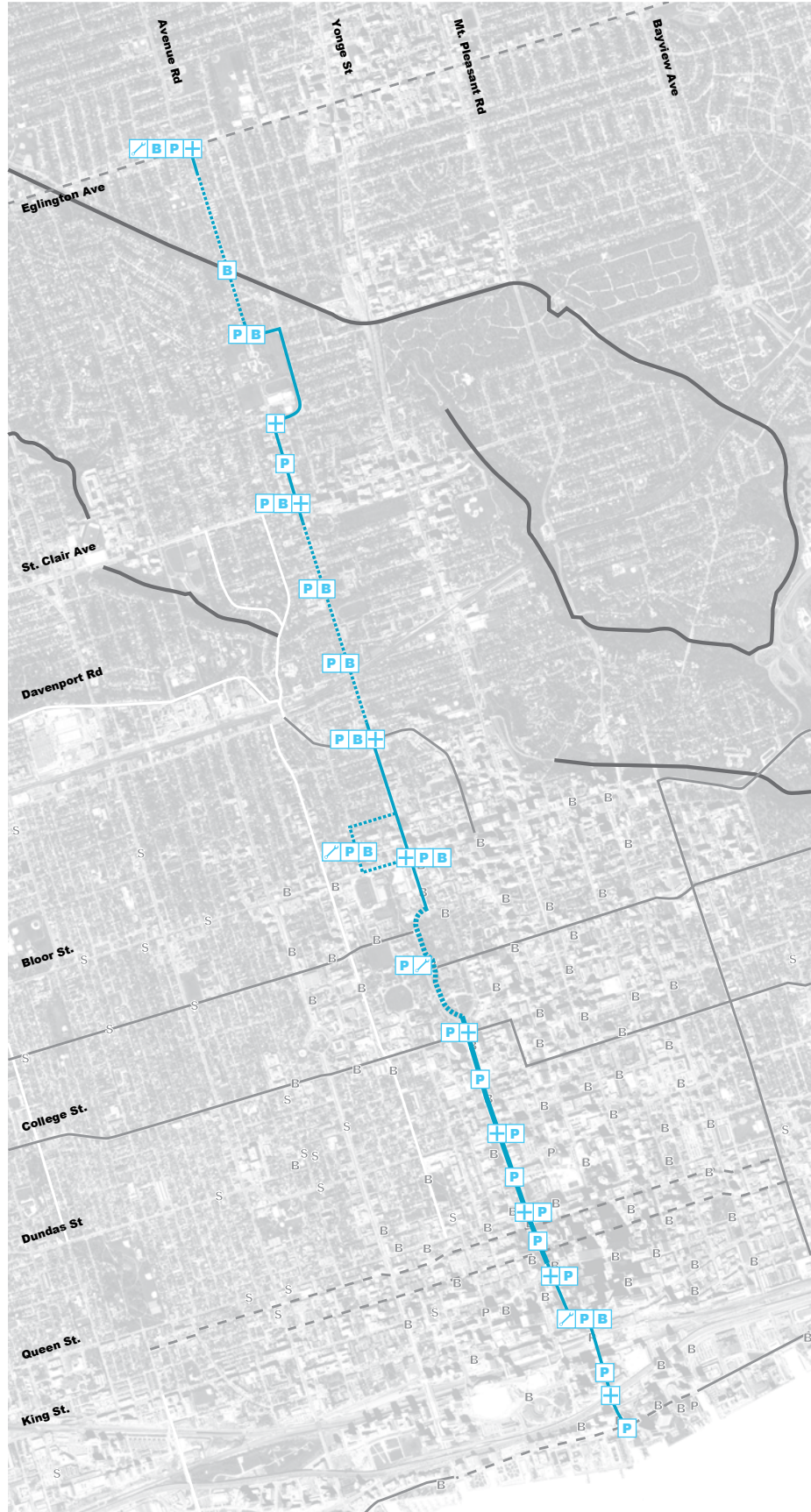


Figure 3-39 Distributed Infrastructure on Avenue-University Route

## 2. Identifying Urban Attractions and Detractions

In order to successfully attract new cyclists, the route design seeks to move beyond the standard cycle track typology and consider tighter integration with the community. This approach knits the cycle path into its surrounding context, creating a more connected and holistic cycling experience, while simultaneously improving the experience of other urban participants. This approach looks beyond simply using safety and convenience to attract new cyclists, and creates a unique, new cycling experience.

In order to place the cycle route in its broader urban context, an identification of existing destinations and attractions to which the cycle route can connect must be made. These attractions can be organized into four distinct categories: *transit hubs*, *institutions*, *cultural destinations* and *parks*. In addition to these attractions, it is important to identify *crossings* with existing bicycle routes, and route *detractions* in need of enhancement. The distribution of these attractions, intersections, and detractions can be seen in Figure 3-46 and Figure 3-47.

**1. Transit Hubs** include major subway and train stations, especially stations which connect different lines or different modes of transportation.



Figure 3-40 Transit Hubs on the Avenue-University route

**2. Institutions** include organizations that attract large numbers of visitors such as schools, hospitals and government buildings.

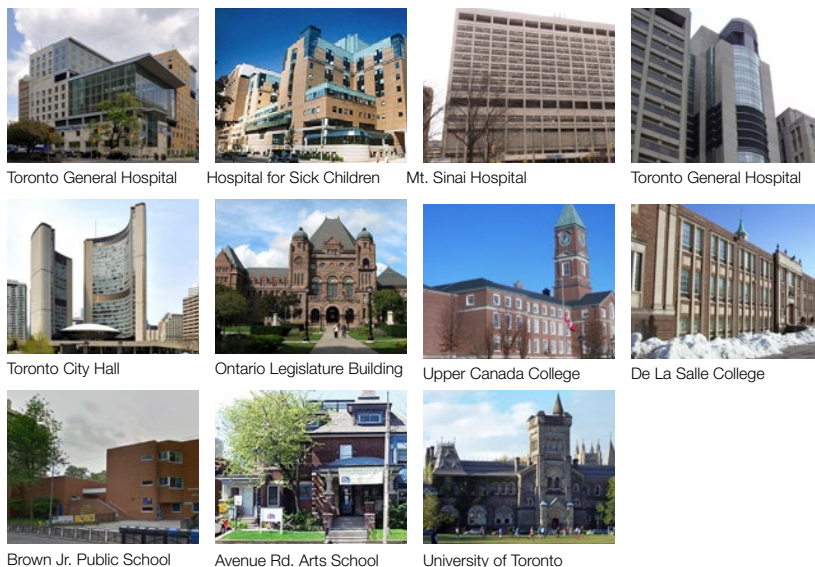
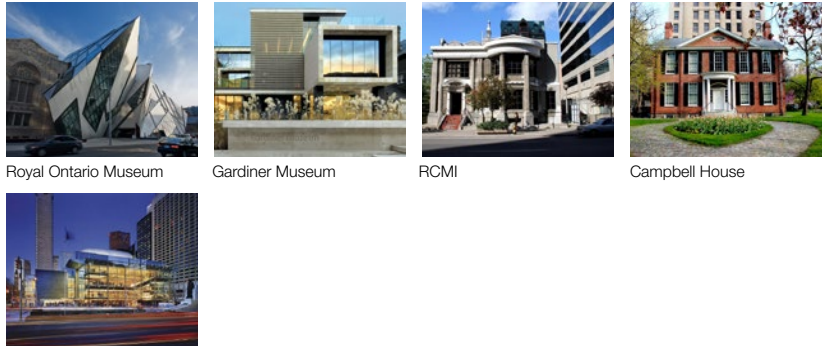


Figure 3-41 Institutions on the Avenue-University route

**3. Cultural Destinations** consist of museums and performance spaces



Royal Ontario Museum

Gardiner Museum

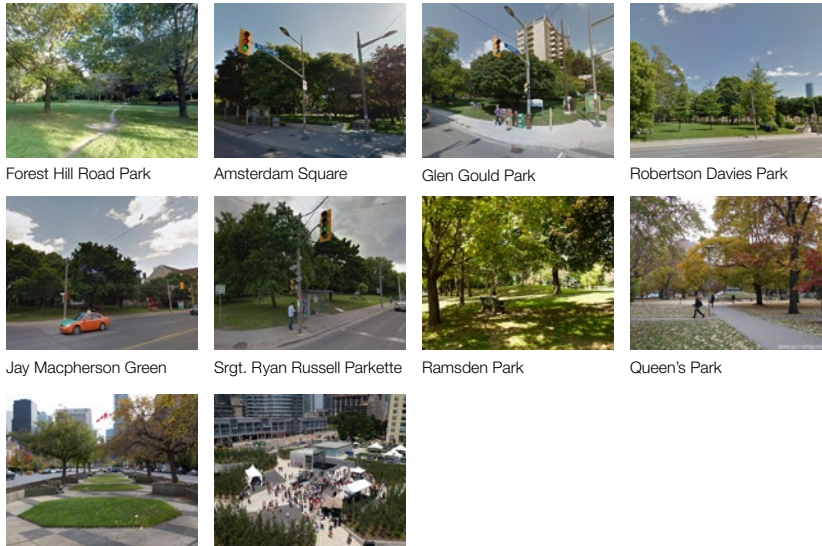
RCMI

Campbell House

Four Seasons Centre for Performing Arts

Figure 3-42 Cultural destinations on the Avenue-University route

**4. Parks** include both civic parks and neighbourhood green spaces.



Forest Hill Road Park

Amsterdam Square

Glen Gould Park

Robertson Davies Park

Jay Macpherson Green

Srgt. Ryan Russell Parkette

Ramsden Park

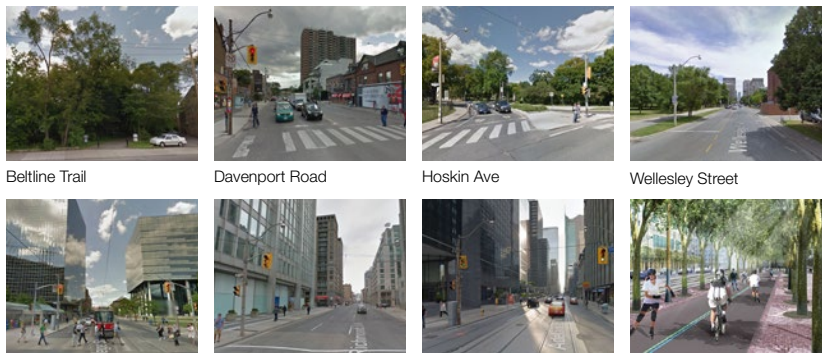
Queen's Park

University Island

Ontario Square

Figure 3-43 Parks on the Avenue-University route

**5. Bike Crossings** are places where the proposed route intersects with existing priority cycling routes.



Beltline Trail

Davenport Road

Hoskin Ave

Wellesley Street

College Street

Richmond Street

Adelaide Street

Queens Quay

Figure 3-44 Bike Crossings on the Avenue-University route

**5. Detractions** are locations with unpleasant cycling conditions



CPR Rail Overpass

Union Station Tunnel

GO and Via Overpass

Gardiner Expressway Overpass

Figure 3-45 Detractions the Avenue-University route

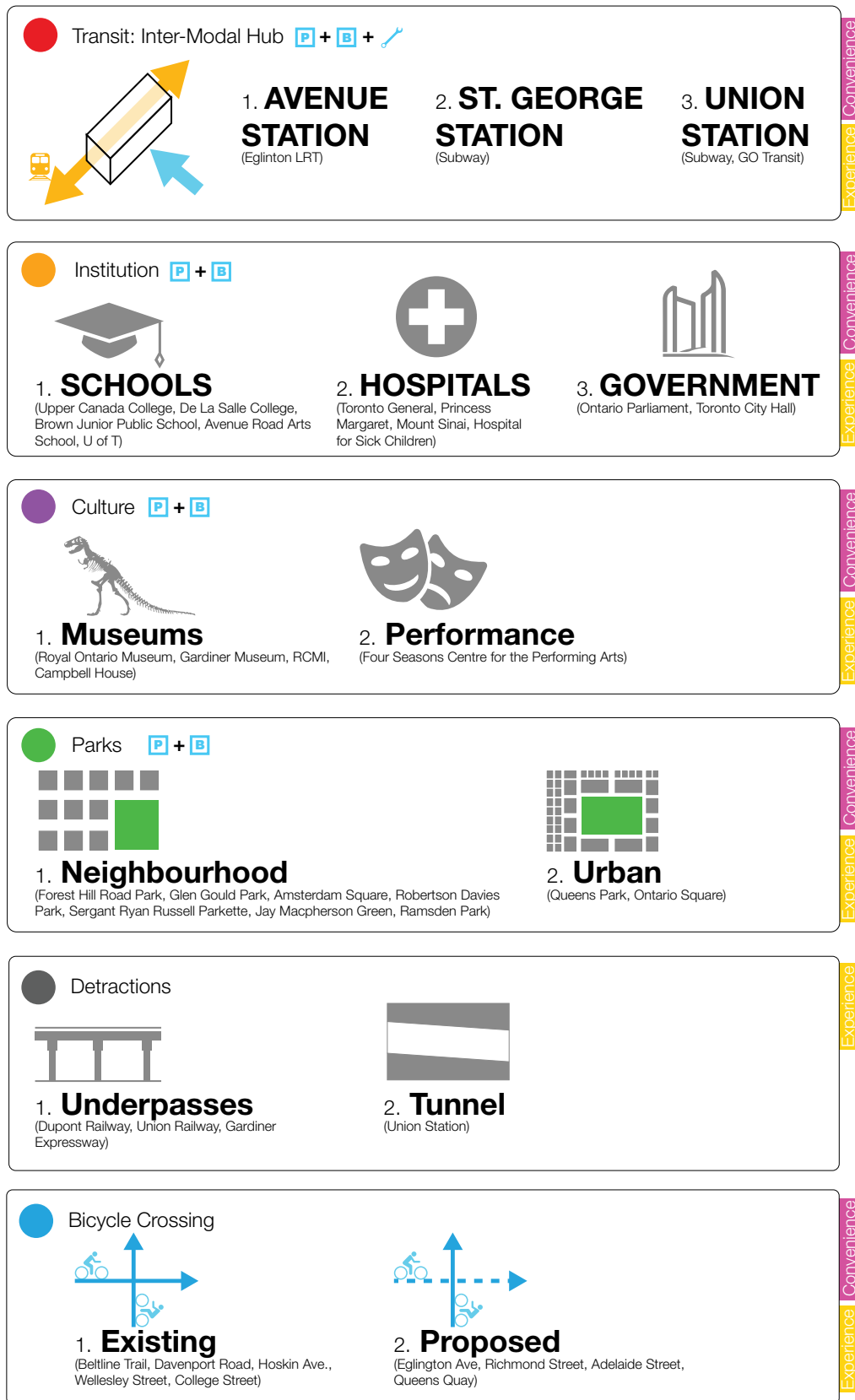


Figure 3-46 Attractions and Detractions



# Avenue / University Cycling Corridor

## Existing Infrastructure

- B Bike Share
- P Secure Bicycle Parking
- S Bicycle Shops
- Bicycle Trails
- Bicycle Boulevards
- Bicycle Expressways
- - Proposed Bicycle Expressways

## Attractions and Detractions

- Transit Link
- Institution
- Cultural
- Park
- Detractions
- Bike Crossing



Figure 3-47 Destinations and Attractions

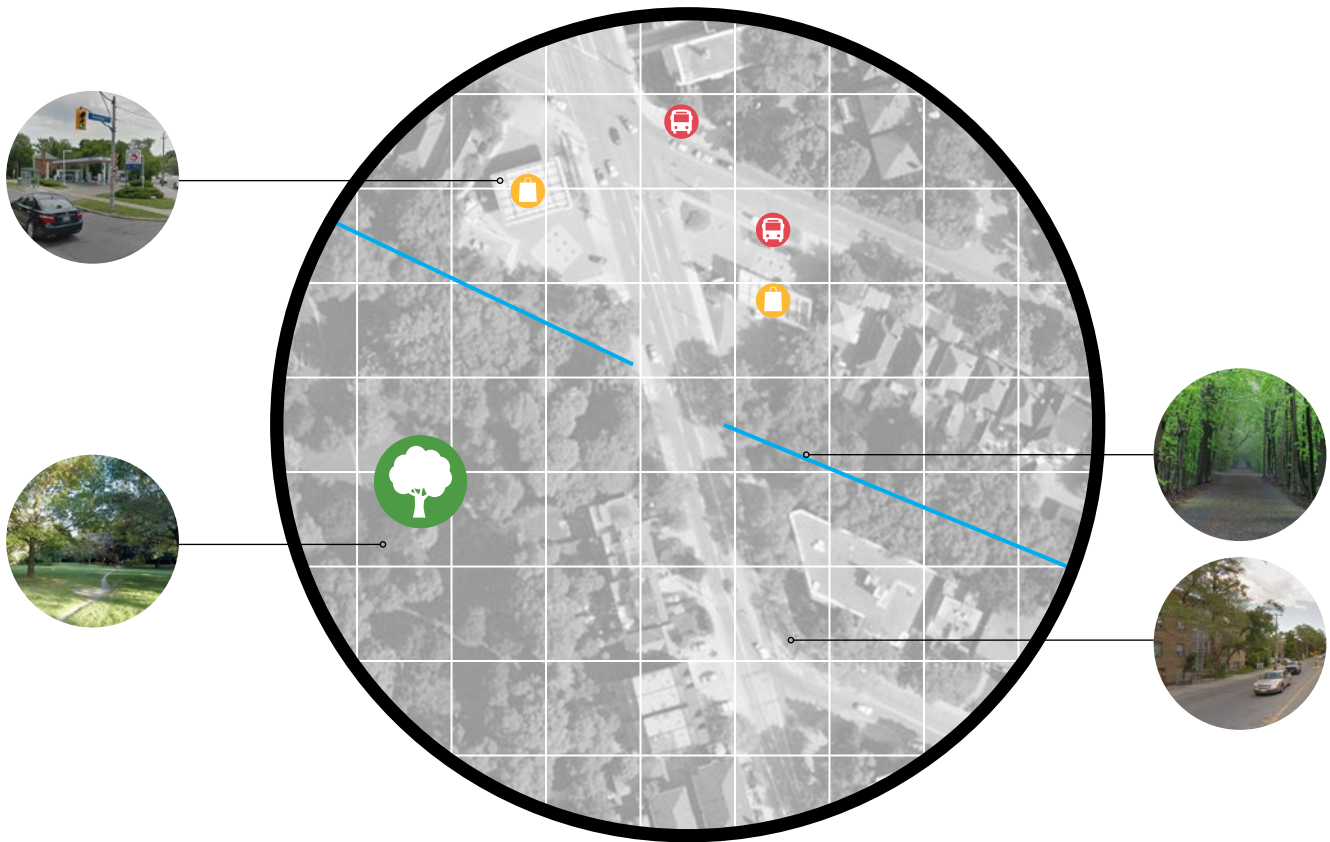
### 3. Local Site Analysis

To determine how the cycling route can best integrate itself with these existing attractions and mitigate these detractions, a careful site analysis needs to be performed to identify the current amenities surrounding these attractions and detractions. Existing amenities include transit stops, cycle routes, parks, retail, restaurants and hotels as well as educational, cultural and political institutions. This investigation identifies shortcomings in the site's amenities which can aid in determining how to best enhance the site experience. Identifying the kinds of people who occupy the neighbourhoods around these attractions, and understanding how these people use the space is also important in understanding the sites. Cycling infrastructures can be bundled with other programs and amenities to create an environment which benefits cyclists and pedestrians alike while simultaneously raising public awareness of cycling.

For the purpose of this thesis, seven demonstration sites were chosen for further study. The interventions at these sites serve as design experiments to explore the potential of design as a catalyst for a cycling culture and to demonstrate strategies for integrating the cycling route into its adjacent communities. These strategies can be applied to similar sites along the route as well as other routes in similar cities. Site specificity comes from a response to the needs and amenities of the particular site.

The following seven sites were chosen to represent a wide range of destinations and attractions existing along the length of the route including: a bicycle crossing, a park, a school, a museum and a transit station. These sites also represent a range of spatial conditions and public space typologies through which the route passes.

# Site Context: Bike Crossing The Beltline Trail



## Amenities

-  **Retail**  
 1. Esso Gas Station  
 2. Husky Gas Station
-  **Bus Stops**  
 14 Glencairn
-  **Parks**  
 Forest Hill Road Park

Figure 3-48 Beltline Trail site analysis

## Neighbourhood Stakeholders

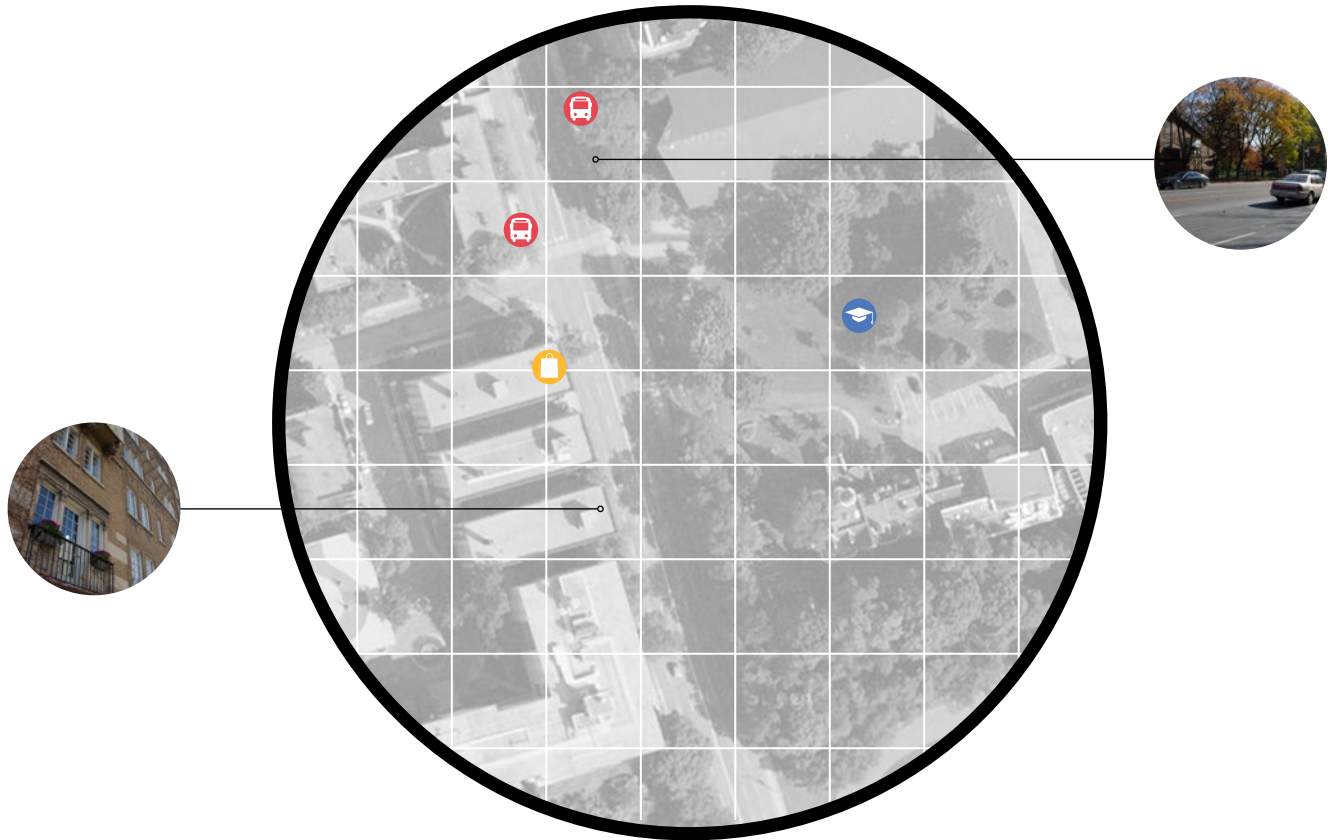
-   
 Families
-   
 Recreational &  
 Commuter Cyclists
-   
 Joggers

## Quality of Space

This busy arterial road creates an uncomfortable crossing for cyclists and pedestrians who are traveling along the Beltline Trail. While the park provides a pleasant green space, the trail currently has minimal presence on the street.

# Site Context: Institution

## De La Salle College



### Amenities



**Retail**  
Quick Run  
Convenience Store



**Bus Stops**  
5 Avenue Rd  
142 Avenue Rd Express



**Schools**  
De La Salle College

Figure 3-49 De La Salle College site analysis

### Neighbourhood Stakeholders



Families



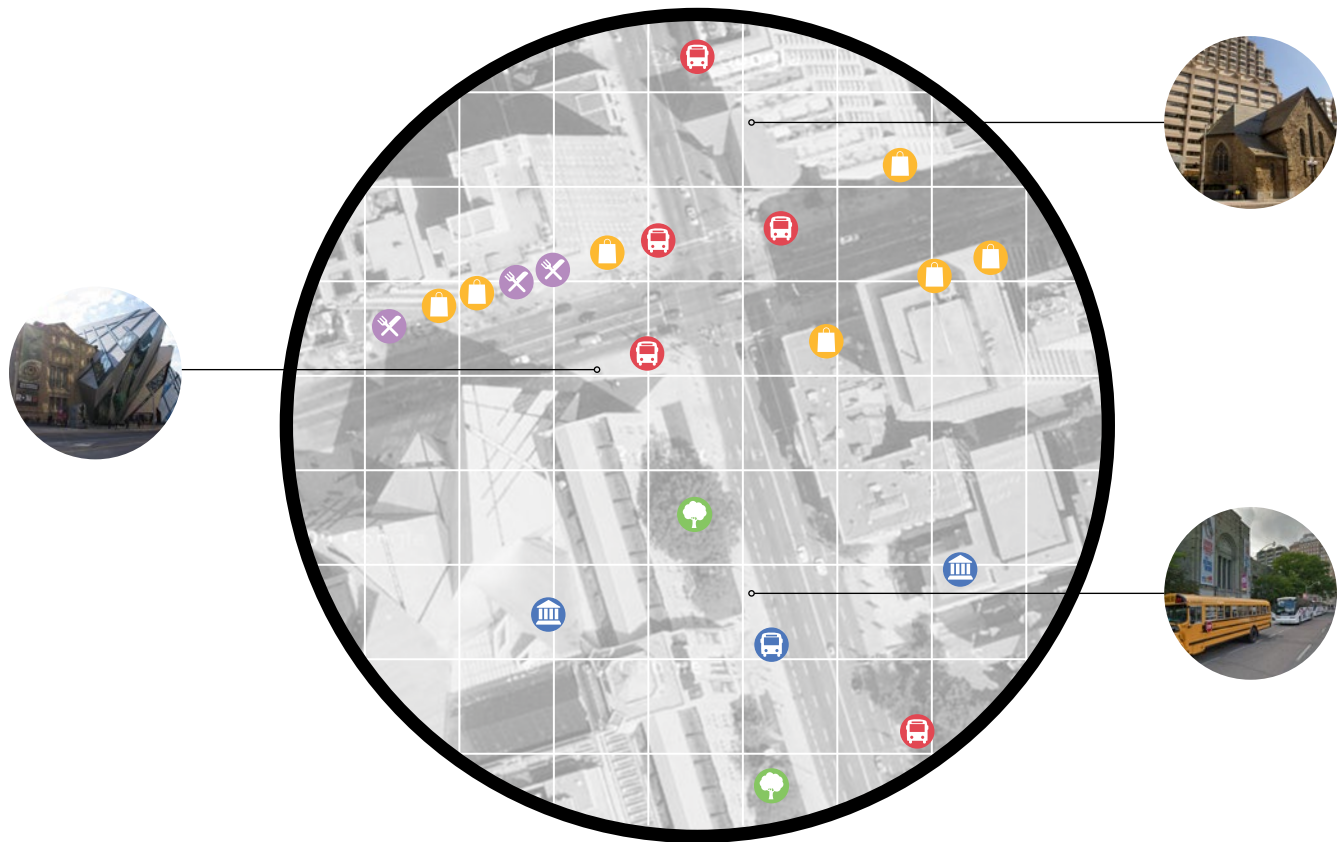
Students

### Quality of Space

The school lacks street presence, tucked in behind a large retaining wall and row of trees. The neighbourhood has a historic quality with many old, but elegant, apartment buildings and houses. A steep hill leads up to the school when approaching from the South, which can be a struggle for some cyclists.

# Site Context: Cultural Destination

## The Royal Ontario Museum



### Amenities

- |  |  |  |  |
|--|--|--|--|
| <p><b>Retail</b></p> <ul style="list-style-type: none"> <li>1. Grand &amp; Toy</li> <li>2. Toni &amp; Guy</li> <li>3. Strellson</li> <li>4. Louis Vuitton</li> <li>5. Mont Blanc</li> <li>6. The North Face</li> </ul> | <p><b>Restaurants</b></p> <ul style="list-style-type: none"> <li>1. Gabby's Bar &amp; Grill</li> <li>2. Subway</li> <li>3. Second Cup</li> </ul> | <p><b>Bus Stops</b></p> <ul style="list-style-type: none"> <li>5 Avenue</li> <li>142 Avenue Rd Express</li> <li>300 Bloor-Danforth Blue Night</li> </ul> | <p><b>Museums</b></p> <ul style="list-style-type: none"> <li>1. The ROM</li> <li>2. Gardiner Museum</li> <li>ROM bus drop off</li> </ul> |
|--|--|--|--|

Figure 3-50 ROM site analysis

### Neighbourhood Stakeholders

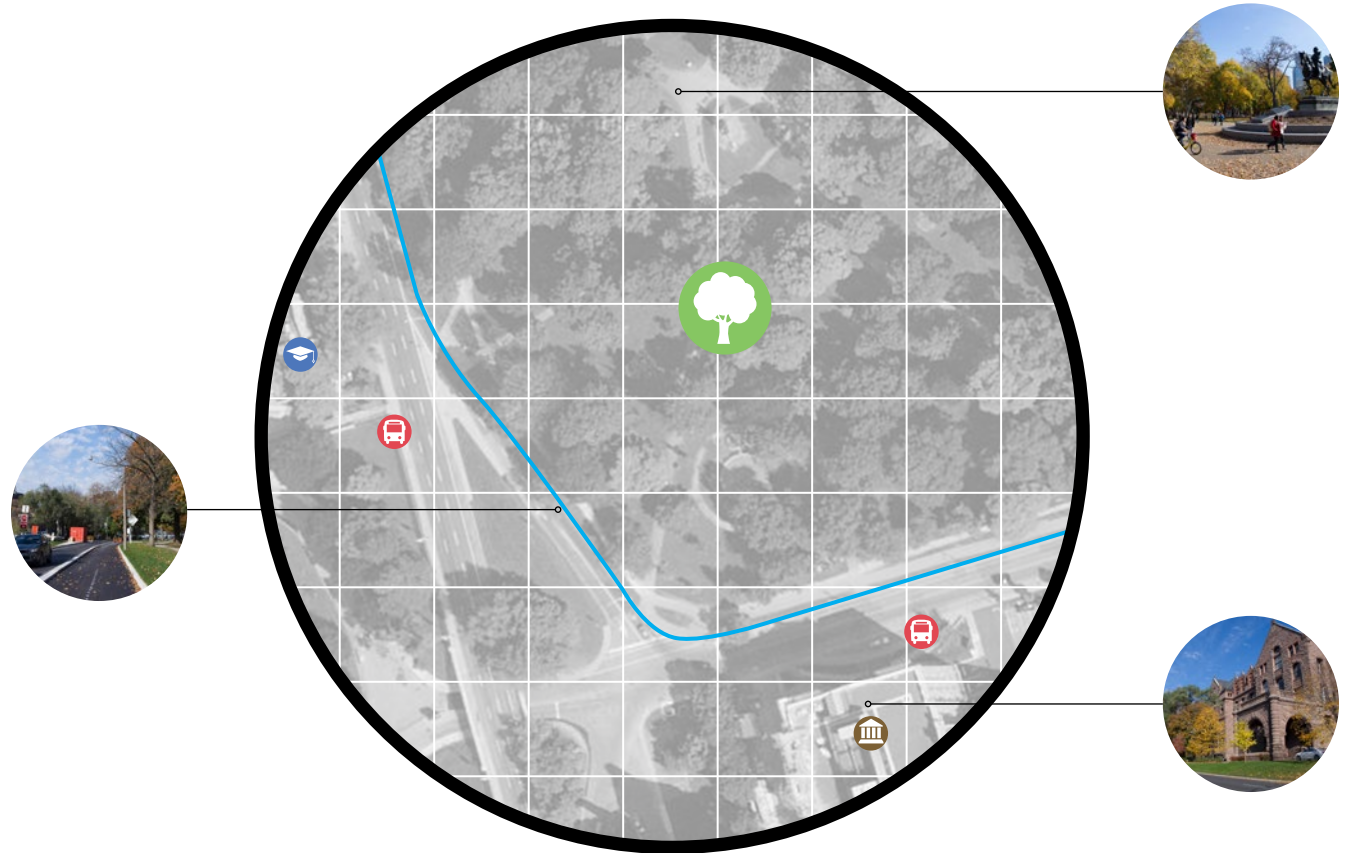


### Quality of Space

This busy intersection is a cultural centre of the city. The area is dominated by the roadway and busy traffic, particularly with the ROM bus drop-off along Avenue Rd. Outdoor public amenities are lacking, other than a few benches and sidewalk plantings in front of the ROM.

# Site Context: Park

## Queen's Park



### Amenities

-  **Schools**  
UofT Hart House
-  **Bus Stops**  
5 Avenue Rd  
142 Avenue Rd  
Express
-  **Government**  
Legislative Assembly  
of Ontario
-  **Park**  
Queen's Park

Figure 3-51 Queen's Park site analysis

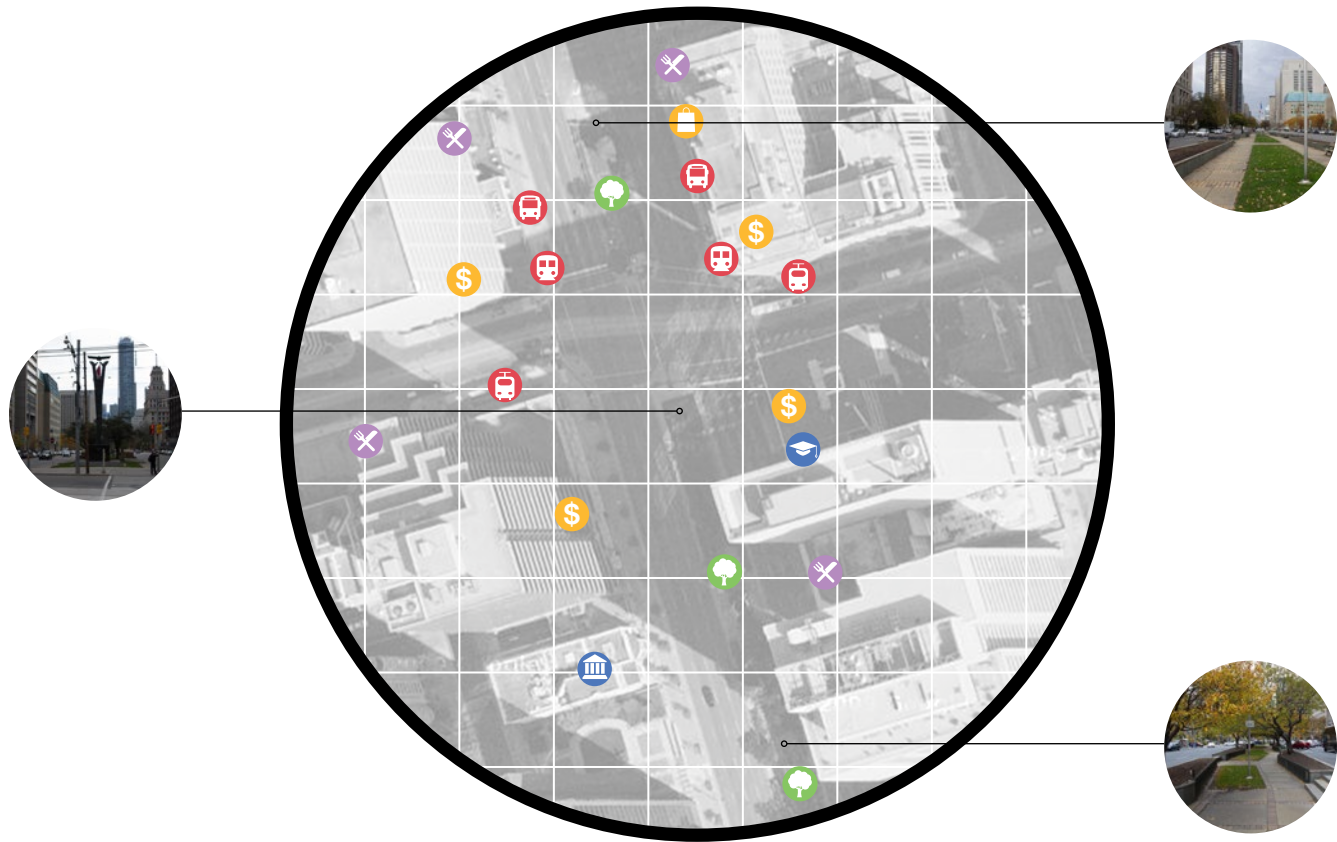
### Neighbourhood Stakeholders



### Quality of Space

Filled with mature trees, the park provides a beautiful natural retreat, particularly attractive in the Fall when the leaves change colour. The park's main features are a series of monuments. In its current state, the park acts more as a route of passage for U of T students and people who work in the area, with few attractions to keep people in the park.

# Site Context: Park University Avenue Island



## Amenities

- Bus Stops**  
142 Downtown Express
- Banks**  
1. BMO  
2. RBC  
3. TD  
4. CIBC
- Restaurants**  
1. Tim Horton's  
2. Timothy's  
3. Avenue Cafe + Bistro  
4. Tim Horton's
- Museum**  
Royal Canadian Military Institute
- Park**  
Linear Island Parks
- Street Car Stops**  
505 Dundas
- Retail**  
AGO Art Rentals and Sales
- School**  
ILSC Language Schools
- Subway Entrance**  
St. Patrick Station

Figure 3-52 University Ave. Island site analysis

## Neighbourhood Stakeholders

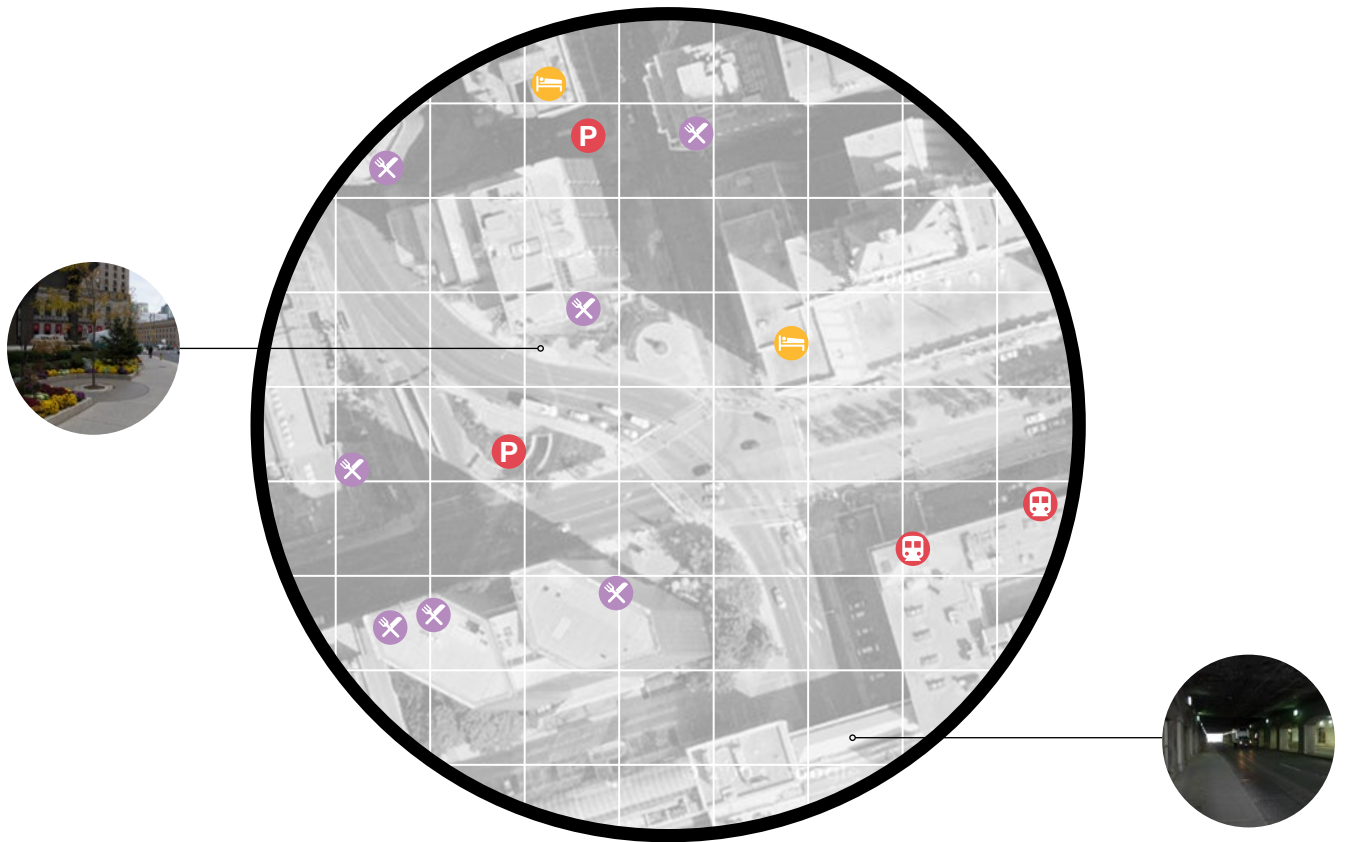


## Quality of Space

A series of planted islands occupy the middle of this monumental civic avenue. Each island is landscaped and planted according to its own theme. Unfortunately, there are limited access points to this linear park and the eight lanes of heavy traffic detract from the experience.

# Site Context: Detraction

## Union Station Tunnel



### Amenities



**Restaurants**

1. Jack Astor's
2. Sushi Cafe
3. Second Cup
4. Tim Horton's
5. Chipotle
6. Starbucks Coffee
7. Casey's



**Hotels**

1. Strathcona Hotel
2. Royal York Hotel



**Subway Entrance**

Union Station



40 York Street Underground Parking

Figure 3-53 Union Station site analysis

### Neighbourhood Stakeholders



Commuters



Tourists

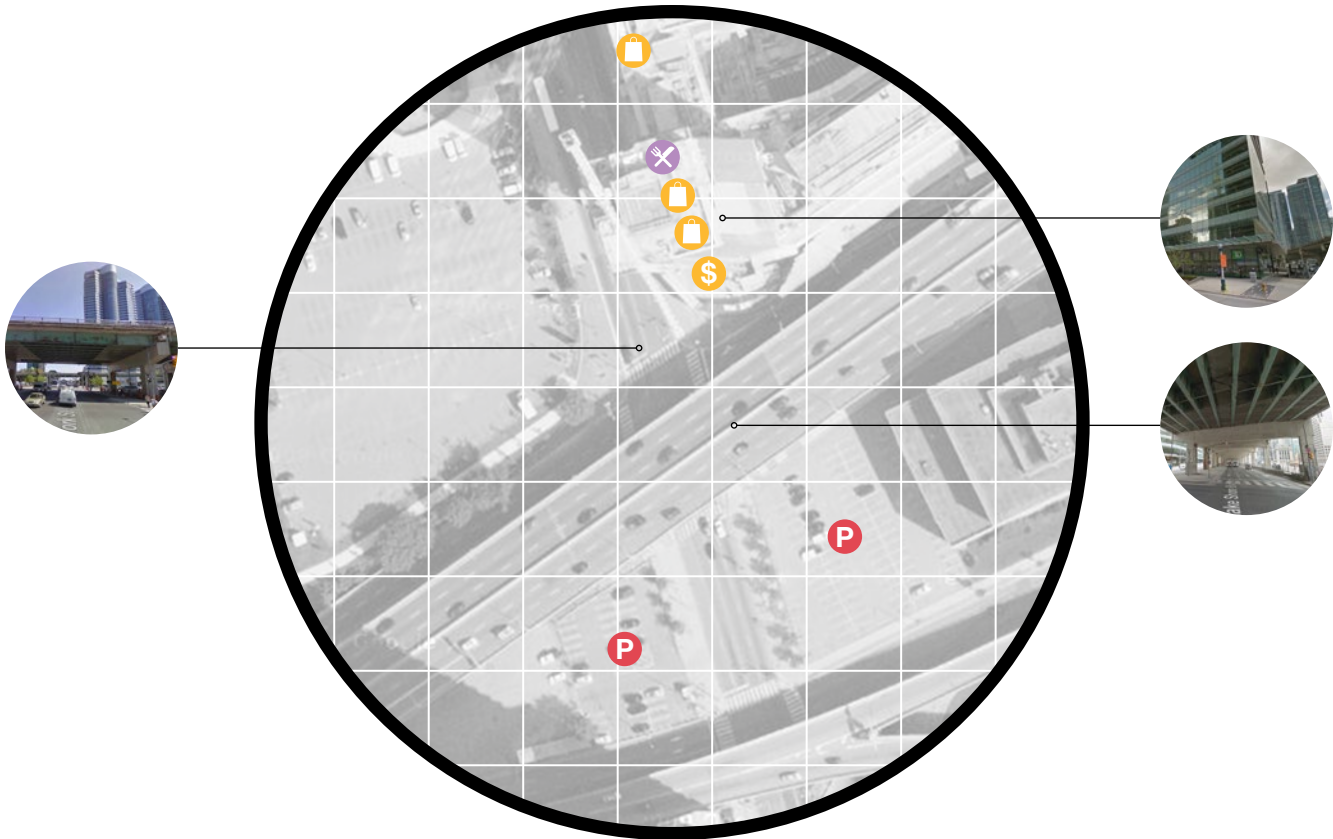
### Quality of Space

The city's main transit hub sees thousands of people each day commuting from across the GTA as well as many visitors from outside the region. The station is currently undergoing renovations to increase its capacity and make the area more pedestrian friendly complete with new plantings and traffic calming measures



# Site Context: Detraction

## Gardiner Overpass



### Amenities





-  **Banks**  
TD
-  **Restaurant**  
Starbucks
-  **Parking**  
Surface Parking with condos to come
-  **Retail**  
1. LCBO  
2. Longos  
3. Telus

Figure 3-54 University Gardiner Overpass site analysis

### Neighbourhood Stakeholders



### Quality of Space

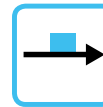
This busy intersection is quite overwhelming for cyclists and pedestrians with four lanes of traffic on Lakeshore Blvd. and an on-ramp to the Gardiner Expressway. The raised highway casts the area in permanent shadow.

## 4. Route interventions

A close investigation of these sites reveal three categories of events which occur along the route's length:

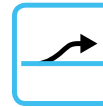
### 1. Pause

Moments of pause occur near clear amenities which attract both cyclists and non-cyclists.



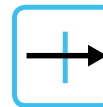
### 2. Diversion

Diversions act as a form of wayfinding, expanding the reach of the route further into the city. These moments direct cyclists to attractions and destination that are located near the route, but are not directly visible.



### 3. Passage

Moments of passage refer to conditions that are meant to be experienced in motion from the seat of a bicycle.



The seven focus sites provide the opportunity to explore all three of these conditions. Figure 3-55 shows which conditions arise at each of the test sites.

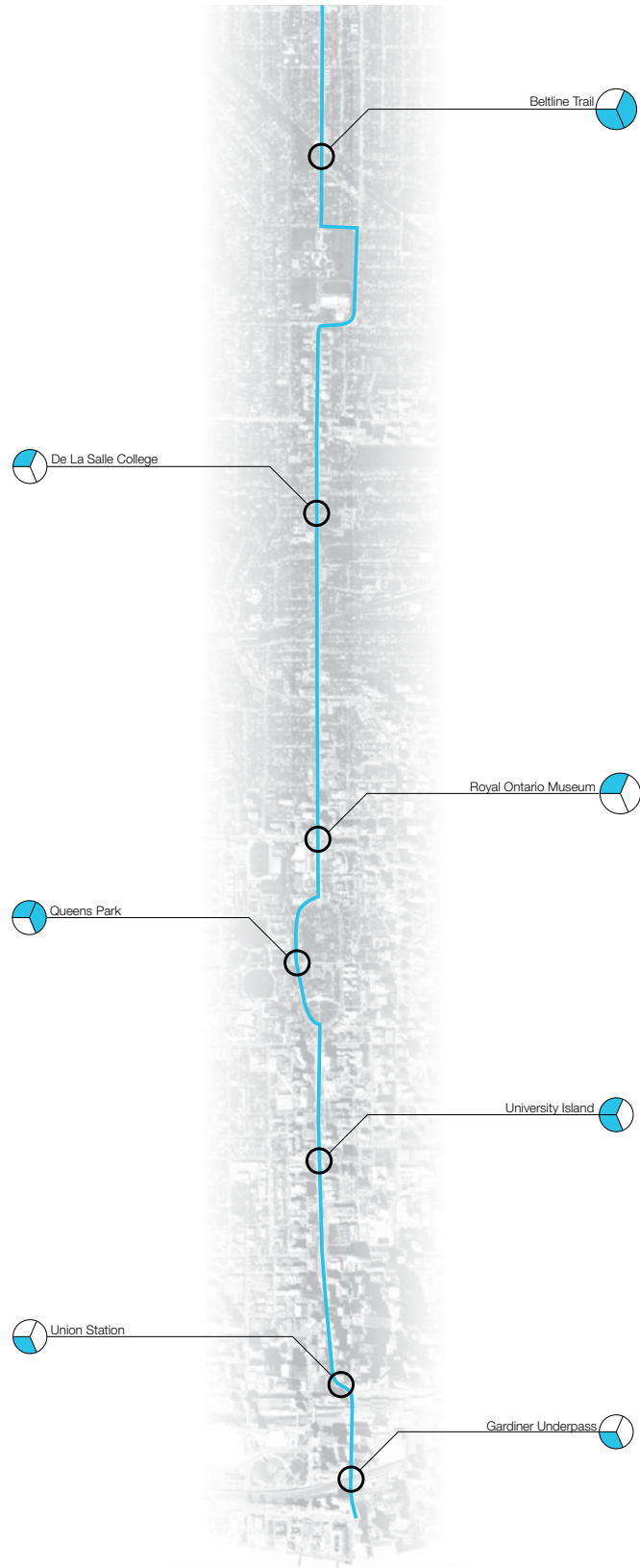
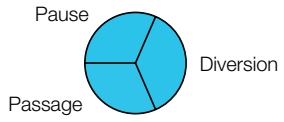


Figure 3-55 Route conditions at each site

## 5. Methods of Augmentation

The following techniques are implemented at these moments of pause, diversion and passage in order to enhance the cycling experience and tie the route into the adjacent destinations. The techniques serve to enhance the program on the site, improve cycling accessibility to existing amenities, and improve the quality of the public space.

### 1. Cycling +

Cycling plus activates a site by adding new program to attract both cyclists and pedestrians to the area. The added program responds to the needs of the particular community, enhancing and supplementing the existing activities of the site.

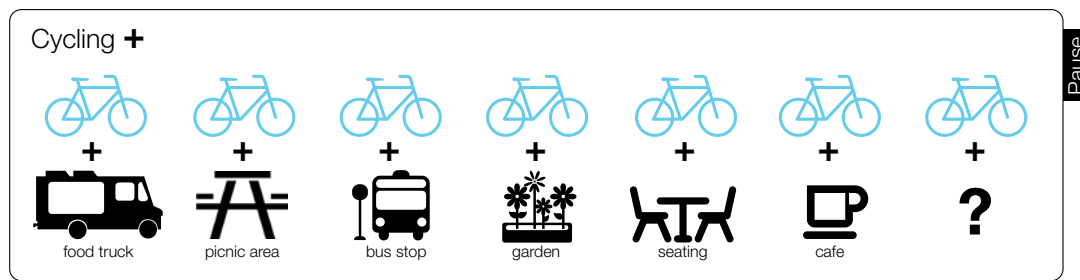


Figure 3-56 Methods of augmentation: cycling +

### 2. Surface Treatment

These surface treatments are meant to control the flow of cyclists on the route as well as to facilitate merging onto and exiting the route. Additionally, these surface treatments inform other road users, such as car drivers and pedestrians, of the presence of bicycles, allowing for safe mediation between all modes of transportation.

Wayfinding Text and Symbols are printed on the route to alert cyclists of upcoming destinations. These markings subtly encourage cyclists to slow down and be more aware of their surroundings. This text applies both to destinations along the route as well as diversions at which cyclists must move away from the main route.

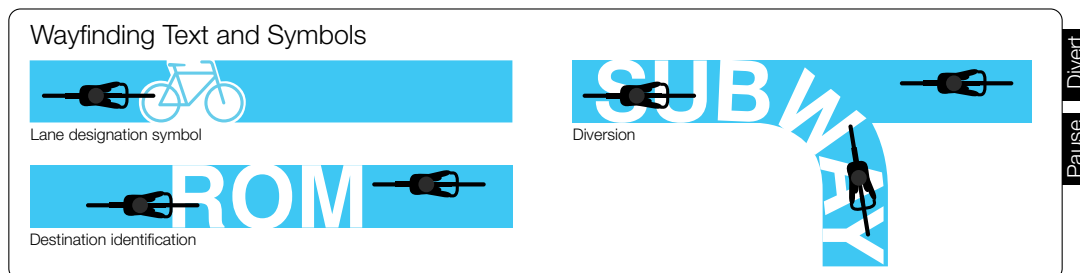


Figure 3-57 Methods of augmentation: wayfinding text and symbols

### Traffic Warning Patterns

are pavement markings on the road surface of intersecting streets to warn drivers that they are approaching a high-volume cycling route. These markings alerts drivers to slow down and be more cautious when crossing the intersection.

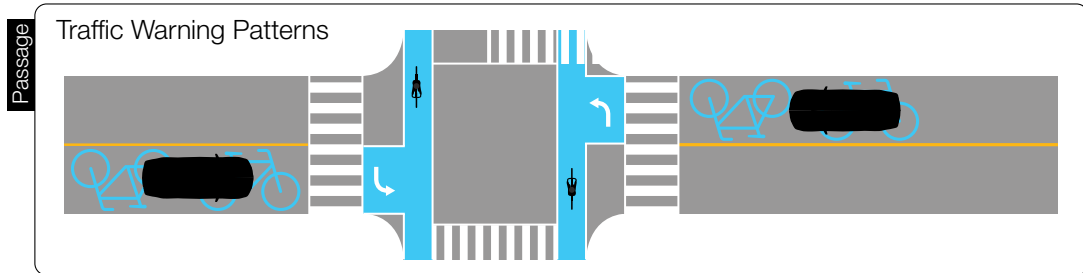


Figure 3-58 Methods of augmentation: traffic warning patterns

### Flow Control

is applied on the cycle path using multiple shades of blue paint to differentiate space for fast commuters versus space for more leisurely riders. This surface treatment ensures that the cycle route is wide enough for faster riders to safely pass slower ones, and for slower riders to carry on at a leisurely pace without feeling rushed or stressed.

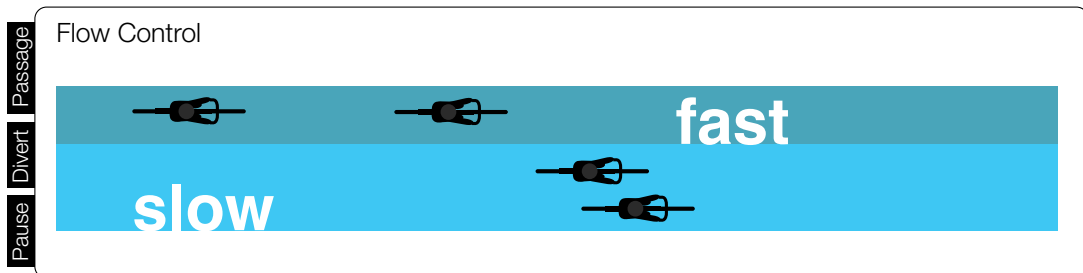


Figure 3-59 Methods of augmentation: flow control

### Shared Zones

are zones around certain destinations where the paving pattern changes to indicate that the area is shared between pedestrians and cyclists. In these transition zones, cyclists travel slower and keep an eye out for pedestrians. Likewise, pedestrians are more aware of the presence of cyclists.

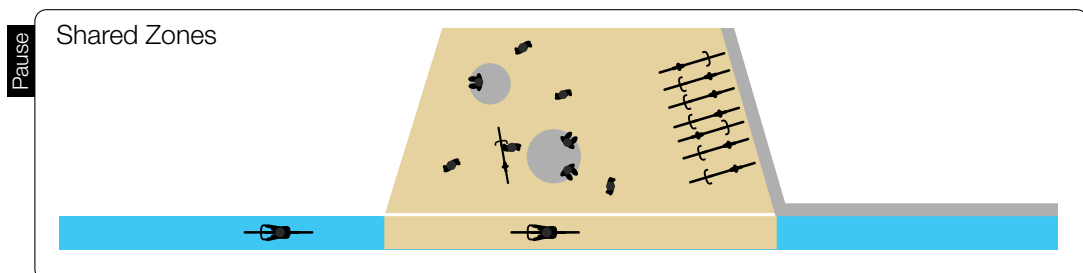


Figure 3-60 Methods of augmentation: shared zones

### 3. Cycling Infrastructure

At many destinations, the cycle route can be tied into the community simply by providing cycling infrastructure to make the destination more accessible to cyclists. These infrastructures include bicycle shares, sheltered bicycle parking, and bicycle repair stations.

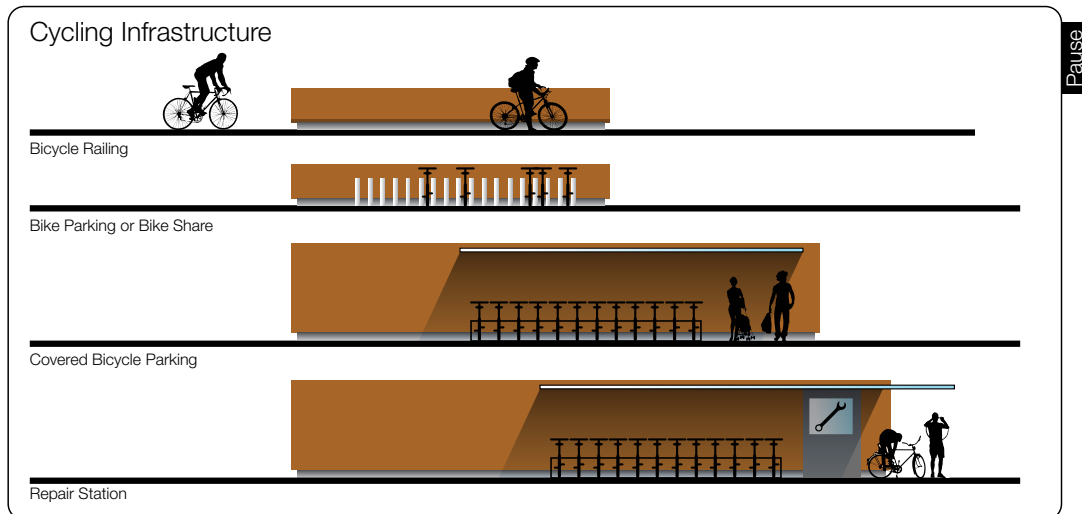


Figure 3-61 Methods of augmentation: cycling infrastructure

### 4. Public Amenity

These methods of augmentation are mainly aimed at improving the quality of public space with which the cycle route interacts. Strategies include the addition of seating, planting, outdoor lighting and wayfinding signage.

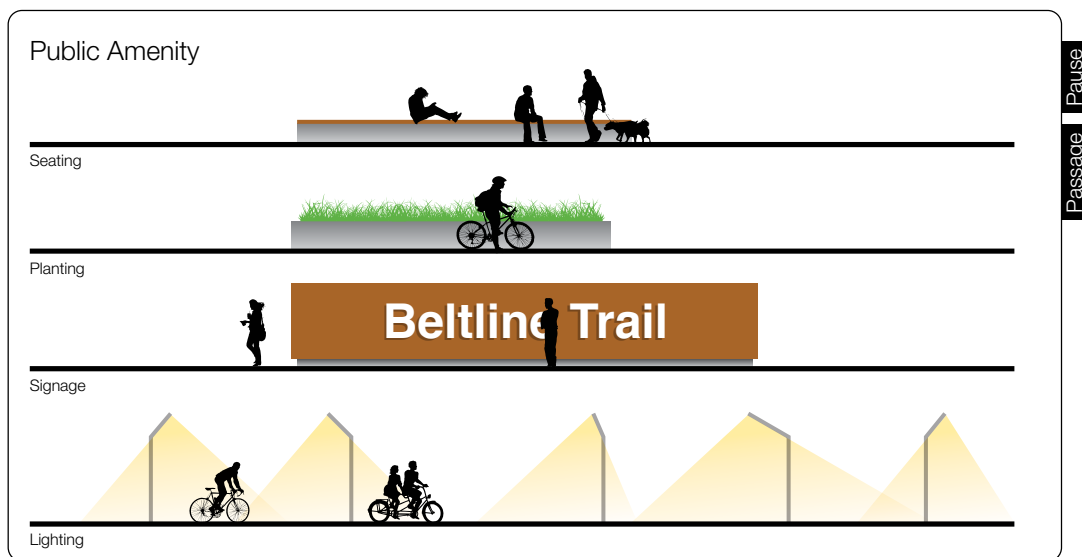


Figure 3-62 Methods of augmentation: public amenity

## 5. Technology

Technological augmentations take the form of interactive elements along the route. They create a unique experience for the passing cyclist. A responsive lighting system which traces the cyclists' movements, or a bicycle counter which tracks the number of riders who have used the route on a given day are both examples of technological augmentations.

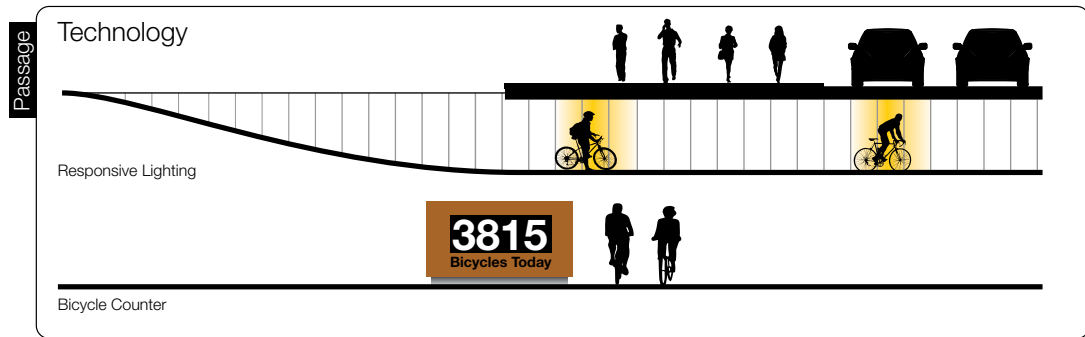
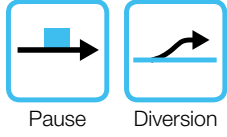


Figure 3-63 Methods of augmentation: technology

# Route Design: Bike Crossing

## The Beltline Trail

### Route Interventions



### Methods of Augmentation

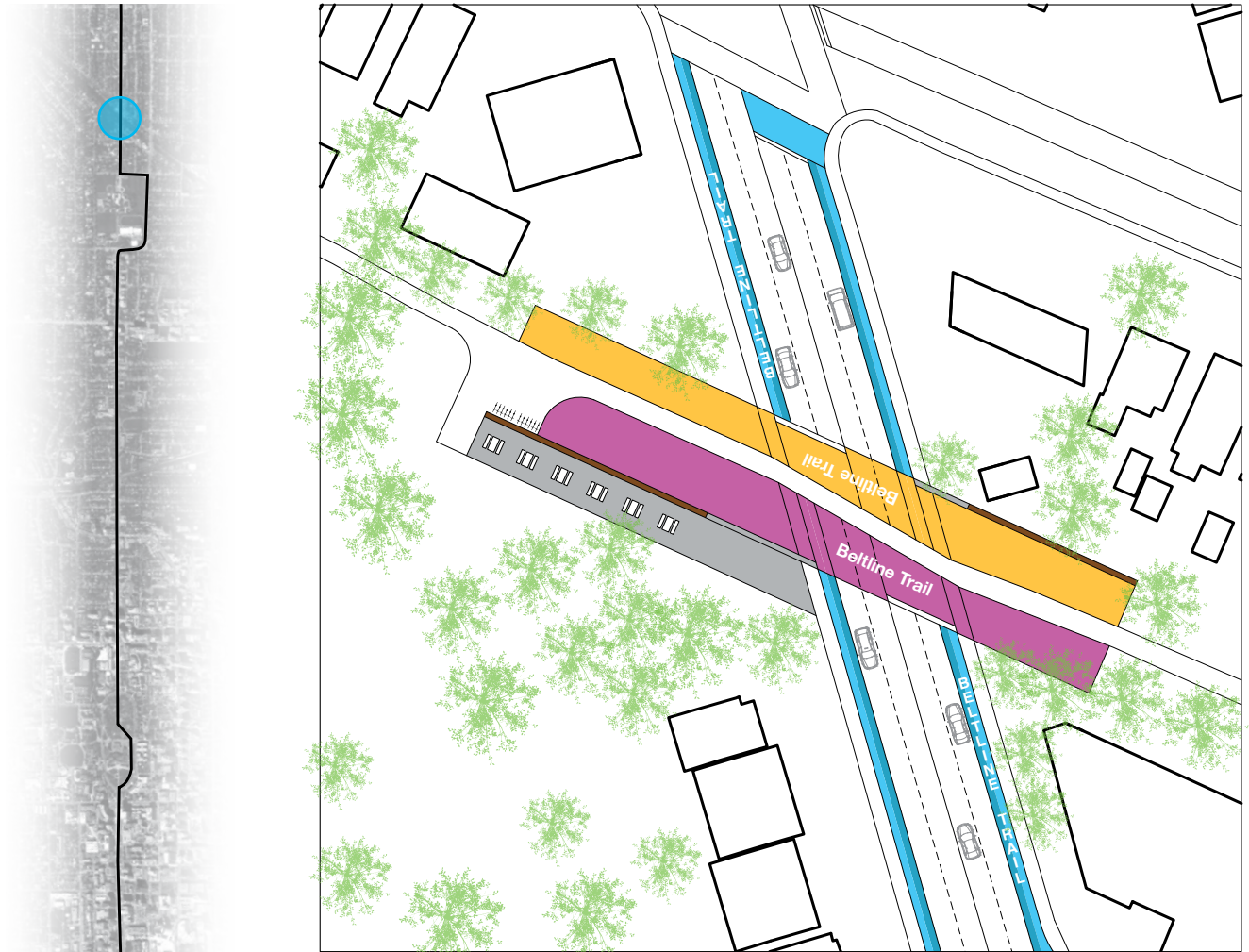
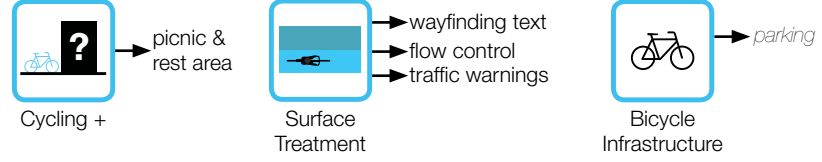


Figure 3-64 Beltline Trail Plan



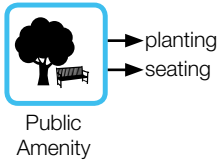


Figure 3-65 The Beltline Trail Perspective

At this point, the route intersects with the Beltline Trail, a cycling and walking trail built on the site of the old Toronto Beltline Railway. Currently the trail is poorly marked and has no crossing at Avenue road. This design proposes a garden to mark the entrance to the trail and Forest Hill Road Park. A new crossing allows cyclists and pedestrians to continue along the trail without having to detour to Chaplin Crescent. At the crossing, paint is used to spill the colours of the garden onto the street. This bold move creates an instant awareness for cyclists who wish to divert to the trail and for drivers to keep an eye out for crossing cyclists and pedestrians. Additionally, a new trail sign forms a wind block for a small picnic area, encouraging people to stop and spent time in the park.

# Route Design: Institution De La Salle College

## Route Interventions



Pause

## Methods of Augmentation



Cycling +

→ bus shelter



Surface Treatment

→ wayfinding text  
→ flow control  
→ traffic warnings  
→ shared zones



Bicycle Infrastructure

→ parking  
→ bike share



Public Amenity

→ seating  
→ lighting



Figure 3-66 De La Salle plan



Figure 3-67 De La Salle Perspective

At this point, the route passes by De La Salle College. In order to encourage students to cycle to school, sheltered bicycle parking and a bike share station are provided in a new mini-plaza at the front of the grounds. The shelter emerges from a berm adjacent to the sidewalk. The nearby bus stop is integrated into the bicycle shelter as a long bench covered by a glass canopy, giving students a place to wait protected from the elements. New contrasting pavement reaches across the road, heightening driver's awareness of the crossing and directing cyclists coming from the North or West.

# Route Design: Cultural Destination

## The Royal Ontario Museum

### Route Interventions



Pause

### Methods of Augmentation



Surface Treatment

- wayfinding text
- flow control
- traffic warnings
- shared zones



Bicycle Infrastructure

- parking
- share



Public Amenity

- seating
- lighting
- signage
- planting

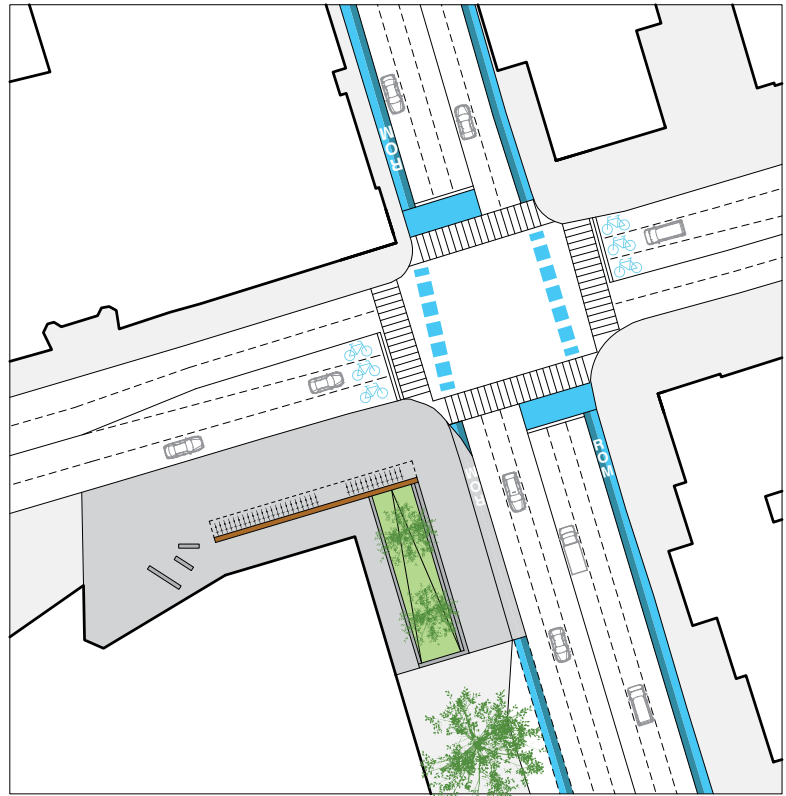
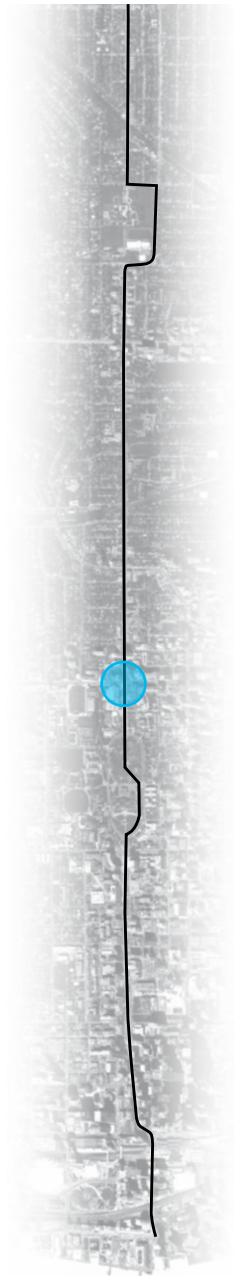


Figure 3-68 ROM plan



Figure 3-69 ROM Perspective

Here, the route passes by the Royal Ontario Museum. Currently the sidewalk to the east of the museum features a small grass lawn with a low metal barrier that is often used as an uncomfortable makeshift seat by people eating lunch from the nearby foodcart. The new design enhances the public space around the ROM by adding a sloped lawn with new plantings as well as new public seating. A bicycle parking station and bike share are provided for those who ride their bikes to the museum. This site also demonstrates safe intersection design with bicycle boxes, advanced signaling and bike lanes painted across the intersection.

# Route Design: Urban Park Queen's Park

### Route Interventions



Pause



Diversion

### Methods of Augmentation



Cycling +

→ cafe



Surface Treatment

→ wayfinding text  
→ flow control  
→ traffic warnings  
→ shared zones



Bicycle Infrastructure

→ parking  
→ share  
→ repair



Public Amenity

→ seating  
→ lighting  
→ planting

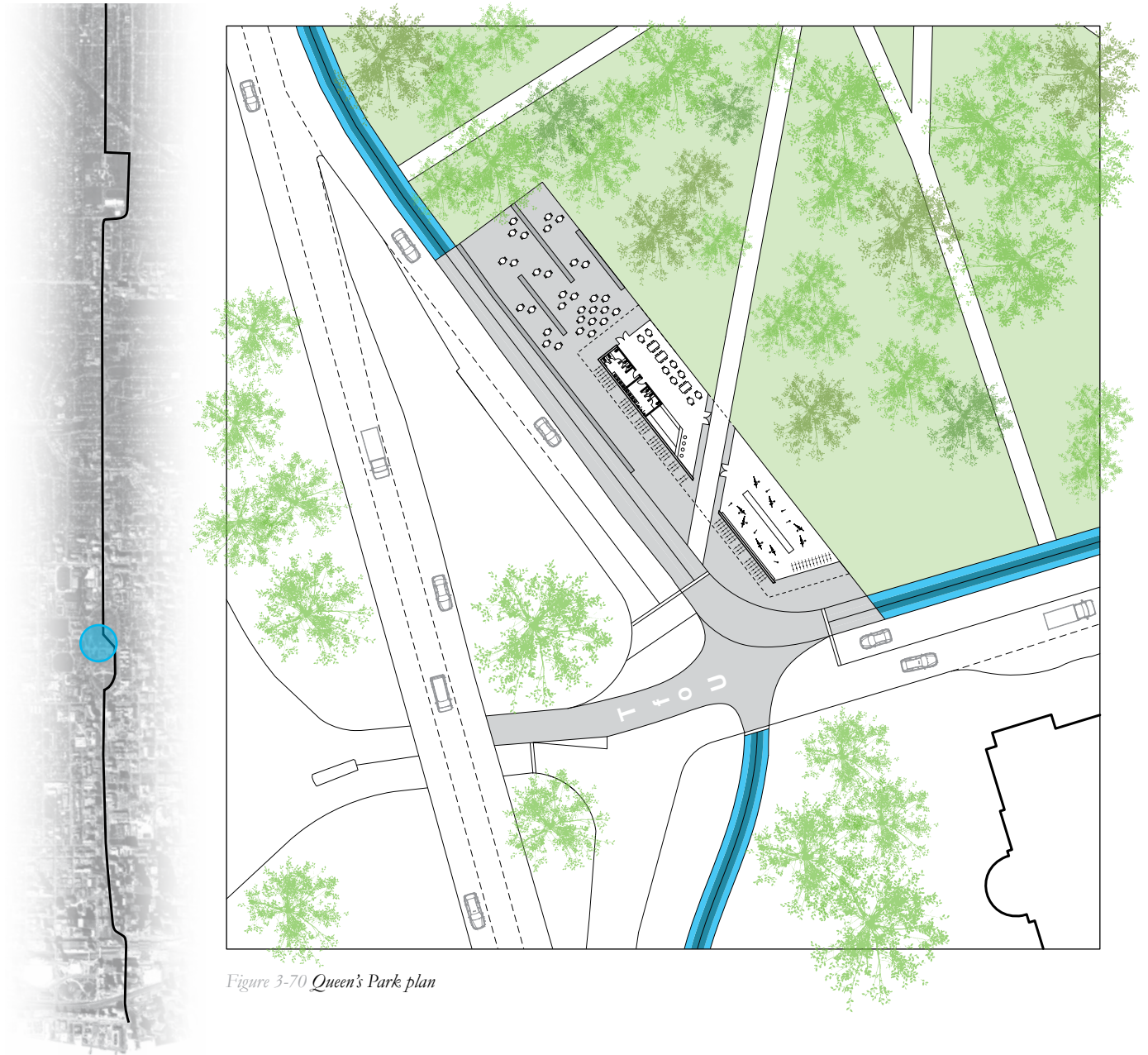


Figure 3-70 Queen's Park plan



At this point, the route passes by Queen's park. The park currently provides a convenient shortcut for cyclists looking to travel from Hoskin Avenue to Wellesley Street. Queen's Park is home to a series of monuments, but is primarily a place of transition. This design adds a new destination to the park. A new public square emerges at the southwest corner of the park, featuring an outdoor café and bicycle repair shop. Passing cyclist can stop to have their bike tuned up, or join a workshop to learn how to work on the bike themselves. At Wellesley Street, the route contains a diversion towards the centre of the University of Toronto campus, one of the city's most popular destinations for cyclists as indicated by the *Transportation Tomorrow Survey*.

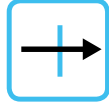
# Route Design: Urban Park

## University Avenue Island

### Route Interventions



Pause



Passage

### Methods of Augmentation



Cycling +

→ food trucks



Surface Treatment

- wayfinding text
- flow control
- traffic warnings
- shared zones



Bicycle Infrastructure

- parking
- share
- railing



Public Amenity

- seating
- lighting
- planting

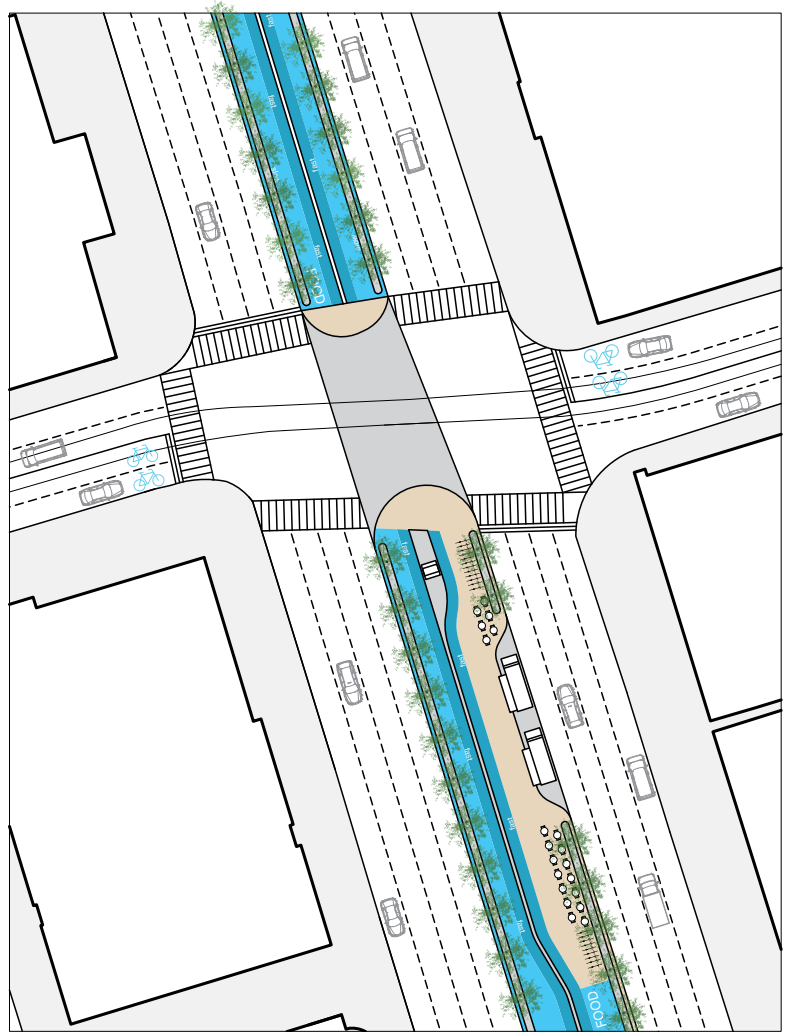


Figure 3-71 University Island Plan



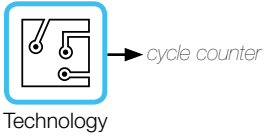
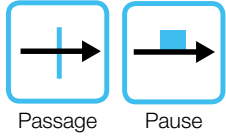


Figure 3-72 University Island Perspective

After passing around the Legislative Building at Queen's Park, the route transfers to the middle of the street to run down the University Avenue island. This underutilized space provides the perfect opportunity for a high-volume bicycle path. Tree canopies are used to create a natural tunnel for cyclists to ride through. The space is further activated with a food truck stop and seating area. A long stretch of the island currently runs through an office district with few restaurants directly on University Avenue, so this addition provides a much needed amenity to the area. A digital cycle counter is also located on the island, allowing riders to see how many fellow cyclists have passed before them. This knowledge generates a collective pride in the growth of cycling.

# Route Design: Transit Connection Union Station Tunnel

### Route Interventions



### Methods of Augmentation

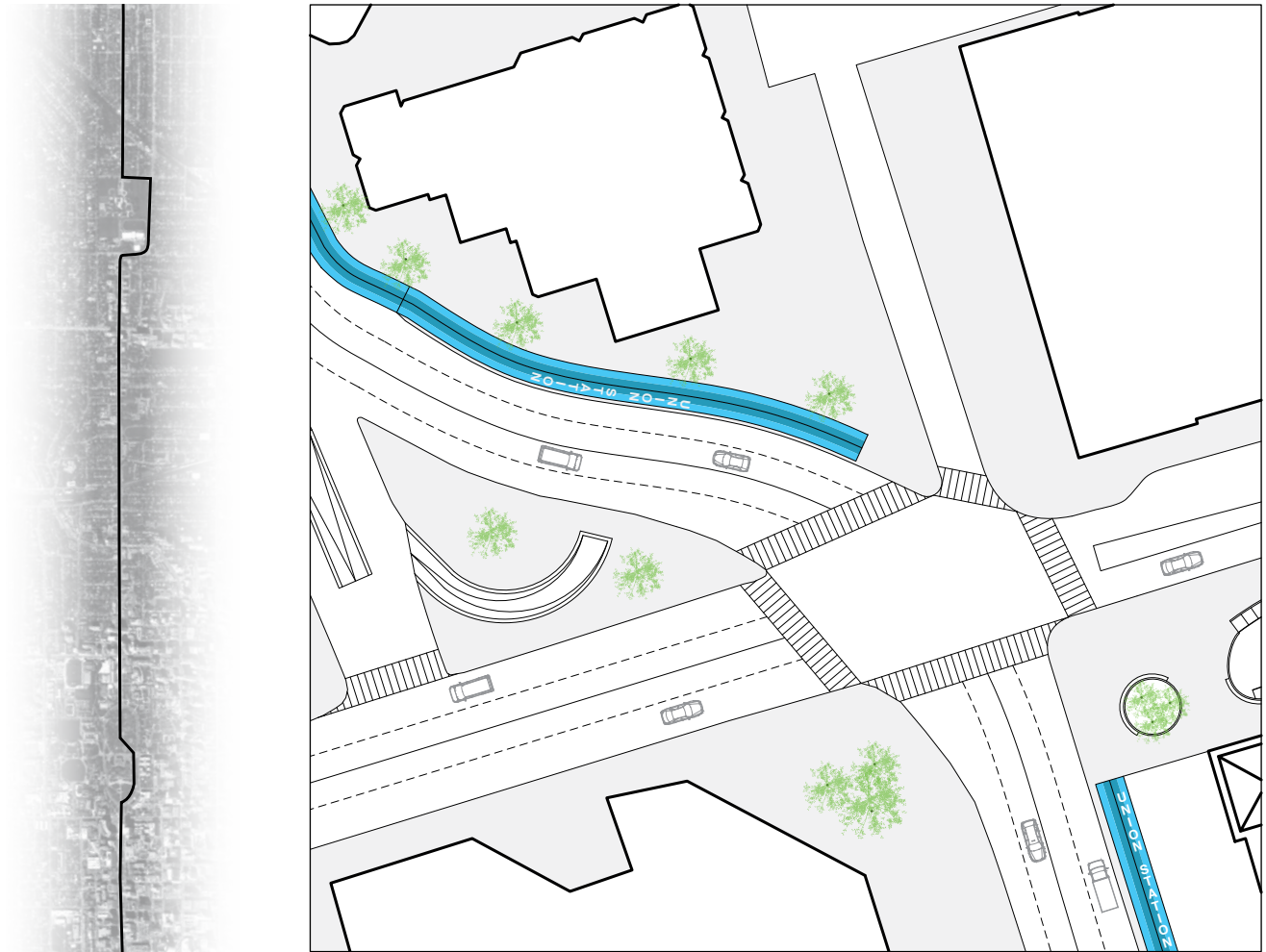
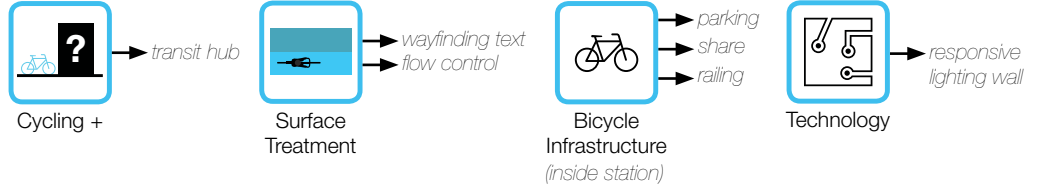
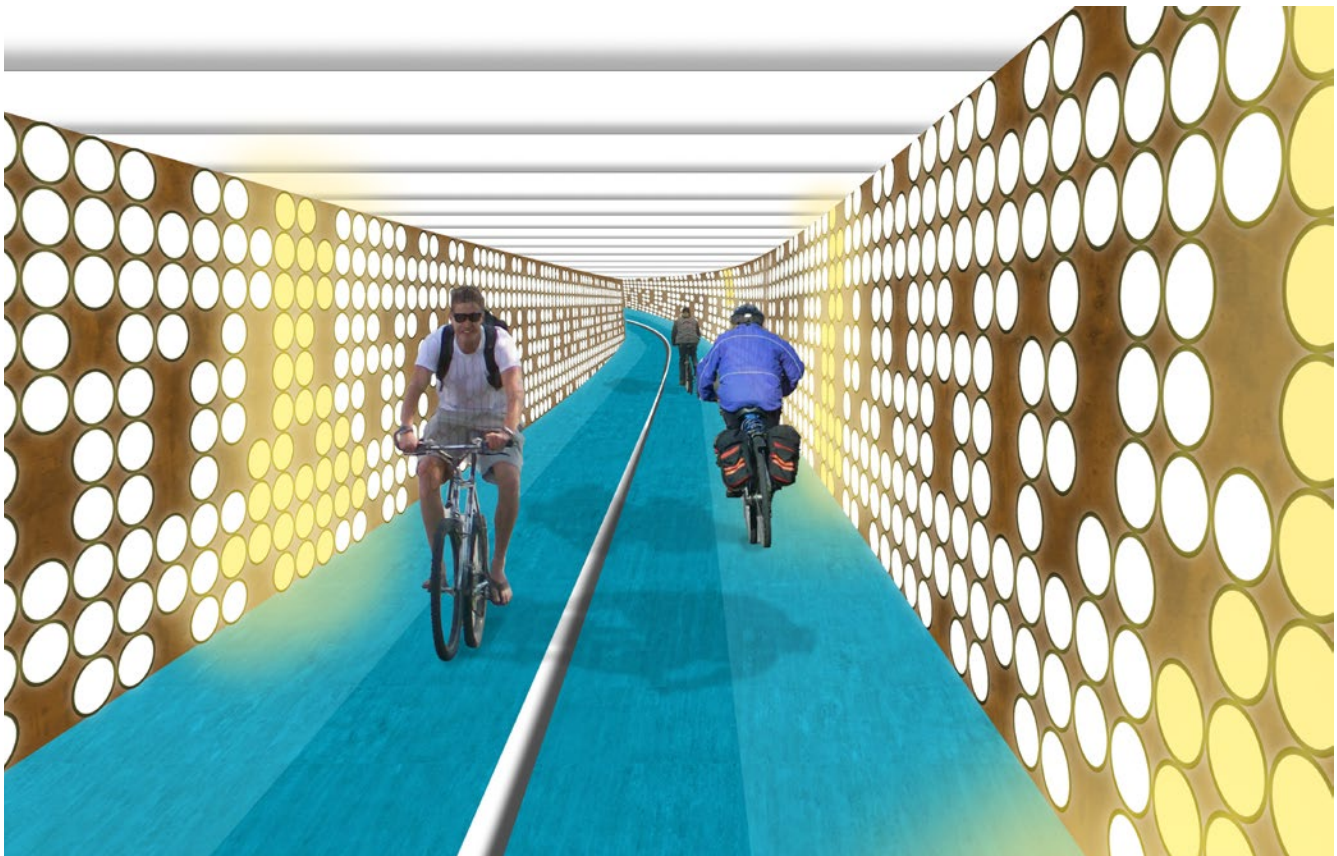


Figure 3-73 Union Station Tunnel Plan



*Figure 3-74 Union Station Tunnel Perspective*

When the route approaches Union Station, it begins to descend underground in order to bypass the busy Front Street intersection and enter a new underground bicycle parking station. To contrast the feeling of descending into the ground, the tunnel is brightly illuminated. An interactive light wall traces the movement of cyclists in real time as they descend into the station.

# Route Design: Transient Experience

## Gardiner Underpass

Route Interventions



Passage

Methods of Augmentation



Surface Treatment

wayfinding text  
flow control



Public Amenity

lighting

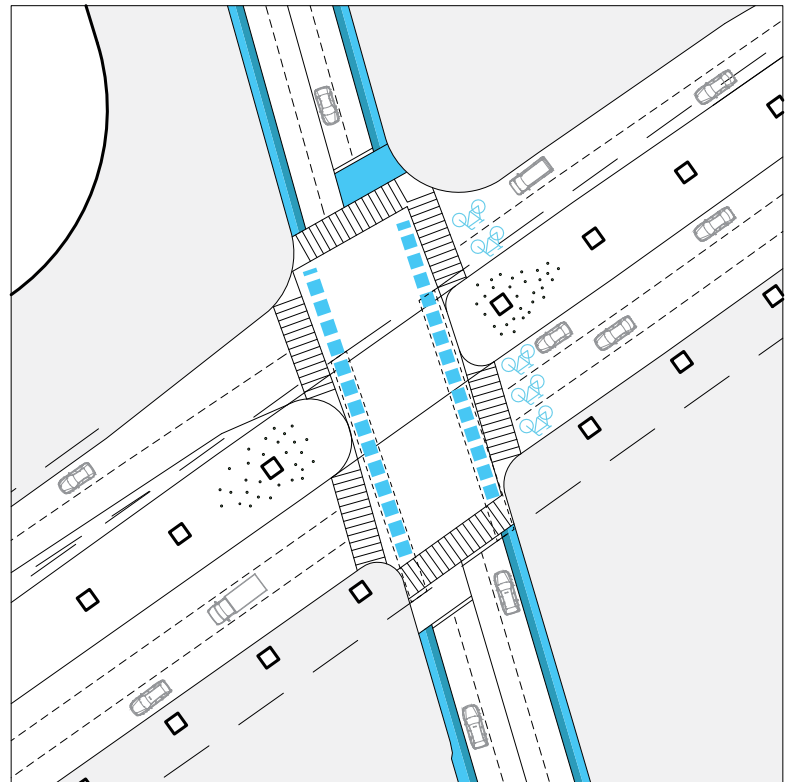


Figure 3-75 Gardiner Underpass plan



*Figure 3-76 Gardiner underpass perspective*

At this point, the route passes below the Gardiner Expressway. This area is a dark, gloomy space, made even more unpleasant by the many lanes of traffic traveling on Lakeshore Boulevard. The design brings the space to life with a new lighting system, making the underpass more pleasant to pass through both day and night. The mid-street traffic islands are populated with a forest of illuminated light posts, providing a dynamic visual experience for passing cyclists and pedestrians alike, while two overhead lights trace the path of the cycle route.

## Design Reflection

The development of these seven test sites using the proposed route design manual, uses design research as a tool for testing theories and revising strategies. The chosen sites are not the only locations for potential development along the route, but they provide a sufficiently diverse sampling to effectively test the proposed strategy. If the route were to be implemented, the same method could be used to develop the remainder of the corridor. The following insights arose from the site-specific route design process and can be used to revise the design manual.

### Amenity Balance

In order to address the needs of each site, a balance must be struck between inserting new non-cycling program and simply enhancing the existing program on the site. The overall goal of the design strategy is to link the cycling route to the surrounding communities and urban attractions. All new amenities should be seen as connectors between the cyclists and the community, functioning to increase the appeal and accessibility of the sites. Attractions that serve a set user base generally benefit most from enhancements and do not require the addition of new program. For example, the De La Salle College design responds to the need for students to use both public transit and their bicycles to commute to school. A bicycle parking shelter with an integrated sheltered bus stop meets this need and improve the commuting experience for the students. On the other hand, sites that seek to attract new visitors can benefit from the addition of new program. For example, at Queen's Park, the addition of a café and bicycle repair workshop enhance the appeal of the site, encouraging visitors to spend time in the park.

### Cohesive Identity

The development of a consistent design language amplifies the experience of the route and create a cohesive, identifiable image. This image facilitates navigation by existing cyclists, and catches the attention of potential cyclists through a more distinct urban presence. The blue painted surface of the cycle path provides one identity for the route. Attraction sites must stand out along the route by exhibiting a secondary collective identity, distinct from the path. In order for each site to maintain its unique character, while still identifying with the other sites along the route, a consistent material pallet and graphics template is implemented, utilizing a system of signage walls, pavement markings and differentiated surface treatment to unify the sites. A connection is drawn to other cycling projects in the city, such as the West Toronto Railpath and the Pottery Road Bicycle and Pedestrian Crossing through the use of corten steel and concrete. The relationship between these projects begins to build a city-wide cycling identity.

### Site Response

The study of the amenities, deficiencies and users of each test site, as illustrated in step three of the route design manual, is key to defining the appropriate design approach. However, the design process reveals the

necessity of looking more closely at the specific usage patterns of each site in order to determine the most appropriate methods of augmentation. Identifying the local amenities gives a general picture of a site's character, and can highlight a need for new program; however, the addition of a more personal street-level survey is often required to identify the site's direct necessities. For example, at the Royal Ontario Museum, there are few surfaces upon which people can sit. As a result, visitors have adopted a low railing surrounding a small patch of grass as a make-shift seat for eating food purchased from the nearby food-cart. By inserting new seating and a small green space, the new design focuses on facilitating the existing activities and making them more pleasurable. This need could not be identified in an urban-scale site study, but requires a street-level analysis of site patterns.

#### Safe Crossings

The necessity for cyclists to cross the street in order to reach certain destination, identifies a need for a strategy that can alert motorists to increased cyclist presence. To address this need, a method was developed in which the surface treatment of the bicycle route is extended out into the street, a visual sign encouraging drivers to slow down and be more aware of their surroundings. This strategy can be seen at the Beltline Trail, in front of De La Salle College, and at the corner of Queen's Park. These enhanced crossings allow cyclists traveling both from the North and the South to safely reach their destination, while also alerting cyclists to nearby attraction across the street.

#### Levels of Separation

The heavier and faster the traffic, the more substantial the separation required to ensure new cyclists feel safe riding alongside traffic. The whole length of the route is envisioned as a separated cycle track, utilizing a raised curb to keep cyclists on a different level from motorists. In order to further address this need for separation, while also acknowledging that certain commuter cyclists are more comfortable near traffic than others, a two lane cycle path was developed. Slower, more hesitant cyclists can ride on the inside lane, adjacent to the sidewalk where they are farther from traffic, while faster, more confident riders can pass in the outer lane. The route takes advantage of site specific features that allow for greater degrees of separation such as planters on the University Island. Here, the trees not only provide a safe environment, but also contribute to a more pleasant atmosphere for cycling.

#### Multi-Functional Components

Building both cycling infrastructure and public amenities are necessary in order to connect the cycling route to the existing attractions. The design process has revealed that an effective way to accomplish this pairing is to create multi-function elements which provide both cycling infrastructure and public amenity at once. For example, at the ROM, a signage wall anchors a bicycle rack and bike share station, while also connecting to new seating and a green space. This multi-purpose strategy provides a unified visual presence, free from infrastructural clutter.





04

# Concentrated Supporting Infrastructure

L, M, S

## Supporting the Route

Significant supporting infrastructure can be conceived of as projects on their own, in support of the route, yet with their own identity. Just as a high quality cycling route can act as a catalyst for a cycling culture, these infrastructures can act as catalysts for cycling routes, drawing a large volume of riders. Unlike distributed infrastructure, which consists of a series of small moves occurring throughout the length of the cycling route, these concentrated infrastructures, only occur at very specific locations, where their need is essential for drawing a large number of people to cycle. There are three main typologies of concentrated supporting infrastructure, each with corresponding location conditions.

First, *transit integration hubs* are located at central transit stations. These stations act as transportation gateways for trips originating outside the city, as well as trips contained within the city's boundaries. They are usually located in the centre of the city's downtown core and bring together many modes of transportation including train, metro, bus and automobile. In order to build a cycling culture, it is essential to acknowledge the bicycle as an essential component of these multi-modal hubs.

Second, *mass bicycle parking stations* are located in compact commercial districts. These large scale parking stations are most common in Europe, due to higher volumes of cycling and the prevalence of pedestrian districts, but they could be paired with large shopping centres in Toronto, such as the Eaton Centre, or districts with very high employment densities. The purpose of these stations is to make cycling more convenient and safe at these destinations which attract a large volume of people.

Finally, *bicycle crossings* traverse major obstacles in the urban fabric such as multi-lane highways, bodies of water, or railway lines. These crossing provide access to areas that were previously inaccessible, or very dangerous for cyclists. They also provide shortcuts available only to cyclists and pedestrians, improving trip efficiency and making cycling more appealing compared to other modes of transportation. Often these crossings are designed to create novel, exciting experiences, that are unique to the cyclist.

For each supporting infrastructure type, this chapter contains an in-depth study of one project followed by a longer catalogue of related infrastructure projects.

Within the City Toronto, the most effective and necessary supporting infrastructure is the transit integration hub. Stand alone mass parking stations are most useful once a large cycling population already exists. Bicycle transit hubs, on the other hand, open up the possibility of cycling to a whole new segment of the population, by encouraging the multi-modal commute. As part of his strategy for building healthy cities

for cyclists and pedestrians, renowned urban design consultant Jan Gehl writes, “bicycle traffic should be automatically integrated into an overall transport strategy. If it is possible to take bicycles on the train, subway and by taxi, then travel can be combined over great distances.”<sup>1</sup> Additionally, studies by John Pucher have shown that the most effective way to incorporate multi-modal bicycle transportation with rail transit is to have large-scale, secure bicycle parking at major stations, as is the practice across northern Europe.<sup>2</sup>

Union Station is a vital transportation hub, not just for the City of Toronto, but for the entire GTA. The Ontario government’s *Big Move* recognizes the station as “the heart of the GTA’s Transportation System” and calls for an expansion to this essential terminal.<sup>3</sup> At the region’s main transportation hub, the station must be able to effortlessly mediate between different modes of transportation. Commuters come and go on the subway, GO train, Via Rail, taxi, car and bicycle. The effective design of the station makes the difference between these modal shifts occurring smoothly or becoming major headaches for all commuters. The design in this chapter proposes a new underground bicycle hub to seamlessly integrate cycling with the inter-modal flows of Union Station.

The following section investigates successful examples of these supporting bicycle infrastructures found in Europe and North America, in order to find best practices and strategies which can be applied to the design of a new cycling hub for Union Station. As demonstrated in the following case studies, such infrastructure is capable of moving beyond the humble bicycle shed, to become a showcase infrastructure project which provides a unique and enticing cycling experience.

Cycle City

## Mass Bicycle Parking

The following precedents provide successful examples of bicycle parking at a large scale. Once cycling reaches a high level of popularity, accommodating parking can become a real challenge. Cities such as Copenhagen have dealt with an overflow of bicycles cluttering the streets much as cities in North America must deal with finding space for an overabundance of parked cars. Fortunately, the bicycle consumes only one tenth of the space taken up by a standard car. As illustrated in the following project, bicycle parking designers have borrowed formal strategies from automotive parking, but have also invented new typologies unique to the bicycle.

Cycle City

# Admirant Entrance Building

Eindhoven, The Netherlands

Massimiliano and Doriana Fuksas Architects, 2010

Capacity: 1700 bikes

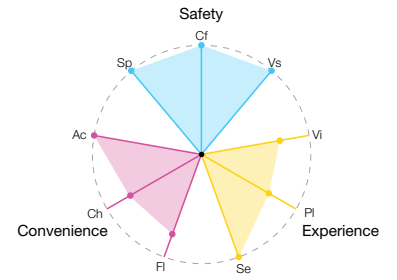


Figure 4-1 Plaza Entrance



Figure 4-2 Bicycle Parking Area

The following strategies were synthesized from a collection of books and articles.<sup>4</sup>



Figure 4-3 Entrance Cone

## Strategy 1: Make it Iconic

While the actual parking area features a rather utilitarian design, the public presence is made quite dramatic by a pair of cone shaped concrete and glass entrance tunnels. These forms clearly demarcate the entrance and their shape naturally draws people in.

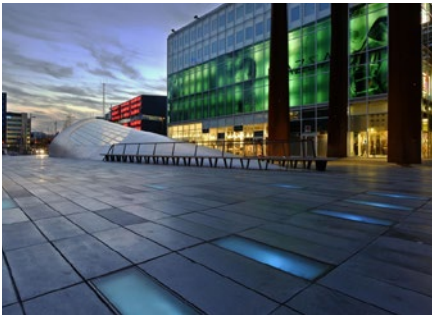


Figure 4-4 Glass tiles

## Strategy 2: Hide Underground

In order to eliminate the clutter of surface parking and leave the square open for pedestrian traffic, the bicycle parking was relegated below ground, filling the entire area below the square. A pattern of frosted glass tiles are mixed amongst the square's pavers to hint at the parking below. At night the light from the parking glows through, illuminating these glass tiles which collectively creating an intricate mosaic of light.



Figure 4-5 Admirant Entrance Building

## Strategy 3: Relate to Context

The bicycle parking was part of a larger urban redevelopment project for a shopping district. Other projects included a shopping mall, media market and office building. The bicycle parking serves all these facilities and is also close to the local train station. The design of the entrance cones echo the design of the larger Admirant Entrance Building, tying the square together with the adjacent building.



Figure 4-6 Bicycle escalator

## Strategy 4: Automate

In order to facilitate access to and from the underground parking the designers have employed ramped escalators. This system is much more efficient than an elevator while still making the parking accessible to those without the strength to push their bike uphill. The escalator also prevents accidents in the narrow space by forcing riders to dismount from their bicycles.

# Bicycle Parking Catalogue

**C** Context specific design

**I** Iconic

**U** Underground

**S** Services and Amenities

**A** Automated

**R** Connected to bike route

## Bicycle Warehouse

Zaandam, The Netherlands  
 NUNC Architecten, 2011  
 Capacity: 700 bikes



Figure 4-7 Bicycle Warehouse exterior



Figure 4-8 Bicycle Warehouse interior

**C S**

## Bermondsey Bike Store

London, UK  
 Sarah Wigglesworth Architects, 2009  
 Capacity: 76 bikes

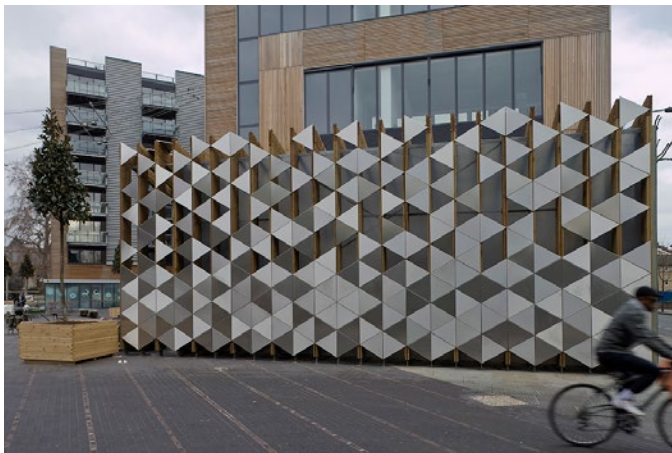


Figure 4-9 Bike Store's patterned facade



Figure 4-10 Bike Store interior

**I**



## The Bike Hangar

Various Locations  
 Manifesto Architecture, 2011  
 Capacity: up to 36 bikes



Figure 4-11 Bike Hangar preliminary rendering

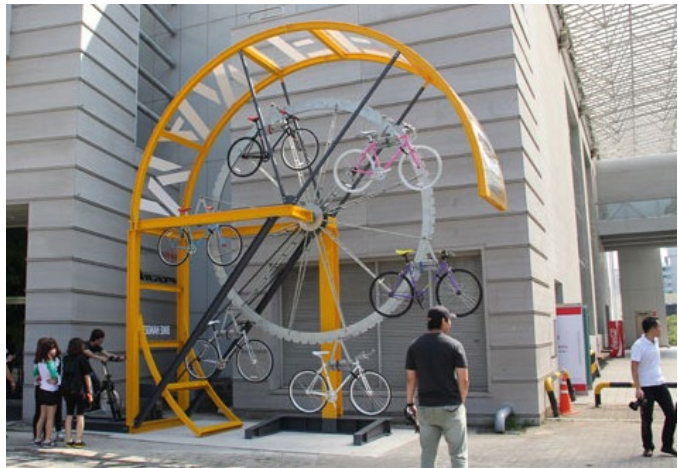


Figure 4-12 Bike Hangar prototype, Seoul, Korea



## Biceberg

Various Locations  
 ma-SISTEMAS, s.l.  
 Capacity: up to 92 bikes



Figure 4-13 Biceberg concept diagram



Figure 4-14 Biceberg interface



Cycle City

## Transit Integration

The following precedents illustrate how cycling can be integrated with other modes of transportation, enabling long-distance multi-modal commutes. In many European cities, especially in the Netherlands, incorporating mass bicycle parking into the design of all major railway stations is common practice.<sup>7</sup> This trend is just beginning to take off in North America, but at a much smaller scale. Seamless integration between cycling and public transit is key to opening up the cycling world to an expanded set of potential riders.

Cycle City

# Stadsbalkon

Groningen, The Netherlands  
 KCAP Architects & Planners, 2007  
 Capacity: 4150

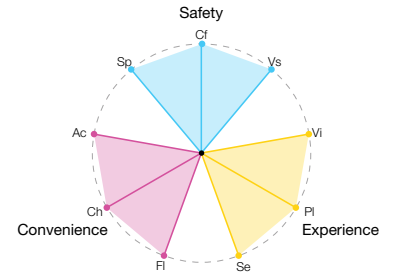


Figure 4-15 Stadsbalkon folded plaza

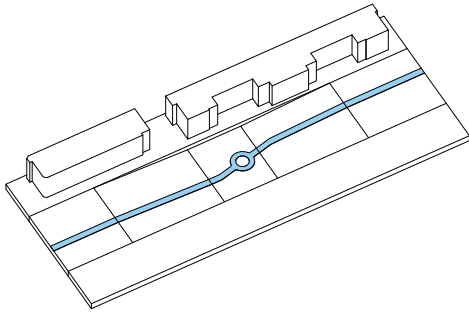


Figure 4-16 Stadsbalkon bicycle route



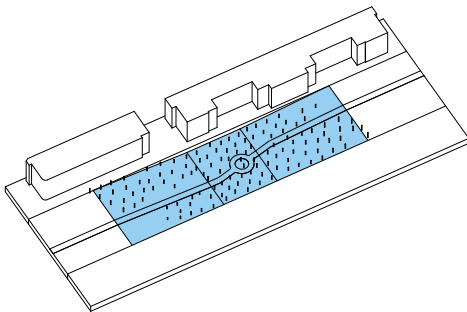
Figure 4-17 Stadsbalkon lightwells

The following strategies were synthesized from a collection of books and articles.<sup>5</sup>



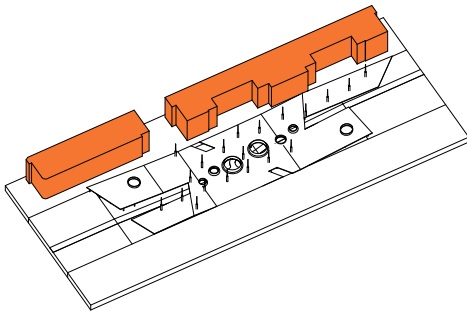
## Strategy 1: Continuous Flow

The adjacent bicycle path flows smoothly into one side of Stadsbalkon and out the other. There is no backtracking or inefficiencies. Even those who are not parking their bicycles are able to experience the thrilling structure as they glide through the roundabout.



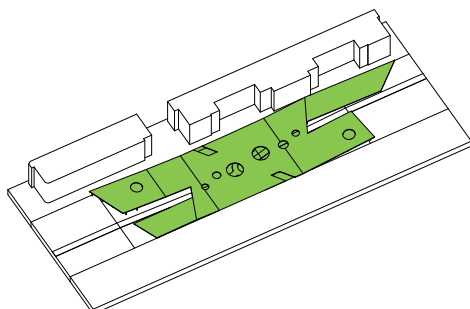
## Strategy 2: Make it Fun

Stadsbalkon goes far beyond the utilitarian bicycle shed, evoking a sense of thrill and novelty. KCAP designed an enticing experience that draws cyclists underneath the balcony structure. Sloped orange columns complement the slender trees to create a simulated forest, while skylights draw light into the expansive parking area. Cyclists glide effortlessly down a gentle slope to the central roundabout, before finding a space for their bikes.



## Strategy 3: Connect

Stadsbalkon is directly connected to Groningen's central train station and located next door to the main bus terminal. Cyclists can conveniently leave their bikes safely parked while they ride the train to home or work. This connectivity greatly expands the range of travel for cycle commuters and even allows citizens to commute to and from other Dutch towns.



## Strategy 4: Multi-use

Stadsbalkon is not merely a bicycle parking facility. By pushing the bicycle underground, it opens up a brand new pedestrian forecourt for the train station. The lively plaza is activated by the trees planted beneath the open skylights, and by the circular benches which surround them.

Figure 4-18 Stadsbalkon Strategy Diagrams

# Transit Hub Catalogue

- C** Context specific design
- I** Iconic
- U** Underground
- S** Services and Amenities
- A** Automated
- R** Connected to bike route

## Rotterdam Central Station

Rotterdam, The Netherlands  
 Benthem Crouwel Architecten, 2014  
 Capacity: 5190 bikes

- C**
- U**
- S**
- R**



Figure 4-19 Rotterdam Central Station bicycle entrance



Figure 4-20 Rotterdam Central Station underground parking

## De Fietsappel

Alphen aan de Rijn, The Netherlands  
 KuiperCompagnons, 2010  
 Capacity: 970 bikes

- I**
- R**



Figure 4-21 De Fietsappel exterior



Figure 4-22 De Fietsappel interior

## Union Station Bicycle Hub

Washington DC, United States  
 KGP Design, 2011  
 Capacity: 100 bikes

- I**
- S**



Figure 4-23 Union Station bicycle hub exterior

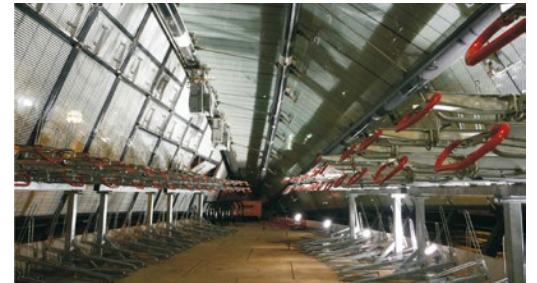


Figure 4-24 Union Station bicycle hub interior

### Utrecht Central Station

C U S R

Utrecht, The Netherlands  
 Ector Hoogstad Architecten, 2013  
 Capacity: 4200 bikes



Figure 4-25 Utrecht Central Station bicycle entrance

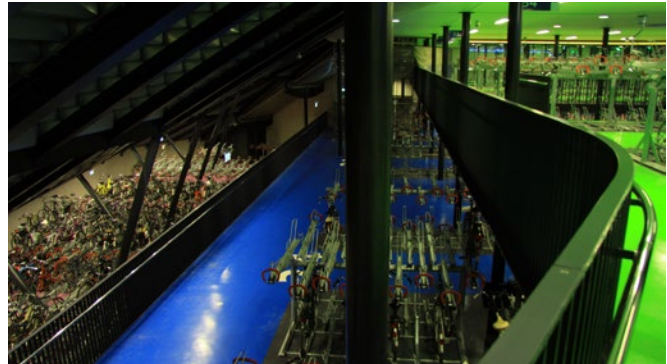


Figure 4-26 Utrecht Central Station bicycle parking below the stairs

### Bicycle Flat

C S R

Amsterdam, The Netherlands  
 VMX Architects, 2001  
 Capacity: 2500 bikes

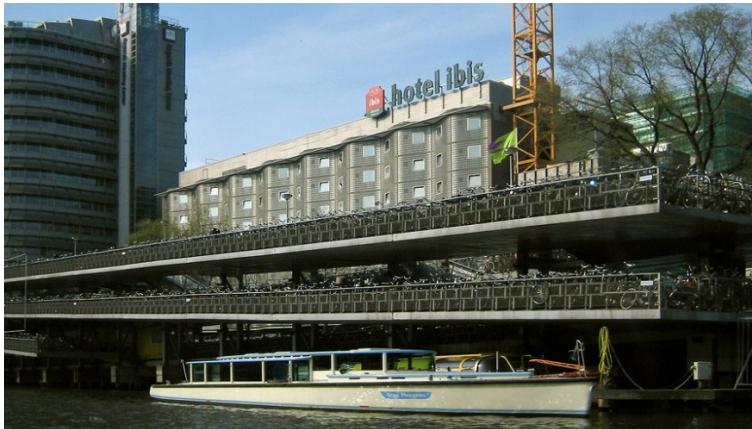


Figure 4-27 Bicycle Flat built over the river



Figure 4-28 Bicycle Flat parking area

### Het Fietstransferium

C S R

Houten, The Netherlands  
 Moveras, Henk Woltjer, 2011  
 Capacity: 3000 bikes



Figure 4-29 Het Fietstransferium train platform



Figure 4-30 Het Fietstransferium bicycle parking

Cycle City



## Crossings

Most bicycle accidents occur where bicycle routes intersect with motor traffic. Drivers and cyclists become accustomed to separation. Then suddenly they are thrown into conflict with each other. Often the danger can be mitigated with careful intersection design, but in certain severe circumstances, more creative solutions are required. The following precedents provide successful examples of crossings where bicycles must either contend with automobiles or navigate a water barrier.

Cycle City

# Hovenring Bridge

Eindhoven, The Netherlands  
IPV Delft, 2012

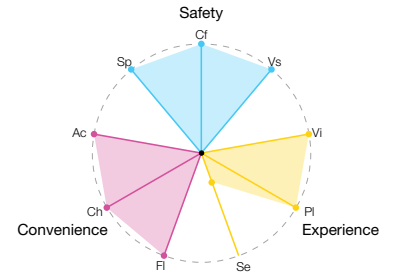


Figure 4-31 Hovenring Bridge traffic crossing

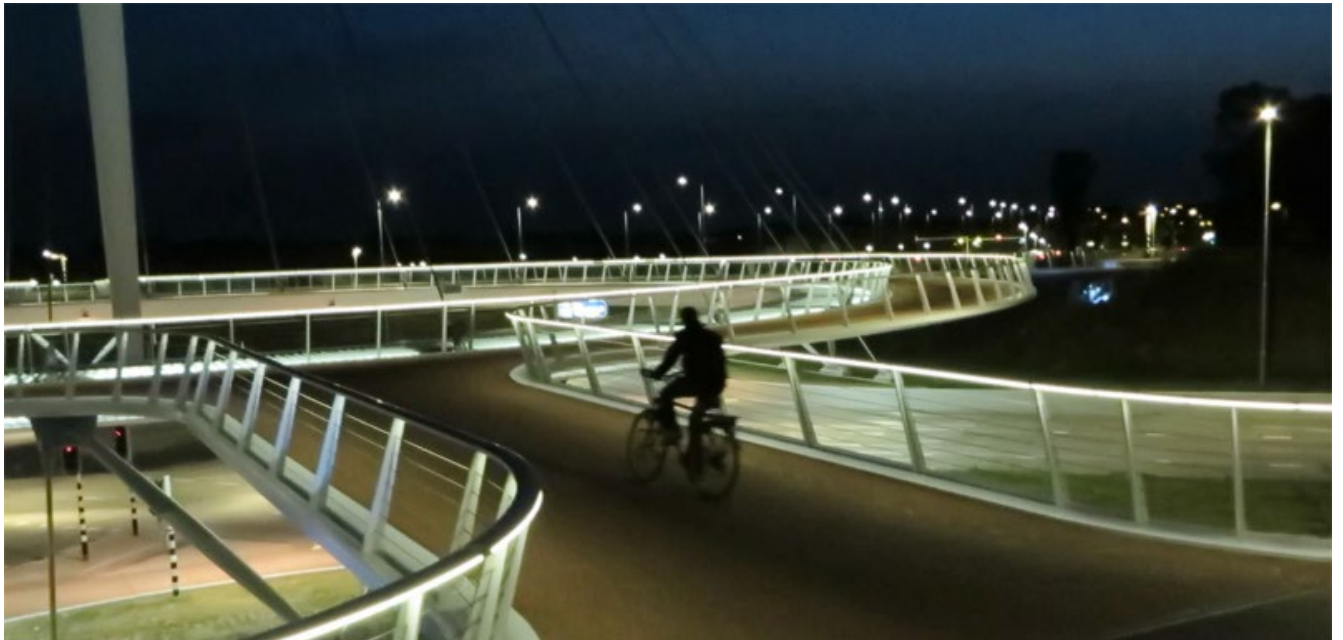


Figure 4-32 Hovenring Bridge cyclist

The following strategies were synthesized from a collection of books and articles.<sup>6</sup>



Figure 4-33 Hovenring Bridge iconic spire

## Strategy 1: Make it Iconic

With its central column and tensile structure, the Hovenring Bridge can be seen for miles. Its unique design and dominance over the intersection demonstrates the value the Dutch place in cycling and mark the entrance to the city of Eindhoven.



Figure 4-34 Hovenring Bridge separation

## Strategy 2: Separate

Priority is given to maximum flow efficiency. Rather than holding up motorists and cyclists with a dangerous and inconvenient at grade crossing, the city opted to develop a unique raised solution.



Figure 4-35 Hovenring Bridge lighting

## Strategy 3: Light Well

In order to improve safety at night, the Hovenring Bridge features lighting built directly into the handrails. The lighting also adds to the iconic nature of the bridge, highlighting its structure so that it stands out against the night sky.



Figure 4-36 Hovenring Bridge intersection depression

## Strategy 4: Stitch

Despite its large size, the bridge manages to sit lightly on the land and seamlessly connect to the surrounding routes. The singular column design keeps views unobstructed for motorists, while a depression of the intersection allows the ring to connect to the approaching cycle paths without the need for excessive slope.

# Bicycle Crossings Catalogue

**W** Water crossing

**P** Shared with Pedestrians

**T** Traffic crossing

**I** Iconic

## Melkweg bridge

**W P I**

Purmerend, The Netherlands  
Next Architects, 2012



Figure 4-37 Melkwegbridge pedestrian and cyclist bridge aerial view



Figure 4-38 Melkweg bridge pedestrian and cyclist canal crossing

## Agade Bridge

**T P I**

Copenhagen, The Netherlands  
Dissing+Weitling, 2008



Figure 4-39 Agade Bridge underside



Figure 4-40 Agade Bridge cyclist crossing

## Bryggebroen Bridge

Copenhagen, The Netherlands  
Dissing+Weitling, 2014



Figure 4-41 Bryggebroen Bridge cyclists view



Figure 4-42 Bryggebroen Bridge aerial view



## From Example to Implementation

Investigating and cataloging innovative cycle parking projects, reveals a number of recurring themes which. A consideration of these design concepts is essential to successfully integrate a bicycle hub into Union Station.

1. An iconic, highly visible design can act as a form of advertising for the facility and for cycling.
2. Putting parking underground is useful where space is limited, keeping the ground plane open for pedestrians.
3. Direct access should be provided to trains and buses from the bicycle parking facility without having to walk back outside.
4. The facility should provide other amenities besides parking such as bike rentals, bicycle repair stations and public washrooms
5. Parking areas should be well marked and organized either with colour or graphics in order to guide users in finding their bikes.
6. Cyclists should be able to ride directly from a bicycle path into the parking facility and ideally right to a parking spot.
7. High capacity parking areas with free daytime parking are more effective in encouraging people to cycle than small paid parking stations.

## Union Station Bicycle Hub

Union Station is currently undergoing a major renovation which includes a new glass train shed roof, seen in Figure 4-43, as well as an overhaul to the station's concourses and platforms. Simultaneously, the TTC is adding a second platform to increase the efficiency of passenger loading, as well as renovating the TTC concourse. In addition, the portion of Front Street in front of the station is being resurfaced to be made more pedestrian friendly, and a new northwest passage is being dug to expand the underground PATH network. In total, \$800 million is being spent amongst all the projects.<sup>8</sup>

Despite all the improvements underway, very little thought has been put into significantly incorporating cycling into this major transportation hub. In 2011, a small bike station was built tucked into the back of Union Station, with no direct connection to either the subway or GO network. The station requires a paid membership and has a small capacity of 160 bikes. The storage facility is very utilitarian, and its design is not much more than an afterthought.

This new proposal seeks to re-imagine how the Union Station revitalization project could have incorporated the bicycle. The design gives cycling a much more prominent position in the station, in order to boost the image of cycling in the city and encourages commuters to incorporate cycling as part of their daily travel routine. The station connects seamlessly with the new Avenue-University bicycle route through a ramped tunnel, allowing cyclists to safely avoid the intersection of University and Front Street. In order not to take up any valuable surface space, the bicycle parking is located one story below grade at the front of the station, with a direct connection to the subway concourse to the East and to the pedestrian moat to the South. Skylights bring natural light into the parking area and activate the pedestrian plaza above (see Figure 4-48), while a feature spiraling staircase connects the bicycle level to the plaza (see Figure 4-49). Upon entering the facility, cyclist ride on a path directly adjacent to the pedestrian moat, giving them a visible presence within the station.

The facility is activated by a cluster of programs surrounding the central staircase. A café allows cyclists and other commuters to mingle and grab breakfast or a snack while watching cyclists glide by on the adjacent path (see Figure 4-51). A repair shop allows commuters to quickly top up their tires, patch a flat, or leave their bike for the day to be tuned up while they are at work. Bicycle repair workshops can also be held here to share skills and allow riders to get to know others in the cycling community. Also located at the bicycle hub is the city's largest bike share station, complete with a bicycle dispensing tower, acting as a beacon for cycling in the city and a form of branding for the station (see Figure 4-49). The vast parking area, with space for 1180 bicycles, is organized by clear, graphically marked out areas and enhanced by a bicycle art wall (see Figure 4-50).



Figure 4-43 Union Station train shed design



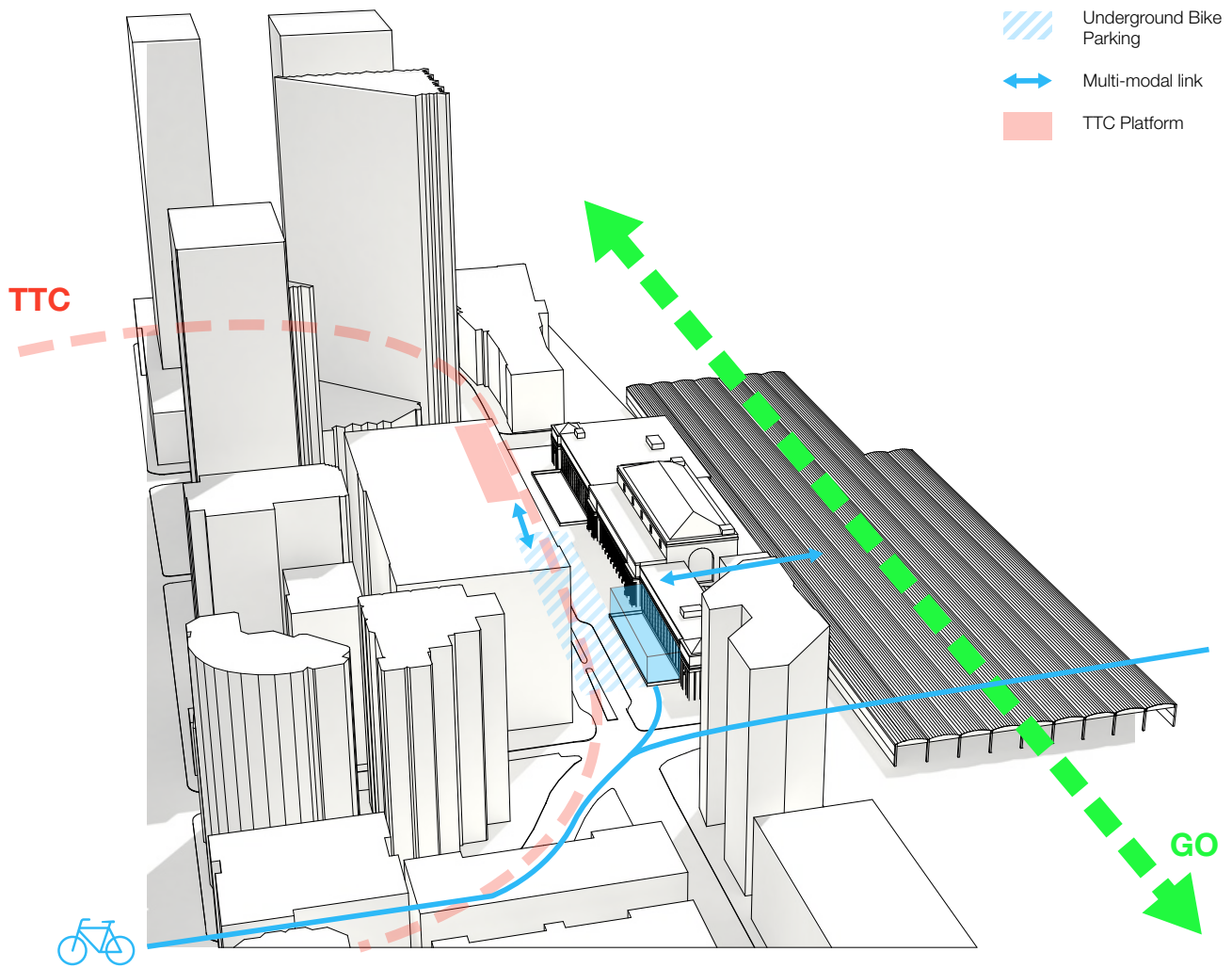


Figure 4-44 Union Station as an inter-modal-hub

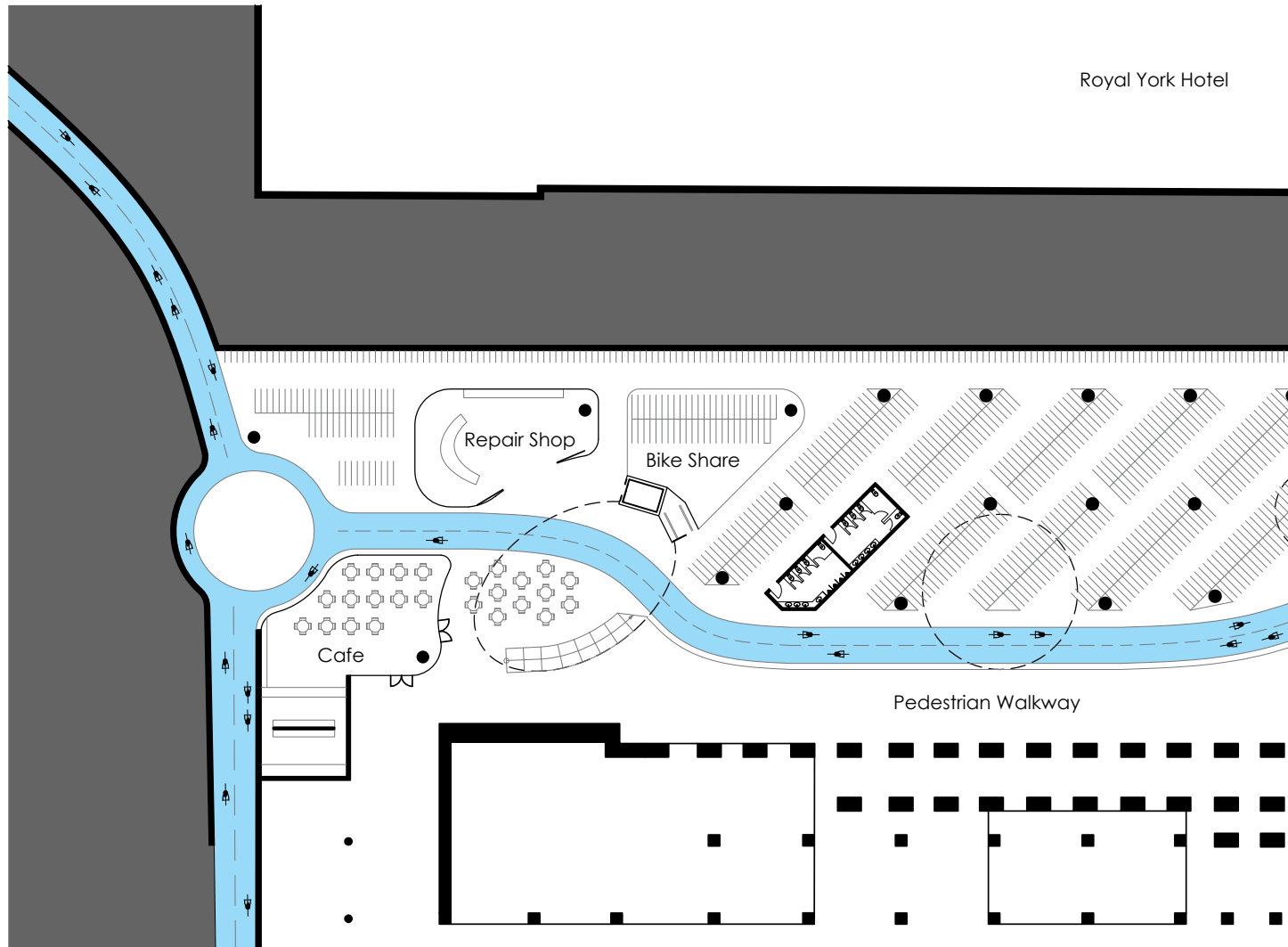
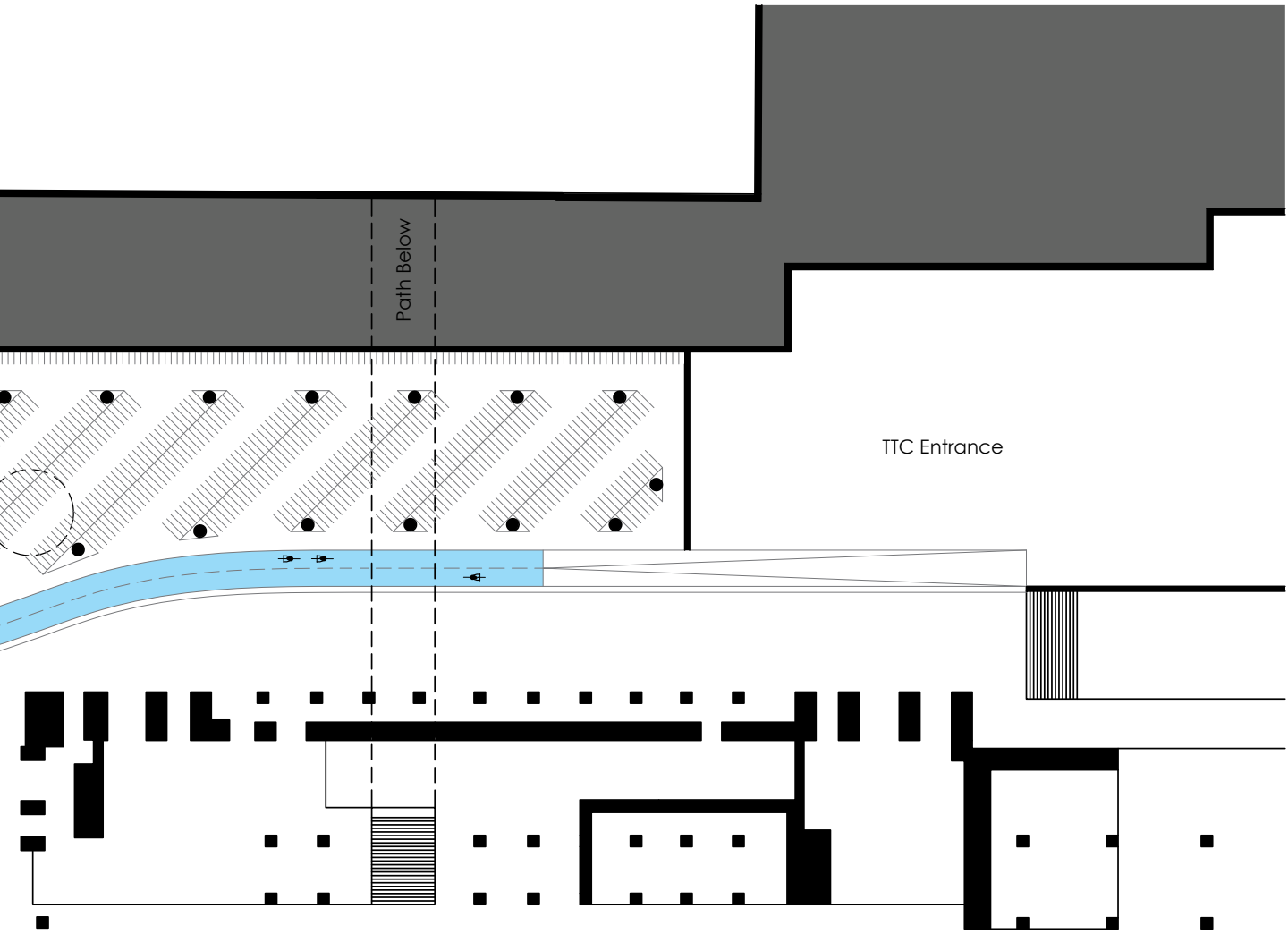


Figure 4-45 Level -1 Plan



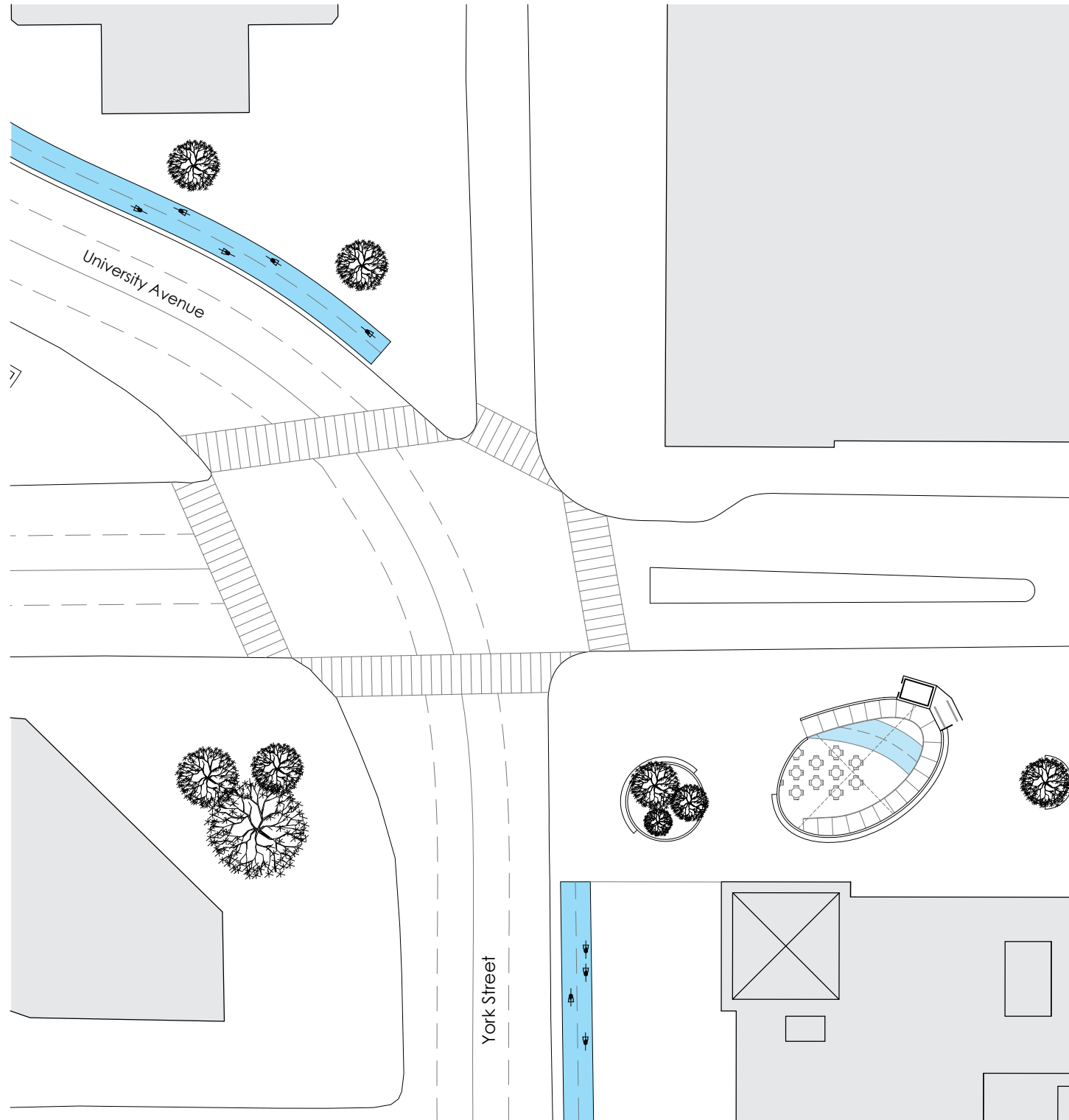
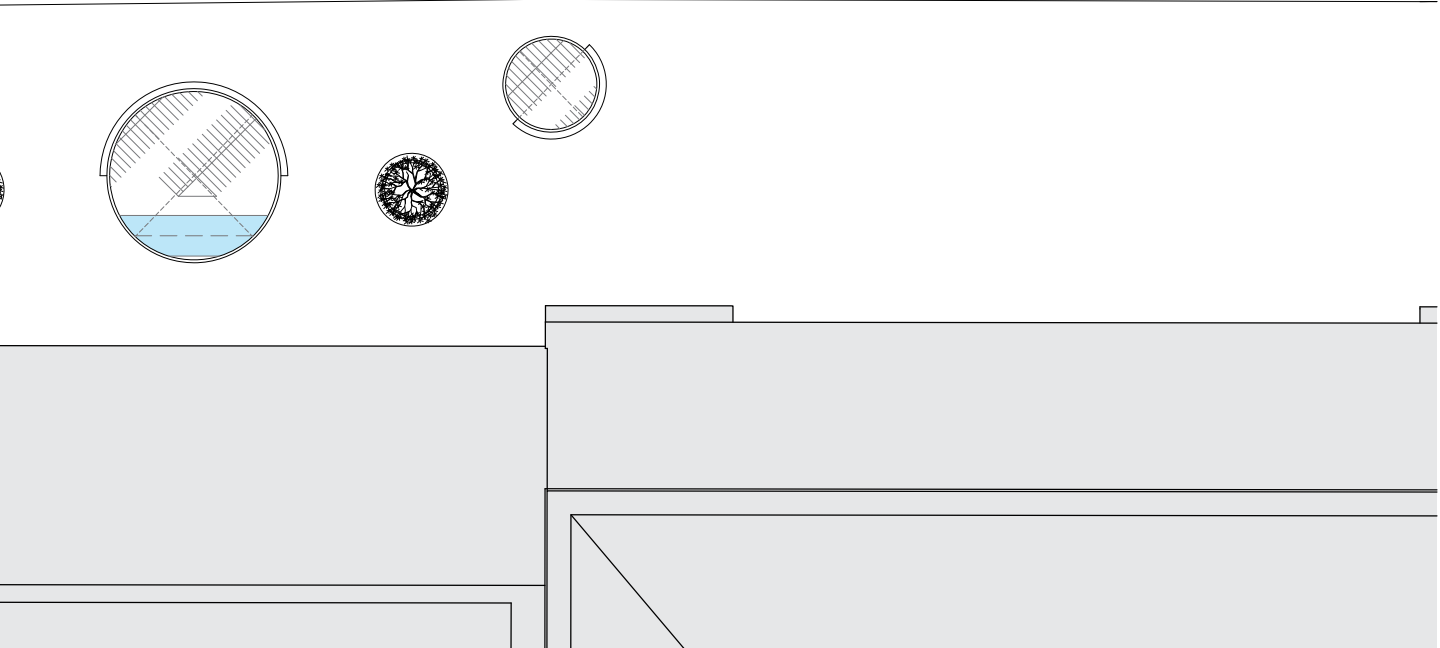
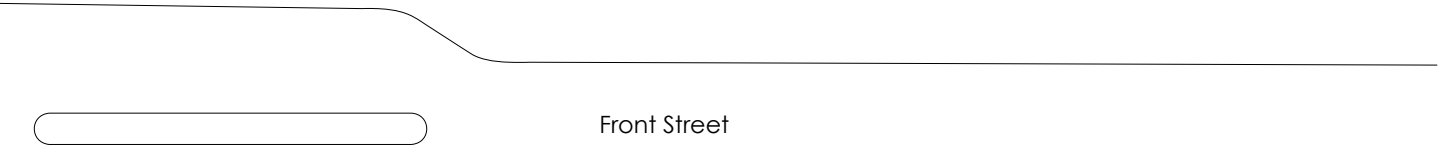


Figure 4-46 Ground level plan



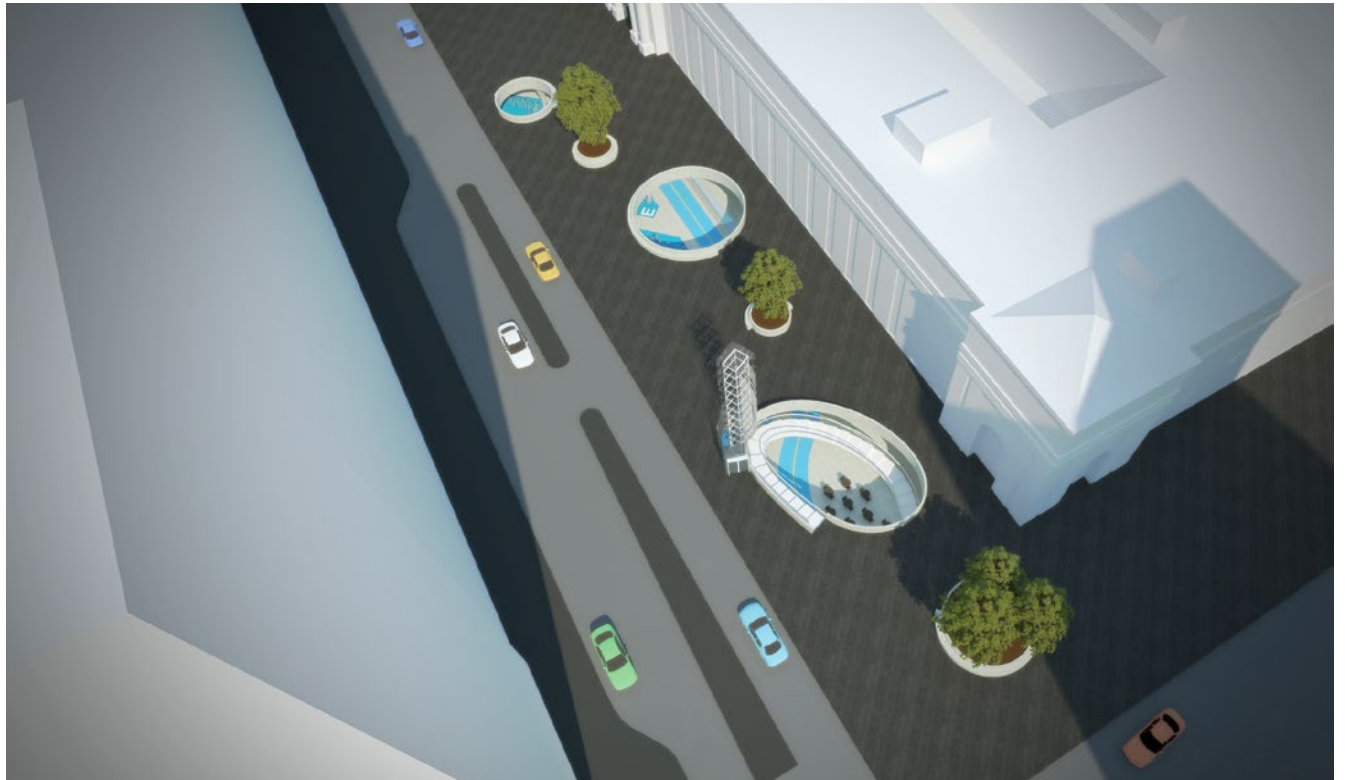


Figure 4-47 Aerial view of plaza



Figure 4-48 View of plaza



Figure 4-49 Pedestrian entrance and bike share tower



Figure 4-50 Underground parking area

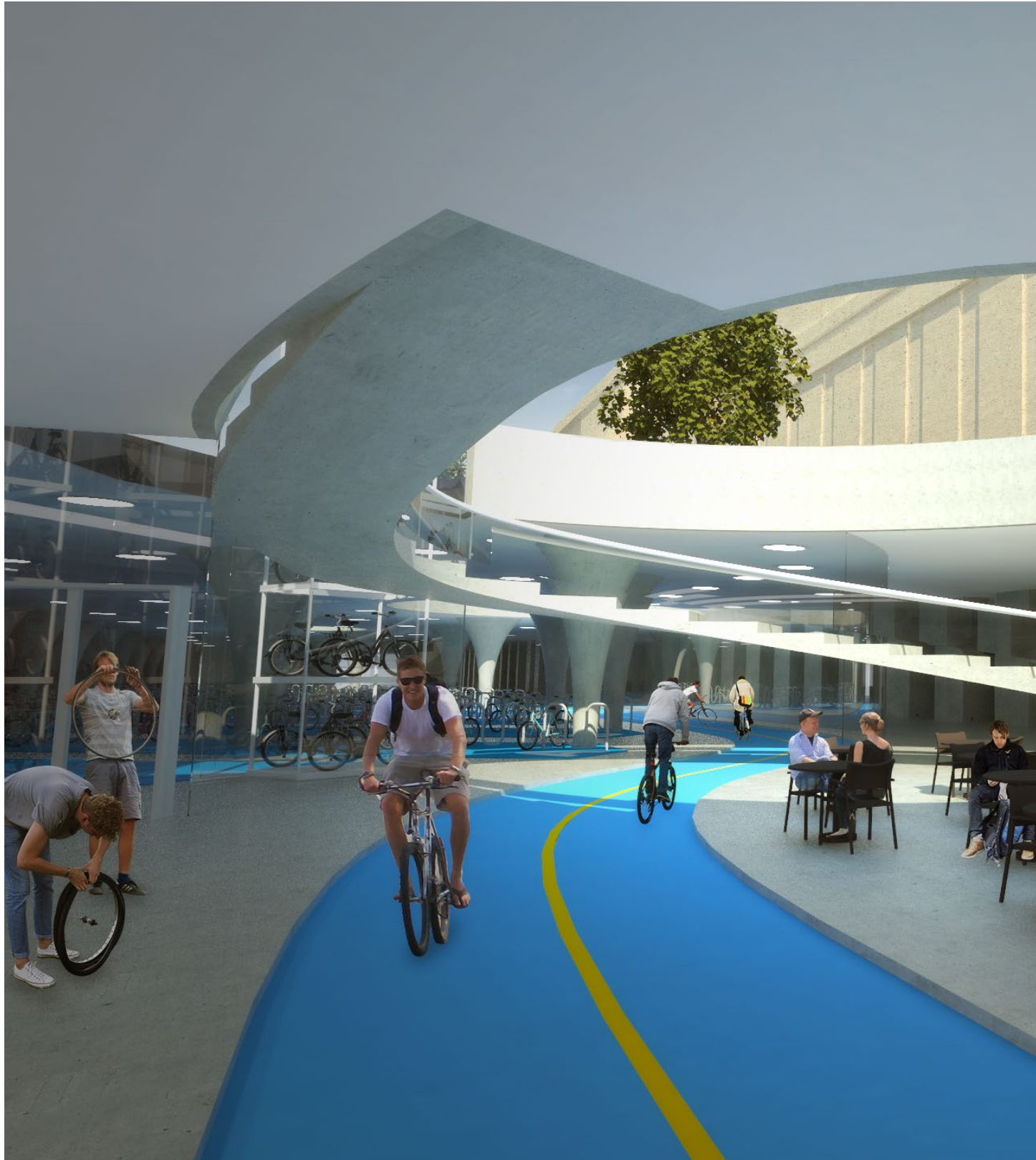
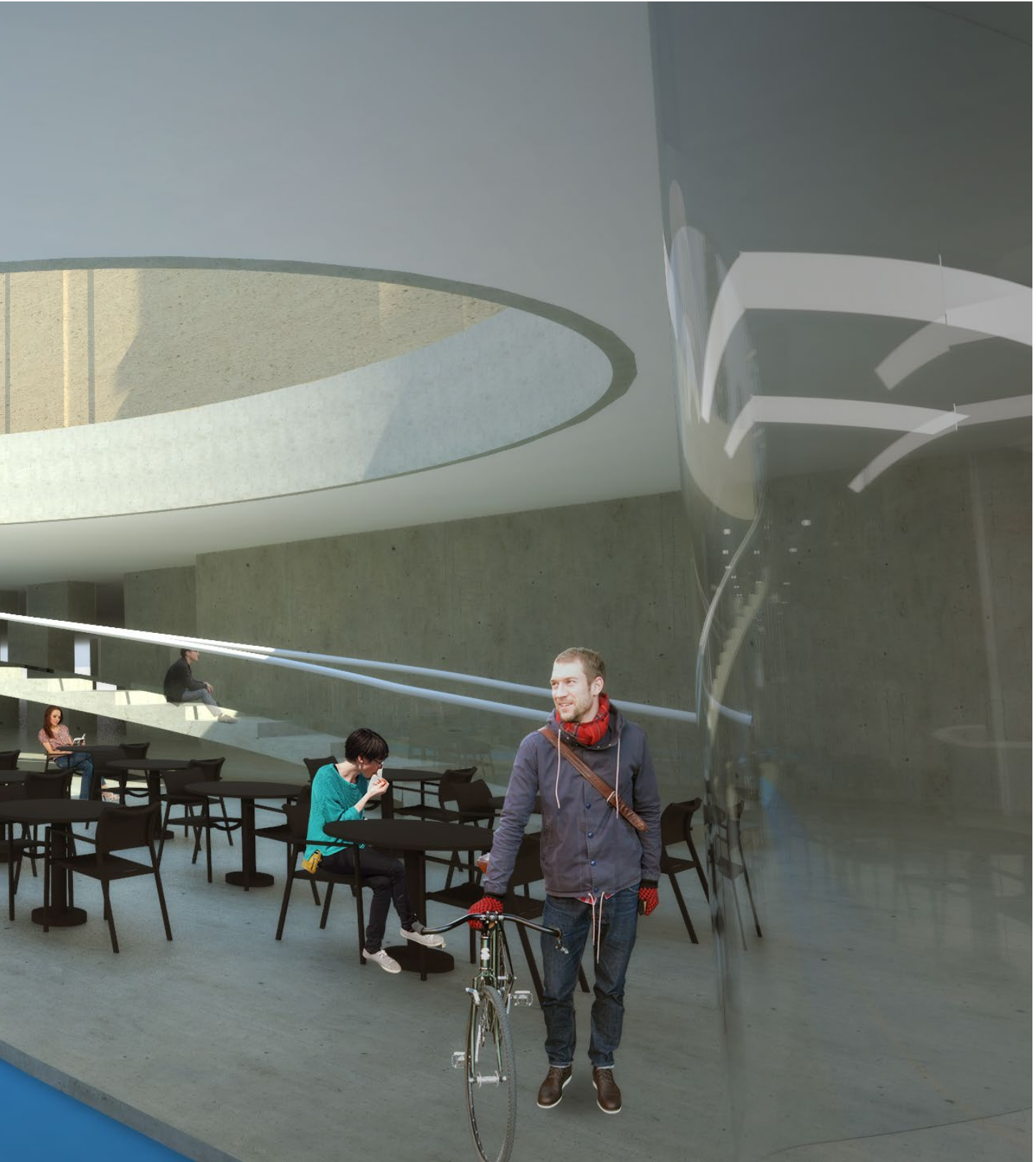


Figure 4-51 View from bicycle path







06

# Conclusion

Toronto is approaching a critical point in its cycling history. Cycling has been growing slowly in the downtown core for years, with cycling's modal share reaching as high as 11.4% in the Trinity-Spadina Ward, one of the highest rates in North America. The city is at point where making a major investment in the right places can set it on a path towards embracing cycling as part of the everyday transportation network, undoing a long held bias towards the car. If the city's leaders can find the political will to give cycling a firm push, then Toronto can leap from simply maintaining the status quo to building a strong cycling culture.

This thesis presents a strategy that can be applied to all cities looking to reap the benefits of an increased cycling modal share. This strategy involves two key steps:

The first step is to develop a deep understanding of cycling in the city, enabling the identification of sites that have significant potential to attract new cyclists through the construction of cycling infrastructures. Studying existing cycling patterns allows for the understanding of the relationships between urban form, cycling infrastructure and interest in cycling. This knowledge facilitates the identification of target sites in which to implement exciting new cycling routes and amenities.

The second step is the design and implementation of these infrastructures. The ability of a route to change peoples' perceptions about cycling relies on the success of its design and the design of its supporting amenities. Unlike Toronto's 2001 bike plan which sought to apply a broad-sweeping approach across the entire city, this design strategy targets specific areas which are determined to have the largest immediate impact. While the majority of cycling routes in the city are built as simple, painted bike lane markings, this approach uses design to elevate the vision of the bicycle route. The Avenue-University route, as seen in Figure 4-52, is conceived as a cohesive entity, carefully stitched into the neighbourhoods through which it passes. It becomes an integrated and visible part of the urban fabric, partnering cycling infrastructures with public amenities to become much more than an afterthought. The route's identity moves beyond the utilitarian, to the iconic. The act of cycling is dramatized, transforming in the minds of potential cyclists from an unappealing activity to an irresistible experience. Showcase projects such as this route become catalysts for expanding the cycling network and developing a cycling culture.

Developing this culture does not necessitate building these showcase routes on every street within the city. Rather, these routes are meant to transform key arteries that can function as highlights within a larger cycling network. They reveal the potential of truly integrating cycling with the existing fabric of the city, and represent a paradigm shift in North American cycle planning. While long term, city-wide plans are important for supporting cycling in the long run, this bold, targeted strategy provides the ability to jump-start interest and excitement around

*Figure 4-52 Aerial view of the Avenue-University cycling corridor*



cycling. Over time, this excitement transforms into dedicated support and facilitates the expansion and enhancement of the rest of the cycling network.

Currently, in Toronto, the development of a cycling culture is being held back by the fact that strong cycling support drops off dramatically outside of the downtown core. To make cycling a vital part of the city's future, it is important to reach out to potential cyclists throughout the city, beginning with those in midtown. The proposed Avenue-University route is well positioned to target these people. The route seeks to create a safe, convenient and exciting cycling experience that will improve the lives of current cyclists while also reaching out to entice non-cyclists to start cycling. Running down one of the city's most iconic arteries, the route raises the profile of cycling. This newfound visibility can help encourage the frustrated commuter to seize the opportunities which cycling presents.

The frustrated drivers, transit riders and hesitant cyclists who once perceived cycling as inconvenient and unsafe due to a lack of connected, traffic-separated routes, now have a safely separated cycle route connecting Eglinton Avenue directly to downtown. Beyond having a safe and convenient route, the would-be cyclists now have a sensually stimulating route which connects them to destinations and experiences along the way. No longer do they have to sit in bumper-to-bumper traffic, or stand elbow-to-elbow jammed into an overcrowded subway car. They are free to move continuously, under their own power, immersed in a comfortable and exciting environment. If they wish to stop, they are surrounded with opportunities to pause and experience the city. The route gives them a heightened awareness of the same city that they had previously become accustomed to passing through in an almost unconscious state. They soon learn that the cycling experience is rejuvenating, leaving them refreshed and ready to meet the challenges of the day. Before long the frustrated commuter has changed from being a hesitant cyclist to a daily rider.

The long distance commuters are enticed by the new Union Station bicycle hub. Walking through the station's pedestrian moat, they see a vista of bicycle parking, with cyclists gently coasting by. They will be tempted to forget about hopping on the TTC to complete their trip. Those who are always rushing to complete their journey on foot now have the option to grab a bicycle and carry on their way. Whether they leave their own bicycle securely parked at the station awaiting their return, or choose to take a bicycle from the bike share, they are liberated to travel wherever they wish within the city. The bicycle hub becomes a nexus of activity, a lively urban space, activating the plaza above. It is a destination where people seamlessly transform between cyclist, pedestrian, transit rider and back again.

The tourist has a new opportunity to see the city from the seat of a bicycle. Where the cycling network once appeared confusing and intimidating, tourists now have a clear route to explore and shared bicycles to rent. The route's cohesive design and consistent graphic system helps them find their way and launches them towards the city's many great destinations and neighbourhoods as they set out to experience all that the city has to offer.

This showcase route, with all of its amenities and connections, holds the potential to vastly increase interest in cycling among Torontonians. People are fed up with their current means of getting around the city and have given up hope that there is a better way. Cycling can be that better way. The Avenue-University route can act as a catalyst for behavioural change, making cycling irresistible for the masses. Support can grow quickly as cycling comes to be accepted as a legitimate mode of transportation across the city.

The route cannot work in isolation; rather it is part of a larger network of bicycle lanes and paths. It enhances the current incomplete network which the city has slowly built over many years, drawing on the network's strengths and making up for some of its weaknesses. As support for cycling grows, so will the demand for infrastructure, and the city will be able to build more iconic and connected cycling routes to compliment the Avenue-University route. The network can then be filled-in with bicycle boulevards on quieter streets. By the time a cycling culture spreads across the far reaches of the city, attracting the whole demographic range, a complete cycling grid will have spread across the city. This network will allow cyclists to travel safely, conveniently and pleasantly anywhere they wish to go and in turn, the city will become a happier, healthier, less congested, and more attractive place to live.

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