Urban Pathways
Redesigning Toronto's Mobility

by

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AUTHOR'S DECLARATION

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.

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ABSTRACT

As an increasing proportion of the world's population travels ever-longer distances between their home and place of work, urban mobility networks have had to cope with this dramatic increase in movement. These networks not only occupy escalating amounts of undeveloped land, but also work to re-shape the public spaces and landscapes of the urban realm. The City of Toronto's mobility (or increasing lack thereof) has an enormous influence on its culture and urban development; the car and its attendant infrastructures heavily govern the city's growth by supporting urban sprawl. In order to redevelop public space, equalize access to mobility, and improve the way we move through the city, a new system of infrastructure is required; one that can negotiate through an asphalt-dominated landscape while creating a sustainable transport alternative.

This thesis proposes new mobility networks as strategies of intensification through a repositioning of the bicycle and by prioritizing its supporting infrastructure along existing underutilized service lands in the City of Toronto. By further developing both the rail and hydro corridors as a city-wide network of mobility paths, and eventually phasing them into a series of linear parkways, distant parts of the city would become accessible for long-haul trips. The second design component is a series of bicycle hubs located at, and tailored to, strategic locations throughout the city's existing corridors and transit lines. These new civic amenities have the potential to enrich urban placemaking, while acting as social centres that anchor newly connected communities.

ACKNOWLEDGEMENTS

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Finally, to Alex, your unwavering support and unconditional love has balanced the past six years and has made this thesis possible. For your selfless interest in my work and for accompanying me on every Toronto cycling adventure, thank you.

DEDICATION

For my family.

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"The culture of a city is often defined by its transportation system: yellow cabs in New York City, bicycles in Beijing, streetcars in San Francisco, highways in Los Angeles, double-decker buses in London, scooters in Taipei, canals in Venice, cyclos in HO Chi Minh City and the Metro in Paris. Often, transportation systems create interdependent relationships with urban form and culture."

Chris Hardwicke, *Utopia: Towards a New Toronto*

Facing page:
Fig.0.1 Macdonald-Cartier Freeway, Toronto.

INTRODUCTION

While surrounded by horrendous Saturday afternoon traffic along one of the busiest highways in the world, the Macdonald-Cartier Freeway, colloquially known in Toronto as the 'four-oh-one', I was taken aback when I counted the width of the highway to be comprised of eighteen lanes of traffic. As I continued to gaze across this vast corridor dominated by concrete, asphalt and taillights I kept asking myself, how can the car be the sole significant means of mobility in the city? How can a city thrive when its citizens are limited to highly controlled network of mobility corridors that deny them social interaction? How can personal mobility in the City of Toronto be available to all citizens when many are unable to drive and are without access to a car? Dutch architect Francine Houben sums up my initial reaction to Toronto's transportation network in *Mobility: A Room with a View* by stating:

> So much stranger that all this space for traffic, this huge network of public spaces in which countless people spend many hours day after day, has come into being with such apparent casualness. The construction of mobility routes seems to be primarily a technical matter, reserved for traffic planners, engineers and politicians, in which designers play no part [...] mobility routes are not only space for traffic but also public space, space to spend time in.[1]

How then, can architects and city dwellers become involved in the boundless topic of mobility? Can design be the instrument through which public space and personal mobility be reclaimed? This introduction will begin to explore the questions posed above, while investigating how past planning decisions by the City of Toronto have led to the struggling mobility system that we see today. The environmental and urban repercussions of the city's transportation policies as well as the current failing attempts to implement a modest cycling network will also be explored. Finally, the case for redeveloping the City of Toronto's rail and hydro corridors as a new system of mobility and a model for

ROAD MOTOR VEHICLES

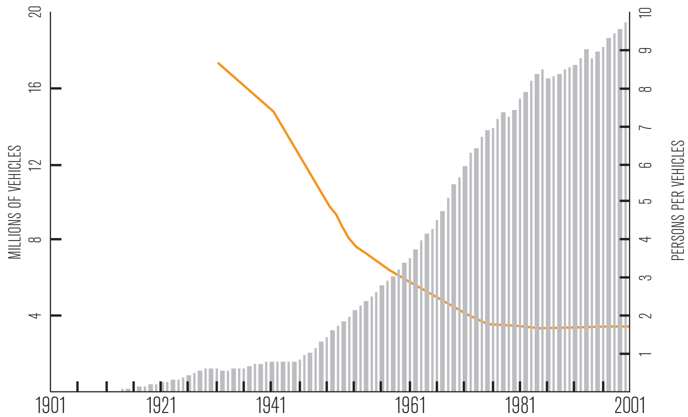


Fig.0.2 As the amount of road motor vehicles increase in Canada the number of people who are dependent on one vehicle decreases.

CRUDE OIL PRICES

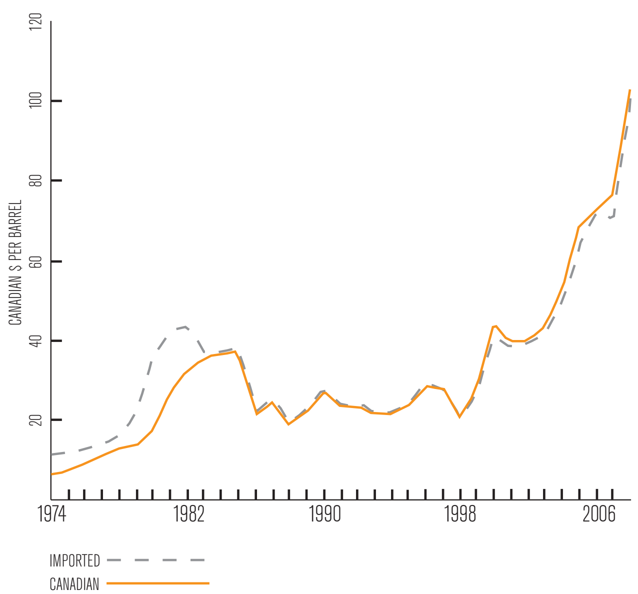


Fig.0.3 Rising crude oil prices are a major concern for the future of car ownership.

incremental urbanism, one that offers both increased mobility and civic space, will be proposed.

Cities around the world are being devastated by the ever-increasing burden of traffic. Today, transportation accounts for nearly thirty percent of world energy use and ninety-five percent of global oil consumption.[2] A significant part of the problem is the enduring popularity of the private automobile – some 40.6 million personal automobiles were produced in 2002, five times that of 1950. The global fleet now exceeds five hundred and thirty million and is projected to grow by eleven million annually.[3] With the uncertainty of rising crude oil prices, mid-century visions of urban utopias dominated by machines are at odds with current environmental debates.

The City of Toronto's decision to prioritize automobile use in its transit planning has resulted in traffic congestion, increased road accidents, and poor air quality. Historically, the response of urban planning departments to such problems has been to reactively build more road capacity. This mindset has displaced funding that would otherwise be available to public and active transit infrastructures and has resulted in the constant and dysfunctional suburban sprawl of the GTA. The resulting travel distances increase travel times and only reinforce automobile use, leading to a tragic spiral of more cars, more roads, more congestion, and more urban sprawl with no end in sight. These planning decisions have not only undermined mobility in the city, but also its livability and urban culture.

There is an underlying urgency for the City of Toronto to develop a sustainable relationship with its transportation system. The Ontario Medical Association estimates that air pollution from automobile use is responsible for 5,800 premature deaths annually across Ontario and costs the province more than one billion dollars a year due to hospital admissions, emergency-room visits and employee absenteeism.[4] Vehicles are also responsible for thirty-five percent of the total greenhouse gas emissions in Toronto, and some twenty-five percent of the surface area of the city is built to accommodate the automobile.[5] According to the 2006 Census, there are over 2.4 million commuters in the metropolitan area of Toronto a day and 71.1percent of these commuters made the trip alone by car.[6] With a projected population increase of 2.6 million by 2031 coupled with the highest commuting time in Canada[7] (sixty minutes each way),[8] it is no wonder that if the present growth of transportation continues, the City of Toronto will incur more than fifty-five billion dollars in new infrastructure costs over the next twenty-five years just to keep up with the current automobile demands.[9] This gluttonous system of mobility consumes valuable urban space, commuters' time, environmental capital, and causes detrimental effects to public health and safety.

Under its current *Official Plan*, the City of Toronto intends to build a city that will accommodate Toronto's growth while decreasing car dependency. In 2001, City Council passed Toronto's *Bike Plan*, a ten-year initiative estimated to cost the city $72.8 million.[10] Once completed, Toronto would boast one thousand kilometres of new bicycle infrastructure; 2010 marked the ninth consecutive year that the city hasn't met its modest targets.[11] A lack of funding, political support and cautious rationing of street widths have all contributed to the *Bike Plan's* failure. While Toronto struggled to implement on-street bike lanes many other North American cities have successfully expanded their bicycle networks over the past three years. Vancouver, New York, and Portland all boast over three times the amount of bicycle lanes than the City of Toronto, despite the fact that Toronto has the highest percentage of population who ride their bicycle.[12]

Recently, bicycle lane expansion has become a popular topic amongst Toronto's City Council and citizens alike. Afraid of tampering with the 'car vote', slow implementation and endless hours of debate seem to be the politicians favourite methods of quieting many grass routes cycling organizations. The City's ignorance towards the bicycle and its benefits can't be ignored forever

Fig.0.4 Thesis symbol.

as there is an increasing demand by the public for a healthier environment in which to bring up their children. As architect Brian Richards mentions in *Future Transport in Cities* "the 'image' of the city in which we live has become important [...] as has the ambition that, the city should be a 'delight' to be in, and a place to enjoy, rather than an environment torn apart by traffic."[13] The City of Toronto is in dire need of a new vision and a plan that will generate both political momentum and financial backing. By developing new ways of conveying and distributing commuters the city will be able to accommodate its growing urban population while recreating its image.

Toronto currently has the opportunity to co-opt its existing underutilized rail and hydro corridors and develop them through incremental design into highly flexible and sophisticated urban parkways. By 'piggy-backing' new programs of mobility and civic amenity within the city's corridors, the initial financial investment needed to launch such a large-scale infrastructural project would be minimal compared to the return. Proposing a network of cycling pathways along existing infrastructure requires no additional real estate in the city, especially along the city's increasingly car congested streets where bicycle lane expansion has become a political issue. Another benefit to proposing cycling lanes in the hydro corridors is the ability of the corridor to become the catalysts for a new series of linear public parkway. The new continuous civic amenity would likely increase land value for the city in areas that were once deemed less attractive. Toronto has the ability to both regenerate derelict or under-performing urban spaces while demarcating itself an innovator within the discourse of contemporary urban mobility and place making.

As cities and their urban environments continue to increase in density, their infrastructure "[...] can no longer be viewed as a purely function and autonomous object, detached from its environment."[14] Dutch architect and traffic specialist, Marc Verheijen writes in *In Transit* that infrastructure has a large social dimension as it enables physical interaction between people and provides space for exchange of ideas and thoughts. For Verheijen, urban life is increasingly taking place within the transit spaces of cities, allowing infrastructure to have a great influence on how the identity and urban image of a city is developed.[15] Verheijen believes that developing mobility networks involves interdisciplinary design, as "designing infrastructure is designing culture,"[16] and with a simple design intervention new urban potential can be tapped within congested cities. *Urban Pathways* and its supporting infrastructure have the ability to provide a new interdependent relationship between urban form and culture that will help to redefine Toronto's image amongst cities of the world.

The thesis is divided into two parts 'investigation' and 'activation'. *Investigation* focuses on three issues: (1) an exploration of mobility, what it means for North American cities and the City of Toronto and how its development through history has affected urban culture. (2) a brief history of the bicycle and how its ability to engage with a city is vital to its success, as well as an analysis of the benefits and challenges of promoting cycling in the City of Toronto. Key points are taken from four cities that have successfully implemented cycling initiatives into their transportation polices and onto their streets. (3) an introduction to Toronto's utility corridors and design proposal, concluding with a study of three revitalization projects that effectively co-opt under utilized infrastructure. *Activation* showcases the design: the approach for developing *Urban Pathways*, challenges associated with piggy-backing utility corridors and phasing strategies to create linear parkways. The design portion concludes with nine test sites that display a series of bicycle hubs and public amenities.

The thesis is conceived as a system that elevates bike riding to equal status alongside private transit (the car) and public transit (TTC and GO Transit) in Toronto. The intention of the thesis is to reallocate space for the bicycle and its supporting infrastructure within the City of Toronto, as the inherent urban complexity of the city should sustain complex and multiple modes of transit, rather than merely supporting a single mode.


ISUZU

01 MOBILTY

"The suggestion of free and equal mobility is itself a deception, since we don't all have the same access to the road."

Janet Wolft, *Mobility*

Facing page:
Fig.1.1 Aging mobility paths.

1.1 FROM FOOTPATHS TO CORRIDORS TO CONCRETE

During the twentieth century, the movement capabilities of human beings has increased immeasurably. Just one hundred and fifty years ago, the distance a person or animal was capable of travelling limited human mobility.[1] During this period there was an inherent balance in the use of public space as a meeting place, market place, and mobility space. Public spaces such as streets and squares, have always acted as a place for people to have face-to-face conversations and exchange information about the city and society. These spaces represented the forum for important events in the city: coronations, processions, feasts and festivals, and town meetings. They were also used as market-space where goods and services could be offered and exchanged. Finally, streets and squares provided a space within the city for the movements of goods and people, providing essential links to various parts of the city and neighbouring communities.[2]

These traditional uses of public space endured until the invention of the bicycle in the late eighteenth century. The bicycle became the first geographically liberating machine to increase personal mobility, freeing its users from schedules and tracks. This allowed all citizens the liberty to explore land that wasn't passable by carriage or train. Canadian geography professor Glen Norcliffe further describes the bicycle's importance in the history of mobility by stating, "bicyclists were able to go where they wished, at their own pace. This geographical liberation was taken much further in the era of the motor car, but modern understandings of the geography of personal space began to take shape during the bicycle era."[3] New patterns and uses of public space appeared with the growing desire for individual freedom heralded by the bicycle.

SOLE USE OF PUBLIC SPACE

Currently, two thirds of the world's population lives within industrialized nations where it would not be uncommon or unusual for a person to travel ten-thousand to fifty-thousand kilometers in one year.[4] The invention of the internal

Fig.1.2 Danish architect Jan Gehl categorizes a heavily dominated auto-centric city as 'The Invaded City' in *New City Spaces*. In these cities, car traffic and parking have saturated the streets and squares leaving little space for the city to successfully thrive, Toronto is an example of an invaded city.

combustion engine in 1894 enabled this drastic increase in personal mobility by altering the traditional use of public spaces.[5] Auto-centric cities have gradually and continuously consumed the space that was once allotted for the city dweller's well being and re-appropriated this space for the sole purpose of supporting the ever-increasing demands of auto infrastructure. This has caused an in-balance amongst the traditional uses of public space, especially within the sprawling suburbs of car-dominated cities. As the success of the automobile has pressured all other uses to become subservient to the "technical requirements of traffic flow[s]"[6] required by the automobile. Italian professor of land use planning, Alberto Magnaghi, sums up the resulting urban conditions of increasing personal mobility in his book, *The Urban Village* by stating:

> In spatial terms, individual mobility has grown with the progressive disappearance of public spaces. The disappearance of meaning in public spaces has led to the break-up of social life into metropolitan 'cruising', with its virtual public squares, network communities in the global village and aesthetics of nomadism and drifting.[7]

Richard Sennett, a professor of sociology, likewise touches on the automobiles dominance of public space in *The Fall of Public Man*, where he suggests that the unfortunate idea of public space as derivative from motion parallels precisely the relations of space to motion shaped by the personal automobile.[8] Sennett further expresses the impact that automobiles have on public life by arguing that:

> Today, we experience an ease of motion unknown to any prior urban civilization, and yet motion has become the most anxiety-laden of daily activities. The anxiety comes from the fact that we take unrestricted motion of the individual to be an absolute right. The private motorcar is the logical instrument for exercising that right, and the effect on public space, especially the space of the urban street, is that the space becomes meaningless or even maddening unless it can be subordinated to free movement. The technology of

Fig.1.3 The New York City 1938 World Fair "Furturama" exhibition became the basis for later highway suburbs around the world.

> modern motion replaces being in the street with a desire to erase the constraints of geography.[9]

The automobile burst all boundaries, scattering new, low-density development across the countryside, devastating the physical fabrics of both older and younger cities.[10] Older cities are forced to adapt their downtowns to traffic volumes that were never considered at the time of their design. The end result is that the space for public contact, communication, and exchange have been erased gradually over time and replaced with an insular means of mobility, the automobile. Rather than encouraging the integration of multiple modes of mobility that engage with the urban and social environment in unique ways, North American cities have grown dependant on the car. Our sole reliance on the automobile to provide personal mobility is rapidly draining global fossil fuel supplies while depleting public space and harming the environment.

North American transportation infrastructure is severely under funded and as it reaches capacity, it begs the question, how did society come to rely solely on a single mode of mobility? What major factors influenced this reliance? These drastic urban changes to existing city centres are a result of the machine-age visions that were ushered in by the demands of the automobile during the Modern movement. Many of the world's most progressive architects explored new ways of adapting the existing dense city to the modern era. Their visions included sleek lines, orderly grids, automated systems and fantastical structures that were all influenced by the design of the automobile and its supporting infrastructure.[11] These concepts have drastically influenced our modern transportation infrastructural systems and urban environments by instilling in North Americans, during the Futurama exhibit at the 1939 World's Fair, ideas of how transportation and personal mobility systems would function and what they should look like.

American architect Harvey Wiley Corbett developed elaborate drawings that

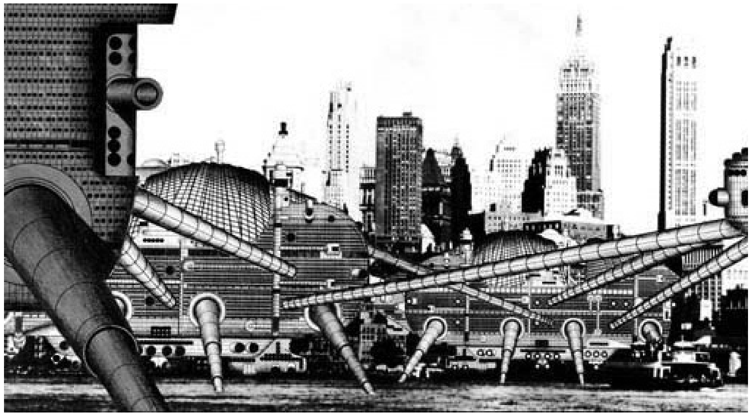


Fig.1.4 English architect Ron Herron proposed the 'Walking City' in 1964 an autonomous robotic structure that could roam the earth depending on the needs or wants of the inhabitants.

Fig.1.5 Multi-level transportation network, Harvey Wiley Corbett, 1913.

depicted a multi-level transportation network. Each level separated different modes of transportation based on their speed of mobility. Corbett's concept of stacking traffic started to respond to the question of how a city could be designed to integrate and negotiate different modes of traffic with different speeds. By separating transportation infrastructure vertically, Corbett explored new ways of "[…] adapt[ing] the existing intense, interactive, and dense city to the modern era."[12]

French architect Le Corbusier recognized the need for concentration of infrastructure in city centres in his proposal of *Ville Radieuse*, or more commonly *Radiant City*. His sketches depict a towering urban corridor conducting traffic on various levels at high speeds through a densely designed city centre. Le Corbusier believed that city streets would only wear the city dwellers down and questioned why they even existed.[13] In his book, *In the City of Tomorrow*, Le Corbusier expands on his dislike of unnecessary thoroughfares by stating "the centre of the great city is like a funnel into which every street shoots its traffic," and concludes that "wide avenues must be driven through the centres of our towns,"[14] to eliminate as many streets as possible. By removing the street Le Corbusier unknowingly removed the space where movement and meeting naturally occur. Without a place for social interaction urban life would not exist, leaving in its wake only separation and fixed segregation.

ENGAGING THE CITY

Not all scholars saw the benefits of redesigning the urban environment based on the needs of the automobile. French sociologist Henri Lefebvre supports the need for social interaction and firmly believes that "the street is more than just a place for movement and circulation" and that there are "consequences to eliminating the street."[15] Lefebvre further elaborates these thoughts in his book, *The Urban Revolution* where he writes that the street contains functions that are overlooked by Le Corbusier: "the information function, the symbolic function, [and] the lucid function."[16] For Lefebvre, it is important to provide

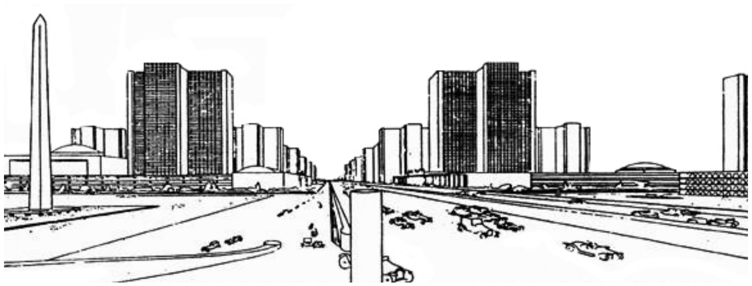


Fig.1.6 Le Corbusier, Radiant City, 1938.

public space to allow active transportation (pedestrians and cyclists) the ability to engage with the city. Therefore, condensing the amount of streets a city has within its core is a short-sided idea brought about by machine-aged visions and supported by large automobile companies with economic agendas. Lefebvre argues that drivers concealed within cars do not engage with the city and its urban fabric the same way that pedestrians and cyclists do; the driver is only focused on getting from A to B:

> City life is subtly but profoundly changed, sacrificed to that abstract space where cars circulate like so many atomic particles […] the driver is concerned only with steering himself to his destination, and in looking about sees only what he needs to see for that purpose; he thus perceives only his route, which has been materialized, mechanized, and technicized, and he sees it from one angle only – that of its functionality: speed, readability, facility.[17]

Contemporary Dutch architect Francine Houben's views on public space run parallel to those of Lefebvre. Houben believes that policy makers need to be reminded that "[…] mobility is not just a matter of tailbacks, asphalt and delays […], the car is for the traveler not simply a means of getting from A to B but also 'A Room with a View.'"[18] Mobility routes for Houben are not just spaces for traffic but "[…] also public space, space to spend time in."[19] But these public spaces, the city streets that Houben speaks of, are becoming increasingly congested with automobile traffic, leaving little opportunities for other modes of traffic to engage with the city. According to anti-sprawlist Jane Holtz Kay, society has become conditioned by the automobile's influence on our environment, both built and natural.[20] Holtz Kay also believes that the automobile has limited the mobility and access of the pedestrian since most urban infrastructure is dominated and dedicated to the automobile:

> Planning for such sixty-mile-an-hour speeds, designing for wastelands of parking, for corridors of concrete, the architect's work has inevitably become carchitecture. Denying the

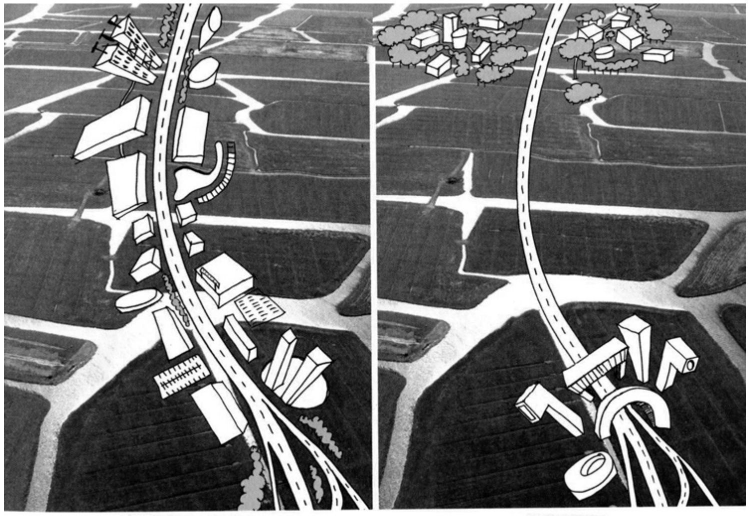


Fig. 1.7 Drivers are only focused on their route from A to B.

> three-mile-an-hour pace of the walker, the world see, from the porch, the surroundings in all tender detail at an easy pace, the once closed-scaled places have spread into a blur with all the individuality and identity of the freeway.[21]

If given the opportunity within the auto-centric landscape, both cyclists and pedestrians alike have the ability to define and activate space as they move through a city centre. These active modes of transit are not limited to linear movements along roads and parking facilities as the personal automobiles is and are therefore able to create intertwined paths that give shape to spaces in a city as they weave places together in a subjective manner.[22] In this respect, pedestrian movements form a real system of existence, which in turn, builds the foundation of the city.[23] According to French scholar Michel de Certeau, it is specifically walking people who bring the city to life. In his 1984 theories of the street, de Certeau writes that a city is rendered worthless without people "the city is to bring nothing but basic stimuli to the population and it is the people who are responsible for making it come alive and give it meaning."[24] The space in the city, once defined by the pedestrian or cyclists will only remain defined for as long as the individual defining the space remains within this space. De Certeau's theories of street interaction are further explored by his definition of the verb, 'to walk'. When walking, de Certeau writes that the person is simply 'lacking space' and "it is [this] indefinite process of being absent and in search of a proper,"[25] that pedestrians and cyclists are able to define and engage with the city surrounding them within a specific time frame. De Certeau expands on the complex relationship that the moving pedestrian has with the city by stating:

> The city is there to be manipulated, molded and used, and yet it emerges the same at the end, for no image projected upon it can ever remain since the pedestrians are not static and nor is the space in which they move. Indeed, I would go as far as to say that the space is not even real, but simply make-believe.[26]

Fig.1.8 The bicycle allows its user to engage with the surrounding urban environment, allowing the rider to form a distinct image of the city.

Fig.1.9 The automobile hinders the driver's ability to engage with its urban environment as the car acts as a physical barrier between the driver and its infrastructure.

Pedestrians and cyclists benefit from a unique engagement with the city, as they are not forced to succumb to the restrictive forms of space that the automobile is limited to experiencing the city from. This freedom enables active transportation to have a different perceptual experience of the city, allowing these forms of movement the freedom to fully explore and engage the urban realm. The benefits that active transit enjoy are partially due to the fact that the pedestrian and bicycle are both self-limiting forms of mobility. As Austrian philosopher Ivan Illich mentions in his book, *Towards a History of Need*, active forms of transportation "allow people to create a new relationship between their life-space and their lifetime, between their territory and the pulse of their being, without destroying their inherited balance."[27] When compared to walking, cycling significantly increases the personal mobility of its users, by allowing its riders to move with greater speed without taking up significant amounts of space, energy, or time. Therefore, the bicycle is a geographically liberating machine that provides the highest engagement with a city without disrupting its inherent balance and use of public space as a meeting place, market place, and mobility space.

The mobility of a city has an enormous impact on its "[…] city culture and urban development as cities are primarily perceived from a moving perspective."[28] This is why the experience of a city is largely determined by its infrastructural systems and traffic flows. The image of the city that a moving person acquires is determined by what they see and experience along the way - the mode of transportation chosen affects the image of the city. A pedestrian's view of a city is formed while walking at about three kilometers an hour. Pedestrians are able to fully engage with their surrounding urban environment as they have time to recognize the patterns of their surroundings and organize these into coherent memories for future way-finding needs. These images, which are formed from experience, are crucial to American urban planner Kevin Lynch's theory that people need to be able to recognize and create personal patterns

Fig.1.10 The bicycle is a geographically liberating form of mobility that is self limiting and environmentally friendly.

of their surroundings in order to become a participant within the stage of the city and its infrastructure.[29] Cyclists encounter and engage with the city in a similar manner to a pedestrian, as cyclists move about the city freely and are not separated from the urban environment by an intermediary device, as a person would be in an automobile. As the cyclist rides through the city at about fifteen kilometers an hour they are able to create a distinct image and memory of their experience, which help create similar engagement tendencies as the pedestrian. Automobiles travel at much greater speeds than pedestrians and cyclists and are restricted to linear movements along streets, limiting the occupant's ability to engage with the urban environment. Roads and highways are meant to provide connections, but at the same time they close off smaller scale connections and spatial ties within a city, which in turn disconnects communities and cultural networks.

Due to congestion and over reliance, the limitations of the automobile are increasing in car-dominated cities worldwide and are prompting a global question. Is there a better way? Can personal mobility be increased and rebalanced within the existing infrastructure by an additional mode of transportation? What new method of movement can negotiate through an automobile dominated landscape, while engaging the user with new forms of infrastructure to create a dynamic interaction between mobility and spatial design to form a new image for the city? Can the bicycle help to rebalance mobility by decreasing the sole reliance on a single mode? With rising environmental awareness the bicycle and its supporting infrastructure have the potential to create an critical impact on urban development and culture of existing cities that are currently dominated by corridors of concrete. Recently, there has been a growing trend in many major cities around the world to reincorporate the bicycle into transportation planning policies. The thesis picks up on this global trend to reduce transportation congestion while supporting multi-layered mobility options in the City of Toronto by promoting the bicycle as an additional method of mobility in the city.


APL
90

"As we look to the 1990s, we see a compact, transit-oriented Metropolitan Toronto as the centre of the region, surrounded by highway-oriented urban sprawl modelled on U.S. cities: Vienna surrounded by Phoenix."

Juri Pill, *Toronto Star* (1990)

Facing page:

Fig.1.11 Canadian Pacific Railway and Don Valley Parkway interact at a junction point during rush hour.

1.2 RAIL TIES + TAIL LIGHTS, TORONTO'S APPROACH

There is no question that Toronto's congestion is smothering its mobility. Today, media headlines are consumed with constant updates on the city's mobility challenges; reports on delays due to car accidents, congestion, and construction have become a part of the commuter's day-to-day life. This pattern of congestion costs all auto-centric cities millions of dollars every year due to maintenance costs, air pollution, hospital visits, delays, and absenteeism. The City of Toronto's current mobility system, which is comprised of several highways, major roadways, TTC (Toronto Transit Commission), GO Transit, and a minor cycling network, can barely sustain the 2.4 million commuters (2006) a day during rush hour.[1] With a projected population increase of 2.6 million people over the next twenty years, the city's existing transportation system will not be able to maintain this drastic increase in ridership as their existing network is already overused and rapidly degrading.[2] The future of Toronto's mobility currently looks bleak, as there are no concrete plans to increase personal movement through the city that do not involve the expansion of automobile based networks and transit plans that service low-density areas. How then, can mobility be increased in a city that is deeply influenced by a powerful car lobby and governed by archaic transportation and land use policies that continue to support a singular mode of transit? The following chapter will investigate how and why the City of Toronto's transportation network has come to be dependant on a single mode of mobility and what can be done to promote the integration of additional modes. The history of transit, highway, and cycling development in the city will also be studied to further explore the past and present transportation and land-use polices that will influence future development in the city.

EXPANDING URBAN FORMS ALTER MOBILITY OPTIONS

In 1907, the City of Toronto's most northern boundary extended only six and a half kilometers north of Lake Ontario to Eglinton Avenue.[3] At this time many political leaders debated on how best to manage the young city's growth. Politicians decided to place the expanding region under the guidance of a struc-

1920 TRANSIT

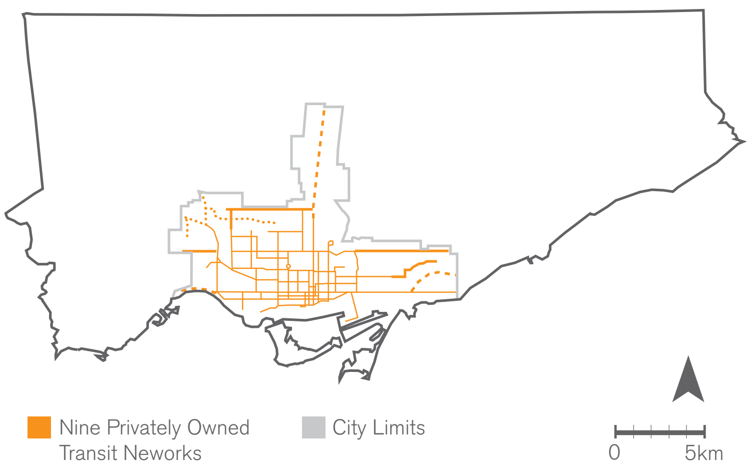


Fig.1.12 Toronto transit map prior to being owned and operated by the city, the network is comprised of nine privately owned transit systems until September 1st 1921.

tured government and mandated that all privately owned utilities be expropriated to this authority giving the government full control over the development of future infrastructure.[4] The City of Toronto grew both rapidly and compactly for the remainder of the decade up until the 1920's, as the city only permitted the expansion of transit to follow development if it could be economically justified. At this time the bicycle played an integral role in Toronto's transportation network as the urban form of the city encouraged cycling. Support for cycling in Toronto is shown by City Council with the construction of three-foot wide bicycle lanes on Spadina Avenue, Harbord Street and Winchester Street.[5]

As the City of Toronto's population continued to grow, citizens outside of the city's boundaries demanded that private transit should extend past the city's existing limits to the country. Private transit had been operating profitably since 1891 and felt no need to risk their investments by expanding the network and so they refused to extend lines beyond the city boundaries.[6] Public disapproval with private services led to severe pressure on the City to provide public transit opportunities to all of its citizens, and shortly after officials authorized the purchase of the existing transit operations. In 1920, the Toronto Transit Commission (TTC) was established by provincial legislation to run all existing transit operations as a public service. The compact character that the city became known for began to change soon after the municipal government took over the transit system in 1921.[7] Fares were immediately raised by fifty percent to fund expansion projects and rebuild existing track lines. This price increase enabled the TTC to operate a self-sustaining business, as they didn't rely on public subsidy. In the next decade the TTC nearly doubled the length of its streetcar tracks, this expansion contributed to the development of urban sprawl, which by definition is when a "[...] city's physical boundaries grow at a faster rate than its population,"[8] and accelerated the development of suburbs across the city, while paving the way for future sprawl.

While local land use planning and policies, socio-economic factors, and con-

CITY LIMITS

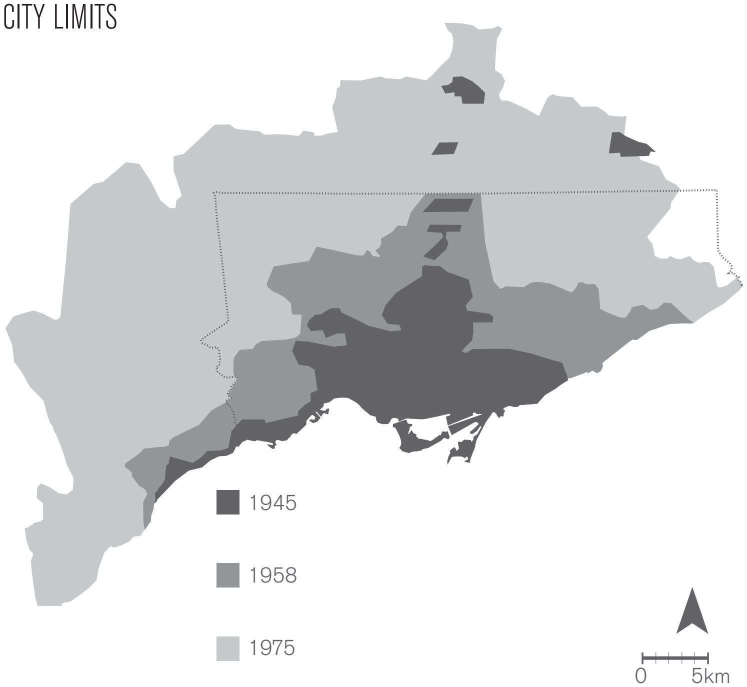


Fig.1.13 General boundaries of urban settlement in the Toronto area.

sumer housing preferences play an important role in driving urban sprawl, the City of Toronto's past transportation infrastructure decisions have determined the city's outward trajectory more than any other single factor.[9] The construction of the first superhighway system in the regions surrounding Toronto had a substantial amount of influence on the pace, size, and scope of urban growth that rapidly occurred. Former city councilor and mayor of Toronto, John Sewell, believes that roads are the most powerful planning tools that exist within transportation infrastructure, and so it would be no surprise that when the Queen Elizabeth Way (QEW) was first conceived in the 1930's, it would leave a lasting imprint on the City of Toronto's development.[10] The good intentions that the City of Toronto had of supplying transit and commuting systems to the suburbs quickly dissipated as the extraordinary cost of serving low-density suburban areas revealed itself. Public transit in the city also began to see declining ridership numbers since this form of transportation highly restricted the mobility of its users to a timeline and set track lines, it could not compete with the allure of increased personal mobility that the superhighways would provide the city's citizens. During this time the bicycle also lost much of its popularity in Toronto, due to the growth of the automobile. The bicycle as a mode of transit could not support the rapidly growing urban form that the automobile ushered in, causing the bicycle to lose allocated space on the road and its popularity. The bicycle as a form of transit would be absent from Toronto's mobility history for the next fifty years, until a second bicycle boom was produced by advent of the ten-speed bicycle.[11]

SUPERHIGHWAY - INDEPENDANT MOBILITY

Toronto's first flirtation with superhighways occurred in 1934, when Thomas B. McQueston, the provincial Minister of Highways, proposed a new road to increase access and mobility between the City of Toronto and Hamilton. Built from nothing, the new Queen Elizabeth Way boasted the first cloverleaf system, concrete road surface, and traffic safety median design in Canada.[12] The highway not only gave a means of rapid movement over long distances, but it also

Fig.1.14 Grass median seperating Middle Road (QEW).

provided the driver with a higher degree of safety that was not possible with any other existing road design.[13]

As John Sewell mentions in his book, *The Shape of the Suburbs*, this new development in superhighway design became a major departure from common practice, since the typical solution to accommodating increased road traffic was to simply widen existing roads. Building a new superhighway system, completely independent of all existing roads, was seen as a *tabula rasa*.[14] Traffic engineers and planners have been heavily criticized for not considering the possible side-effects and consequences of building completely new roads that bypass existing towns just to provide a faster connection from A to B. Sewell questions if these designers realized that this new superhighway would become a magnet for development and if they anticipated adjacent land to the new road would remain rural.[15] There are no records that these questions were ever asked or even considered, as the impetus for the new roadways was to create a way to maneuver around congestion. The superhighways simply provided a route for drivers to by-pass existing cities quickly. This increase in speed enabled the automobile to become the most effective and efficient means of personal mobility as the highways helped to re-link the sprawling suburbs to the city centre at a speed that public transit could not contend with. Superhighways became the poster child of all future transportation design and a matter of great interest to urban planners and traffic engineers alike.

MODAL SPLIT - PUBLIC vs. PRIVATE

After the Second World War, people naturally sought the suburban dream that they had been promised. Images of what this dream would look like entered the minds of North Americans during the 1939 New York World's Fair, sponsored by General Motors. The exhibit entitled *Futurama*, showcased car culture and its new age design strategies that proposed North American cities would be saturated with a grid of fourteen lane superhighways in the next twenty years.[16] U.S. President Dwight Eisenhower quickly acted on these proposals

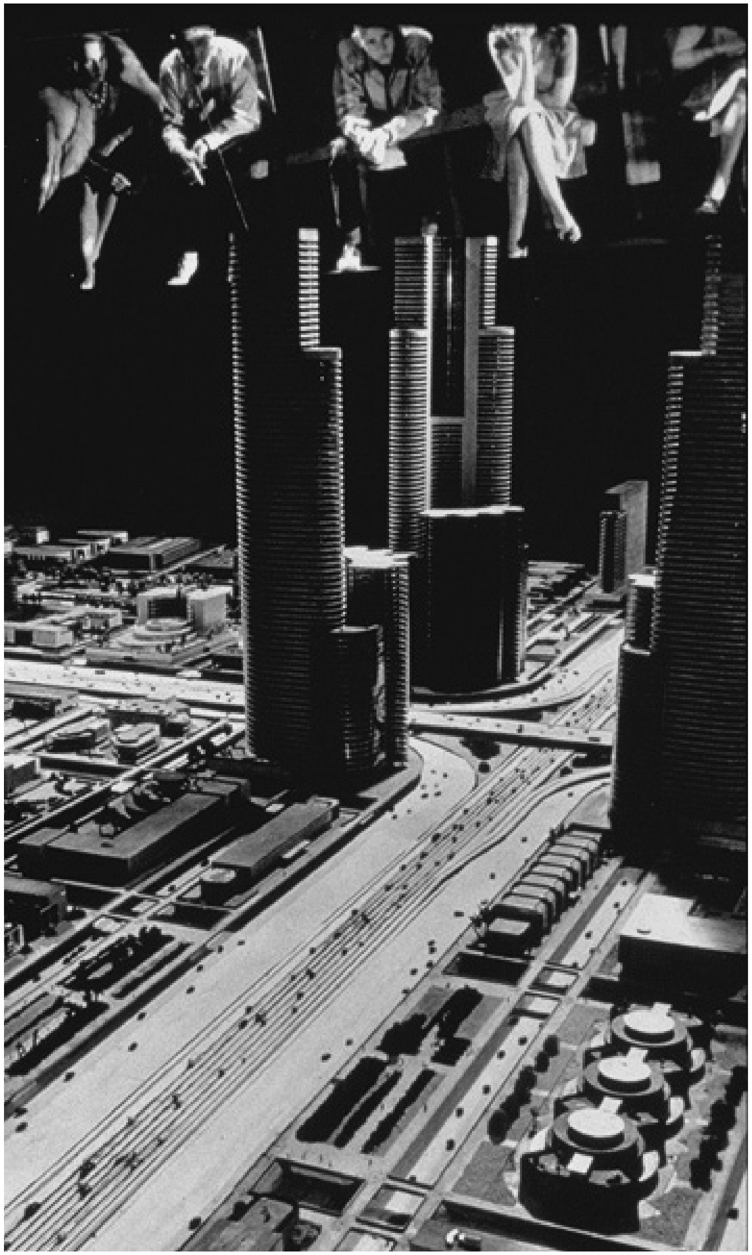


Fig.1.15 Viewers in chairs hover over the futuristic city on the 'Futurama' ride at the 1939, New York World's Fair.

following the end of the war by initiating a national highway construction program that became a major component in promoting the automobiles success and popularity for decades. As seen in the enthusiastic and original designs for its own highways, Toronto was no exception. The city's urban area once considered to have had a compact and dense urban form came under substantial pressure to expand outwards to accommodate this dream. As the city spread, and as communities with much lower densities were constructed (Toronto's pre-World War Two neighborhoods had densities ranging from twenty-eight to thirty-six units per hectare, and post-war densities of ten to fifteen units per hectare.)[17] efficiencies were lost, and transit began to incur an operating deficit since routes required denser populations to operate profitably. This avalanche of suburban growth forced the city's municipal government to take the lead role in providing a master plan for all infrastructural growth. The *1943 Toronto Master Plan* proposed the construction of several Superhighways (later to be designated as 400 series highways) and underground rapid transit routes along Yonge, Queen, and Bloor Street.[18] The superhighway network was strategically designed to form a closed system with every highway terminating at another highway and never at a city street.[19]

The *1943 Master Plan* did not address the expected modal split between private transportation and transit, however the city's actions to commence construction of the superhighway network immediately showed their prejudice, since it was not until 1946 that the construction of the Yonge subway line gained approval. The delay in construction to the city's first subway line was partly due to the fact that all twelve suburbs of Toronto and the city itself had to share infrastructural funding from the Provincial government. The Province of Ontario decided to consolidate these distinct municipalities in January of 1954 in order to organize transportation funding among other initiatives. Three month later, the Municipality of Metropolitan Toronto (Metro) opened Canada's first subway line, which ran along Yonge Street from Eglinton Avenue to Union Station.[20] The line was almost completely paid for by TTC's fare profits, and

1943 MASTER PLAN

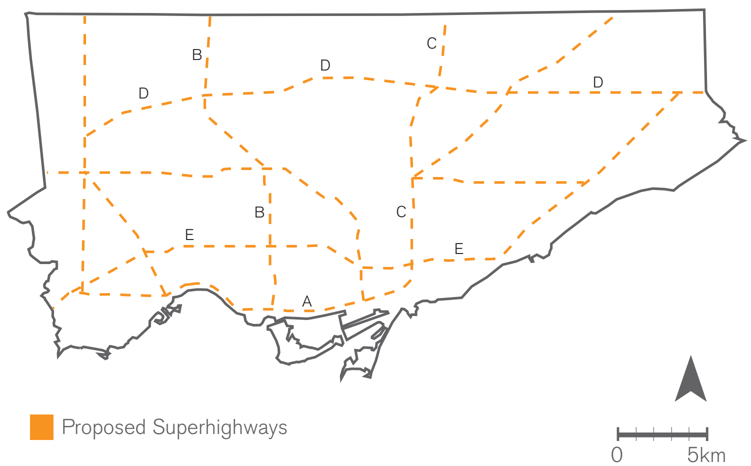


Fig. 1.16 Route A is where the Gardiner Expressway is later built; B ran north along the route of the planned Spadina Expressway; C ran north from Lake Ontario to Coxwell Street in the city's east end; route D ran where the current Highway 401 is located; and E ran along Bloor Street.

1966 SUBWAY PLAN

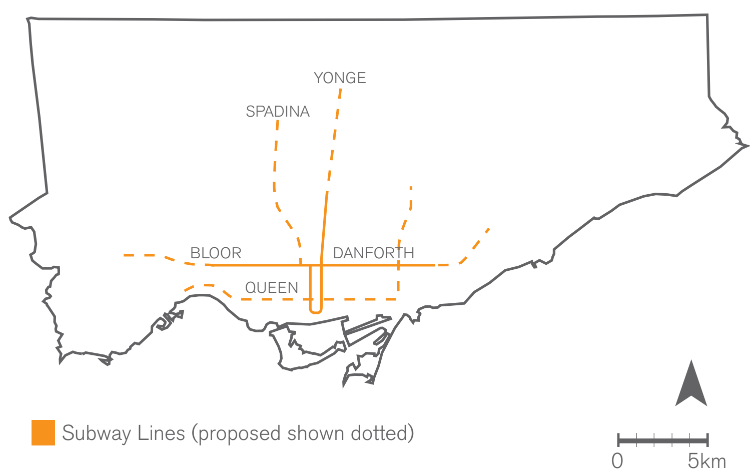


Fig. 1.17 The Yonge Subway line is completed in 1954, its success prompted the construction of the Bloor-Danforth, completed in 1966.

became an overnight success. Plans were drawn up immediately to expand the new subway line, however the TTC would not be able to fund the expansion projects alone, since the company began losing capital gains due to the bus services that were needed to reach the growing suburbs. The Metro government stepped in for the first time to help fund the expansion project, paying over fifty percent of the costs, while the TTC also received partial funding from the provincial government.[21] Even with two levels of subsidies the TTC was quickly outpaced by the development of urban sprawl and its supporting transportation of choice, the automobile. Future subway developments would not be self-financing, nor would they service high-density routes and by the late 1950's the TTC's entire capital budget was paid for exclusively by city taxpayers.[22] In the late 1960's, Metro decided to extend the Bloor-Danforth Subway line east to Scarborough Town Centre, through areas that were then (and even today) too low in population density to justify a subway service. The expansion project was initially estimated to cost $68 million dollars in the sixties, however upon its completion in the 1980's, the new line cost Metro over $230 million to construct a subway line that serviced industrial areas and sprawling suburbs.[23] Canadian writer and environmentalist Lawrence Solomon writes in his book, *Toronto Sprawls*, that almost all subway expansion routes are solely determined by political will, their financial viability never a deciding factor.[24] This major financial oversight set the stage for unthinkable budget deficits that would become a permanent feature of the TTC and Metro partnership.

SUPPORTING A SINGLE MODE

While TTC and Metro struggled to provide funding for public transportation and maintain the system during the 1950's to the 60's, the budget for highways and roads at this time was unrestrained. Road construction and planning became the largest benefactor of provincial spending in the 1950's.[25] This freedom to spend unlimited budgets on roads enabled regional and local development in the Toronto area to become heavily influenced and shaped by the automobile and its newly constructed supporting infrastructure. This expansive network

1959 EXPRESSWAYS

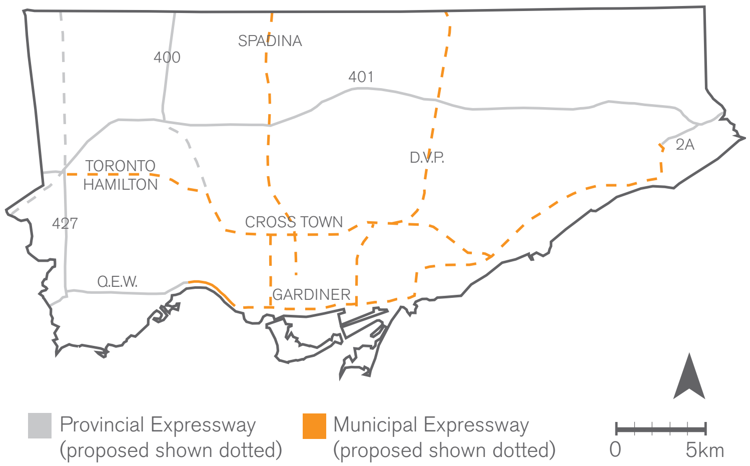


Fig.1.18 The provincial government funded the majority of all Superhighways to date, the cost to operate and construct these highways are never picked up by the municipalities that depended on them.

of roads and highways allowed suburban commuter traffic to move freely between their home and place of work along the newly completed Highway 401. Development proceeded accordingly, quickly jamming the highways with bumper-to-bumper traffic and creating the now ubiquitous rush hour traffic jam.

In 1959, Metro staff produced the Official Plan for the Toronto area. The plan shows the recently completed and operating superhighways 400 and 401, as well as the locations for future expansion projects Highway 403, 404, and 407.[26] The newly proposed network of highways were established and designed by planners years before developers had even purchased the land and lobbied for development approvals or servicing, causing the design of the closed loop network to be outdated before it was even constructed. Highway 401 had now become one of the world's busiest highways: though initially designed in the late 1940's to provide low-volume, trans-provincial connections well north of the city, by 1960 the highway became grossly congested. The mania for the automobile went even further. Metro built Highway 427 in the early 60's, west of the downtown, to provide access between the QEW and 401 and as a secondary route to Barrie. Just east of the downtown, The Don Valley Parkway, built in the early 60's according to routes that were laid out almost a decade prior to its construction, extended a decade later north into York Region as Highway 404. Parallel to and well north of the 401, Highway 407 had been planned since the 50's, even though construction started in 1987.[27] In a matter of decades, Toronto had become a city surrounded by a grid of expensive superhighways, none of whose costs were borne by the communities that relied upon them. No matter how much money the provincial government poured into highway construction, it would never be enough, since the promise to relieve congestion would never be realized as long as the city depends on a single mode of transit to provide its mobility.

ATTEMPS TO EQUALIZE MOBILITY

In 1964, the provincial government established the Metropolitan Toronto and

1966 EXPRESSWAYS

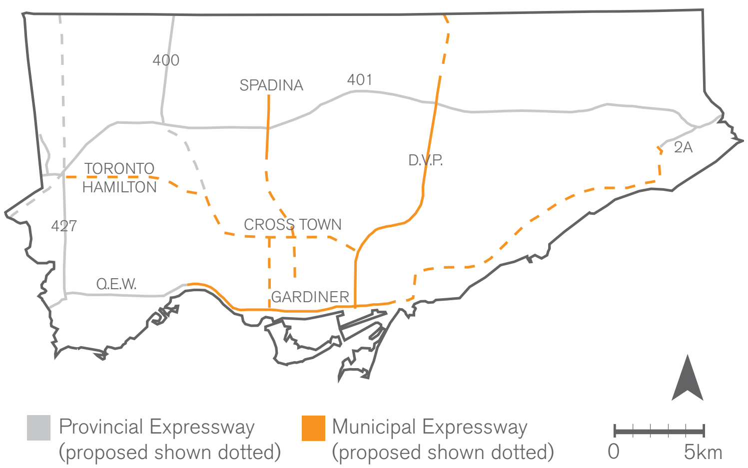


Fig.1.19 By 1966 the City of Toronto's highway network is beginning to resemble the 1943 Master Plan.

Region Transportation Study (MTARTS) to review transportation data and propose alternate transportation options for the city.[28] However, no sooner had this study begun when Minister of Highways Charles MacNaughton announced that Highway 401 would be expanding into an express/collector system within the Toronto area, with a total of twelve lanes – six in either direction.[29] The MTARTS study clearly stated that "large and expensive roadways were not resolving transportation problems in the Toronto area,"[30] and that the automobile is not the only answer to the city's transportation needs. The committee strongly suggested that the city incorporate multiple modes of transit within the existing insular network to provide additional mobility options for commuting within the congested city. After two years of study the committee proposed that a commuter rail system be put in place. In order to make the proposal economically feasible, the committee suggested that the city rent existing CNR tracks.[31] This proposed system of transit would link Toronto's financial core to the growing bedroom communities of the city, thereby making the suburbs viable yet again.

Once the GO Transit's commuter rail system opened in 1967, its ridership quickly grew from four million in 1969 to 12.7 million in 1977, increasing again to twenty-five million in 1985.[32] The new commuter rail network expanded from an initial 145 kilometres to a 1448 kilometre system of bus and rail transit in just twenty years. The provincial government paid the entire capital cost and much of the operating costs of GO Transit, since passenger demand could not justify the commuter rail network. By 1978, the province subsidized $2.30 of every average $5.21 fare.[33] GO's ridership growth patterns shared a similar fate to the TTC's as both modes of transportation relied on low-density suburbs for their revenues. Although the TTC and GO both depend on bedroom communities for their profits, the scale of the two operations greatly differ, since the TTC only carries passengers an average of three kilometres; GO Transit carries passengers five and six times that distance.[34] Both TTC and GO Transit are at a huge disadvantage to the personal automobile and have a tough task of

GO TRANSIT

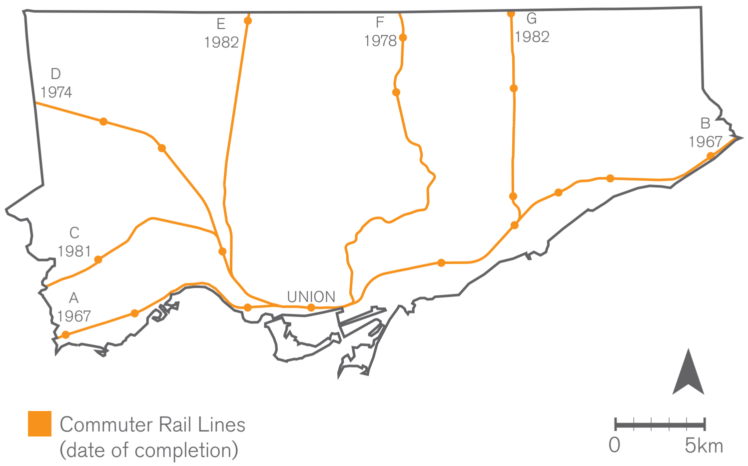


Fig.1.20 The first commuter rail line is opend in 1967, line A (Hamilton) to B (Oshawa); the second C (Milton); third D (Georgetown); fourth E (Barrie); fifth F (Richmond Hill); lastly G (Lincolnville).

1985 SUBWAY PLAN

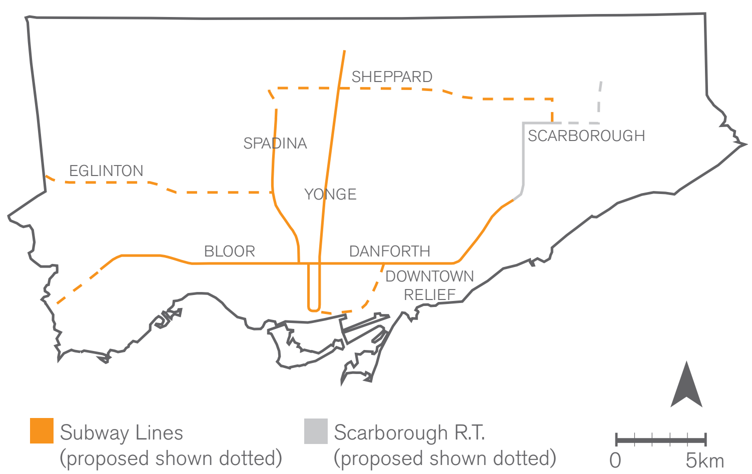


Fig.1.21 In 1978 the Spadina line opened from St. George to Wilson station and in 1985 the Scarborough Rapid Transit line opened.

ever competing with such a dominant mode of transportation since sprawling suburban land forms have created a system that is uneconomical for municipal agencies to provide affordable and timely service.

Soon after GO Transit became established as a commuter system in 1965, the provincial government decided to focus its energy and funding on reshaping the TTC services from a local transit network into a regional commuting service. With additional funding and support from the province, the TTC became a worldwide transportation showcase, receiving awards in the 1970's and 80's for its safety and design.[35] These were the golden years of Toronto public transit; with over 324 million riders a year, the TTC experienced a surplus of $1.9 million dollars annually.[36] Unfortunately, the 1990's provided the TTC with a series of hardships from which it would never fully recover. Political indecisiveness slowed subway developments to a halt, severe recession-era budget cuts (up to two-thirds of transit funding), and the inability to service the still voracious areas outside of Toronto caused the TTC's ridership to drop by twenty percent and forced operators to limit their service instead of investing in new transit infrastructure. TTC and GO faced even more hardships once Mike Harris's Progressive Conservative Party came to power in June 1995. Premier Harris and his supporting government disliked the public sector and thought that the best way for the province to recover from the recession was to reduce pubic expenditures, including public transit.[37] Harris quickly cancelled all provincial transit funding and declared that the province was no longer financially responsible for GO subsidies. Why, Harris asked, "[…]should homeowners in North Bay pay extra income tax just to help someone in Toronto take the subway to work?"[38]

In the years after Harris slashed transit funding, the TTC racked up hundreds of millions of dollars of debt that had to be carried by the municipal government. In 1998, the TTC's deficit amounted to $175 million due to low ridership and reduced service.[39] Between 1989 and 2001, fares doubled to help pay for operational costs. At this time the TTC was the only major transit system in the world that did not receive subsidies from senior levels of government.[40] Despite overwhelming evidence that something was seriously amiss with the City of Toronto's transportation system, the federal government as of 2001 had no national transit strategy, setting it apart from virtually every other industrialized nation.[41]

REPEATING COSTLY MISTAKES

During the late 1990's, Toronto mayor Mel Lastman misguidedly persuaded his political supporters to fund a one billion dollar subway expansion along a suburban arterial road that terminated at a shopping centre after just four stops.[42] Transit planners highly recommended that the mayor consider relocating the route to a denser location in the city, however their efforts were in vain as both the municipal and provincial leaders chose the politically expedient route. Toronto journalist John Lorinc, who specializes in urban affairs, comments in his book *The New City* that the city ended up "[…] constructing a subway to nowhere."[43] Lorinc also points out that pricy new rapid transit lines soaked up large amounts of public funding without necessarily improving service.[44] Once the new Sheppard Subway line opened in 2002, it became widely recognized as an expensive failure, since city transit planner's predictions of high operating costs and low ridership quickly became reality. Toronto's public transportation history seems to be continuously repeating its past mistakes, rather than learning from them, as both private and public transit networks are still servicing low-density regions of the city and encouraging more sprawl by increasing their access to the downtown. Public transit was originally established in the City of Toronto to increase personal mobility, however since opening in 1921 TTC has paradoxically enabled sprawl, which has created higher commute times and congestion in the city. The effect that the automobile has on the city is a closed circle: automobiles encourage low densities, and low population densities require automobiles. It is a never-ending cycle that more construction cannot fix.[45]

2003 DENSITY, CAR OWNERSHIP + DRIVING PATTERNS

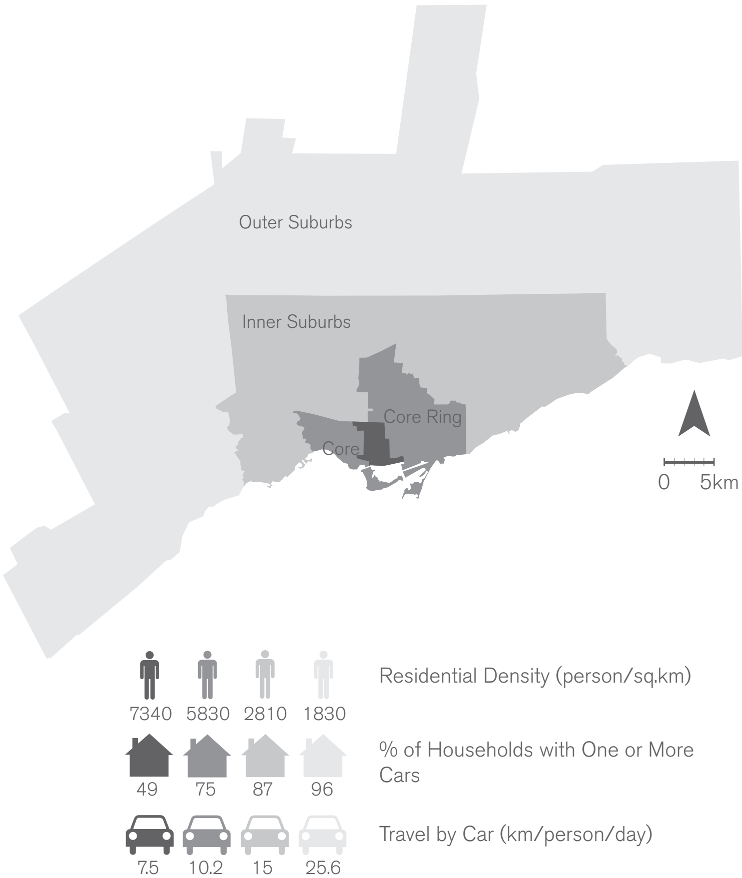


Fig.1.22 Torontonians that live in the outer suburbs of the city have the lowest population densities, highest percentage of households that own one or more cars, and travel the longest by car daily.

While transit took a hit in the 1990's, there is no shortage of new highway projects being proposed and built within the City of Toronto. After the provincial government downloaded all transit subsidies onto municipalities, the province invested newly freed-up financial resources into further developing regional highway expansion projects, which were often a reward for political support in the suburbs. As superhighway projects continued to be proposed, Region of York officials revealed the harsh reality and by-products of the enduring transportation crisis:

> If commuters continue to use their cars to get to work at the same rate they currently do, then by 2021 there will be a need for one hundred additional arterial lanes constructed along corridor roads. Automobile emissions in the form of carbon monoxide, carbon dioxides, volatile organic compounds and dust will be spread across all of Southern Ontario.[46]

These warning to the province were not heard. The provincial government continued to move their master plan forward, ensuring that ninety percent of the province's population lived within a ten-kilometre radius to a major highway corridor.[47] Automobile congestion and spending to support infrastructural demands climbed to an all time high at the turn of the millennium, creating even more uncontrolled sprawl, reducing its citizen's transportation means, and thereby decreasing efficiency. Highways became dangerously clogged with traffic while GO Transit and the TTC were similarly operating at capacity during rush hour. This increase in traffic congestion prompted a group of social and environmental groups to advocate both the quality of life and social equality issues to politicians. Central to this political reform movement is a growing awareness of the detrimental health, social, and environmental effects associated with automobile use and the effects of urban sprawl.[48] The results of this movement helped to re-emerge the bicycle as an integral part of the city's transportation system through the development of the 1999 Bike Plan. The

2009 SUBWAY PLAN

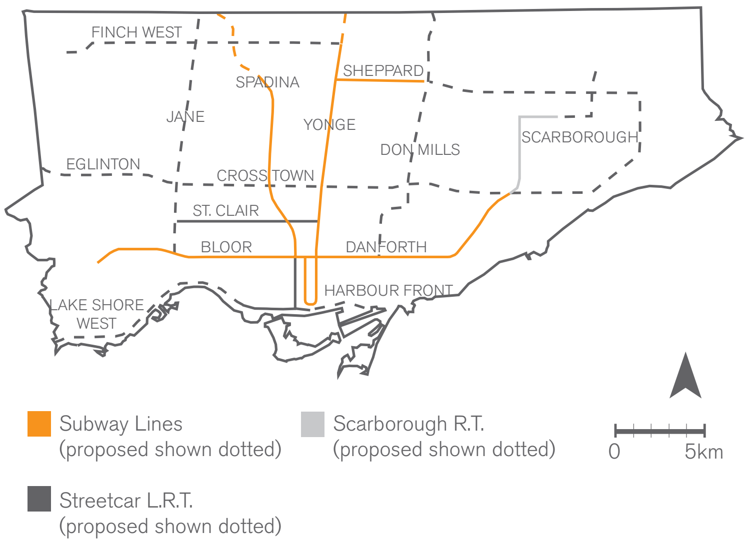


Fig. 1.23 In 1997 the Spadina streetcar LRT opened and in 2002 the Sheppard line opened from Yonge to Don Mills.

plan committed to developing one thousand kilometers of bicycle infrastructure within the next ten years; unfortunately the city never would meet their modest yearly construction goals, causing the visions of the Bike Plan to never be fully realized.

As warnings from top officials and planning departments filled the desks of both the municipal and provincial governments, highways continued to be built and existing roads expanded to accommodate the exploding number of personal automobiles in the city, until the new McGuinty government grabbed the attention of politicians with its strategy for infrastructure investment in the document *ReNew Ontario, 2005-2010*. The document depicts the server long-term effects that congestion and gridlock will have on the City of Toronto's yearly budget as well as the effect that commute times and vehicle emissions will have on the city unless investment in alternate modes of transportation occur.[49] The document states that:

> Delays caused by gridlock and congestion in the Greater Toronto Area cost the economy about two billion dollars per year in lost time and lost productivity. According to the Toronto Board of Trade, the cost of congestion in the Greater Toronto Area, if left unchecked, will exceed three billion dollars per year by 2020. If current development patterns continue and rates of investment in public transit do not increase, commute times may increase by as much as forty-five percent in southern Ontario; emissions from vehicle may increase by forty-two percent.[50]

The grim picture of the city that the document depicted resonated in the minds of city politicians and led to new initiatives for public transit. However, with the government's commitment to extend the Spadina Subway line north to York University, it became clear that the city had not learned from past expansion failures nor listened to new infrastructure reports. The York University line once again aimed to extend public transit through low-density suburbs that

2009 EXPRESSWAYS

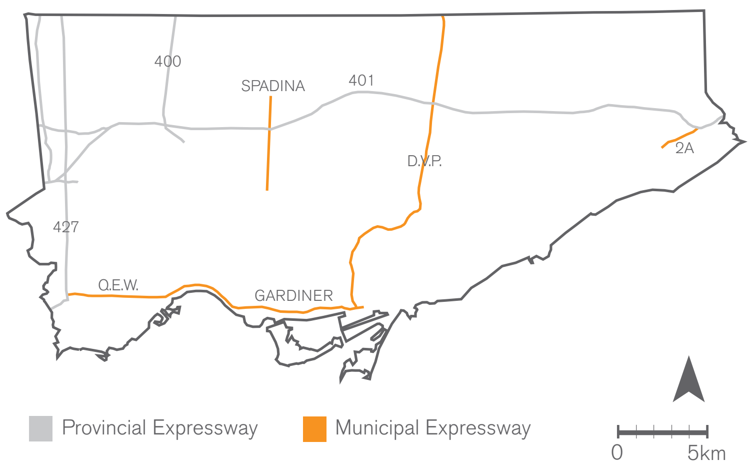


Fig.1.24 In 2007 71.1% of all Toronto's commuters drove to work alone in a car, causing national commuting times and congestion to skyrocket.

were predicted to carry less people per day than a minor bus route in the city centre.[51] The report dishearteningly supports even more roadway and highway expansion projects that were proposed by the Harris government years earlier. The infrastructure strategy plans for new highway corridors including the Niagara-GTA corridor, the completion of Highway 407 east, and (northerly) extensions of Highways 404 and 427. The superhighways strategy also proposed that Highways 403, 404, and the Queen Elizabeth Way receive high occupancy lanes – that is, lanes reserved for cars that are carrying two or more people.[52] These lanes are built to increase capacity for vehicles and decrease congestion during rush hours, but require the highway to be widened. As more roads are proposed and existing ones expanded, more land is being allotted to automobile infrastructure and pressure placed on adjacent land since it is easily accessible to the superhighway network. These proposed highways are identical to the superhighways that the provincial government has been building for over fifty years.

As Sewell argues in *The Shape of the Suburbs*, the City of Toronto has apparently learned little from the failures of the past to control sprawl. The city has over fifty years of proof that building more highway capacity will not relieve traffic congestion; rather, it will only increase sprawl and therefore increase traffic congestion over time. The city needs to get to the source of the problem - the over reliance on a single mode of transit - and realize that in order to reduce over dependency on the automobile, additional modes of mobility must be created to help alleviate congestion. Alternative mobility options must have the ability to negotiate through the existing automobile dominated urban form, while linking with existing public transit routes to help increase ridership. Jane Jacobs points out in her book, *The Death and Life of Great American Cities*, that planning and design professions are still approaching the transportation problem with old world view and dated values:

> Today's plans show little if any perceptible progress in comparison with plans devised a generation ago. In

Fig.1.25 (Left) The Wiwili Bridge in Freiburg Germany ca. 1960. Both lanes are reserved for motor vehicles. (Right) The Wiwili Bridge today. Motor vehicles are banned from the bridge allowing bicyles have the right of way over the entire width of the roadway.

> transportation, either regional or local, nothing is offered which was not already offered and popularized in 1938 in the General Motors diorama at the New York World's Fair, and before that by Le Corbusier. In some resects, there is outright retrogression […][53]

Although the statement above addressed the design profession in the 1960's, it remains relevant to Toronto's current transportation decisions that are governed by out dated auto-centric views. The City of Toronto will continue to sprawl if its transportation funding and ideology remains the same. A city that once received awards for its modern advancement in the public transit sector now watches its own system decay before its eyes, taking a back seat decade after decade to car culture and its growing infrastructure.

GLOBAL TRANSPORTATION LEADERS

In recent years a handful of cities in North America and in Europe have recognized the need to improve the social, environmental, and economic impacts of transportation. Yet most cities are far from achieving this goal, especially Toronto. The Netherlands, Denmark, and Germany are all countries that took a stance during the energy crisis of 1973 by creating and implementing car-restrictive, land use, urban development, and transport policies. Germany offers the strongest comparison to Canada as both countries have a federal system of government, competitive economies, high standards of living, important automobile industries, high levels of car ownership, and extensive roads networks. With so many similarities, how did Germany become a front-runner in the environmental and transportation debate and Canadian cities like Toronto get left in the dark? How is Toronto still permitted to expand and construct highways when similar cities in Europe have found a way to successfully balance the need for personal mobility, the environment, and the health of their cities that do not involve the expansion of roads and highways?

Germany's transportation, land use, and urban development policies have not

Fig.1.26 Muensterplatz in the 1960's prior to the countries car-restriction policies.

Fig.1.27 Muensterplatz in 2000 is now a car-free zone.

always been as sustainable as they currently are. Between the 1950's and 60's the country aimed at adapting to the growing number of automobiles by vastly expanding roadways, highways, and parking facilities. As car use and ownership increased, roads and highways were becoming severely congested at peak periods and causing traffic fatalities to escalate sharply. Rising car traffic also increased noise and air pollution, which caused the quality of life in many neighbourhoods to suffer. These negative side effects of the automobile triggered a grassroots revolt, which resulted in the creation of many of the progressive transportation and land use policies that Germany has today.[54] As Assistant Professor of Urban Affairs and Planning, Ralph Buehler, writes in the article *Sustainable Transport that Works: Lessons from Germany*, this newly progressive attitude towards transportation planning was "stimulated further by the energy crisis of 1973, [and] car-restrictive policies gradually became more widespread and better coordinated throughout the rest of the 1970's and continued to expand in successive decades."[55] Buehler further explains that Germany's success in transportation mobility is based upon five simple categories of government policies: taxes and restrictions on car use, attractively priced and well coordinated public transport services, urban development and land planning policies that encourage compact and mixed-use development, infrastructure for non-motorized travel that is safe and convenient, and lastly, all of these policies have been fully coordinated to ensure their mutually reinforcing impact.[56]

Car-restrictive policies have not hindered the county's automobile industry as Germany's car ownership has increased faster from 1950 to 2006 than all North American cities.[57] Although Germany has high car ownership rates, their use per capita in 2005 was less than half the use in North America. Germans drive less since the overall cost of owning and operating an automobile is about fifty percent higher than in North America due to high taxes and fees on car ownership, usage, and petroleum.[58] Highways in Germany also differ from North American cities as the country has less high-speed roads penetrating the centres of its cities, even as Germany boasts the fastest and third largest highway network in the world. Car use is further restricted by designing the layout of roads within cities with deliberate dead-ends, turn restrictions, one-way streets, no-car zones, and low speed limits in residential areas that require cars to travel at a *walking speed* of seven kilometers per hour.[59] Germany did not implement restrictive car policies on its citizens until the country had a high quality public transit alternative that included the development of convenient walking and cycling facilities. The country's public transit services are more successful than those in North America since they have higher passenger fare revenues and lower operating costs due to the fact that they have new equipment and can seat more passengers per bus, tram, metro, and train. Public transit in Germany is coordinated by one federal government sector - there is no regional or municipal government in control - which enables the country's transit planners to fully coordinate all schedules, routes and fares. This promotes transit as more convenient, financially viable, and faster than the automobile. Transit planners in Germany have also integrated both walking and cycling into transportation infrastructure planning, and since the 1970's the program is funded at both the municipal and state level.[60] Cooperation and funding from all levels of government is key to the bicycles' success in Germany: the country currently boasts some of the highest cycling levels in the world due to intense integration with public transit, complete infrastructural design that increases safety, and widespread marketing to encourage lifestyle changes.

Germany's achievements in restricting car use and implementing advanced transit planning would never have been possible had it not been for the country's ability to have all three levels of government interact in a bottom-up and top-down land-use planning process based on cooperation, compromise, and mediation.[61] This cooperation has enabled the country to balance high levels of car ownership with safe, convenient, and affordable public transit that includes advanced cycling and walking facilities. Germany's success offers a valuable model in which automobiles can peacefully co-exist with other modes of active

Fig.1.28 Queen Street transit choices.

and environmentally friendly transportation, provided that car-restrictive policies are adopted where mobility situations become problematic and alternative transportation options are provided prior to policy implementation. The German government was able to overcome a powerful car lobby and the automobile's immense popularity among German consumers to put into place all the necessary transit, land use, and taxation policies to bring their country to the forefront of contemporary urban mobility and environmental design. Germany's success suggests that the most feasible way to allow alternative transportation options to grow in a vehicular city is to manage the automobile, not eliminate it.

It is imperative that the City of Toronto fosters a genuine competition between different modes of transportation (the automobile, GO Transit, TTC, and cycling) while emphasizing sensible land use policies. In order to increase current and future mobility through the city and re-engage people with their urban space and cultural networks. A new approach to transportation planning must be proposed in the near future, one that moves away from supporting a single mode of mobility to support the integration of multi-modal and environmentally sound modes of transportation that have the ability to pair with existing infrastructure, while creating real opportunity for increased personal mobility in the City of Toronto.

02 SELF PROPELLED TRANSIT

> *"Cycle tracks will abound in Utopia."*
> H. G. Wells, *A Modern Utopia*

Facing page:
Fig.2.1 Parked bicycles.

2.1 GEOGRAPHICALLY LIBERATING MACHINES

If sustainable transportation is defined as "transport that meets the needs of the present without compromising the ability of the future generations to meet their own needs,"[1] it is evident that our current over-reliance on an automobile based network will continue to act as a detriment to the current and future generation's mobility requirements.

In 2007, global production of the bicycle topped one hundred and thirty million, more than doubling the fifty-two million automobiles produced in the same year.[2] It is no wonder that the bicycle is so popular as a mode of transportation: it is relatively inexpensive to own and operate, requires little infrastructure, provides aerobic exercise, is non-polluting, requires little resources to manufacture, consumes a fraction of the space of a car, and has no effect on the opportunities of others and on the choices that they make.[3] Promoting cycling as a clean and efficient alternative mode of transportation is a practical way for car-dominated cities to reduce their traffic congestion while confronting the continually emerging environmental debates and mobility issues.

So why is it that most car owners use their automobiles when in many cases it would be more cost effective, sensible, and feasible to go by bicycle and public transit? How did the bicycle, a geographically liberating machine for personal mobility, become disregarded as a mode of transportation in North America, when today it is a vital part of many European cities and developing nation's transportation planning? The following chapter will investigate the major advantages and deterrents to cycling in Canadian cities as well as what implementation would need to be put into place in order to promote the bicycle as an additional and viable mode of transportation within a singular saturated modal nation.

HISTORY

The ingenuity and design of the first bicycle is a product of the Victorian era's

Fig.2.2 Early 18th century 'Draisine' style bicycle featured a breastplate, iron braces suspending the wheels from the frame, and an ornate dome over the front fork.

imagination and determination. In 1813, German baron, Karl von Drais developed one of the first horseless carriages, a mechanical four-wheeled vehicle that could be propelled forward by working a cranked axel with the legs of one of its passengers, while another rider steered the machine by means of a tiller.[4] Drais's design was seen as an oversized, awkward failure by his peers. Years later Drais proposed a radically different solution that would liberate people from years of depending on horses for mobility by developing the "Lauf-Maschine" (running machine), later known as a "Draisine" or "Velocipede" (meaning fast foot in Latin).[5] In 1817, Drais exhibited the first human-powered land vehicle that would later become the most significant contribution to the design of a pedal-powered and compact basic bicycle. The rider of the Draisine sat erect and propelled the machine forward by pushing off the ground as if they were walking or running. This new machine accelerates the natural act of walking and running while allowing the rider to cover greater distances with less effort than a pedestrian.[6] Drais's early bicycle design paved the way for three phases of technical developments of the bicycle: the 1860's 'Boneshaker' era, the mid-1870's 'Highwheeler' era, and the 'Safety' bicycle of the 1890's.[7] By the end of the nineteenth century nearly all the essential features that a contemporary bicycle is comprised of had already been developed; the low-mount profile, wheels of equal size, rear-wheel drive powered by a chain, and inflatable rubber tires.[8]

The first Velocipede brought excitement and new possibility when they arrived in North American cities in the late 1800's.[9] At this time personal transportation is limited to the distance that a horse is capable of travelling in a day. The advent of the bicycle transformed the way that personal mobility is viewed, as the bicycle became the first geographically liberating machine that was affordable to the common man. Bicycles allowed their riders to be in even more control than when riding a horse, it did not tire, nor did it require rest and water. Cyclists are able to go wherever they wished and at their own pace, they did not have to follow rail lines, schedules, and fixed stopping points that trains

Fig.2.3 A wooden prototype of a diagonal-frame bicycle during the 'Boneshaker' era of the 1860's.

Fig.2.4 The Humber 'Safety' bicycle of 1884 had nearly all of the features of a contemporary machine: low-mount profile, rear wheel drive powered by a chain, and inflatable rubber tires.

and streetcars are subjected to. On a bicycle, the rider has the liberty to travel along almost any right of way, stopping and turning at their leisure, allowing the bicycle to become a self-limiting mobility machine, molding places together by creating a new relationship between time and space.

The ability of the bicycle to transverse land that was previously too rough to pass by carriage and over distances that had formerly been unthinkable is the single most important impact that the bicycle had in Canadian cities.[10] This new democratic machine promised affordable personal transportation and a healthy recreational outlet to all citizens, allowing the bicycle to become an appealing personal vehicle to all social classes:

> [...] to youths it gave speed; to women, freedom; and to many ordinary citizens it was simply a source of great pleasure and utility. To all it offered exercise and adventure. On the open road, cyclists found tranquility, fresh air, good exercise, and even fellowship. For many, the bicycle was truly an eye-opener. Whether used along or in conjunction with the local train network, it enabled the rider to reach and experience new landscapes and towns.[11]

Not all critics and users supported the bicycle. Many felt the bicycle would become a fad, since the first 'Safety' bicycles cost about one hundred and fifty dollars – well beyond the means of the average workers salary who made around twelve dollars per week.[12] In Canada, cycling had a larger influence on social modernity through class relations since the cost of owning a bicycle could only be afforded mainly by the Anglo elite, causing the bicycle to become a highly visible signifier of status.[13] However, the bicycle boom in the early part of the twentieth century brought the price of owning a bicycle down significantly allowing all social classes the opportunity to own and operate a bicycle. The bicycle had completed its transition from a "rich man's toy to a poor man's carriage" proving that this geographically liberating machine was indispensable.[14] The bicycle not only launched improvements on roads and production

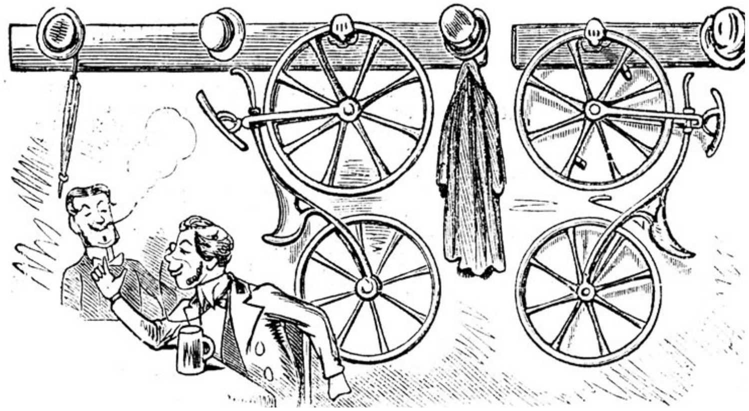


Fig.2.5 An Austrian caricature from the boneshaker era already envisioned a practical role for the bicyle in everyday life, 1869.

methods (which provided the early foundations of the automobile industry) but also made a substantial impact on geographical consumption patterns, while increasing the desire to obtain personal mobility.

The bicycle boom in North America would be short lived. In 1898, cycling quickly declined in Canadian cities due to the advent of the motor vehicle.[15] The automobile's cutting edge technology quickly obliterated the bicycle's appeal by increasing the rider's mobility past the capabilities of the bicycle while remaining affordable to the average worker. Although the use and popularity of the bicycle in North America re-emerged during World War Two (since production of the personal automobile was temporarily suspended) it quickly declined once again after the war. In spite of the travails of the bicycle industry following World War Two, cycling usage continued to increase in European countries and in developing nations as these countries continued to rely on the bicycle to provide safe, efficient, and inexpensive transport to its citizens.[16] Although the bicycle in North America would never dominate the roads as it did during the last quarter of the nineteenth century, the bicycle remains credited with offering cities"[…] new and compelling opportunities for technical and commercial development," while being regarded as "[…] one of the great technical and social contributions of the Victorian age."[17]

To date, Canadians have never made use of the bicycle as a mode of transport to the same degree that most major European cities have. Owing partly to the fact that Canadian's have relied on the personal automobile to be their main source of mobility for decades, which encouraged urban sprawl and city centres to spread out in great distances, and partly due to the fact that Canadians have been enamored with the automobile and mobility since the early twentieth century.[18] These influences have led to the limited practical use of the bicycle in Canada and a built up ignorance toward the advantages of this modern self-powered form of transport. As Canada's population and congestion caused by automobile traffic increases, the country continually moves further and further away from their commitment to the Kyoto Protocol of reducing the country's GHG (Green house gas) emissions by six percent by 2012.[19] Canadian transportation policies and practices are currently not headed in the right direction, since from 1990 to 2002 GHG emissions from transportation sources increased by twenty-four percent.[20] If Canada is serious about reducing pollution caused by the over reliance on the private automobile they must consider the benefits of the bicycle and fund its supporting infrastructure.

ADVANTAGES

Since over a fourth of all trips in Canadian cities are less than 3.2 kilometres in length, a distance that can be easily covered by the bicycle, there is obvious potential for the bicycle to decrease the country's dependency on the automobile while reducing GHG emissions among other benefits.[21] The bicycle is the most sustainable and benign form of transport as it omits no air or noise pollution, consumes far less non-renewable resources than any motorized transportation, is non-polluting, and non-threatening to most other road users.[22] Moreover, the only energy cycling requires is provided by the user and in turn the user benefits from cardiovascular exercise and the freedom of independent mobility. Urban space can be more efficiently used in city centres since cycling requires only a fraction of the roadway and parking spaces that an automobile currently consumes, this reduction in space requirements would also aid in alleviating growing traffic congestion in city centres.[23] Cycling is also an economic mode of transport for both the direct user and to the city as public infrastructure and the costs associated to the bicycle are significantly less than the automobile. This enables the bicycle to be the most equitable mode of transit since it is affordable by virtually everyone and is easy to operate. In short, the bicycle is the most environmentally, socially, and economically sustainable mode of transport.[24] With all of these benefits, why then does bicycle levels in Canadian cities remain so low?

COMPARING PER PERSON TRAVEL SPACE NEEDS

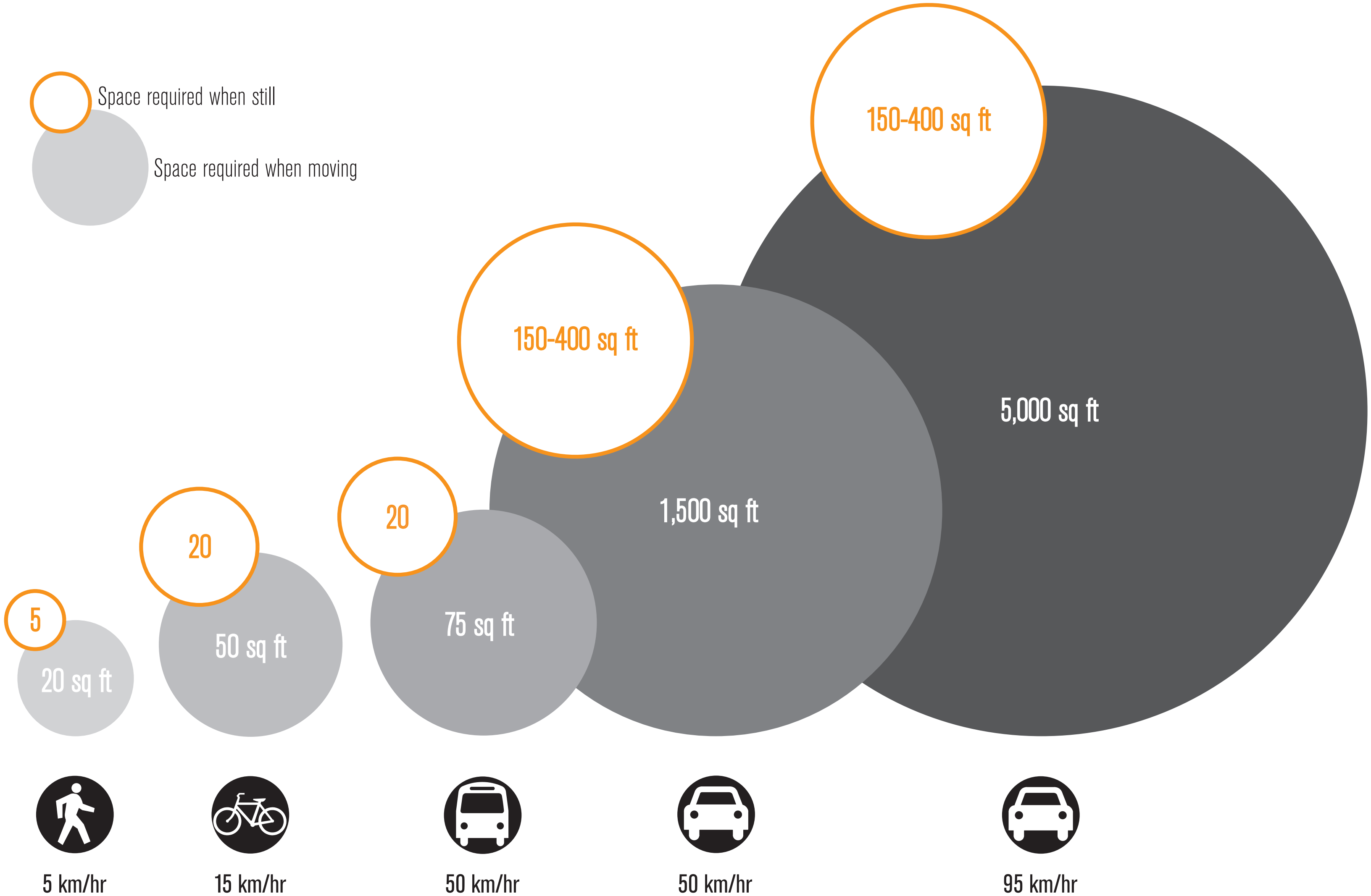


Fig.2.6 A car's footprint when still ranges from 150 to 400 square feet. A human's footprint standing is at most 5 square feet, and a cyclist or bus passenger takes only 20 square feet. To hold the single unmoving person, a car needs 30-80 times the amount of space as a pedestrian, and up to 20 times the space of a cyclist or transit user. Due to a cars size and speed, when travelling it consumes the greatest amount of space. A car travelling at 50km/hr requires 1,500 square feet of space per vehicle, and 5,000 square feet of space for 100km/hr. Pedestrians only require 20 square feet when travelling, 50 for a cyclist, and 75 for a public bus passenger. As a car increases its speed the amount of space it requires grows exponentially.

PARKING SPACE

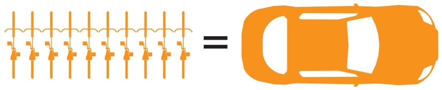


Fig.2.7 Ten bicycles can be parked in the space of one automobile, and if stacked, the bicycle parking ratio would be 20:1.

TRANSPORTATION COSTS

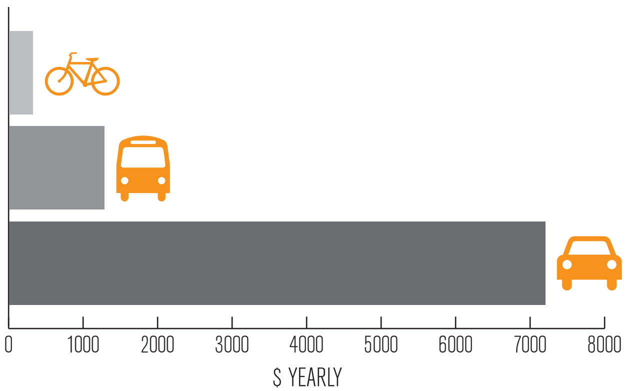


Fig.2.8 The bicycle costs a fraction of the amount that a car would to own and operate per year, after the initial purchase of the bicycle, the costs would decrease significantly.

COSTS TO BUILD AND MAINTAIN PARKING

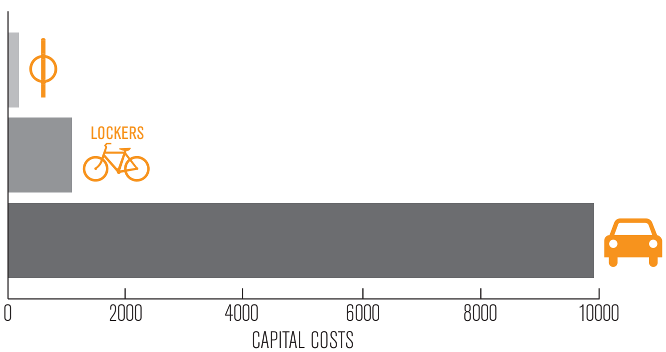


Fig.2.9 Post and ring bicycle parking costs only $125 to install and maintain, bicycle storage costs $1000 to install and maintain, and one space in a parking garage costs a vast $10,000 to construct and maintain.

DETERANCE

There are many factors that have effected and continue to affect the bicycles success in Canada. Bicycle trips only accounted for an average of 1.2 percent of all commuting trips in the country in 2001 this low ridership is largely due to the lack of funding and involvement by both the federal and provincial governments.[25] Both levels of government have neglected cycling as a serious mode of transport as the federal government has no involvement in the funding or planning of any cycling related initiatives, the majority of the provinces have only minor roles. Virtually all planning and funding of bicycle related networks are left for the municipalities to co-ordinate and pay for, especially cities within Ontario.[26] Urban Planning Professor, John Pucher, and Ralph Buehler, an Assistant Professor of Urban Affairs and Planning write in the article, *Cycling Trends and Policies in Canadian Cities,* that perhaps the most important challenge that Canadian cities must overcome in order for cycling to be successful is how to integrate the bicycle amongst low-density, sprawling suburbs:

> Such sprawling suburban developments are almost entirely car-oriented, with segregated land use patterns, excessively long trip distances, and an almost complete absence of facilities for cycling. Cycling is concentrated in the denser urban core, with the bike share of travel steadily declining with increased distance from the center. The strong trend toward suburbanization of both population and jobs in Canada works against efforts to promote cycling.[27]

The lack of automobile restrictive policies in Canada on gasoline prices, motor vehicle registration fees, sale taxes on cars, roadway tolls, and parking prices have allowed the automobile to dominate transportation land use policies and promote sprawling neighborhoods where cycling is not a viable mode of transport due to unrealistic travel distances.[28] By imposing traffic calming of residential neighbourhoods, car free zones, and parking restriction on the automobile, Canadian cities would then be able to refocus their energy and funding on coordinating the integration of public transit networks with those of cycling.

EFFICIENCY

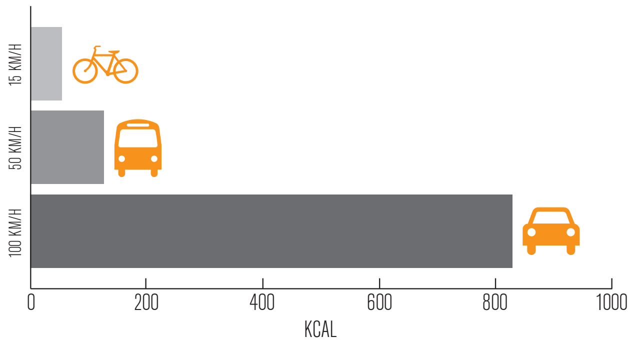


Fig.2.10 Bicycles transfer 90% of your energy into movement. Cars transform 25% of the energy it receives into movement. The energy used to travel one kilometer on a bicycle would move a car twenty metres.

MANUFACTURING RESOURCES

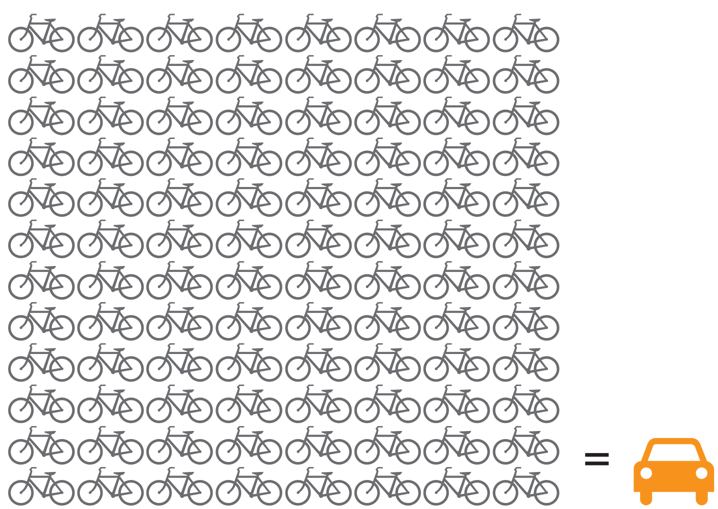


Fig.2.11 The energy and resources required to build one car could be used to manufacture ninety-six bicycles.

This collaboration would allow cycling networks to act as a feeder and distribution network to existing transit hubs in order to provide sustainable transportation to low-density, sprawling neighbourhoods.

Pucher and Buehler view all Canadian cities cycling facilities as incomprehensible and poorly integrated regional networks when compared to European cycling facilities.[29] The lack of coordination and funding from all levels of government is a serious factor that is effecting cycling levels, once coupled with underdeveloped cycling infrastructure and opportunities it becomes obvious that there are many negative factors and disadvantages associated with cycling in Canada. Insufficient cycling infrastructure such as parking facilities and separate bicycle lanes forces cyclists to share the road with automobile traffic, this often diminishes the feasibility and safety of using the bicycle as a mode of transport, especially for children, the elderly, the inexperienced, and for anyone who finds cycling in mixed traffic stressful and unpleasant.[30] There are also many psychological barriers to cycling in Canada, since public attitude and cultural difference create strong beliefs that impact transport choices. Cycling has not always been regarded as a mode of transport, but rather as something associated with childhood play and recreation.[31] Most Canadian drivers view utilitarian cycling as something you do when you can't afford to own and operate an automobile, for habitual drivers, cycling creates a poor social image. Although weather and climate are said to be major deterrents to cycling levels, many Canadian cities that experience severe winters with high levels of snow fall such as Montreal, Ottawa, and Winnipeg all boast higher levels of cycling than the City of Toronto, where winters tend to be milder.[32] If Canada is serious about overcoming the current disadvantages associated with cycling in order to reduce pollution caused by the over reliance on a single mode of transport, the private automobile. They must consider the benefits of the bicycle and commit to both coordinate and fund an extensive cycling infrastructure across the country, while implementing policies to curb low density sprawl and restrictions on automobile use age. But how can an automobile dominated

BICYCLE SHARE TRIPS IN CANADIAN CITIES

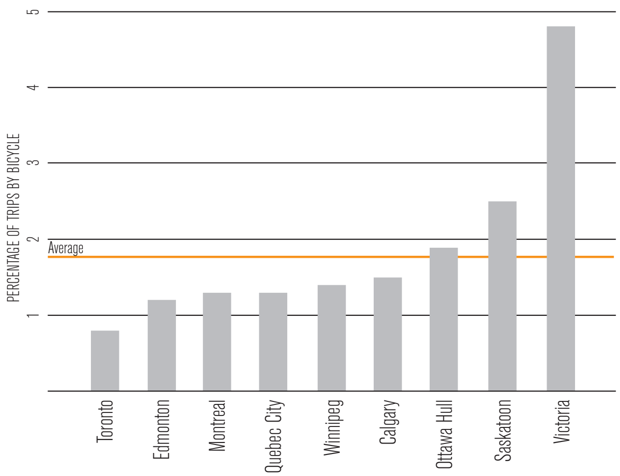


Fig.2.12 Statistics Canada 2007 bicycle share trips in chosen cities: Toronto 0.8%, Edmonton 1.2%, Montreal and Quebec City 1.3%, Winnipeg 1.4%, Calgary 1.5%, Ottawa Hull 1.9%, Saskatoon 2.5%, Victoria 4.8%.

country get started? What policies and best practices from other successful cycling countries, such as Germany, The Netherlands, and Denmark can be implemented in Canada to facilitate the bicycle as a contender in the country's current mobility debates?

CYCLING LEADERS

Dutch, Danish, and German's all share high standards of living and have rising incomes that support growing automobile ownership levels. Yet the bicycle is thriving in this environment, even when people are free to make their own mobility choices and can easily afford the automobile.[33] Buehler and Puncher both comment that the success of cycling does not depend on income or in lacking transportation options to force people onto their bicycles. But rather, its success depends on the amount of cycling polices that are coordinated to ensure cycling becomes convenient and safe.[34] The main attraction of cycling in all three country's has been "[…] the provision of separate cycling facilities along heavily travelled roads and at intersections, combined with extensive traffic calming of residential neighbourhoods,"[35] while coordinating a multi-faceted set of self-reinforcing polices. These polices were adopted by government officials to mitigate the social and environmental harm of automobiles in city centres and to provide an increase in personal mobility within a highly restrained, congested, and dense urban centre.[36]

Cycling has not always thrived as a mode of transport in the Netherlands, Denmark, and Germany. In all three countries, cycling levels dropped significantly from 1950 to 1975. Its recovery is due to a massive reversal in urban and transport planning policies following the 1973 energy crisis.[37] While history, culture, terrain, and climate are all factors that effect cycling levels, cycling success in all three country's from 1975 to current levels have all been attributed to government policies: transport, land-use, urban development, housing, environmental, taxation, and parking.[38] In sharp contrast to the lack of car-restrictive polices in Canada, cycling has prospered in the Netherlands, Germany,

BICYCLE SHARE TRIPS IN EUROPE, NORTH AMERICA + AUSTRALIA

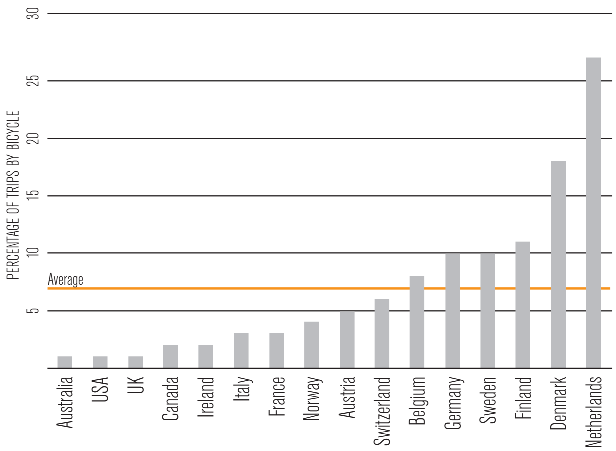


Fig.2.13 Percentage of trips made by bicycle: Australia 1%, USA 1%, UK 1%, Canada 2%, Ireland 2%, Italy 3%, France 3%, Norway 4%, Austria 5%, Switzerland 6%, Belgium 8%, Germany 10%, Sweden 10%, Finland 11%, Denmark18%, Netherlands 27%.

and Denmark over the past three decades due to harsh car restrictions. Rather than catering to the automobile by expanding highways and parking facilities like Canadian cities do, these European countries have focused their attention and funding on serving their citizens in order to create more people-friendly, livable, and sustainable cities.[39]

Not only do the Netherlands, Denmark, and Germany boast continually increasing levels of cycling, but their cyclists are comprised of all levels of age and income.[40] These vast demographics are the result of extensive cycling specific training and promotional safety programs that are run by the local level of government while being mandated and funded by higher levels. Dutch, Danish, and German children all receive safety training and cycling techniques as part of their school curriculum by the fourth grade.[41] Another crucial safety element is training motorists to be aware of cyclists and how to avoid endangering them, since non-motorist transport benefits from a propriety legal status. Traffic-calmed streets in residential neighbourhoods also help to promote cycling in all Dutch, Danish, and German cities. Some techniques include reducing the legal speed limit to thirty kilometers an hour or even to a walking speed, prohibiting through traffic, requiring automobiles to yield to non-motorized users, incorporating car free zones in city centres, or imposing a 'bicycle street' policy where cyclists are given priority over the entire width of the street.[42] Another technique that has been implemented in all three countries to increase cycling is to integrate cycling networks with existing public transit systems.[43] By providing safe and adequate amounts of parking at both train stations and throughout the city centres, these European cities have successfully allowed the bicycle to act as a feeder system for public transit, thus discouraging the automobile to be used for this leg of the trip.

With a significant portion of Canada's population now living in city centres, there is tremendous potential for all levels of the Canadian government to increase bicycle use by following classic European examples. European officials

Fig.2.14 Denmark is one of the world's most bicycle friendly nations, a tradition reflected in this poster from 1949 for the National Travel Association of Denmark.

have shown that by re-integrating the bicycle into transportation planning policies, educating both the public and drivers on cycling benefits and safety, and discouraging driving with restrictions and taxes on automobile ownership and parking, governments can greatly enhance bicycle use, while alleviating urban congestion and pollution to help create more livable cities. The integration of cycling into Canada's current transportation system requires a change in both the planning and design of our roads and urban space. It is simply a matter of providing equal consideration to all modes of transportation instead of giving priority to a single mode of mobility (the automobile) and its supporting infrastructure.


CITY OF TORONTO
LOCK BICYCLE TO POST

"Every time I see an adult on a bicycle, I no longer despair for the future of the human race."

H. G. Wells

Facing page:

Fig.2.15 Scaffolding in Yorkville absorbing post and ring bicycle parking as structural support.

2.2 TORONTO RIDES WITH TRAINING WHEELS

The bicycle is severely under used and over looked as a mode of transportation in the City of Toronto. Many trips that Torontonians currently use their personal automobiles for could easily be replaced solely by the bicycle or in combination with public transit. But how can the City of Toronto redevelop their current bicycle network with little funding and guidance from both the provincial and federal governments and when bicycle lane expansion on existing streets has become contested by many city politicians? Is it possible for a city that suffers from a lack of cycling leadership, political will, and funding to overcome both urban sprawl and a car dominated vote at city hall to become a leader in the global urban mobility debate by reallocating space within the city to the bicycle? The following chapter will examine Toronto's past and current cycling programs and the roadblocks that the *1999 Bike Plan* is currently batting in order to propose new initiatives that would promote the bicycle as an alternative mode of personal mobility in the City of Toronto.

In the *2009 Official Plan*, the City of Toronto "intends to build a transit city that will accommodate Toronto's growth while reducing car dependency."[1] The document, entitled *Building a Transit City* plans to equalize the opportunities of all modes of transportation, especially sustainable ones such as public transit, cycling and walking in order to encourage a viable alternative to the automobile.[2] The good intentions that the *Official Plan* lays out for promoting cycling have yet to be seen in the city. This causes cycling infrastructure to continually lag behind the increasing interest of cycling in the city as well as the growing number of cyclists. Prior to the release of the *Official Plan* document in 2009, the City of Toronto's *1999 Bike Plan* held the sole vision of creating a safe, comfortable, and bicycle friendly environment throughout the city for ten years.[3] The *1999 Bike Plan* committed to developing one thousand kilometres of new bicycle infrastructure, which is to be comprised of 495 kilometres of bike lanes ($20,000/kilometres), 249 kilometres of off-road paths ($255,000/kilometres), and 260 kilometres of signed routes ($2,000/kilometres).[4] The ten-year

Fig.2.16 Cycling hardships in Toronto.

initiative (approved by City Council in 2001) would cost the City of Toronto $72.8 million to construct and is projected to double the number of bicycle related trips by 2011, while decreasing the number of bicycle collisions and injuries.[5] Despite the city's initial confidence in their proposed bicycle network, 2010 marked the ninth consecutive year that the city failed to meet its modest targets of one-hundred kilometres per annum. Of the 495 kilometres of on-street bike lanes that were approved in 2001, today only one hundred and fifteen kilometers (less than a quarter of the initial goal) exist within the city streets.[6] In fact, the city removed existing bicycle routes along Spadina Avenue in 1994 as well as along St. Clair West and Queen Street West in 2004, rather than implementing a complete street approach that would balance all modes of transportation within the restrictive widths of the streets.[7]

While the City of Toronto struggles to excuse their problematic efforts of implementing bicycle lanes on city streets, during the past three years many other North American cities have successfully reintegrated cycling back into their transportation policies. Just four years ago, car related congestion in Montréal had become a nuisance not just to the downtown core, but also along adjacent bridges and highways and surrounding residential neighbourhoods. In 2007 the City of Montréal decided to confront the city's congestion problems by releasing the *2007 Transportation Plan*, which explicitly favoured alternative modes of transportation.[8] This repurposing of the bicycle allowed the city to commit to doubling its cycling infrastructure in just seven years. The City of Montréal (unlike the City of Toronto) is currently on track to meeting its yearly bicycle objectives, in 2008, eighty kilometres of new bike lanes and paths were constructed and in 2009 an additional sixty kilometres were added to the network.[9] This rapid increase of safe cycling lanes within the city helped to facilitate Canada's first automated public bicycle share system. In just eighteen months, BIXI, whose name is a combination of "bicycle" and "taxi" has been designed and installed at four hundred stations across the city. Montréal's bicycle share network provides the city with over five thousand rental bicycles,

Fig.2.17 Typical BIXI bicycle station in Montréal.

whose fare system (free for the first half hour, and $1.50 for the next, in addition to a yearly, monthly or daily subscription fee)[10] encourages utilitarian use rather than recreational. The program, which launched in the spring of 2009, has become an undeniable success. In just the first week, over 150,000 BIXI bicycles trips were made and within the first year of operation the BIXI boasted 1.14 million bicycle trips.[11]

FLAWED NETWORK

The success of Montréal's BIXI program has sparked global attention, awards, and interest from many international cities that are seeking similar success from a bicycle rental program. London, England and Washington D.C. are just a few of the cities that have incorporated the BIXI bicycle share program within their city streets. In August of 2010, former mayor of Toronto, David Miller, quickly joined these cities by proudly announcing the approval of Toronto's very own BIXI program. One thousand bicycles, located at eighty stations, no more than three hundred metres apart, are set to saturate Toronto's downtown core in the spring of 2011 and will cost ninety-five dollars for a year subscription.[12] The mayor's actions in approving the BIXI program are severely premature, as the City of Toronto has yet to provide its cyclists with an adequate grid of continuous cycling infrastructure.

A close examination of the city's initial *2001* and current *2010 Toronto Cycling Map* shows that there are currently no continuous east-west, or north-south connections throughout the city once *Shared Roadways* (signed, on-street routes) and proposed bike paths are removed. For the past ten years the City of Toronto has been supporting a cycling master plan that continues to rely on the least expensive ($2,000/kilometre) and effective form of bicycle infrastructure (signed, on-street routes) to connect the fractured network. The majority of the one-thousand kilometers of bicycle infrastructure that were initially proposed in 2001 are conveniently located along wide streets and within winding residential roads that do not encourage the bicycle as a viable mode

THE CITY OF TORONTO'S 2010 CYCLING MAP

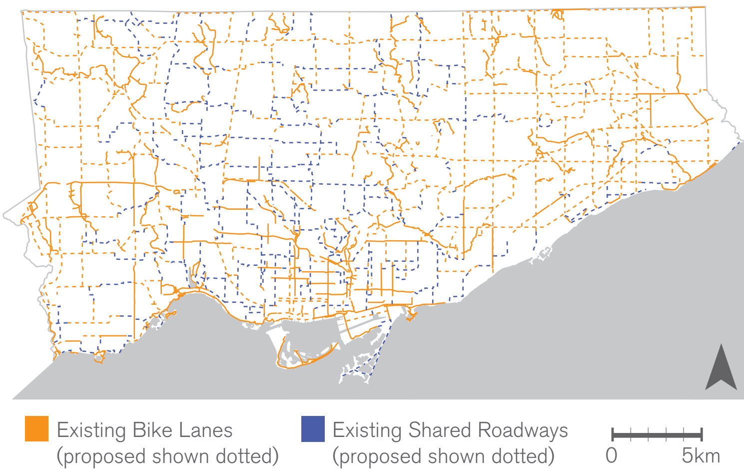


Fig.2.18 The city's proposed Bicycle Network seemingly looks complete and aggressive.

2010 TORONTO CYCLING MAP AFTER "SHARED ROADWAYS" ARE REMOVED

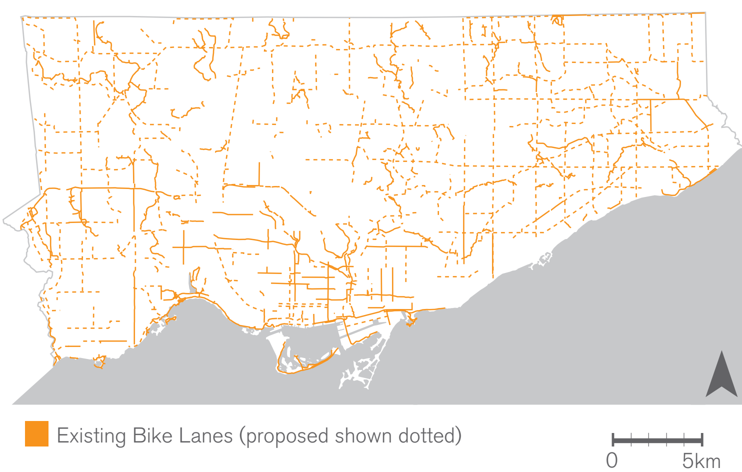


Fig.2.19 Once all existing and proposed "Shared Roadways" (signed, on-street routes) are removed (since they hardly qualify as a bike lanes) it becomes apparent that the city's bicycle network is fractured.

of transportation since these routes are indirect and therefore time consuming. Toronto's current bike plan continues to suffer from two major oversights, the first being the *lack of connection between bike lanes and existing transit stations*, which if reconfigured would allow the bicycle to act as a feeder system to public transit. The second is the bike *networks inability to enable cyclists to negotiate across existing infrastructure* such as highways, mayor roadways and intersections, and rail lines. Currently the city's solution for crossing these major transportation infrastructure points is to follow "connections" (noted in the legend of the *2010 Toronto Cycling Map* as being suggested links between off-road paths and other bikeways, or across major barriers, such as 400 series highways, this may entail travel on busy major roads)[13] routes that are timely and unrealistic. These disconnections cause cycling in the city to be viewed as unsafe and will only ever discourage new riders in the city, especially children, families and those that fear cycling on city streets that do not have properly separated bicycle lanes.

Toronto's proposed BIXI program not only suffers from a lack of continuous supporting infrastructure, primarily separated on-street bicycle lanes and safe intersection crossings, but also from the fact that the program is a purely urban and not a suburban initiative. The zone of the bicycle share network severely limits the use of the system as it is bound by Bathurst, Bloor, Jarvis, and Lakeshore in the downtown, a distance north-south of only 2.9 kilometres. Although household ownership levels for bicycles are consistent throughout Toronto (2.2 bikes/household),[14] bicycle use varies greatly throughout the city. After examining each of the city's forty-four wards transportation trends, it is clear that the city's 2006 modal split for cycling of 0.8 percent is heavily supported solely by downtown cyclists.[15] Cycling as a mode of transportation decreases significantly, while automobile use increases, as you move away from the city centre and enter the inner suburbs. This decrease in cycling is largely due to that fact that the majority of the city's bicycle infrastructure is located within the downtown core and since commuting solely by bicycle from the

2010 TORONTO CYCLING MAP AFTER PROPOSED LANES ARE REMOVED

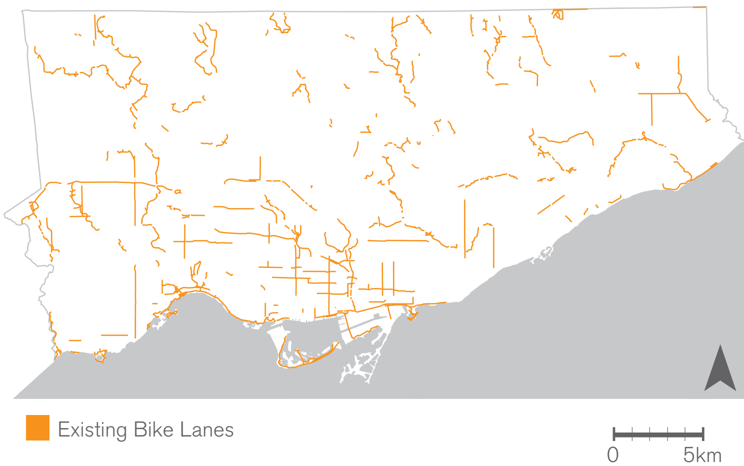


Fig.2.20 Current disconnected bicycle path network.

suburbs is currently too great a distance for the average recreational cyclist. It also would require the cyclists to ride along busy streets without the aid of bicycle lanes. By locating Toronto's BIXI program within downtown wards that currently benefit from a relatively balanced modal split, the city's suburbs will continue to suffer from a serious lack of bicycle related infrastructure and will continue to be disconnected from the city's downtown cycling facilities.

For the City of Toronto to assume that by simply replicating Montréal's BIXI program in their downtown core that they would create similar positive results prior to executing a plan to reallocate space within the city for cyclists is naive. As the BIXI program could potentially add an additional one thousand cyclists to the currently car and transit dominated downtown streets where there are currently few safe lanes for cyclists to move from potential pick up and drop off BIXI stations. Although a public bike rental program would make a significant contribution to promoting the bicycle as a viable mode of personal mobility within the City of Toronto, it is completely unrealistic and ineffective without a continuous network of supporting bicycle infrastructure that has the ability to service all wards within the city. The City of Toronto needs to refocus their attention to improving their *city-wide* cycling network prior to spending their limited funding on a public bicycle share network that would only service a restricted zone, since the city's own *Toronto Staff Report* revealed in 2005 that seventy-four percent of people are not comfortable riding bikes along city streets that do not have bicycle lanes.[16]

HISTORY OF BIKE IMPLEMENTATION

Building bicycle lanes along city streets may seem like a simple and inexpensive way to create an aggressive *city-wide* cycling network in Toronto, but it is certainly easier said then done. The City of Toronto has struggled for years alongside the Toronto Cyclists Union (founded in 2008) and Toronto City Cycling Committee (founded in 1975) among others, to promote cycling as a practical mode of transportation in the city. The first record of bicycle lane

TORONTO'S MODAL CHOICE

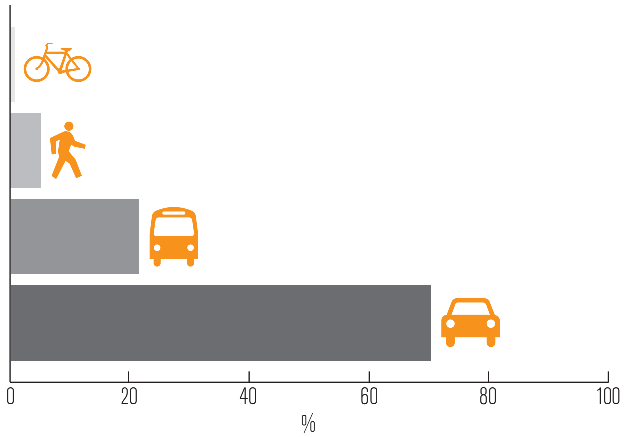


Fig.2.21 The 2006 Canadian Census showed that of the 2.4 million commuters in the metropolitan area of Toronto: 71.1% used a personal automobile to get to work, 22.2% used public transit, 5.9% walked, while only .8% cycled.

construction in the city did not occur until 1896 when Toronto City Council approved lanes along Spadina Avenue (later removed in 1994), Harbord Street and Winchester Street.[17] It was not until the late 1970's that Toronto's cycling community grew substantially due to a political reform movement led by social and environmental advocates who felt cycling would help to rebalance social equality and quality of life to the citizens of Toronto. A key ingredient to this movement, which continues to drive cycling advocacy groups today, is the "increasing public awareness of the environmental and social impacts associated with automobile use, urban sprawl and the need for change."[18] Although this movement helped to re-emerge the bicycle as an integral part of the city's transportation system, the city's efforts in developing cycling infrastructure since the late 1990's has lost significant energy and enthusiasm when compared to many other North American Cities. This plateau in the city's cycling initiatives can be seen in the results of the *2009 City of Toronto Bike Survey*, which compares the experience of cycling in the city from 1999 to 2009.[19] Although overall cycling usage levels and general satisfaction have increased over the past ten years, there remains dissatisfaction with the quality and quantity of the city's cycling infrastructure. A mere six percent increase in cycling levels from 1999 to 2009 have been attributed to the city's inability to meet projected bikeway yearly goals, leaving many recreational and utilitarian cyclists as unpleased with Toronto's cycling experience as they were a decade ago.

The city's struggle to expand on-street bicycle lanes were highlighted once again in late May of this year when City Hall fought an epic seven-and-a-half-hour battle, after weeks of debate, of whether or not car traffic on Jarvis Street should be reduced from five lanes to four to accommodate bicycle lanes.[20] The debate gained major media coverage and sparked the "war on cars" argument at city hall and resulted in the agreement that new bicycle lanes are to be installed along Jarvis Street between Charles Street in the north and end abruptly on Queen Street to the south. The completion of the approximately

WARD MODAL CHOICE

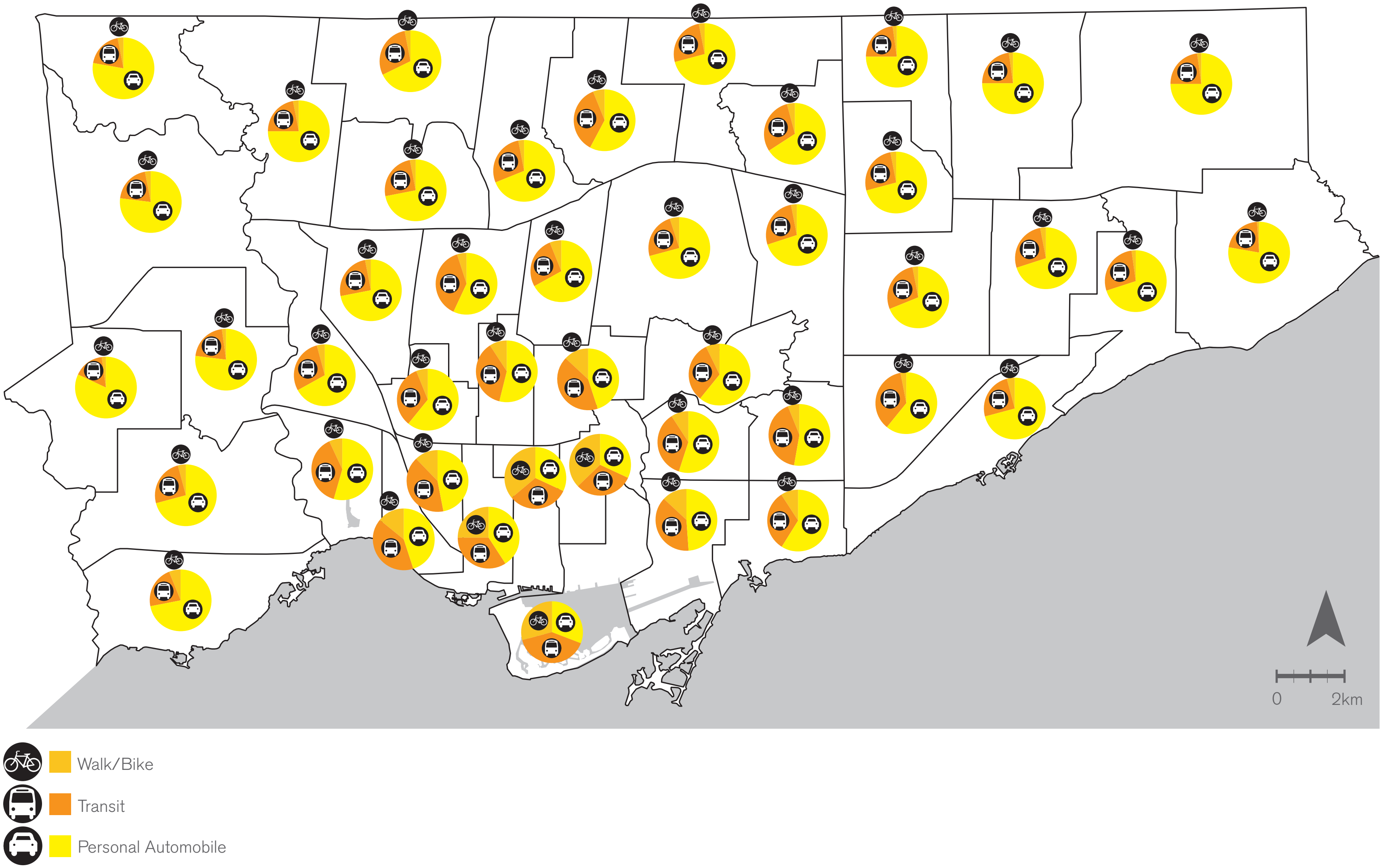


Fig.2.22 The 2001 Canadian Census travel characteristics show that Toronto's core area has a balanced use of all three modes of transport (personal automobile, transit, and walking/cycling), as you move away from the city centre to the inner suburbs, the personal automobile heavily dominates modal choice.

TORONTO CYCLIST AGE PROFILE

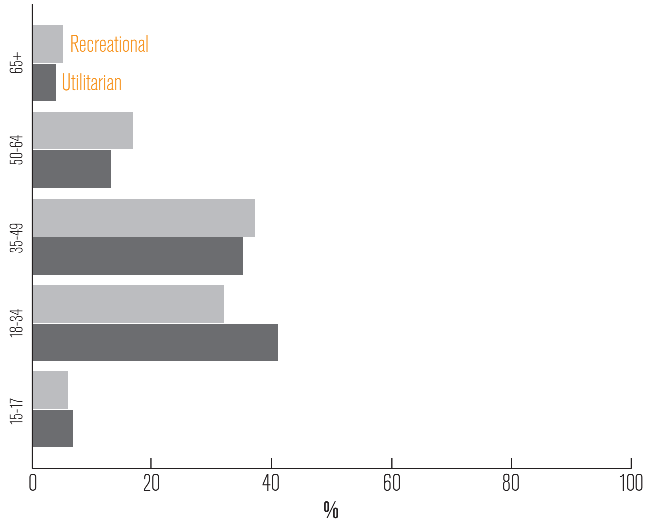


Fig.2.23 Toronto cyclists tend to be between the ages of eighteen and forty-nine.

SEASONAL CYCLING IN TORONTO

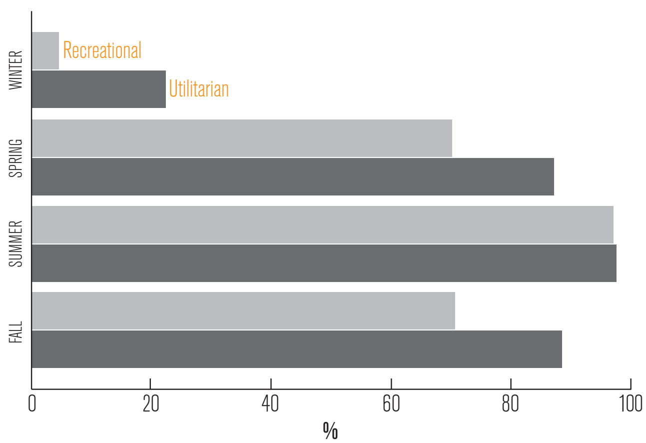


Fig.2.24 Cycling levels drop significantly by both recreational and utilitarian cyclists during the winter months.

one-and-a-half kilometers of on street bike lanes on Jarvis is a bitter-sweet success for the cycling community in Toronto, since the additional lanes fail to connect to key destinations, causing the new lanes to be seen as half measures and unsafe routes.[21] It seems that City Hall and its supporting advocacy groups are overly concerned with the *quantity* of on-street bicycle lanes rather than being focused on building a *city-wide* cycling network that would enable riders to reach distant parts of the city. Until City Hall can commit its energy and funding to developing *quality* bike lanes (separated on-street paths by a concrete curb or alternative off-street paths that create a continuous network of bicycle lanes) over *quantity* (currently signed bicycle routes and painted on-street paths that are discontinuous) they will continue to struggle to meet the needs of cyclists, while creating an unsafe environment that will not promote cycling as an alternative mode of transportation in the city.

TORONTO'S CHALLENGES

There are several challenges that the City of Toronto must overcome in order to fully promote cycling in the city. The results from *Toronto's 1999 Cyclists Survey* indicates that although cyclists come from a broad spectrum of education and income levels, cyclists are more likely to be university graduates who live in a household with a total annual income of at least eighty thousand dollars.[22] Utilitarian cyclists in the city who were surveyed tend to be male (sixty-one percent) rather than female (thirty-nine percent), however the male and female split for recreational cycling are equal.[23] The survey also revealed that the majority of Toronto cyclists are within the age bracket of eighteen to thirty-nine, with significant decreases in cycling usage in younger and older citizens. During the winter months the City of Toronto's cycling levels suffer from a dramatic decrease in ridership in both recreational and utilitarian usage as unfavourable weather conditions remains a serious challenge for cycling in the city. Both the yearly fatality and injury rates in Toronto also remain a serious concern and deterrent to cycling in the city since there are three cycling related fatalities and over a thousand personal injuries that occur on average

CYCLING FATALITIES + INJURIES/YEAR

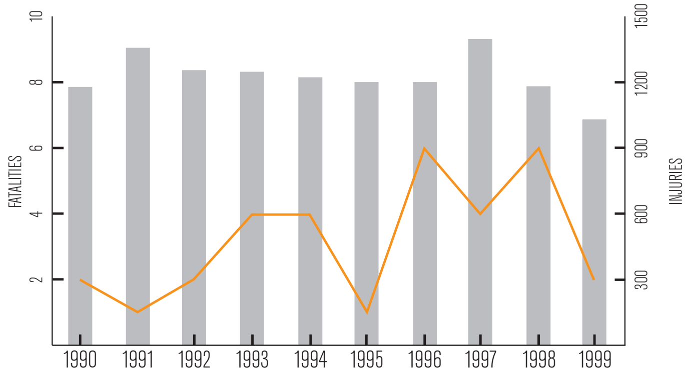


Fig.2.25 On average there are three cycling related fatalities per year in Toronto and over one thousand injuries.

BICYCLES REPORTED STOLEN/YEAR

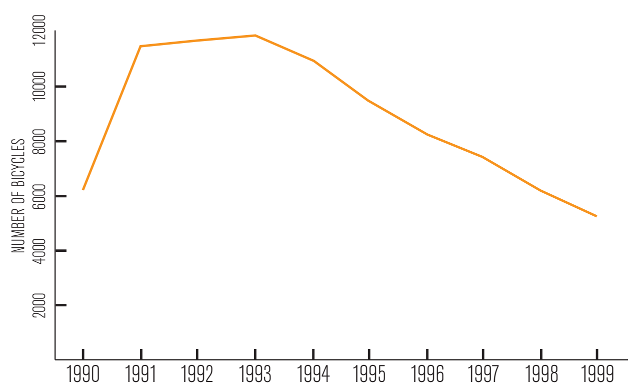


Fig.2.26 Bicycle theft in Toronto is valued at $3.5M annually.

every year over the past decade.[24] Bicycle theft in Toronto has decreased over the past decade but still remains a significant reason why a majority of cyclists do not ride their bicycle for utilitarian purposes. Over ninety thousand bicycles have been reported stolen to the police between 1990 and 1999, with an average bicycle value of four hundred dollars, bicycle theft represents three-and-a-half million dollars every year.[25]

CYCLING INITIATIVES

Despite the city's struggle to execute the construction of on-street bicycle lanes the popularity of the bicycle in Toronto continues to grow at a grassroots level. One of the City of Toronto's most successful cycling initiatives to date is the city's extensive bicycle parking facilities. Toronto offers over 14,500 post-and-ring stands as of 2004 (the highest in North America), which are unfortunately located throughout the city on sidewalks.[26] The post-and-ring bike stands have become a successful symbol of cycling in the city despite the fact that they do not offer protection from unfavourable weather conditions and have only one point of connection for locking, which increases the possibility for theft. In May of 2009 Toronto opened North America's first indoor bicycle station, located on York Street in the West York Street Teamway of Union Station. The secure bicycle parking facility holds one-hundred-and-eight bicycles, a change room, mechanic stand, and a vending machine with emergency bicycle repair parts.[27] The station cost the city four hundred thousand dollars to construct and charges cyclists twenty dollars a month in addition to a lifetime membership fee of twenty-five dollars.[28] The major short-fall of the indoor bicycle station is its location, since the station has no street address and is difficult to access by bicycle. The lengthy maze-like connection to Union Station and the inability to bring a bicycle through Union during rush hour and onto both subway and commuter rail transit, all act as deterrents to the bicycle stations success.

In spite of parking challenges, Toronto cyclists benefit from an array of programs to promote cycling in the city. Extensive CAN-BIKE safety courses

Fig.2.27 North America's first indoor bicycle station, located near Union Station.

Fig.2.28 2009 Ride for Heart and Stroke cycling fundraiser along the Don Valley Parkway.

are offered throughout the city to provide cycling education and training to all age groups and skill levels.[29] The city's largest bicycle promotion, *Bike Month* occurs during the month of June and has over one hundred bicycle specific community events that aim at raising awareness of the benefits of cycling, while encouraging people to ride their bicycles.[30] Toronto's largest charity event, *Ride for Heart and Stroke* occurs during *Bike Month* and requires the city to temporarily close down the Don Valley Parkway and the Gardiner Expressway to car traffic to allow over thirteen thousand participants to cycle along a portion of the city's downtown highways. The City of Toronto also has a cycling specific website (www.city.toronto.on.ca/cycling/index.html) that allows cyclists to download the city's cycling map, which is revised yearly.[31] The site also advertises bicycle events in the city, safety course schedules, links to cycling advocacy groups, updates on infrastructure progress, permit requests for post-and-ring installation, as well as repair and snow removal request forms.[32] In addition to the city's website, a monthly e-newsletter called *Cyclometer,* reports on cycling infrastructure projects and programs to help promote cycling awareness and use in the city.

Although Toronto has developed many programs to promote cycling, the city still faces the major question of how to mend and expand the existing cycling network, since their current method (on-street bicycle lanes) has become disputed by city politicians and a timely endeavor. In 2006, Toronto architect, Chris Hardwicke proposed a radical cycling strategy that would not consume additional space in the city, not even on city streets. By elevating a network of glass enclosed cycling tubes called, *Velo-city*, Hardwick created a highway for bike commuting that connects distant parts of the city while repurposing utility corridors and underutilized land along side highways.[33] The cycling tubes ability to fit "[…] into spaces that trains, subways, and roads simply can't fit into due to their size, noise or pollution,"[34] is the projects greatest asset. *Velo-city* offers "a parallel infrastructure that acts in support of other modes of transit,"[35] since the proposed system connects to subway, railway, highway and parking lots.

Fig.2.29 Chris Hardwicke's Velo-city, an elevated highway for bicycle in the City of Toronto.

Fig.2.30 The West Toronto Railpath is a two kilometer greenway running from Dupont to Dundas West on the alignment of a former rail corridor.

However, a weak point of the project is its inability to interact with these different modes of infrastructure. Hardwicke has developed a project that provides the bicycle with the same level of dedicated infrastructure in Toronto at the cost of both segregating the cyclist from the urban environment and limiting their flexibility to move through the city freely, as the elevated tubes act in a similar manner to a highway. The cyclists' mobility in the city would be constricted by the frequency of on and off ramp access with further problems occurring when the system passes through street intersection and street level integration. The spirit of the project to reallocate off-street space for cyclists and connect to existing transit in the city is strong, however, the proposal is weaken by elevating and separating cyclists from street level and existing infrastructure. A viable *city-wide* cycling network in the City of Toronto must be designed to integrate within the existing infrastructural landscape rather than simply layering a 'highway' model solution.

In October of 2009, the City of Toronto experimented with a new form of off-street bicycle path by repurposing an abandoned stretch of a utility corridor. The first section of the *West Toronto Railpath* stretches two kilometers south from Cariboo Ave. to Dundas West along the alignment of a former rail corridor that has been transformed into a linear public park.[36] Once the remaining four-and-a-half kilometers of park and pathway are funded, designed, and constructed the *Friends of the West Toronto Railpath,* a community based non-profit organization will have successfully assisted the city in connecting Toronto's Junction Neighbourhood to the city's downtown and lakefront.[37] The sustainable transportation corridor has the ability to increase the personal mobility of more than two hundred and fifty thousand residents by providing a direct, safe, car-free route into the downtown core and the GO Bloor transit station.[38]

The new off-road cycling corridor is currently the city's most aggressive, creative, and successful cycling initiative to date as the project has begun the process of regenerating underperforming urban space alongside an active util-

DISTANCE TO TRANSIT

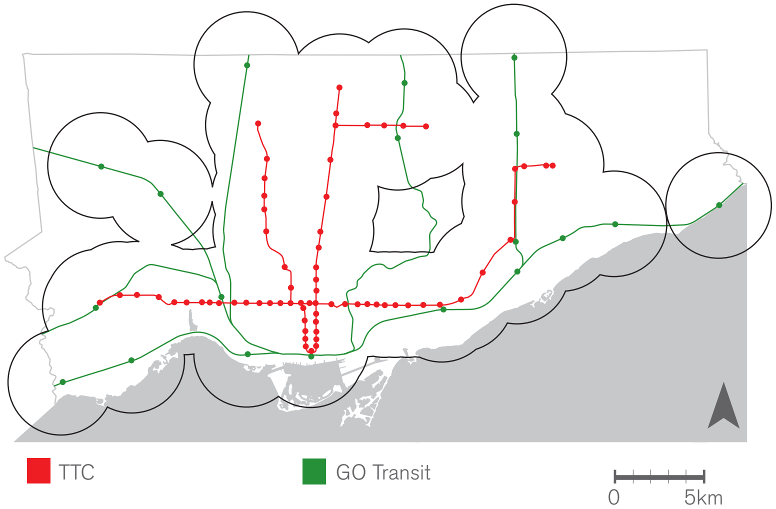


Fig.2.31 The majority of Toronto citizens live within a 3km radius/15 minute bicycle ride from a transit station.

ity corridor. The success of the *West Toronto Railpath* has developed positive urban implications by creating "two kilometers [of] new frontage where new residential units can be located, working symbiotically with the parkway to open up an intercity area of former industrial lands, and by invigorating employment districts."[39] Although the new cycling corridor is a positive cycling initiative in Toronto, the four million dollar project is of little use for prospective cycling commuters until phase two of the proposal is complete[40] – or until the project connects to additional downtown bicycle lanes. Another criticism of the bicycle corridor is the lack of separation between pedestrians and cyclists, as the linear parkway path is too narrow to safely accommodate both active modes of transportation. Despite these criticisms, the *West Toronto Railpath* is the city's most profitable cycling infrastructural initiative to date.

SCALES OF MOBILITY – PAIRING SYSTEMS

While all the above factors contribute in explaining why cycling levels have remained low and increased slowly over the past decade, *distance* continues to be the largest factor that affects Toronto's cycling levels. Distance caused by low-density sprawl is the most frequent reason why fifty percent of recreational cyclists do not use their bikes for utilitarian trips.[41] However, according to the 1996 Canada Census, eighty-one percent of Toronto residents live within a three kilometer or fifteen minute bicycle ride to a TTC or GO Transit Station.[42] The majority of commuters who reside within a three kilometer radius currently use a personal automobile for this short lag of the commute. The bicycle could easily replace this distance if secure parking as well as other bicycle related amenities are put into place and if existing bicycle policies of both GO Transit and the TTC were altered to accommodate the bicycle. Currently the pairing of TTC and cycling is difficult, since bicycles are not permitted on buses, streetcars, and subways during weekdays from 6:30am to 9:30am and from 3:30pm to 6:30pm.[43] Although the TTC does offer some bicycle parking at specific stations, it does not provide an adequate amount of secure and sheltered bicycle parking that would be necessary to promote intermodal coordi-

ACCESS DISTANCE TO GO TRANSIT STATIONS

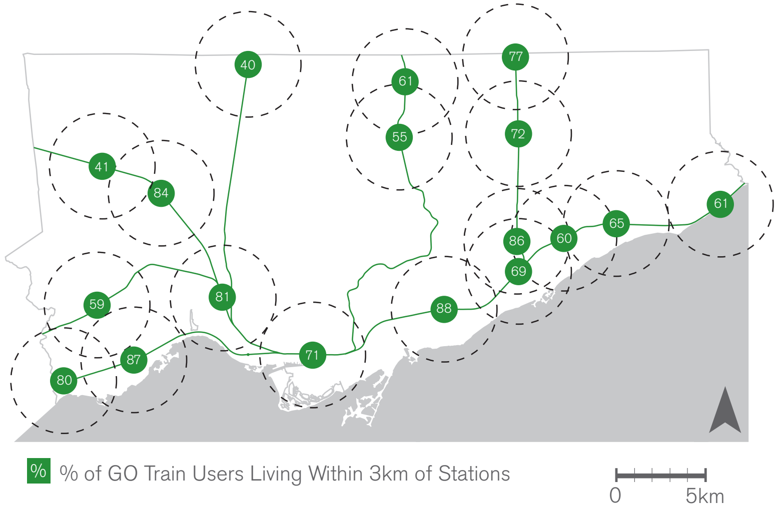


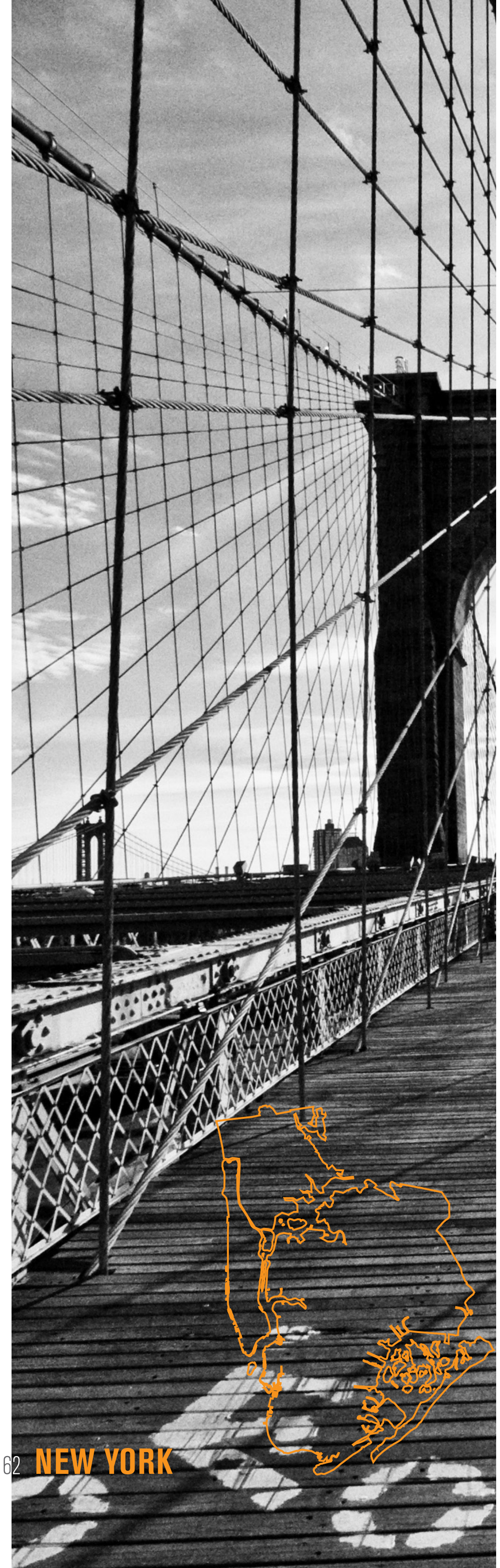
Fig.2.32 A 2007/2008 rail passenger survey shows that on average, 69% of all GO Transit users live within a 3km/15 minute bicycle ride of a station.

nation of cycling with public transit. GO Transit's bicycle policies are similar to TTC's as they permit bicycles on all trains, except those arriving at Union Station from 6:30am to 9:30am and leaving Union Station between 3:30pm to 6:30pm (the central and busiest passenger hub for inner city transit, with over a quarter of a million passenger per day).[44] Bicycles are also prohibited within Union Station at these times and only four bicycles are allowed on each GO railcar at any time. Currently taking bicycles onto buses, subways, and trains is rather unrealistic, inconvenient, and a time-consuming task that often requires potentially "dangerous maneuvers up and down stairs, along platforms, and through narrow aisles."[45] Toronto transit's outdated bicycle policies and the lack of supporting infrastructure to access these stations are currently limiting the ability for cycling to potentially act as a feeder system to transit. The *2009 City of Toronto Bike Survey* shows that secure bicycle parking at transit stations has the potential to increase combined cycling and transit trips, since seventy-four percent of utilitarian and sixty-six percent of recreational cyclists say they would combine cycling and public transit if secure bicycle parking is provided.

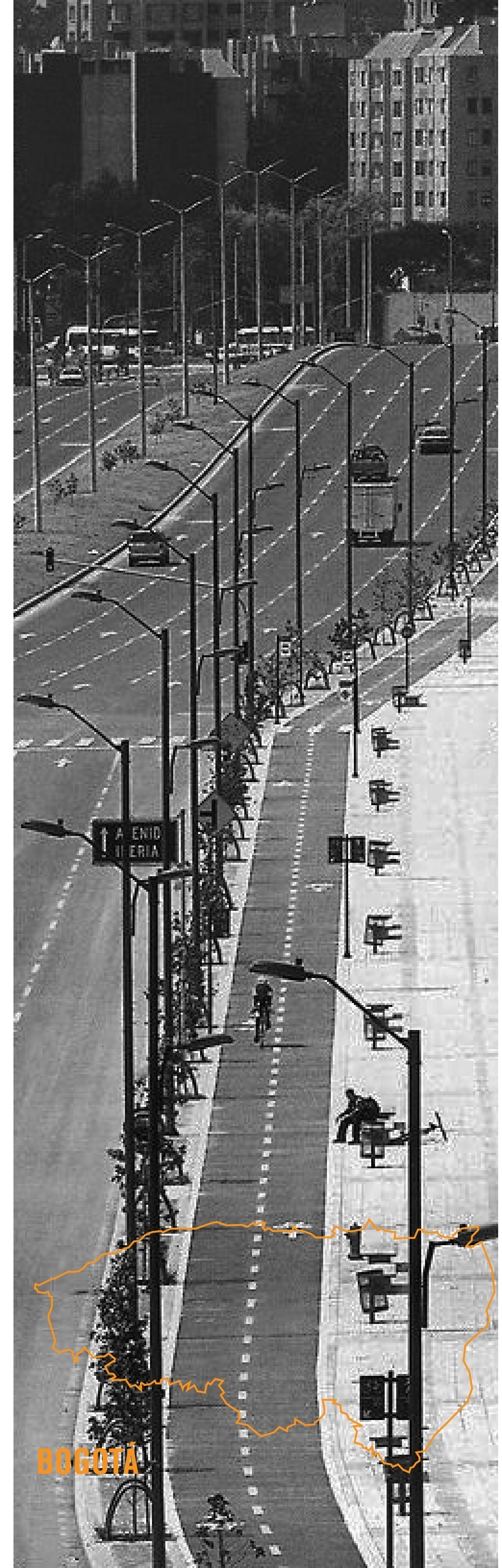
There is presently a great opportunity within the inner suburbs of Toronto for the bicycle and its supporting infrastructure to provide a sustainable mobility option for suburban commuters, by developing a robust and continuous network of long-haul bicycle routes that connect to existing transit stations while avoiding the on-street bicycle lane political debates. Further development of both active and abandoned rail and hydro corridors would both help to regenerate under-performing urban space within the city and expand the city's existing cycling network without interfering with the "car vote". This integrated approach would allow the bicycle to become a more competitive mode of transportation within Toronto's sprawling suburbs, while creating a sustainable mode of transportation for future generations. If Toronto is committed to alleviating current and future congestion within their sprawling suburbs, they must consider the many benefits of the bicycle and commit to supporting its reintegration into the city's existing transportation policies.

COPENHAGEN

MÜNSTER



NEW YORK



BOGOTÁ

Fig.2.37 World map locating case study cities.

2.3 CITIES WITH WILL

As the need for personal mobility increases, many cities are attempting to reincorporate the bicycle into their transportation policies and onto their streets as a viable mobility solution. The following chapter examines how the cities of Copenhagen, Münster, New York, and Bogotá have all successfully transformed their transportation policies and infrastructure from a vehicular-based system to one that incorporates and encourages cycling. These four cities are chosen for their unique cycling initiatives, diverse set of physical and non-physical city statistics, and for demonstrating different attitudes towards cycling reformation through political leadership. Each case study begins with bicycle statistics, city data and a map of the cycling network; this allows for comparison amongst the case studies and with the City of Toronto. Key points are taken from each city to determine how urban design, political will and infrastructural changes can be considered in the transformation of the City of Toronto's transportation infrastructure.

Facing page left to right:
Fig.2.33 Cycle chic guide, Copenhagen.
Fig.2.34 Radstation in Münster.
Fig.2.35 Bicycle path on Brooklyn Bridge.
Fig.2.36 Ciclorrutas in Bogotá.

COPENHAGEN
DENMARK

“Riding a bike is like brushing your teeth in Copenhagen. It’s part of our everyday life.”
Andreas Rohl, Manager of Copenhagen’s Cyling Infrastructure, *The Star, May 28, 2007*

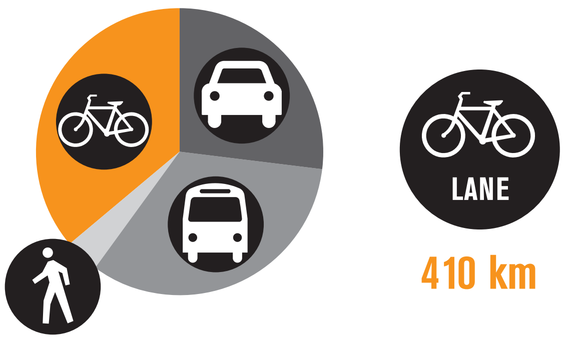


Fig.2.38 Modal choice (left), Length of bicycle lanes (right).

CITY STATISTICS

AREA: urban 455.61 km²
POPULATION: 528,208 City 1,894,521 Metro
DENSITY: 5,985 km²
CLIMATE - AVERAGE HIGH: 11.1˚C
- AVERAGE LOW: 5˚C
- AVERAGE PRECIPITATION: 525 mm
- AVERAGE SNOW FALL: rare
CAR OWNERSHIP: 35% of households
DATE OF INITIAL BICYCLE INFRASTRUCTURE: 1920
BICYCLE FACT: known as the most bicycle friendly city in the world

Fig.2.39 Copenhagen’s current bike lanes shown in orange, bicycle highways shown dotted.

Fig.2.40 Cyclists counter and bicycle repair station.

Fig.2.41 Bicycle boxes at intersections.

Fig.2.42 Hand and foot rail at intersections.

Fig.2.43 Green wave, synchronized traffic signals.

Fig.2.44 Bicycle and pedestrian bridge.

Before the 1960's, Copenhagen was a city renowned for cars, traffic jams and pollution. Today, 1.2 million kilometers are cycled daily on the city's extensive bicycle network. The city has further developed its cycling infrastructure by implementing a Complete Streets design to their main roads and intersections. The initiative includes bicycle boxes and advanced traffic signals at intersections, physically separate bicycle lanes with on street parking for bikes, a free bicycle rental program (City Bike) in the downtown core, two new bicycle bridges and Green Wave, a synchronized traffic light program for cyclists travelling twenty kilometres an hour during rush hour.[1] The city also plans to invest more than two hundred million dollars in cycling facilities between 2006 and 2024 and estimates that by 2015, half its residents will commute by bicycle.[2]

The City of Copenhagen is currently developing a system of interconnected green bicycle routes called Greenways; the aim is to facilitate fast, safe, and pleasant bicycle mobility from one end of the city to the other. The network will cover more than one hundred kilometres and consist of twenty-two corridor routes. Such corridors include abandoned railway lines, excess space along operational rail lines and roadways, and through green spaces and parkland. The vision for the high-quality network includes the following features: smooth and even road surface (free from leaves, ice and snow), no detours, homogenous visual expression, service stations with air and tools along the routes, the ability to maintain a high speed, quick and safe crossing at intersections, and the use of Green Wave through closely spaced traffic lights.[3]

+/- KEY POINTS FOR DESIGN FRAMEWORK

+ Implement bicycle infrastructure guidelines similar to Complete Streets.
+ Develop a network of bicycle paths akin to Greenways.
- The City of Toronto is currently lacking financial backing.
- Toronto's urban area is almost four times that of Copenhagen's, therefore a cycling network must be paired with existing transit lines to be viable.

MÜNSTER
GERMANY

"Riding a bike is regarded as a virtue and a philosophy in Germany."
Berthold Tillmann, Mayor of Münster, *Minnesita's Online News Source*

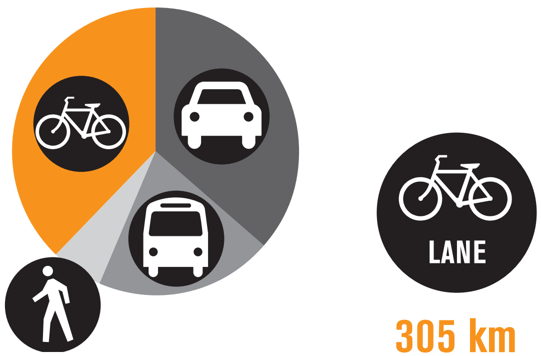


Fig.2.45 Modal choice (left), Length of bicycle lanes (right).

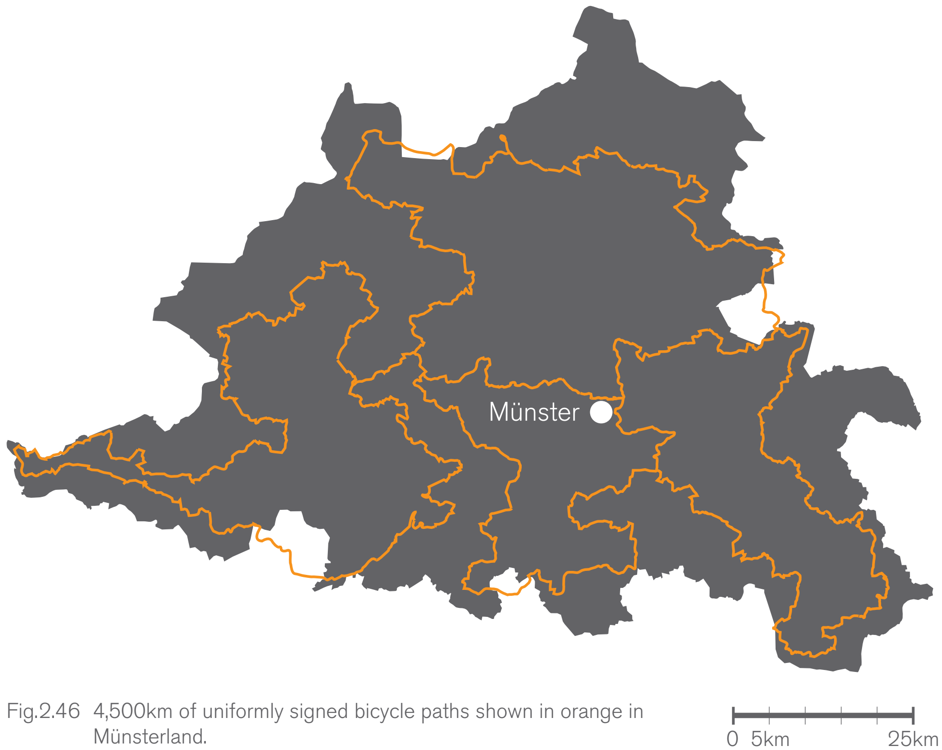


Fig.2.46 4,500km of uniformly signed bicycle paths shown in orange in Münsterland.

CITY STATISTICS

AREA: urban 302.89 km^2
POPULATION: 280,000
DENSITY: 901 km^2
CLIMATE- AVERAGE HIGH: 13˚C
- AVERAGE LOW: 4.6˚C
- AVERAGE PRECIPITATION: 758 mm
- AVERAGE SNOW FALL: rare
CAR OWNERSHIP: 45% of households
DATE OF INITIAL BICYCLE INFRASTRUCTURE: 1950
BICYCLE FACT: known as Germany's cycling capital

Fig.2.47 Aerial view of the Radstation and main train station square.

Fig.2.48 Elevation of the main entrance to the Radstation.

Fig.2.49 Secondary entrance to the Radstation.

Fig.2.50 Interior of the Radstation.

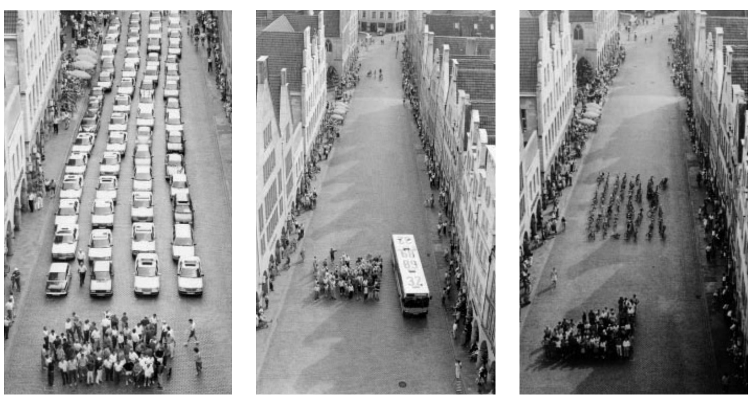


Fig.2.51 Comparing space usage by car, bus and bicycles, Germany planning office, 2001.

During the 1960's mobility craze in Germany, the City of Münster took a stance on its urban development. Rather than allowing itself to be cluttered by the exploding number of personal automobiles, the city invested in public transit and a network of bicycle paths.[4] Today, bicycle traffic is the embodiment of Münster's eco-mobility, thanks to years of promotion, planning and implementation by city council. Its success has always been based upon the overall concept of bicycle traffic design rather than on single measures. This is why the bicycle, is the most commonly used means of transport in the city, accounting for more than one hundred thousand riders daily.[5]

In Münster, where there are three times as many bicycles as residents, it becomes clear why bicycle traffic has the highest priority in urban planning. A car-free ring road wraps around the historic city centre where bicyclists are given green light priority over vehicular traffic. Cycling education is also given in school starting at the age of three. Courses are taught yearly by police officers and children are tested on their bicycle traffic knowledge at the age of nine.[6] In 1999 a modern bicycle station, or *Radstation*, was constructed adjacent to the city's main train station. The facility offers secure parking for 3,300 bikes as well as a repair shop, rentals, washing station and locker room facilities. The station's glazed facade allows light to penetrate down the bicycle-only ramp to the underground parking area, where it connects to all train platforms. This *Radstation* is the largest in Germany and on the back of its success, a second station is being built at the opposite end of the railway station.[7]

+/- KEY POINTS FOR DESIGN FRAMEWORK

+ Design a bicycle network based upon a complete concept and not single measure solutions, ie. quality over number of kilometres built.
+ Allow bicycle stations to house both bicycle specific amenities and those that can be used by the community.
- Toronto is currently lacking the politcal will to achieve its modest yearly bicycle network targets due to pressure of the "car vote".

NEW YORK CITY
UNITED STATES

"Whether through increasing and improving bicycle lanes or building bike shelters near transit hubs, by making New York more bike friendly, we're taking steps to prepare for the future."
Micheal Bloomberg, Mayor of New York, *News from the Blue Room*

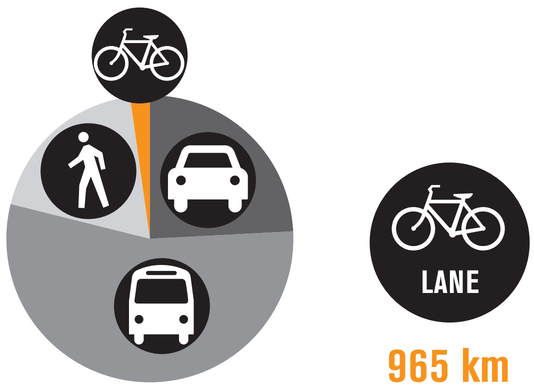


Fig.2.52 Modal choice (left), Length of bicycle lanes (right).

CITY STATISTICS

AREA: city 1,214.4 km²
POPULATION: 8,363,710 City 19,006,798 Metro
DENSITY: 10,606 km²
CLIMATE- AVERAGE HIGH: 17°C
- **AVERAGE LOW:** 9°C
- **AVERAGE PRECIPITATION:** 1,262.1 mm
- **AVERAGE SNOW FALL:** 571.5 mm

CAR OWNERSHIP: 46% of households
DATE OF INITIAL BICYCLE INFRASTRUCTURE: mid 1950's
BICYCLE FACT: 35% increase in cycling between 2007 and 2008

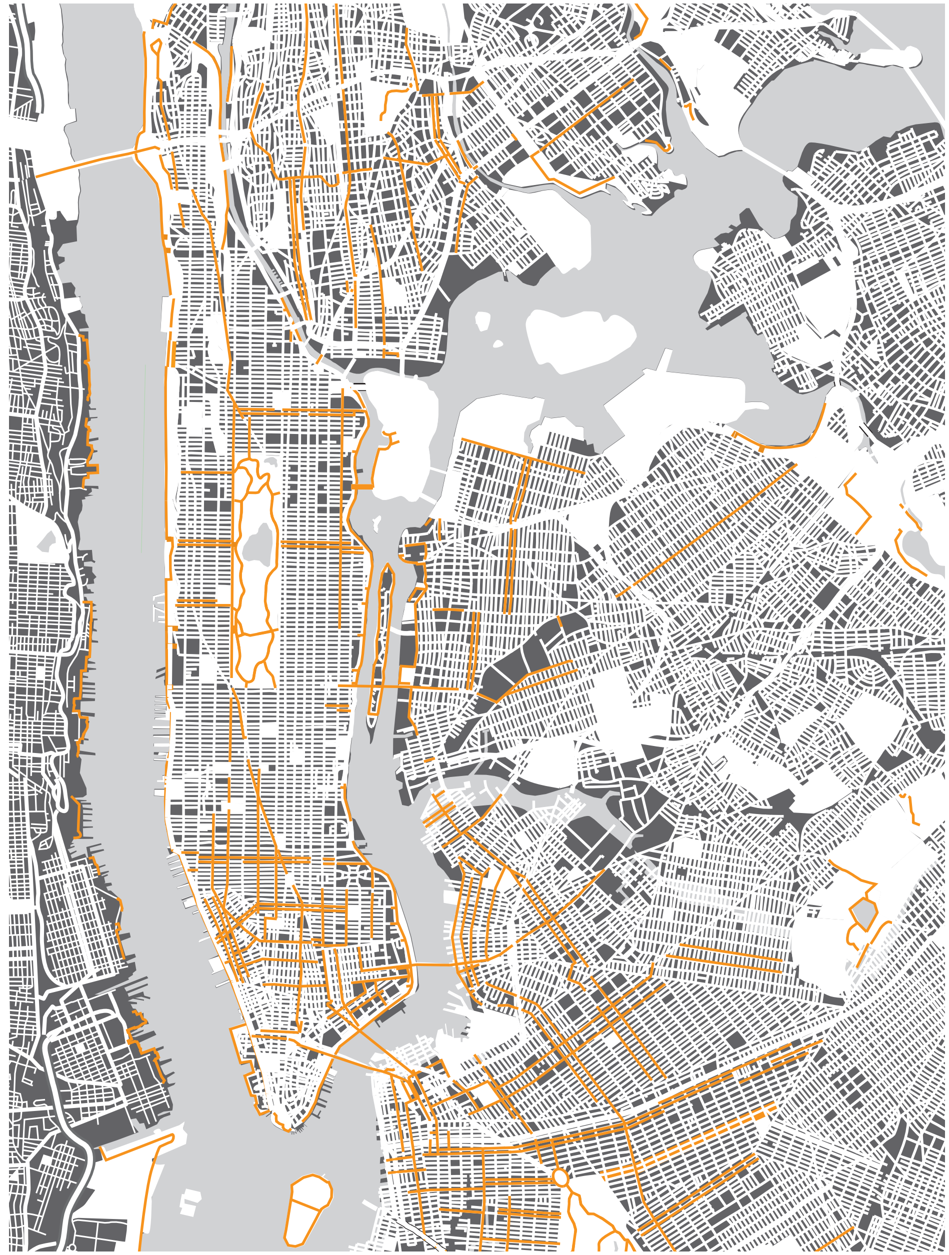


Fig.2.53 New York's current bike lanes shown in orange.

0 2km

Fig.2.54 Green bicycle lane with buffer.

Fig.2.55 Protected on-street lane.

Fig.2.56 Protected on-street bicycle lane with left hand turning lane for automobiles.

During the past three years, the City of New York has worked tirelessly to become the bicycle capital of the United States. In June 2009, the city's Department of Transportation announced the completion of their ambitious 2006 goal: building three hundred and twenty-two kilometres of bike lanes in all five boroughs. By completing this initiative the city nearly doubled its on-street bicycle network while using the opportunity to re-shape the city's streets by making them more user friendly for all modes of transportation.[8] The current mayor, Michael Bloomberg, has had leading roles in both promoting and supporting the three year project since it was a central part of his PlaNYC, an initiative to reduce carbon emissions by getting drivers out of their cars. The mayor, upon accepting the Bicycle Friendly Community award stated "we're trying to make it easier for people to use their bikes as a viable means of transportation."[9]

In order to overcome the challenges of intense traffic, wide one-way avenues and older narrow streets, a new style of bicycle paths needed to be designed specifically for New York City. The new design provides robust separation between vehicular and bicycle traffic, comfort and safety, defined cyclist routes through intersections and left hand turns, and is tailored to the many styles of existing streets. Thanks to the aggressive urban design plans of the city, commuter cycling increased twenty-six percent during 2009. The New York City Department of Transportation remains committed to its goal of doubling bicycle commuting by 2015, and is currently on track in developing 2,897 kilometres of bike lanes by 2030.[10]

+/- KEY POINTS FOR DESIGN FRAMEWORK

+ Allow challenging street configurations to become unique design opportunities that are both street and city specific, rather than looking for standard practice solutions.
- New York City's separated bicycles lanes typically occur on wide, one-way avenues, this was key to their success. The majority of Toronto's main streets are two-way and not as wide.

BOGOTÁ
COLUMBIA

Cars are"the most powerful instrument of social differentiation and alienation that we have in society."

Enrique Peñalosa, Former Mayor of Bogotá, *Globe Life, June 25, 2007*

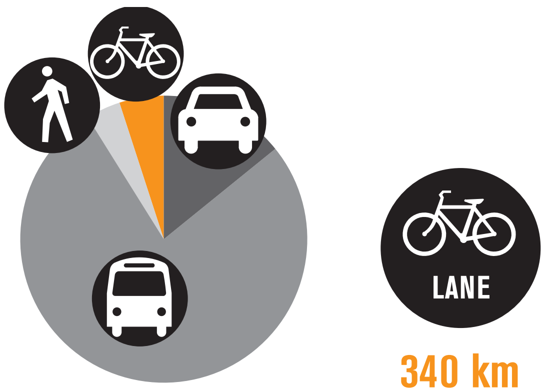


Fig.2.57 Modal choice (left), Length of bicycle lanes (right).

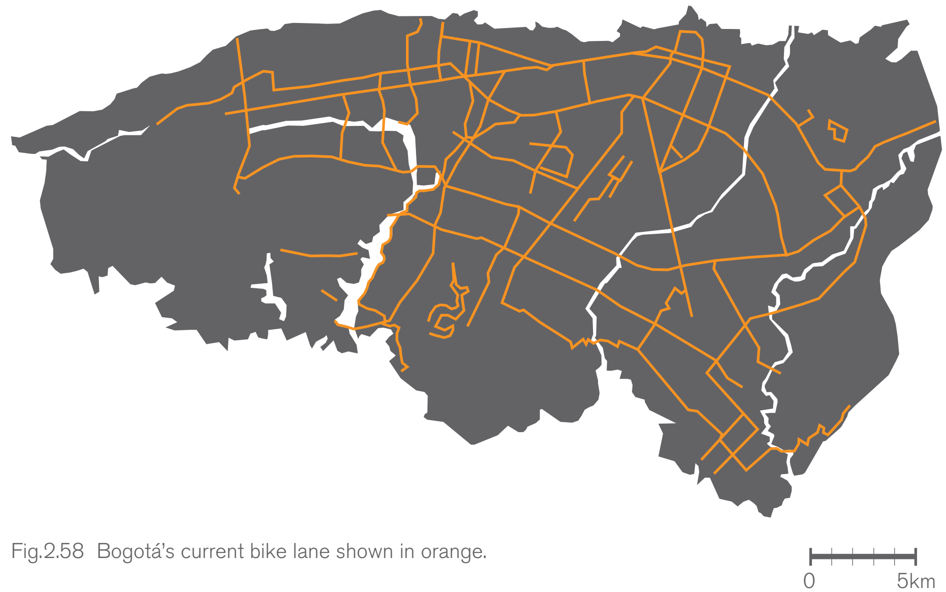


Fig.2.58 Bogotá's current bike lane shown in orange.

CITY STATISTICS

AREA: city 1,587 km^2
POPULATION: 7,319,600 City 8,361,000 Metro
DENSITY: 4,602 km^2
CLIMATE- AVERAGE HIGH: 18˚C
- AVERAGE LOW: 7˚C
- AVERAGE PRECIPITATION: 946 mm
- AVERAGE SNOW FALL: 0 mm
CAR OWNERSHIP: 13% of households
DATE OF INITIAL BICYCLE INFRASTRUCTURE: late 1980's
BICYCLE FACT: car free roads on sunday and holidays from 7am-2pm

Fig.2.59 Off street residential bicycle paths.

Fig.2.60 Off street two-way bicycle paths.

Fig.2.61 Interior vertical bike parking.

Fig.2.62 Staffed bicycle parking station.

Fig.2.63 Car free days, sundays and holidays from 7:00am to 2:00pm.

When Enrique Peñalosa became mayor of Bogotá in 1998, plans for a new fifteen billion dollar highway system were given to him. Mr. Peñalosa boldly discarded these plans, as his vision for the city didn't include a transit project but rather one of mobility that would increase the happiness of his citizens. To achieve this, he increased taxes on gasoline, prohibited car owners from driving during rush hour more than three times per week, reallocated real estate along the city's main arterial roads to the *TransMilenio* (a rapid bus transit system), and created the most extensive cycling network in the developing nations called, *Ciclo-Rutas*.[11] Peñalosa says "a bikeway is a symbol that shows that a citizen on a thirty dollar bicycle is equally important as a citizen in a thirty thousand dollarcar."[12] Since the construction of the *Ciclo-Rutas*, bicycle use has quintupled in the city and it is estimated that there are three hundred to four hundred thousand trips made daily.[13] High ridership statistics are the result of a well-designed network that takes into account the morphology and topography of the city, as well as connecting the bicycle paths to the *TransMilenio* by installing free, convenient and secure bicycle storage facilities near all major bus terminals.

By generating a new sense of belonging to the city, Mr. Peñalosa has successfully linked the "economics of happiness" to urban design. As a result, the city's crime rates and traffic accidents have decreased by more than fifty percent and commuting times have dropped by thirty percent. By 2001, the measures of the mayor were so popular that Bogota's citizens have voted to ban private cars entirely during rush hour by 2015.[14]

+/- KEY POINTS FOR DESIGN FRAMEWORK

+ Promote cycling to transit stations by providing secure bicycle parking.
+ Create equality amongst modes of transit by relocating funds.
- Since Bogota's car ownership was only 13% it was possible to close down streets rather than looking elsewhere to create temporary or permanent recreational space. In Toronto 71.1% of citizens use a personal automobile to commute to work.

03 HIDDEN CORRIDORS

"Today […] the greatest task confronting us is to evolve, invent, and create a new urban environment: a place of meeting and interaction; a place that is adaptable and pluralistic; a place of man-made and natural beauty."

Moshe Safdie, *The City After the Automobile*

Facing page:
Fig.3.1 Intersection of CN rail and Finch hydro corridor.

3.1 RECLAIMING TORONTO'S UTILITY CORRIDORS

Although the pattern and usage vary in detail throughout world history "public space has always served as a meeting place, market-place, and traffic space."[1] However, as individual mobility increases in developed nations, the nature of public space is changing from a place of occupation into a place of transit. French sociologist Henri Lefebvre believes that this change in use of public space prevents movement from taking place within urban life, resulting in a forced separation of movement.[2] City dwellers are experiencing a division in their own habitat, which is being pulled "apart by the insertion of alien and degrading objects and functions."[3] David Burwell from *Project for Public Spaces*, writes that until people "think of transportation as public space,"[4] especially in North American cities, mobility space will continue to hold the single function of acting as connecting tissues between transportation infrastructures.

As the City of Toronto's population continues to grow an increasing amount of underdeveloped land is being developed for the sole purpose of mobility. For years, the city has enjoyed the privilege of expanding outward from the city centre to accommodate this increase in personal mobility. This however, is not a sustainable system of growth and consequently the failed system now limits expansion options of both public space and mobility in Toronto. The barrier effect of Toronto's transportation infrastructure is significant. The roads, highways, and railways that are built to provide connections in the city have now isolated communities by creating "rigid boundaries of social and ecological zones […].[5] As traffic intensifies in the city, the barrier effect that transportation infrastructure will exert on disconnected communities will increase greatly and reinforce multiple corridor effects. How then, can the City of Toronto expand its existing mobility infrastructure when undeveloped space is limited and when city streets are becoming increasingly congested with car traffic and contested spaces for bicycle lane expansion? Is it possible for Toronto's future transportation to also act as public spaces that encourages social interaction, while connecting to and negotiating through existing infrastructure?

Fig.3.2 Looking west along Toronto's Finch Hydro Corridor from GO Transit's Old Cummer Station.

INTENSIFICATION OF TORONTO'S SERVICE LANDS

Urban Pathways is a cycling-based infrastructure design proposal that will co-op existing operational and abandoned utility corridors in the City of Toronto. By reactivating selected hydro and rail corridors throughout the city, a new network of continuous mobility pathways has the potential to increase personal mobility for all citizens by providing a safe, convenient, and affordable alternative mode of transportation. The partnership of cycling amenities and infrastructure to existing TTC and GO Transit stations is essential to the success of the mobility network. This pairing of transportation will allow cycling to act as a feeder system to the existing transit network, while helping to create additional mobility choices for inner suburb residents.

Another important design initiative of *Urban Pathways* is the phasing of the mobility network into a series of linear parkways. Currently, Toronto spends the lowest amount on public space and park operations in North America,[6] therefore in order to propose new transportation corridors that also function as public space, the proposal must be phased in order to acquire the necessary funding and support from the City of Toronto's Transportation Services and Parks, Forestry and Recreation. During phase one, a network of continuous mobility paths will be built within selected utility corridors that will connect to specific transit stations. New bicycle hubs will be located at these existing transit stations as well as selected access points along the network to promote the cycling corridors as viable commuting option; these stations will house amenities for both cyclists and their community. An early partnership with both TTC and GO Transit will aid in funding future phases, since *Urban Pathways* has the ability to increase transit ridership. During the initial phase all necessary infrastructural connections will be constructed in order to allow the new mobility system to negotiate through all modes of existing infrastructure. The creation of a continuous bicycle path will then enable phase two to layer more park and public related amenities to the network, transforming the mobility network into a transportation corridor and linear parkway.

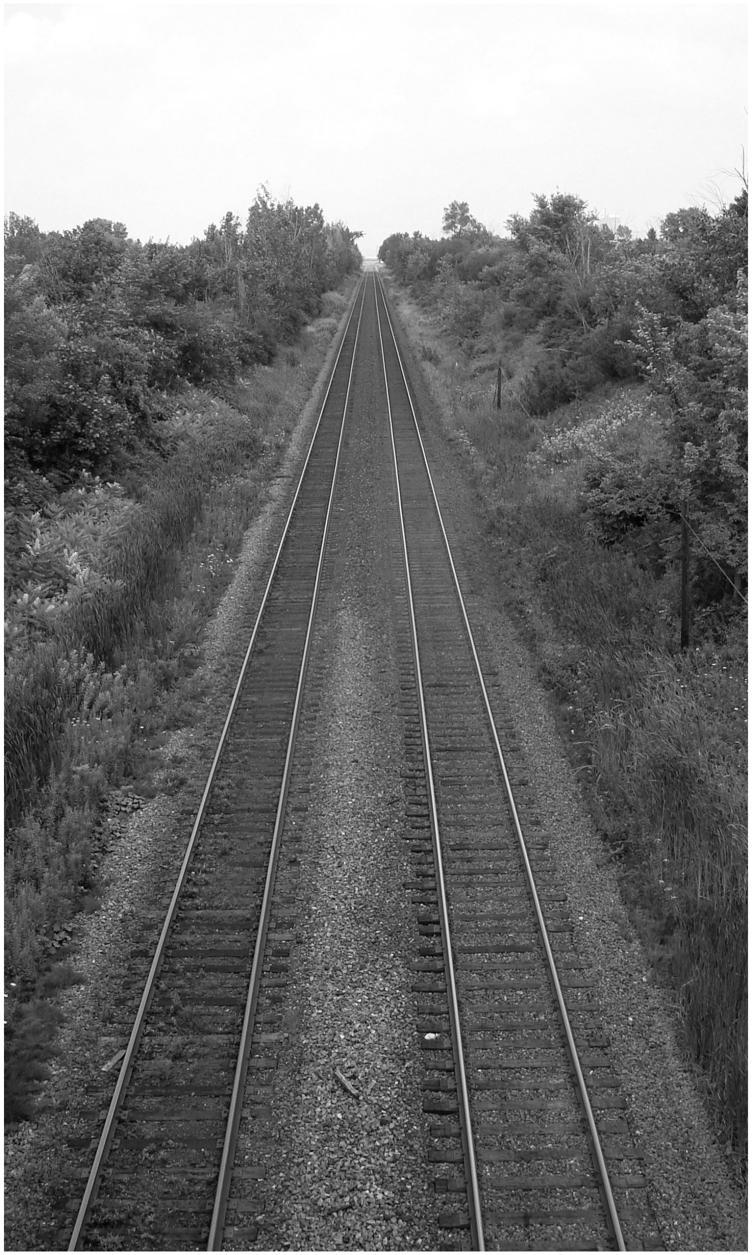


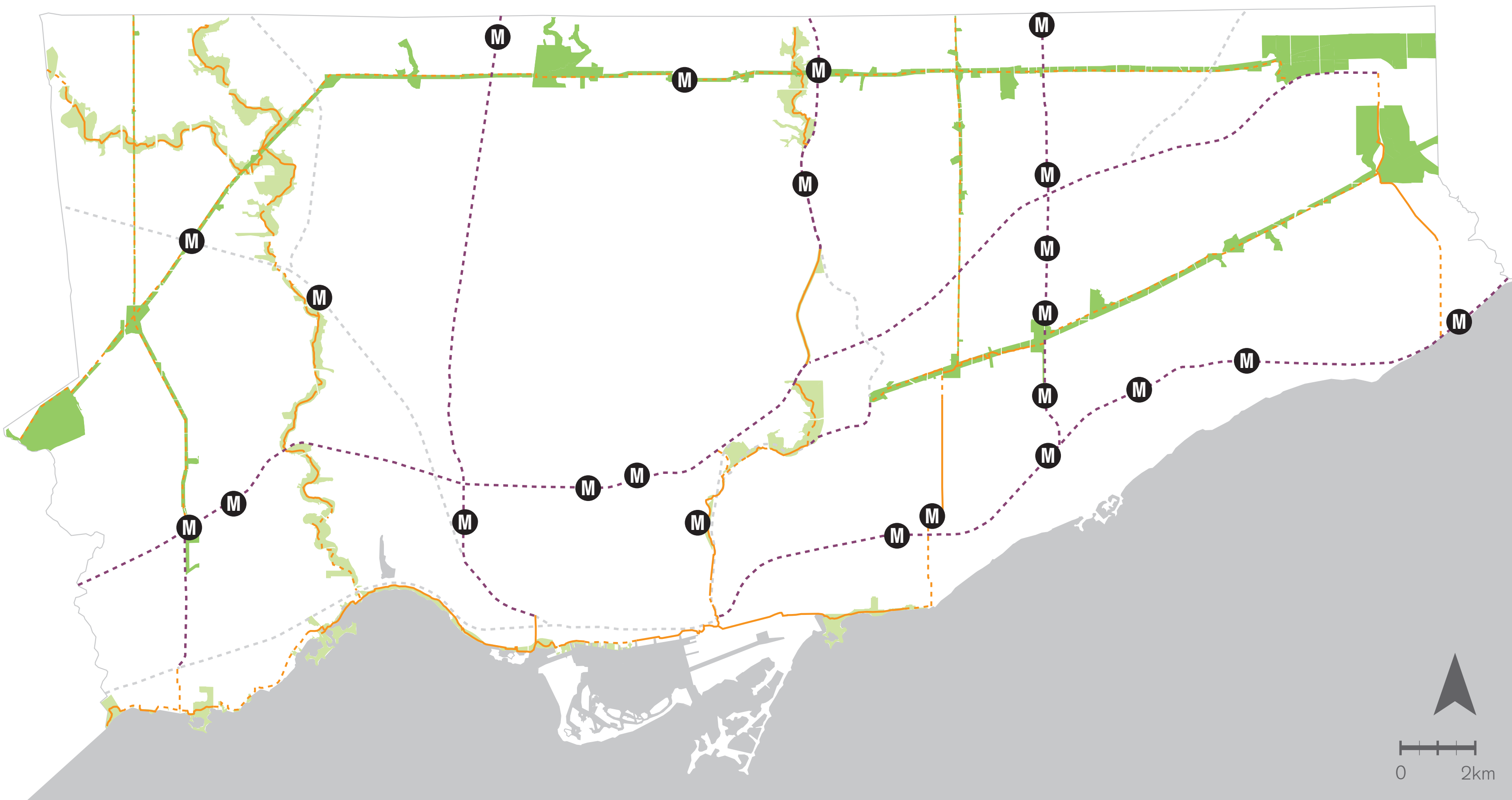
Fig.3.3 Looking west along one of Toronto's Canadian Pacific Railway lines from the Pharmacy Avenue over pass.

Urban Pathways has the ability to layer civic amenities within underutilized utility corridors in the City of Toronto while generating both economic and urban benefits. The revitalized public mobility corridors will aid in joining the currently divided communities alongside existing utility corridors and create new frontages for existing developments. This could potentially increase land value for adjacent properties that were once deemed less attractive. New addresses could also generate additional building developments alongside utility corridors while supporting an increase in density of existing public programs. The incremental redevelopment of existing utility corridors would allow both mobility and public space to increase in the City of Toronto without requiring any additional real estate, especially space within city streets. *Urban Pathways* requires a change in lifestyle for many Toronto citizens, however the networks ability to activate under-programmed corridors, while creating new sustainable mobility options and public space in the city significantly out weighs the change in lifestyle. As the network will create a healthier urban environment for future generations to grow up in and new landmarks within Toronto's urban environment that will enhance the relationship between mobility and culture.

NETWORK STRATEGY

The thesis is focused on providing a *continuous* network of *long-haul* mobility paths that will provide connections to distant parts of the city and selected transit hubs. *Long-haul* paths provide safe and efficient crossings at intersections, the ability to maintain high speeds, and most importantly, uninterrupted infrastructure. Existing and proposed on-street bicycle lanes by the City of Toronto will provide the networks *short-haul* connections. With the intention that the success and popularity of *Urban Pathways* will provide the necessary political support needed to construct future phases of separated on-street bicycle lanes, located at strategic locations, to provide additional connections to the mobility corridors and linear parkways. The infrastructural challenges associated with co-opting existing services corridors will be explored in the remainder of this chapter and further addressed in the *Activation* portion of the thesis.

URBAN PATHWAYS MOBILITY NETWORK - LONG-HAUL



Park/Recreational Field

Rail Corridor (grey-unused)

Hydro Corridor

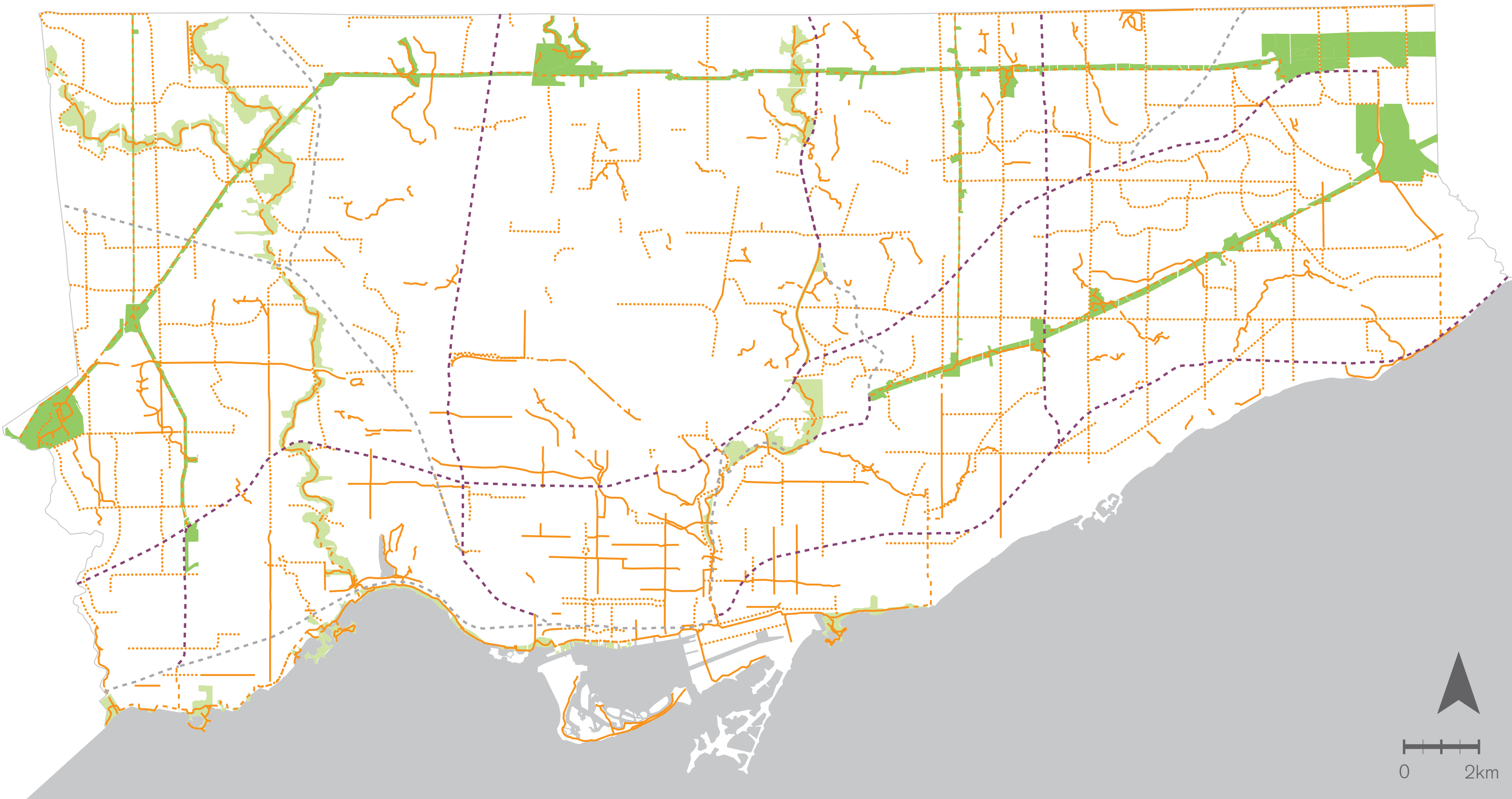
Mobility Path (solid-exsiting, dashed-proposed)

Transit Station

Operational and abandoned rail and hydro corridors as well as existing recreational corridors create a network of long-haul mobility paths that connect to specific transit stations across the City of Toronto.

Fig.3.4 Long-haul network.

FUTURE MOBILITY NETWORK - LONG + SHORT-HAUL



Park/Recreational Field

Rail Corridor (grey-unused)

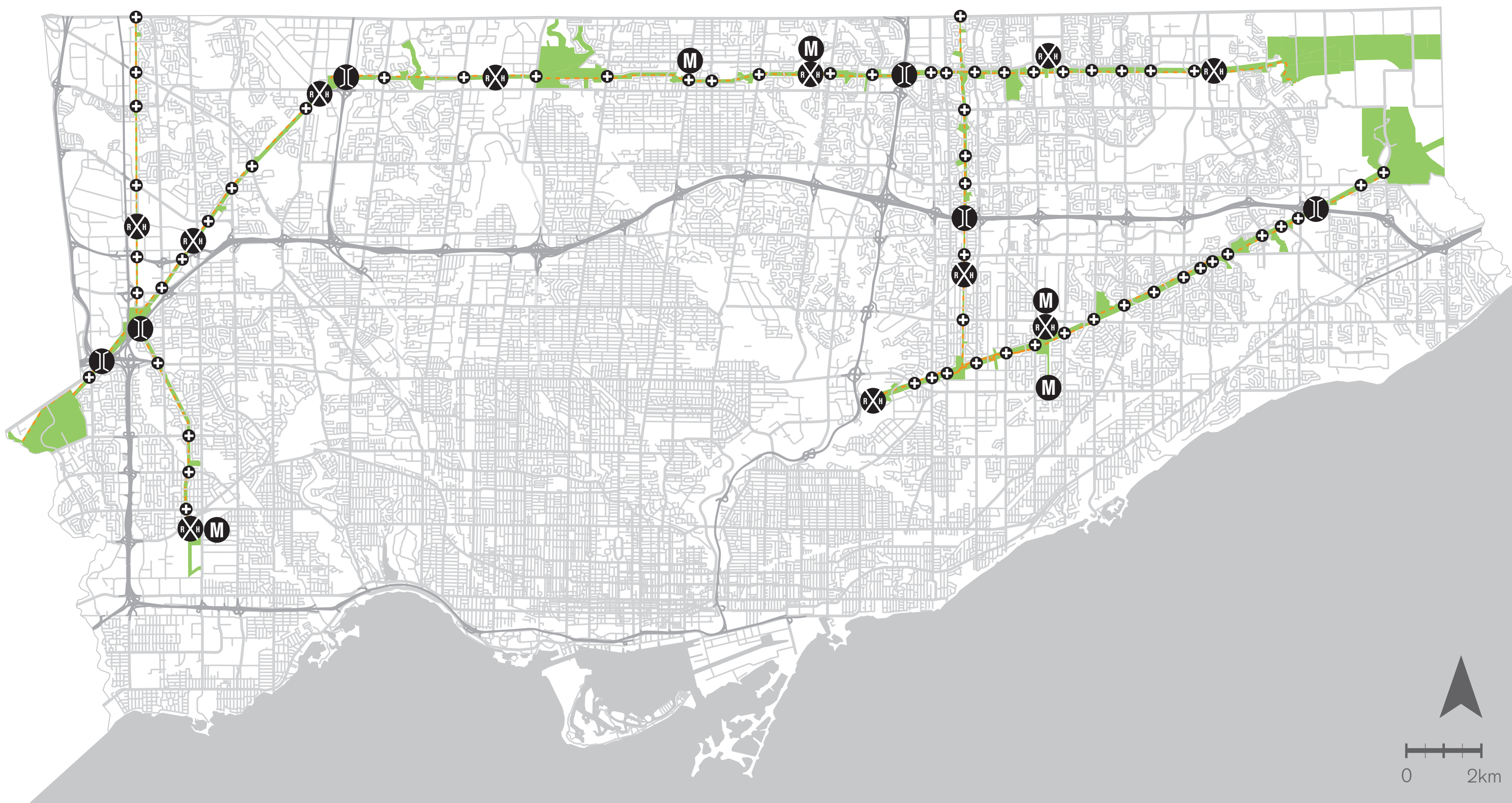
Hydro Corridor

Mobility Path (solid-existing, dashed-proposed, dotted-future on-street bicycle lane proposed by City)

The pairing of *Urban Pathways* (long-haul) with the City of Toronto's current and proposed on-street bicycle network (short-haul) would further increase personal mobility in the inner suburbs, by creating additional access points and route options.

Fig.3.5 Long and short-haul network.

UNPACKING HYDRO CORRIDORS



- Intersection - Hydro + Rail
- Intersection - Hydro + Major Street
- Intersection - Hydro + Highway
- Transit Station
- Hydro Corridor
- Mobility Path (solid-existing, dashed-proposed)

Co-opting existing hydro corridors in the City of Toronto requires an infrastructural design solution, as the corridors are a highly interrupted system. As selected hydro corridors negotiate through the existing urban landscape they are continually fractured by the city's highways, rail lines, and major roadways.

Fig.3.6 Unpacking hydro corridors.

UNPACKING RAIL CORRIDORS

Intersection - Rail + Hydro

Intersection - Rail + Rail

Intersection - Rail + Highway

Transit Station

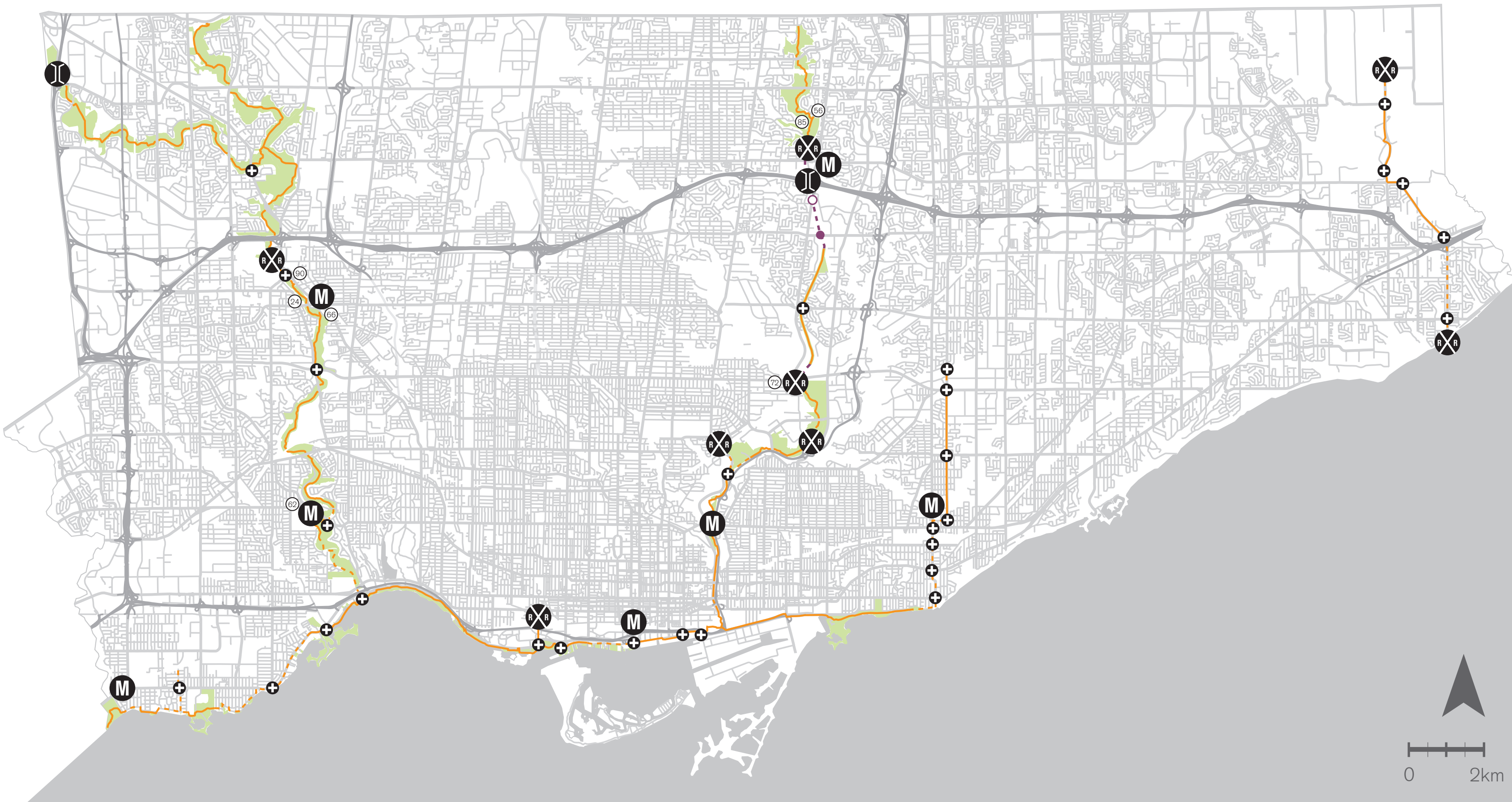
Overpass   Underpass

Rail Corridor (grey-unused)

Co-opting rail corridors in the City of Toronto requires an infrastructural design solution, as the corridors are constantly forced to shift vertically to maneuver through existing infrastructure. The intersection of highways, other rail lines, and major streets all cause these disturbances.

Fig.3.7 Unpacking rail corridors.

UNPACKING RECREATIONAL CORRIDORS

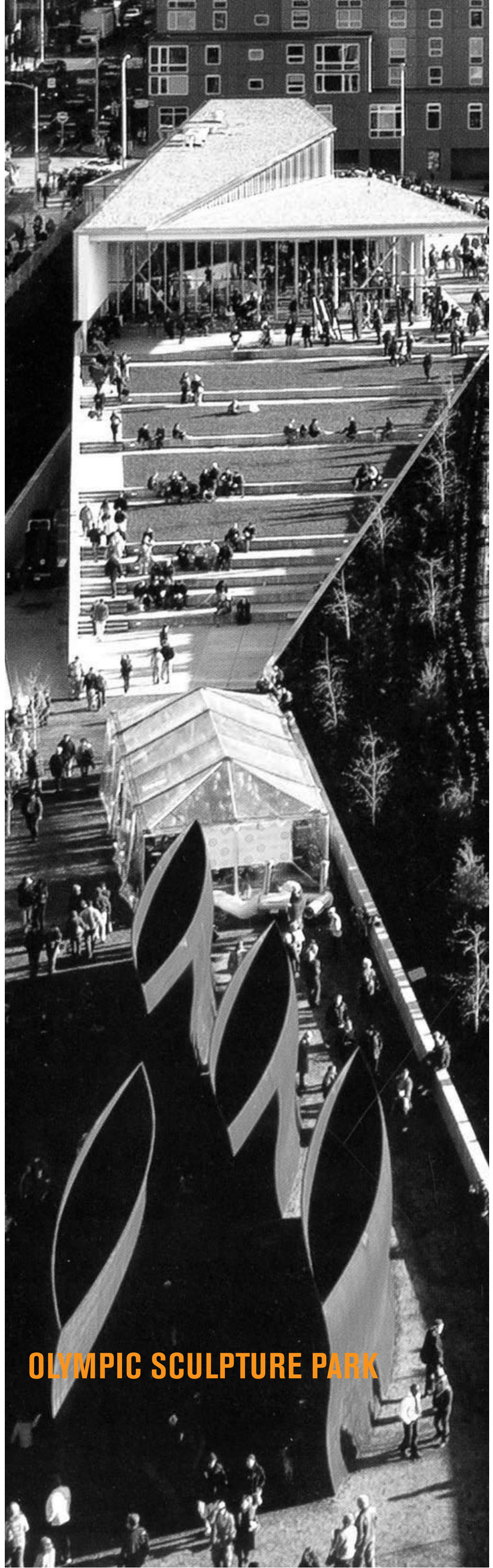


- Intersection - Rec. + Rail
- Intersection - Rec. + Major Street
- Intersection - Rec. + Highway
- Transit Station
- ## Number of Stairs
- Park/Recreational Field
- Mobility Path (solid-existing, dashed-proposed)

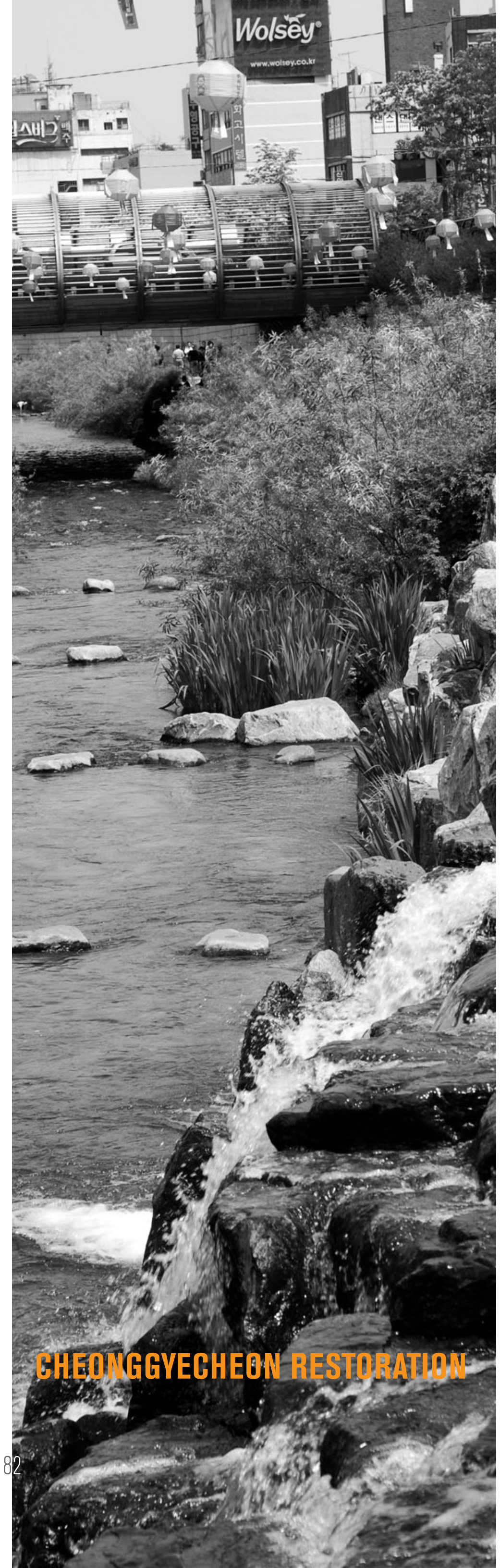
Existing recreational corridors contain paths that are currently unsuitable to act as long-haul mobility routes as they are discontinuous at several major streets and have vertical shifts in the landscape that cause delay for cyclists (stairs with no bicycle infrastructure). Mending the fractured recreational corridors also requires negotiation with the city's highways and rail lines.

Fig.3.8 Unpacking recreational corridors.

HIGH LINE



OLYMPIC SCULPTURE PARK



CHEONGGYECHEON RESTORATION

Fig.3.12 World map locating precedent projects.

Facing page left to right:

Fig.3.9 High Line, New York City, abandoned elevated rail line.
Fig.3.10 Olympic Sculpture Park, Seattle Washington, reconnecting industrial lands.
Fig.3.11 Cheonggyecheon Restoration Project, Seoul Korea, unearthing a concealed river by removing a highway.

3.2 RECYCLING URBAN INFRASTRUCTURE

With the global population growing alongside an increasing demand for healthier lifestyles, mature cities around the world are struggling to create space for urban parks. Parks provide essential amenities to city dwellers such as fresh air, relaxation, and spaces for social interaction. How then can cities in developed nations tackle the issue of creating new space for urban parks? Since carving out green space is not always feasible in densely developed urban centres, the solution must be more creative and incorporate such area as 'greyfield' sites: the spaces *between* buildings and other under-utilized sites of defunct infrastructure to create the opportunity for new park typologies to emerge.

The following chapter examines how three revitalization projects have created new public spaces from disconnected, abandoned and underutilized industrial and infrastructural sites. The High Line in New York City is unique for its incremental redevelopment of an abandoned elevated railway. The innovative phasing, layering of program, and thoughtful interlacing of hard and soft surfaces has attracted other new design developments along its length. Seattle's Olympic Sculpture Park is comprised of a continuously constructed landscape that reconnects the city to its waterfront. The project is an example of how to successfully negotiate existing transportation infrastructure, while providing a focus for the city with new civic amenities. The final precedent is the Cheonggyecheon restoration project in Seoul, South Korea, where a new linear park is created by removing an elevated highway that concealed a river and separated the city for four decades. The new public park connects the north and south sides of the city and represents a growing national emphasis on the quality of life in urban centres.

Fig.3.13 Section one completed, Gansevoort Street to 13th Street, view looking south from the Standard Hotel.

Fig.3.14 A rambling textural effect is created from the linear concrete planks, the transplanted rail tracks aid in creating a linear aesthetic.

ABANDONED ELEVATED RAIL LINE

HIGH LINE

New York City, New York

The High Line is a remarkable example of the transformation of a defunct industrial corridor into an urban park. A formally derelict elevated railway line located in the West side of Manhattan is being redeveloped into a 1.45 mile long pedestrian park, with the first portion opened to the public in the spring of 2009.[1] The rail line was originally constructed in the 1930s to remove dangerous freight trains off of Manhattan's city streets.[2] The development was part of the West Side Improvement initiative that targeted Manhattan's largest industrial district to provide direct connections to factories and warehouses allowing trains to move through the upper stories of buildings.[3] The elevated rail spanned twenty-two blocks, from thirty-four Street to Gansevoort Street, and was eventually abandoned in the 1980's.[4]

The High Line went into decay and disrepair for twenty years and was slatted to be demolished by the City of New York had it not been for the efforts of two neighborhood activists. They founded the non-profit organization *Friends of the High Line* in 1999 to protect, preserve, and renovate the discarded infrastructure into an open public park.[5] Along with advocating the High Line's preservation, the grassroots organization worked alongside the city's administrative staff to reverse the demolition policy through the federal Railmaking program. After the organization conducted a study to determine if the High Line project would be economically viable, it was found that the "new tax revenues created by the public space would be greater than the cost of construction."[6] This allowed the project to gain the city's support in 2002 and initiated an open ideas international design competition, 'Designing the High Line'. An overwhelming seven hundred and twenty design proposals responded to the unique opportunity of redesigning a raised rail corridor.[7] A second, invited competition produced the winning entry, joint venture by James Corner Field

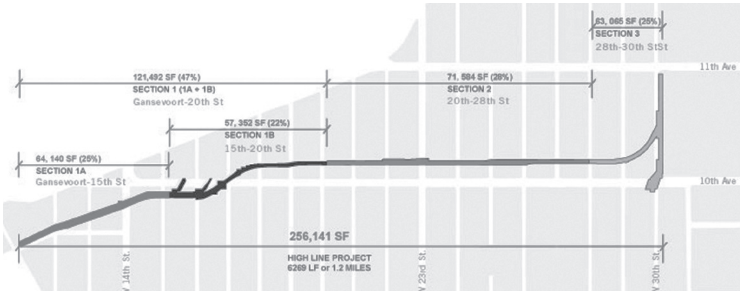


Fig.3.15 Phasing the proposal into three sections allowed the project to become economically viable.

Fig.3.16 An elevated square is formed by the High Line's crossing of 10th Avenue at 17th Street, views of midtown and the Statue of Liberty can be seen.

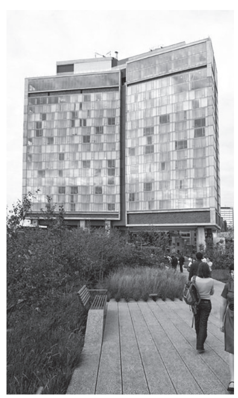


Fig.3.17 IAC office building, designed by Frank Gehry.
Fig.3.18 HL23 residential building, designed by Neil Denari.
Fig.3.19 Standard Hotel, designed by Todd Schliemann.

Operations (landscape architecture) and Diller Scofido + Rentro (architecture). The selected design created a sequence of "varied environments within a cohesive and singular landscape"[8] while retaining a sense of the "self-sown wilderness"[9] that was original to the abandoned landscape. In order to rehabilitate this abandoned corridor into a lush, green, and populated public park, the design team phased the proposal into three sections. This allowed the non-profit organization to both privately and publically campaign for the first portion of the construction budget and seventy percent of the annual operating costs.[10]

The success of the reclaimed High Line has attracted more than thirty notable developments adjacent to the park, including condominiums by Jean Nouvel and Shigeru Ban, Frank Gehry's IAC Headquarters, and Polshek Partnership's Standard Hotel.[11] The park's rise to prominence in the West Side of Manhattan has encouraged a higher standard of design throughout the area. The success of the project is largely due to neighborhood activists, innovative design and phasing, strong political will, and private donations. The *Friends of the High Line* has transformed a quintessential piece of New York's industrial history into a vibrant new park typology for the future.

RECYCLING URBAN INFRASTRUCTURE BY PRODUCTS

- The project is an example of what can be accomplished through private-public partnerships with the government, business community, and non-profit organizations.
- Innovative reclamation projects have the ability to attract notable developments that can increase land value and appeal.
- By phasing the project into three sections, the Friends of the Highline were able to raise public and private funding incrementally. After the first section of the project was completed the new tax revenues produced can be reinvested into the next phase of the project along with additional private campaigning.

Fig.3.20 Landscape creates connections between art, ecology, city, and landscape.

Fig.3.21 Public art paths transverse rail lines and roadways.

RECONNECTING INDUSTRIAL LANDS

OLYMPIC SCULPTURE PARK

Seattle, Washington

Like most post-industrial cities, Seattle is disconnected from its waterfront by transportation infrastructure.[12] In 2001, New York City based architects Weiss Manfredi were commissioned by the Seattle Art Museum (SAM) to reinvent the concept of the urban park and create a new landscape for their outdoor sculpture collection. The 8.5 acre site is comprised of three separate and contaminated parcels of industrial land, located on the edge of the downtown with views to Elliott Bay in the district of Puget Sound.[13]

The Olympic Sculpture Park's design is an uninterrupted Z-shaped "green" public park that seamlessly connects the urban core and the museum's outdoor art exhibition to the revitalized waterfront by rising over the existing transportation infrastructure with sloping planes. By designing a continuously constructed landscape, the architects created a connecting structure that doubles as the largest urban park along the waterfront. This new hybrid landform provides 2,200 feet of unbounded pedestrian movement, which has been long denied between downtown Seattle and the newly refurbished beachfront at the base of the site.[14]

Throughout the site, parallel lines converge along the tilting planes of the constructed landform to provide the primary diagonals that link the city and bay along the Z-shaped plane.[15] A 12,000-square-foot multi-use pavilion provides enclosed exhibition space for the museum as well as room for performances and educational programming.[16] As one descends from the pavilion down the urban parkway, native plantings reveal a temperate evergreen forest, a deciduous forest, and a shoreline garden with aquatic terrace, each representing the major Northwestern landscapes.[17] The pedestrian's journey also reveals the rhythm of overlapping concrete retaining walls, which act as a mediating device


Fig.3.22 Z-shaped landforms connect three former industrial sites to the waters edge.

Fig.3.23 Shifting plans establish distinct zones to create topographically varied settings for art exhibitions.

that "links architecture, earthwork, landscape, and art"[18] to the rail corridor and roadway passages below.

Since it's opening in 2007, the $30.8 million dollar urban park has been deemed a successful public space and a triumph for the City of Seattle for several reasons.[19] The waterfront trail is accessible year round and provides pedestrians and cyclists with a place for recreation adjacent to the downtown. The Olympic Sculpture Park promotes sustainability for Puget Sound by providing environmental education to the public and through its continued partnership with local environmental and academic institutions such as the Seattle Public Utilities and the King Conservation District.[20] The project restored a contaminated industrial land with a public resource that relinks the downtown with the city's waterfront.

RECYCLING URBAN INFRASTRUCTURE BY PRODUCTS

- The park is a thriving example for all post-industrial cities of how abandoned industrial and infrastructural land can be successfully transformed into a functional cultural institution while providing its citizens with an urban park that elegantly negotiates the existing transportation network.
- The project acts as a catalyst of what is possible when multiple organizations collaborate for a common goal, such as increasing the well being of citizens by constructing new public parkland projects, restoring and re-purposing underutilized land and creating nodal architectural elements that will provide a focus of civic amenities.

UNEARTHING A CONCEALED RIVER

CHEONGGYECHEON RESTORATION PROJECT

Seoul, South Korea

During the Joseon reign, the Cheonggyecheon River was built to provide drainage for the city of Seoul. The river flourished for hundreds of years until the city's population in the 1940's grew so rapidly that a squatter settlement made its home along the river and began to heavily pollute the area.[21] During Seoul's 1970's economic boom it was considered a symbol of progress when the Cheonggyecheon River was covered with concrete and replaced by a four-lane elevated highway to make way for a building expansion project.[22] The 5.8 kilometer highway brought a rise in air pollution, congestion, noise and deteriorating health conditions to its citizens.

In the later half of the twentieth century there has been a shift in awareness and priorities for many municipalities world-wide, however this is not always the case. In Seoul emphasis is now placed on equality, not efficiency, environmental protection over new development and people over traffic.[23] To conceal a river that had become heavily polluted due to neglect while burying its cultural resources and history was an act that was in line with past values of urban development.

When Lee Myung-bak was elected mayor of Seoul in 2001, he quickly developed a dramatic plan to remove the elevated highway that separated his city and create green space to help stimulate the economy of the area.[24] Several government organizations were put in place to oversee the 5.8 kilometer landscaped greenway that was to run alongside the revitalized river and reconnect the north and south districts of the city in order to rejoin the cultural and environmental resources. The green corridor was completed in 2005 and boasts a landscaped shoreline, an elaborate network of pedestrian pathways that include waterfront decks and stepping-stones that bridge the two banks, as well

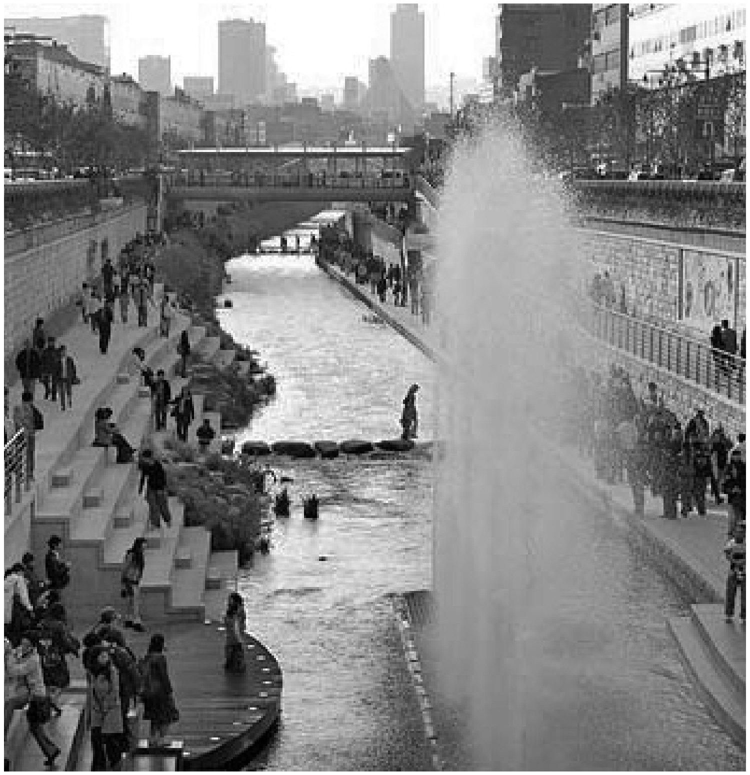


Fig.3.24 The city removed and elevated highway and restored a river into a public parkway.

Fig.3.25 An urban park bridges the gap between north and south districts of the city and brings people together.

Fig.3.26 Chenoggye elevated free-way seperated Seoul's city centre.

Fig.3.27 Freeway support's remain to symbolize the river's history.

Fig.3.28 Stepping stones provide access across river and promote public interaction and play.

Fig.3.29 Lighting transforms the parkway into a theatrical linear stage at night.

as a new Rapid Bus Transit system to accommodate the displaced traffic. The Cheonggyecheon Restoration Project took two years to complete and cost the city of Seoul $281 million (US).[25]

The benefits of the Cheonggyecheon Restoration Project go beyond the physical improvements and civic facilities that were added to the site. The project's has served to created microclimates within a downtown core while reducing pollution. Mayor Lee Myung-bak and his supporting government successfully converted a defunct piece of infrastructure into a thriving green public corridor in the centre of the city within an aggressive time line. The growing international praise for the Cheonggyecheon Restoration project has prompted the City of Seoul to use this project as a catalyst for revitalization to further develop its downtown into a major tourist attraction for both South Korea and overseas tourists.

RECYCLING URBAN INFRASTRUCTURE BY PRODUCTS

- The project has created an interdependent relationship between urban form and culture that has become a catalyst for the City of Seoul's down town rejuvenation master plan as well as a national example of how to define cities in South Korea worldwide.
- The restoration work brought balance to citizens and neighborhoods on both sides of the river by reconnecting cultural and environmental resources and restoring their pride in their city.
- The urban park represents the City's recommitment to its citizens in providing adequate green civic space and public amenities in the downtown.

ACTIVATION

Fig.3.30 Bicycle traffic.

"The world will not evolve past its current state of crisis by using the same thinking that created the situation."

Albert Einstein, *Cradle to Cradle*

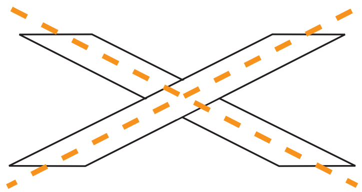
4.1 APPROACH

In order to address the numerous infrastructural challenges associated with co-opting existing service corridors, illustrated in the *Reclaiming Toronto's Utility Corridors* chapter, each infrastructural site condition that requires a design intervention is grouped into one of the following *Urban Form* categories: *Junction Box*, *Vertical Slip*, and *Transverse Link*. Junction Boxes are nodal points along the proposed network where infrastructure is required to enable two systems of mobility to negotiate by one another. Sites include the intersection of rail and hydro corridors and the intersection of two rail corridors. Vertical Slips require infrastructure to shift the networks plane vertically to negotiate through existing conditions, for example rail corridor over and underpasses and existing stairs. Transverse Links occur when the network crosses a mobility system that is unused. Sites included the intersection of a hydro corridor and unused major street, unused rail corridor, and highway, as well as the intersection of a rail corridor with a highway.

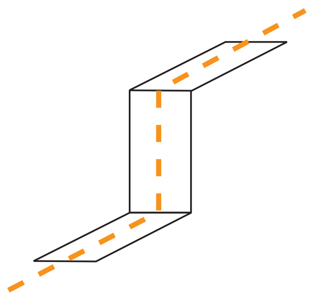
Each *Urban Form* is further sub-categorized as *Heavy, Medium*, or *Light* infrastructural interaction, depending on the scale of negotiation required and dependence of the system. Once the infrastructural conditions within *Urban Pathways* are mended, both cycling and public amenities can be layered onto the newly connected *long-haul* network. The following chapter applies the *Urban Form* strategy onto a series of test sites that are further developed throughout the *Application* portion of the thesis. Access to both hydro and rail corridors, basic design principles, and the phasing of *Urban Pathways* into a series of linear parkways are addressed in this chapter.

Facing page:
Fig.4.1 *Urban Pathways* symbol.

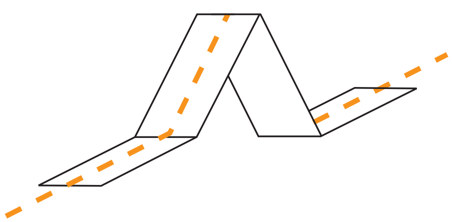
URBAN FORM



JUNCTION BOX

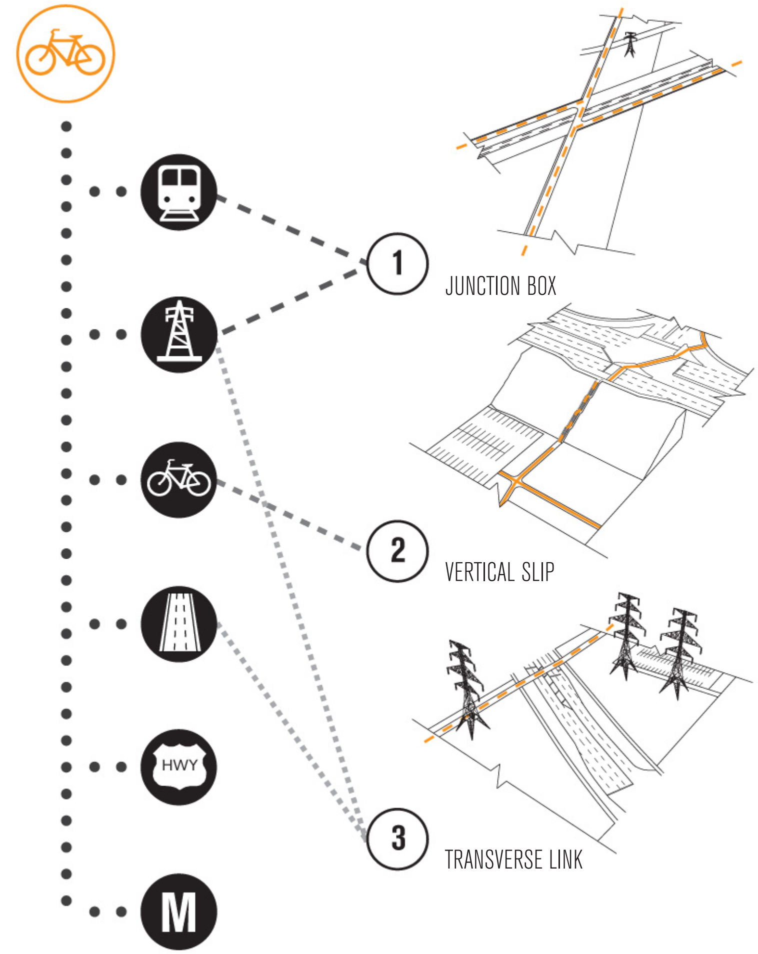


VERTICAL SLIP



TRANSVERSE LINK

LIGHT

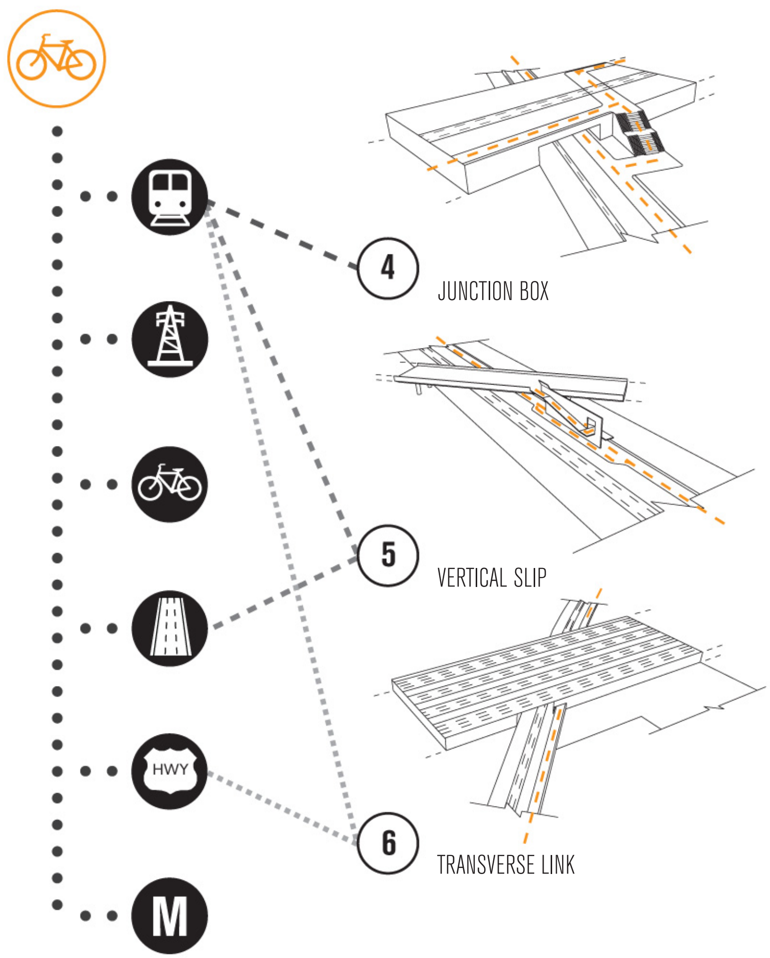


Light urban form requires minimal infrastructural interaction.

Rail Corridor	Major Street
Hydro Corridor	Highway
Bicycle Path	Transit Station

Fig.4.2 Light form.

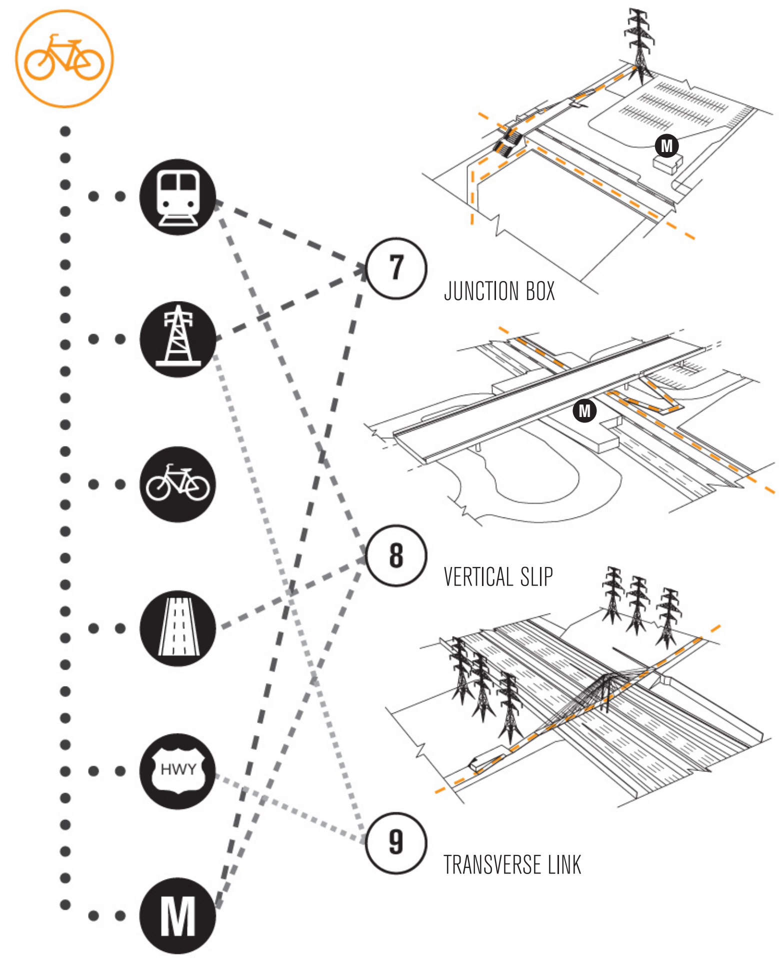
MEDIUM



Medium urban form requires additional infrastructural interaction.

Fig.4.3 Medium form.

HEAVY



Heavy urban form requires substantial infrastructural interaction due to the presence of a transit station or a major highway that disconnects the network.

Fig.4.4 Heavy form.

HYDRO CORRIDOR ACCESS

Fig.4.5 Hydro corridor access with connections to future on-street bike lanes proposed by the City of Toronto.

Fig.4.6 Junction Box - Heavy (intersection of a hydro and rail corridors with a transit station)

Fig.4.7 Transverse Link - Light (hydro corridor is intercepted by a major roadway)

Fig.4.8 Transverse Link - Heavy (hydro corridor is intercepted by a highway)

A portion of both the rail and hydro corridors within the proposed *Urban Pathways* network is broken down in the following set of images to illustrate the typical frequency of access along each corridor. Access to the network along hydro corridors is the most frequent as access occurs at all major and minor streets and intersections with rail corridors. Due to frequent vertical shifts along rail corridors, access to these mobility paths is less common. Typically access to rail corridors occurs at intersections with hydro corridors, other rail corridors and with major streets that the City of Toronto is proposing a future bike lane along (short-haul routes). To further develop each portion of rail and hydro corridors, nine sites are chosen within the corridors to address each *Urban Form* infrastructure challenge.

Urban Pathways mobility paths follow a basic design principle of linear path and node. The path mends the existing infrastructure to provide a continuous long-haul mobility option, while the node provides both cycling and public amenity. Mobility paths are positioned along the edges of rail and hydro corridors and only shift direction towards existing amenities.

RAIL CORRIDOR ACCESS

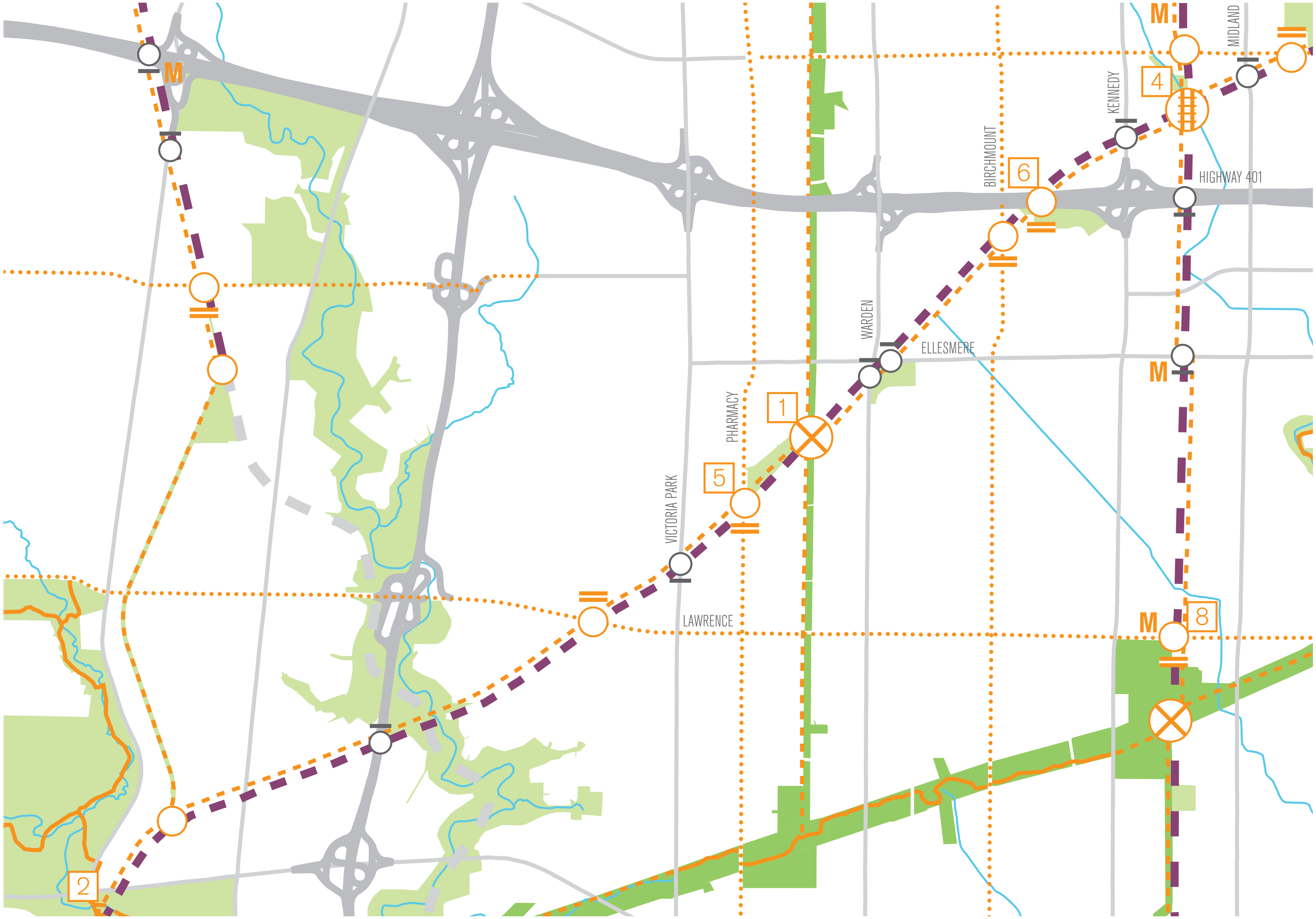


Fig.4.9 Rail corridor access with connections to future on-street bike lanes proposed by the City of Toronto.

Fig.4.10 Junction Box - Light (intersection of a small hydro and rail corridor)

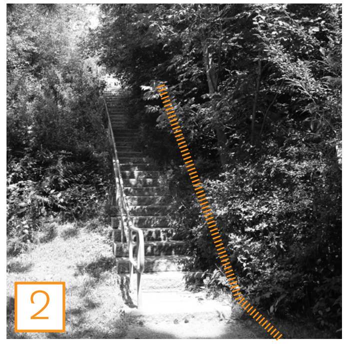


Fig.4.11 Vertical Slip - Light (recreation corridor stairs)

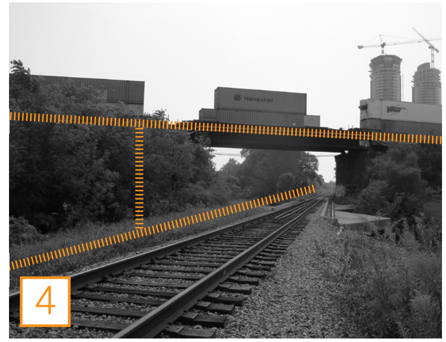


Fig.4.12 Junction Box - Medium (raised intersection of rail corridors)

Fig.4.13 Vertical Slip - Medium (intersection of a rail corridor and major street)

Fig.4.14 Transverse Link - Medium (intersection of a highway and rail corridor)

Fig.4.15 Vertical Slip - Heavy (intersection of a rail corridor and major street with a transit station)

Test sites

Flush Intersection - Rail + Hydro

Raised Intersection - Rail + Rail

Flush Intersection - Rail + Path/Road

Transit Station

Rail Overpass + Access point

Rail Overpass

Rail Underpass + Access point

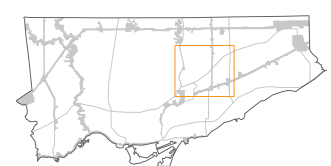
Rail Underpass

Park/Recreational Field

Rail Corridor (grey-unused)

Hydro Corridor

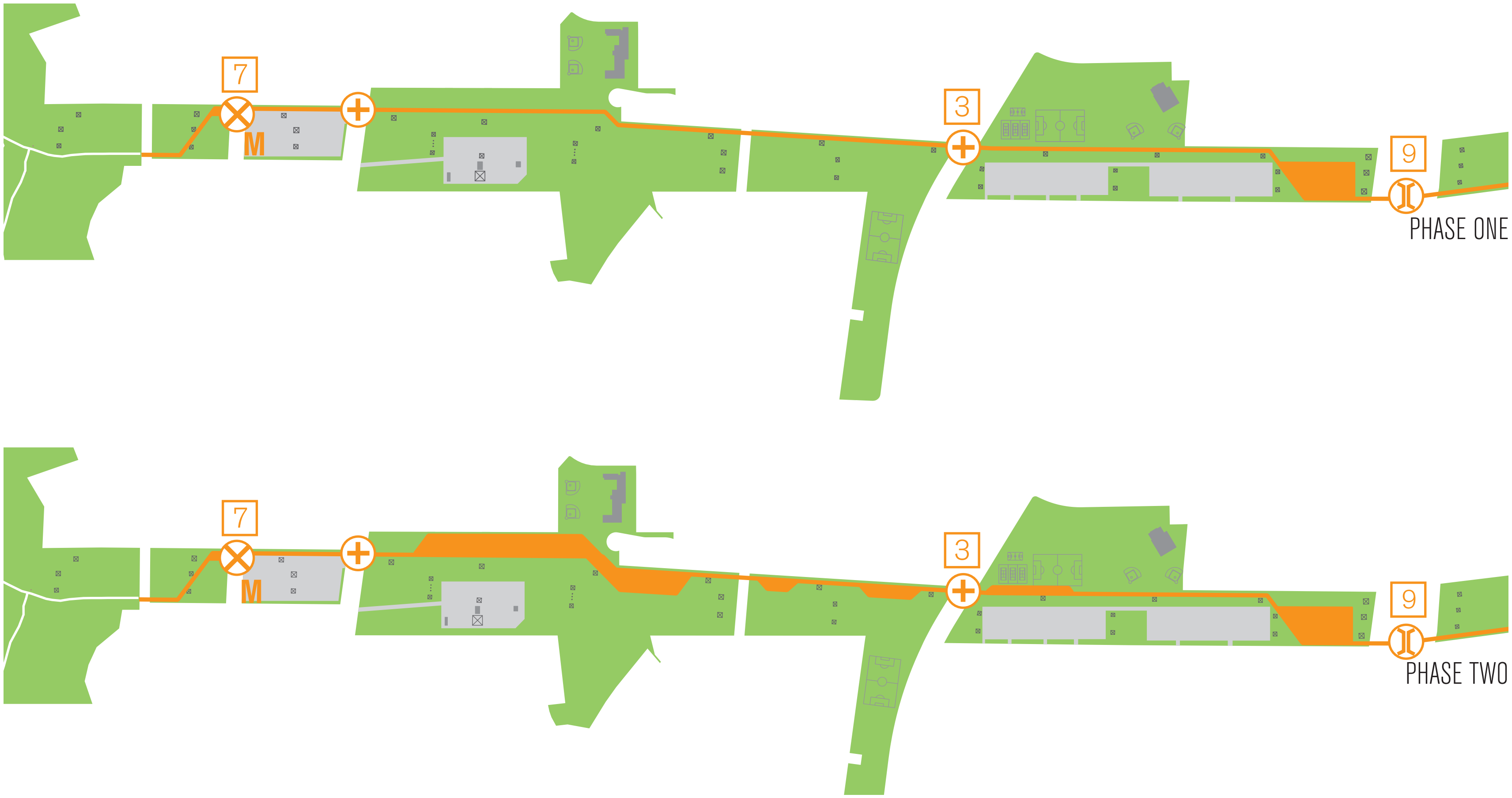
Mobility Path (solid-existing, dashed-proposed, dotted-future on-street bicycle lane proposed by City)



Key map

0 2km

PHASING - LINEAR PARKWAY



Test sites

Intersection - Hydro + Major Street

Flush Intersection - Hydro + Rail

Intersection - Hydro + Highway

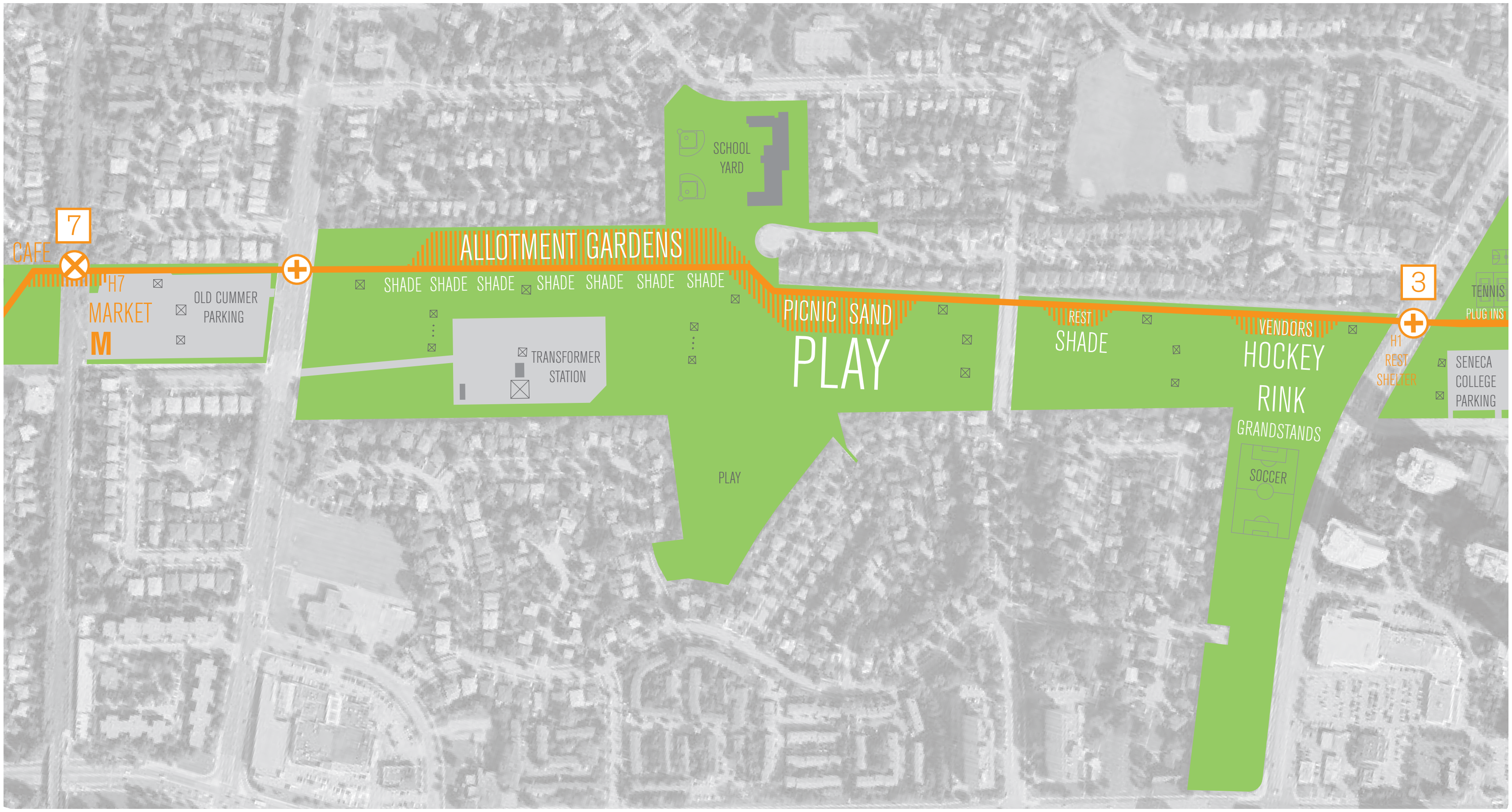
Transit Station

Hydro Corridor

Mobility Path and Hub

Key map

Fig.4.16 Phasing a portion of Finch Hydro corridor into a linear parkway.

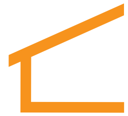


PHASE TWO AMENITIES

During phase one all necessary infrastructural connections will be constructed to allow the mobility paths to become a continuous network. Bicycle hubs with public amenities will be constructed during this phase and located at specific transit stations and strategic locations throughout the network. *Urban Pathways* will be further developed into a series of linear parkways by layering additional public and park amenities within hydro corridors during phase two. Recreational playing fields, allotment gardens, rest, shade, and picnic areas are a few potential amenities that will aid in transforming the mobility corridors into multi-functioning public spaces.

Fig.4.17 Phase two, additional public amenities.


Vending


Shelter


Information

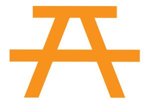
Bicycle Rental


Washroom

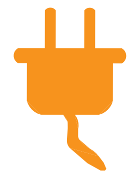

Play

Bicycle Parking


Community Mural


Picnic


Skating


Plug In


Rest


X-Country Skiing

Bicycle Lane


Shade


Allotment Garden

Metro Station


Repair


Concert


Sports Field


Tobogganing


Hydro Corridor

Bicycle Safety Course


Skate Park

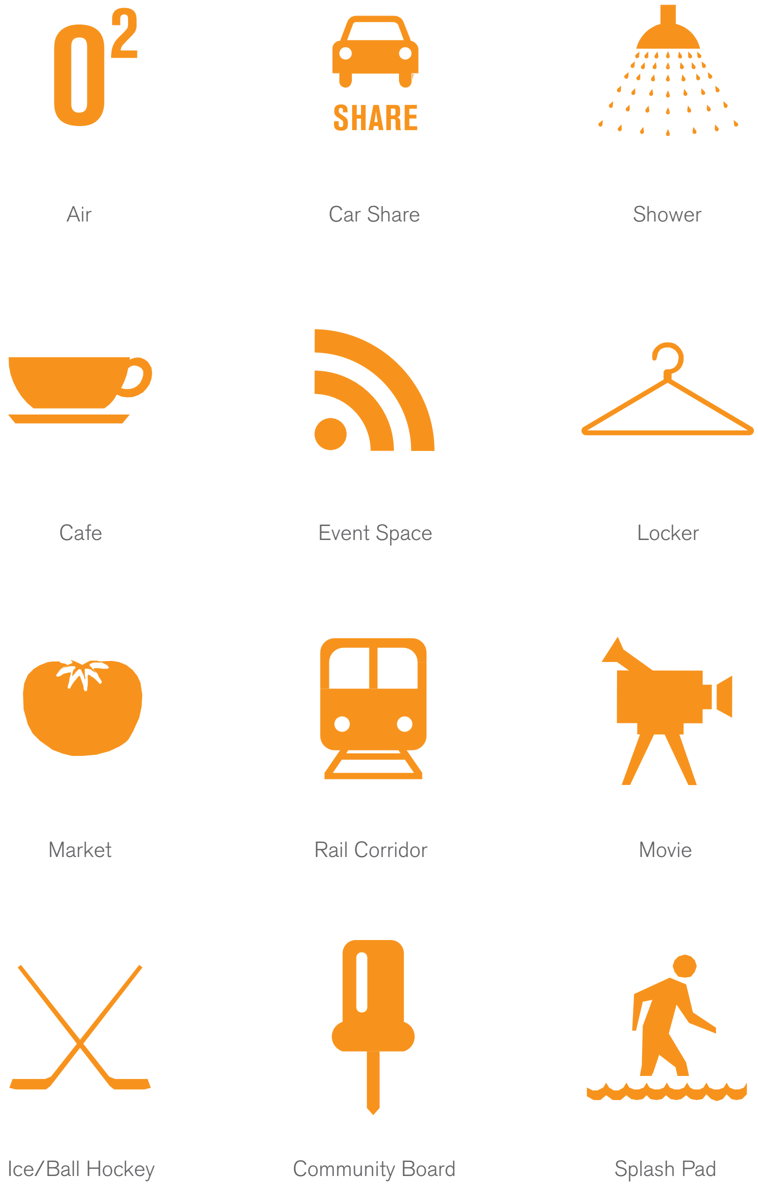


Fig.4.18 Network amenities.

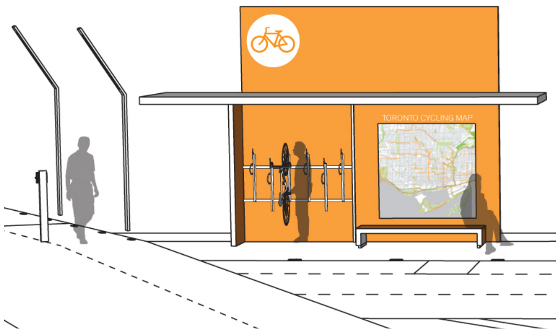
4.2 KIT OF PARTS

Urban Pathways is comprised of several network components: bicycle hubs, lighting, public amenity, and path material. Each component will be address in the following chapter and later applied to nine test sites.

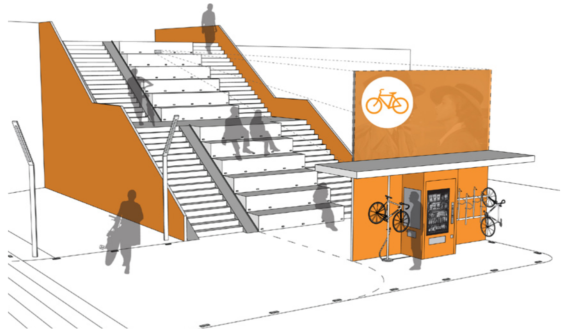
Bicycle Hub breakdown:
Seven bicycle hubs provide a range of amenities for different network applications: recreation, commuter, repair, and parking. As each hub is applied to a site, new public opportunities are created allowing the hubs to act as amenities for both cyclists and their communities.

H1 -vertical parking hub
-locate at bus stations and along corridors near existing amenities
H2 -commuter repair hub
-locate along rail corridors
H3 -expanded self-service repair hub (snack/repair parts vending machine)
-locate at sites where infrastructure intersects
H4 -recreational hub (washroom)
-locate within existing recreational corridors or near existing parks
H5 -expanded recreational hub (café)
-locate within existing recreational or hydro corridors that will be phased into linear parkways
H6 - commuter hub (washrooms, lockers, showers, and parking)
-located near existing TTC and GO Transit stations
H7 -large commuter hub with recreational amenities (café/bicycle rental and full service repairs)
-located at intersection of two corridors where one will be phased into a linear parkway

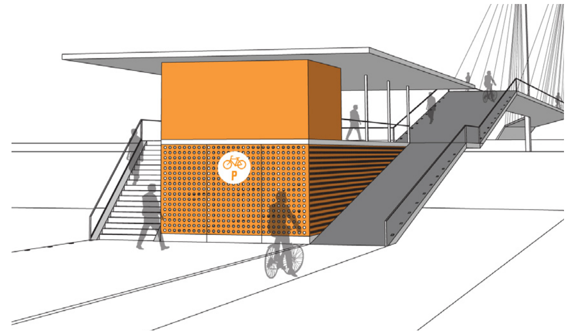
BICYCLE HUBS



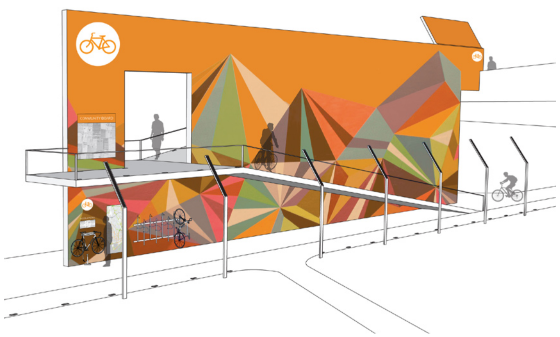
HUB ONE - PARKING



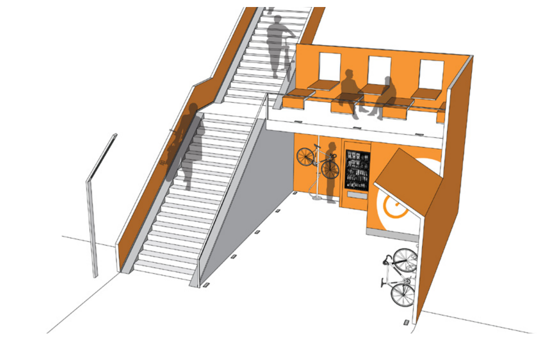
HUB THREE - VENDING



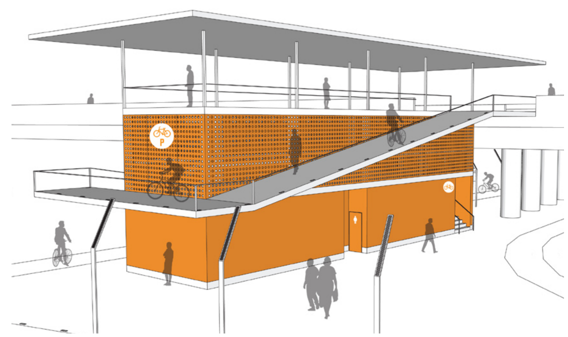
HUB FIVE - CAFE



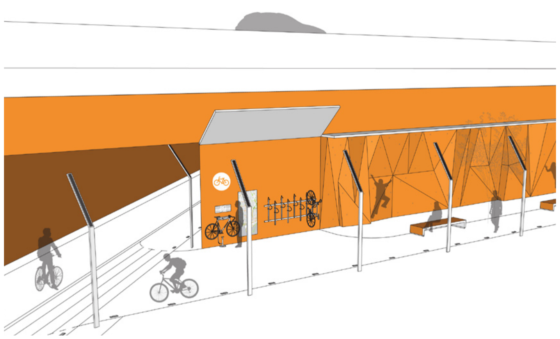
HUB TWO - REPAIR



HUB FOUR - RECREATION

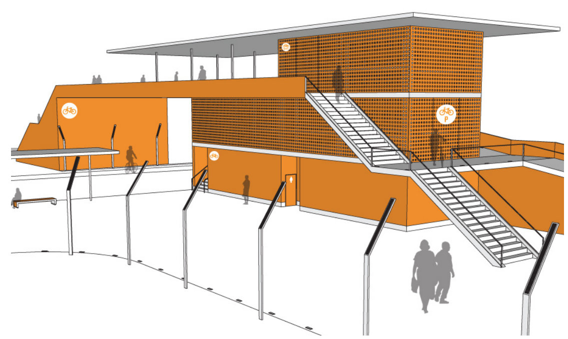


HUB SIX - COMMUTER



HUB TWO - REPAIR

HUB FOUR - RECREATION



HUB SEVEN - COMMUTER + RECREATION

Fig.4.19 Hub types one to four.

Fig.4.20 Bicycle hub amenity breakdown.

LIGHTING

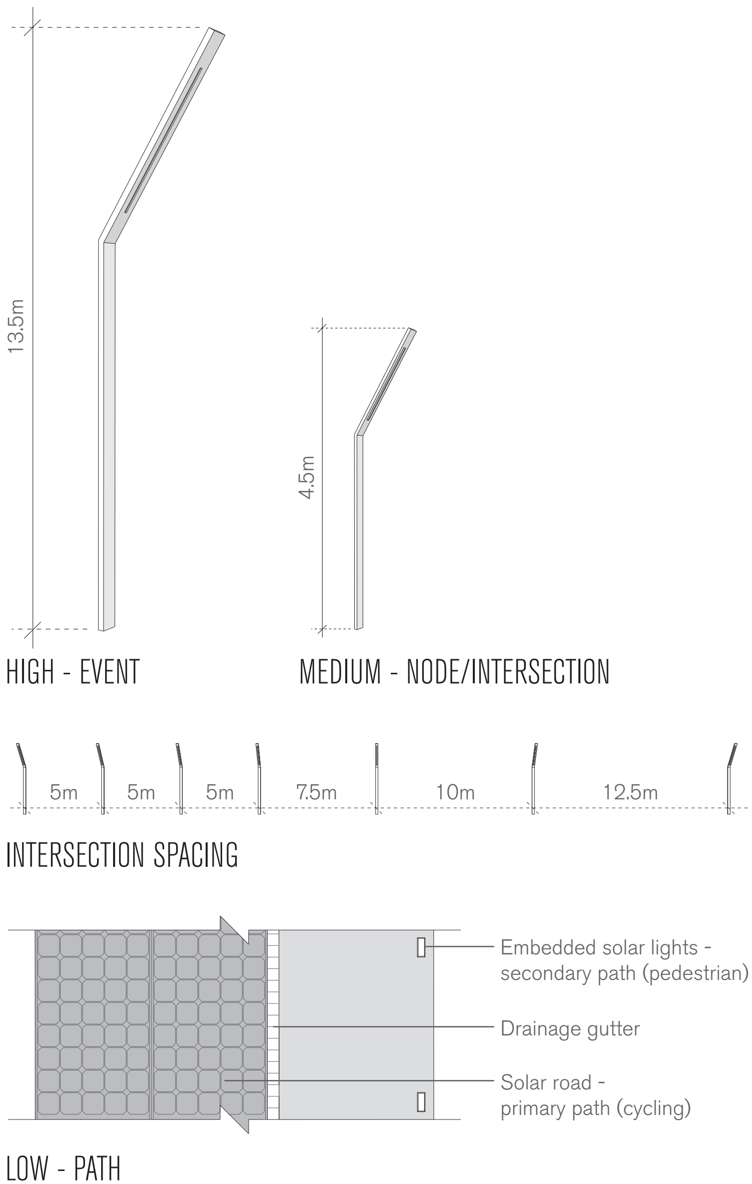


Fig.4.21 Lighting strategy.

Urban Pathways lighting strategy is comprised of high, medium, and low solar lights. High lighting occurs at public amenities and event spaces along the networks hydro corridors. All infrastructure intersections and nodal points (bicycle hubs with public amenity) within the proposed mobility network require medium lighting to provide safety. The medium lights gradual increase of placement allows the network user to become aware of approaching intersections and amenities along the path. Low solar lights are embedded within all secondary paths (pedestrian) and connecting infrastructure elements such as stairs, ramps, and bridges. This allows the secondary paths to read as a continuous yet separate entity throughout the corridors. Primary paths (cycling) are comprised of and lit by solar roads, which have the ability to distribute power and data along the path, lighting the route for cyclists only when the path is in use.

MATERIAL

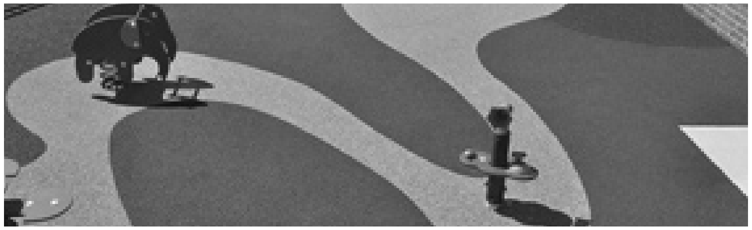


Fig.4.22 Soft - Playpad

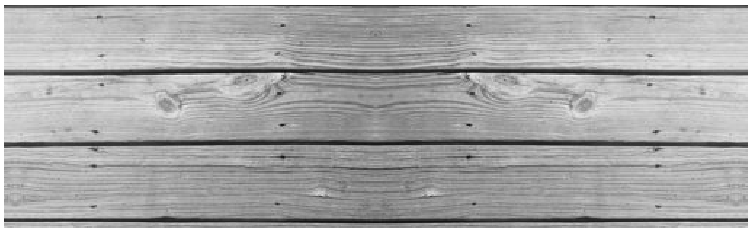


Fig.4.23 Hard - Wood Decking (amenity/hub flooring)

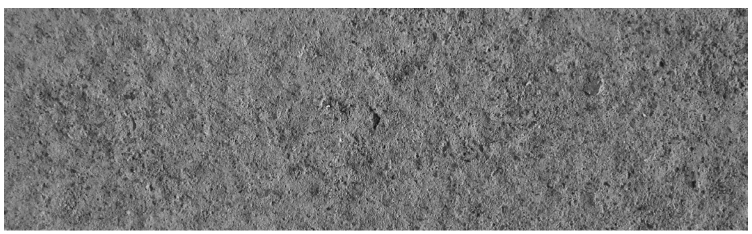


Fig.4.24 Hard - Concrete (secondary pedestrian path)

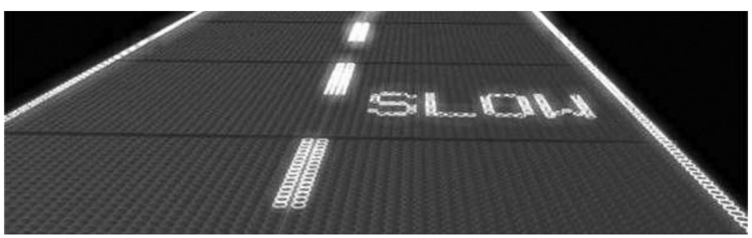


Fig.4.25 Hard - Solar Road (primary cycling path)

Materials help to define space and provide way finding along the corridors. Hard surfaces create the primary and secondary linear mobility paths that develop a continuous *long-haul* mobility network. The two paths provide space for different speeds of mobility and are separated by a continuous drainage board; paving patterns allow these systems of mobility to negotiate one another at all intersections and nodal points.

Pedestrian paths (secondary) are two metres in width and are comprised of concrete. These paths have the ability to be used for cross-country skiing routes during the winter months, as snow removal is difficult within the corridors.

Cycling paths (primary) are three metres in width and are comprised of a sophisticated solar road technology. The top layer of solar roads is a material that provides traction and weatherproofing to the lower two layers. The middle electronic layer is where solar collecting cells have the ability to store and distribute energy, melt snow and ice, as well as control lighting, communication and monitoring. The base layer distributes power and data.[1] With limited accessibility for path maintenance, solar road technology enables Urban Pathways to remain operational during the winter while having the potential to go off grid and become a self-sustaining network.


7
3
9
4
6
1
5
8
2
108

1. Junction Box - Light
2. Vertical Slip - Light
3. Transverse Link - Light
4. Junction Box - Medium
5. Vertical Slip - Medium
6. Transverse Link - Medium
7. Junction Box - Heavy
8. Vertical Slip - Heavy
9. Transverse Link - Heavy

Facing page:
Fig.4.26 Location of nine test sites.

4.3 TEST SITES

The following nine test sites address all major infrastructural challenges that *Urban Pathways* must resolve in order to create a continuous *long-haul* mobility network. The sites have been divided into *Urban Form* categories depending on the amount of infrastructure that they require (heavy, medium, and light), as well as what infrastructural form they address (junction box, vertical slip, and transverse link).

Each site is a prototype, as their design intervention has the ability to address similar sites with the same *Urban Form* throughout the network. All sites have been designed to illustrate *Urban Pathways* during phase one and rendered to demonstrate summer usage.

1.0 JUNCTION BOX

LIGHT

Fig.4.27 Key map, similar Light Junction Boxes (intersection of rail and hydro corridors) are shown dotted.

EXISTING
Public Amenity

- Park Land
- Recreational Field
- Public Library
- School
- Community Centre

H4 PROPOSED
Bicycle Hub

- Information
- Air
- Repair
- Vending
- Bicycle Parking
- Washroom

PROPOSED
Public Amenity

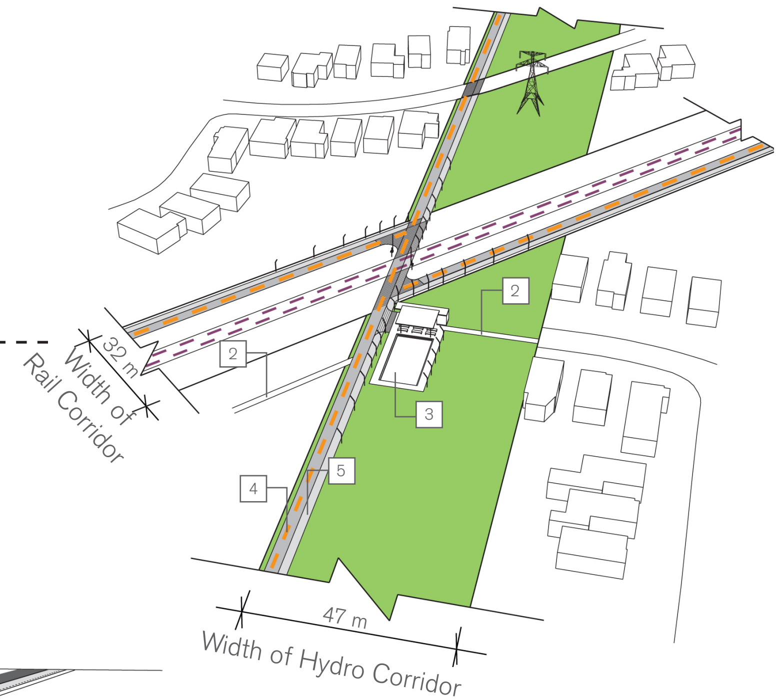
- Shade
- Splash Pad
- Ice Skating
- Rest

- Park/Recreational Field
- Rail Corridor
- Hydro Corridor
- Mobility Path (dashed-proposed, dotted-future bicycle lane by City)

- Rail Corridor
- Hydro Corridor
- Bicycle Path
- Major Street
- HWY Highway
- M Transit Station

Fig.4.28 Site one is the intersection of a narrow hydro corridor and rail corridor within a residential area. Mobility paths are proposed along each corridor and require a simple infrastructural intervention to connect the proposed paths through the corridors.

1 Rail Barrier
2 Existing Path
3 Splash Pad/Ice Skating
4 Primary Path-Cycling (solar path)
5 Secondary Path-Pedestrian (concrete)
6 Solar Lighting
7 Embedded Solar Lights
8 Bicycle Repair/Air
9 Vertical Bicycle Parking
10 Information Board/City Cycling Map
11 Vending Machine (bicycle parts/refreshments)
12 Accessible Washroom



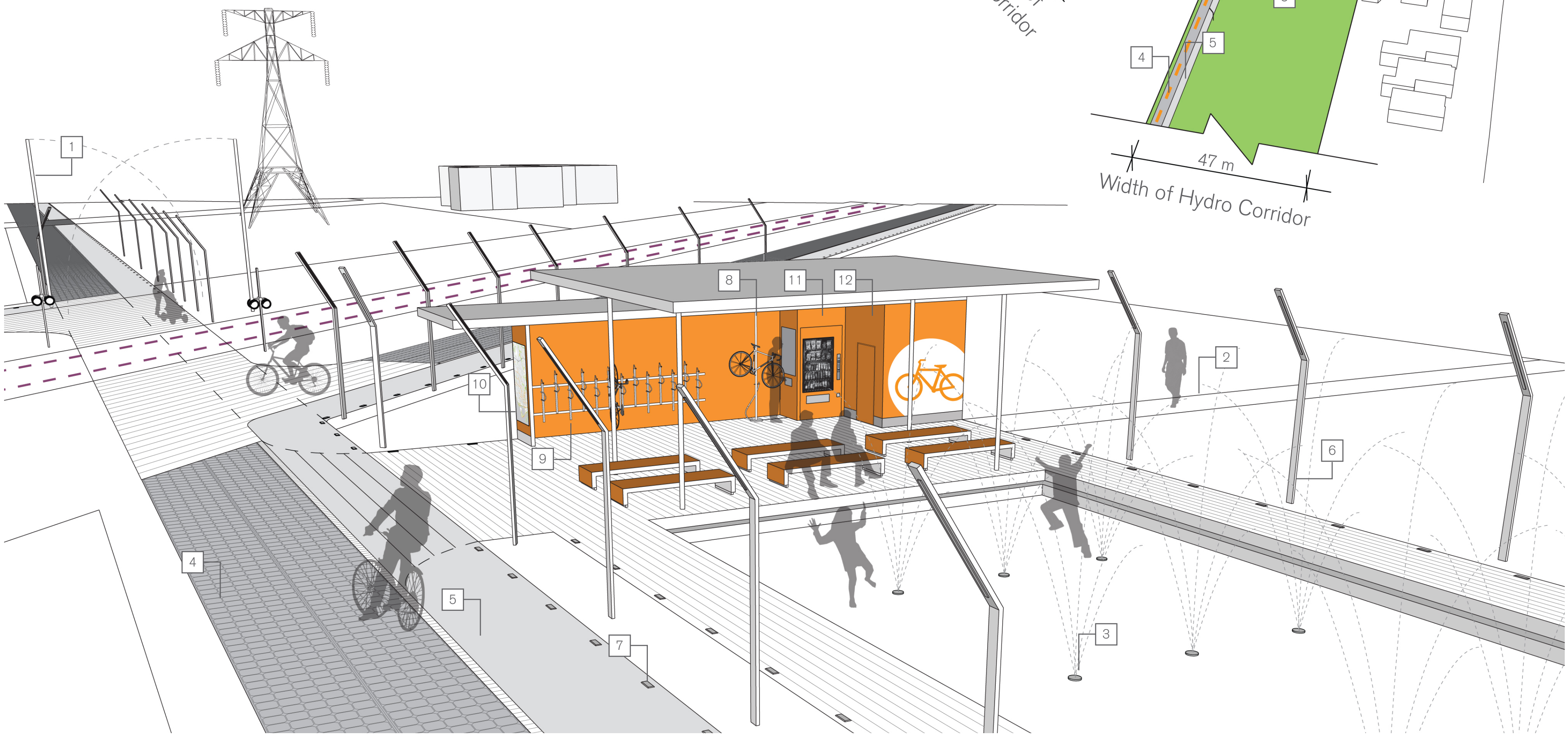


Fig.4.29 Lighting, path material, and rail barriers provide the necessary components to enable the proposed mobility paths to negotiate through the intersection of a rail and hydro corridor. Hub h4 provides seasonal amenities for both summer and winter cyclists and year round public activities for neighbouring residential communities.

2.0 VERTICAL SLIP

LIGHT

Fig.4.30 Key map, similar Light Vertical Slips (existing stairs within Recreational Corridors with no bicycle infrastructure) are shown dotted.

EXISTING
Public Amenity

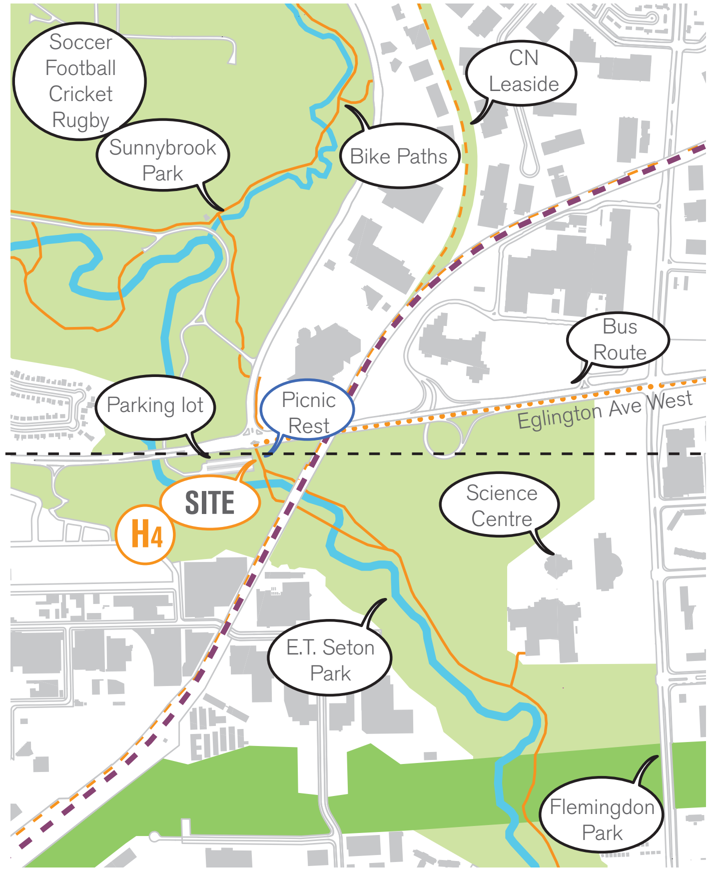
- Park Land
- Recreational Field
- Science Centre
- Bicycle Path

H4 PROPOSED
Bicycle Hub

- Information
- Air
- Repair
- Vending
- Bicycle Parking
- Washroom

PROPOSED
Public Amenity

- Picnic
- Rest



- Park/Recreational Field
- Rail Corridor
- Hydro Corridor
- Mobility Path (solid-existing, dashed-proposed, dotted-future bicycle lane by City)

Rail Corridor

Hydro Corridor

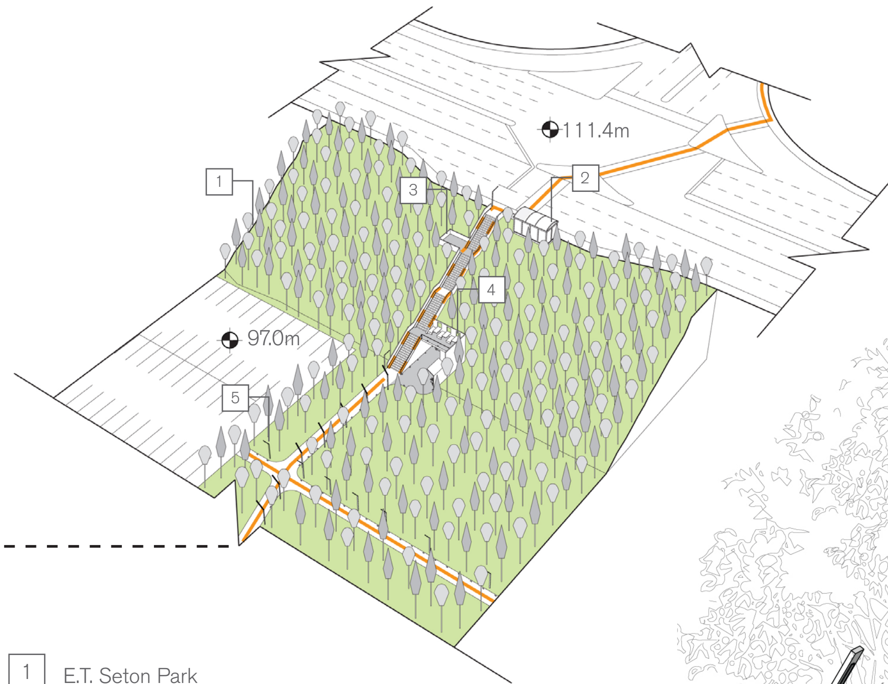
Bicycle Path

Major Street

HWY
Highway

M
Transit Station

Fig.4.31 Site two lies between Sunnybrook Park and E.T. Secton Park near the Don Valley River. Currently, seventy-three stairs separate the existing recreational path that connects the parks; this prevents cyclists from efficiently connecting through the parks and to Eglington Ave. West (bus route and future on-street bicycle lane).



1 E.T. Seton Park

2 Existing Bus Stop

3 Rest/Lookout Point

4 Picnic

5 Solar Lighting

6 Existing Stair

7 Bicycle Gutter/Tube Lighting

8 Embedded Solar Lights

9 Bicycle Repair/Air

10 Vending Machine (bicycle parts/refreshments)

11 Accessible Washroom

12 Information Board/City Cycling Map

13 Vertical Bicycle Parking

Fig.4.32 Bicycle gutters mend the fractured recreational infrastructure allowing the existing corridor to act as a long-haul mobility path for cyclists. Recreational hub H4 provides amenities for cyclists and additional public amenities within the public park (picnic/rest). Low and medium solar lighting lengthen the corridors hours of operation and safety.

3.0 TRANSVERSE LINK
LIGHT

Fig.4.33 Key map, site three. Orange dots represent similar sites, grey represent sites where existing bicycle paths and major streets intersect.

EXISTING
Public Amenity

- Park Land
- Recreational Field
- School
- College/University

H1 PROPOSED
Bicycle Hub

- Information
- Bicycle Parking

PROPOSED
Public Amenity

- Rest
- Shelter

- Park/Recreational Field
- Hydro Corridor
- Mobility Path (solid-existing, dashed-proposed)

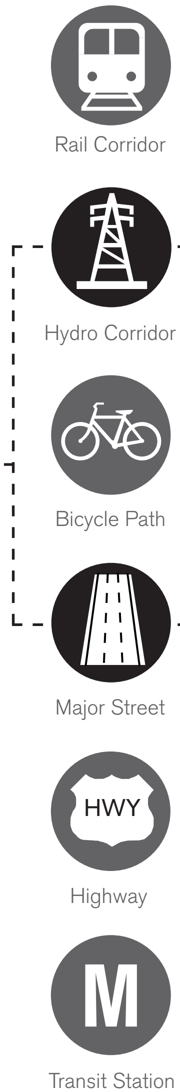


Fig.4.34 Site three crosses Don Mills Road near an existing bus stop (with no shelter). Proposed mobility paths within the Finch Hydro Corridor require infrastructure to negotiate across a major street.

Fig.4.35 Push button crossing stands and path patterns gives cyclists and pedestrians the right-of-way over vehicular traffic. Hub H1 allows cyclists to pair with existing transit networks by providing sheltered parking.

4.0 JUNCTION BOX
MEDIUM

Fig.4.36 Key map, similar Medium Junction Boxes (raised intersection of rail corridors) are shown dotted.

EXISTING
Public Amenity

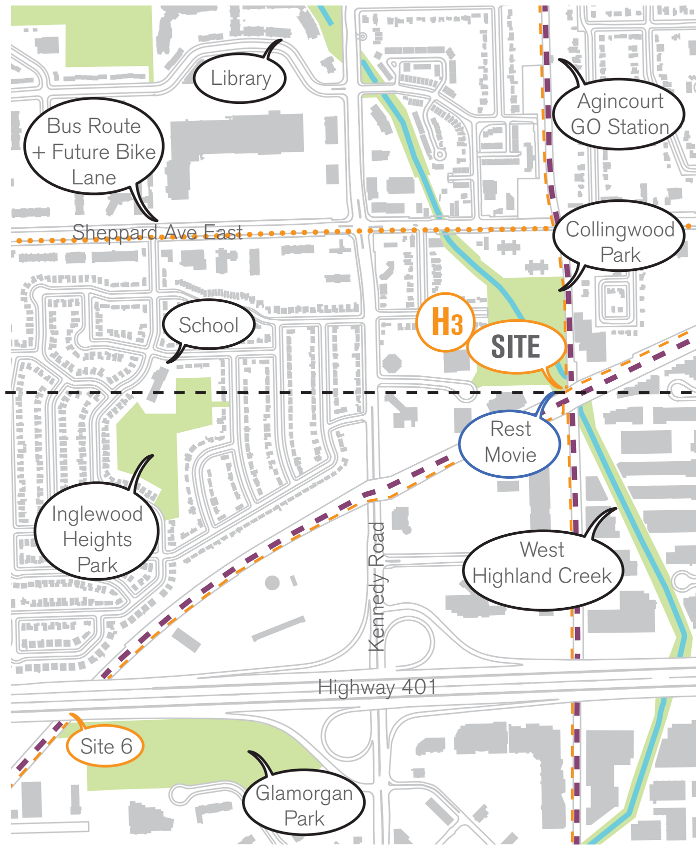
- Park Land
- School
- Public Library

H3 PROPOSED
Bicycle Hub

- Information
- Air
- Repair
- Vending
- Bicycle Parking

PROPOSED
Public Amenity

- Rest
- Movie



Park/Recreational Field

Rail Corridor

Mobility Path (dashed-proposed, dotted-future bicycle lane by City)

Fig.4.37 Site four is located adjacent to Collingwood Park, West Highland Creek, and the raised intersection of two rail corridors (GO Transit and Canadian Pacific Railway). Mobility paths are proposed along each corridor and require both vertical and transverse infrastructure to connect the paths.

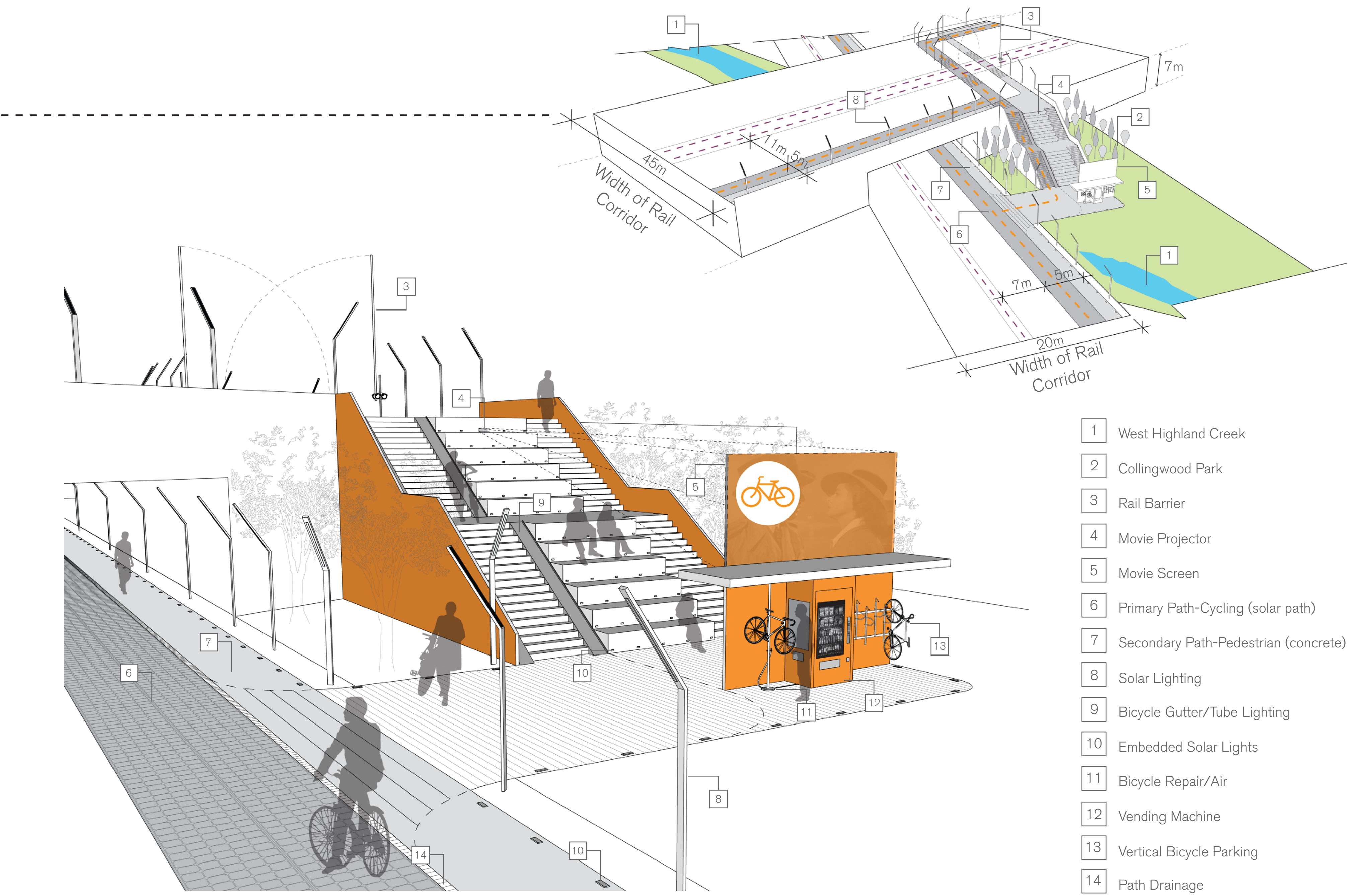


Fig.4.38 A series of stairs with bicycle gutters connect the rail corridors while providing a view of Collingwood Park, a place to rest, and watch an outdoor movie. Rail barriers allow the existing raised rail corridor and proposed mobility paths to safely negotiate by one another.

5.0 VERTICAL SLIP

MEDIUM

Fig.4.39 Key map, site five. Orange dots represent similar underpass sites, grey represent overpass sites that have similar infrastructural conditions.

EXISTING
Public Amenity

- Park Land
- Recreational Field
- Public Library
- School
- Community Centre

H2 PROPOSED
Bicycle Hub

- Information
- Air
- Repair
- Bicycle Parking

PROPOSED
Public Amenity

- Community Mural
- Community Board

- Park/Recreational Field
- Rail Corridor
- Hydro Corridor
- Mobility Path (dashed-proposed, dotted-future bicycle lane by City)

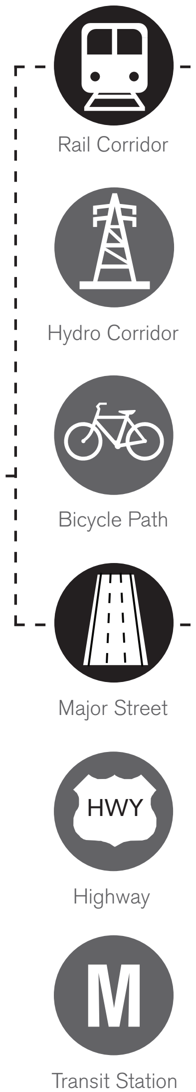


Fig.4.40 Site five occurs at the raised intersection of a major street and rail corridor and is adjacent to recreational fields, a community centre, and school of art.

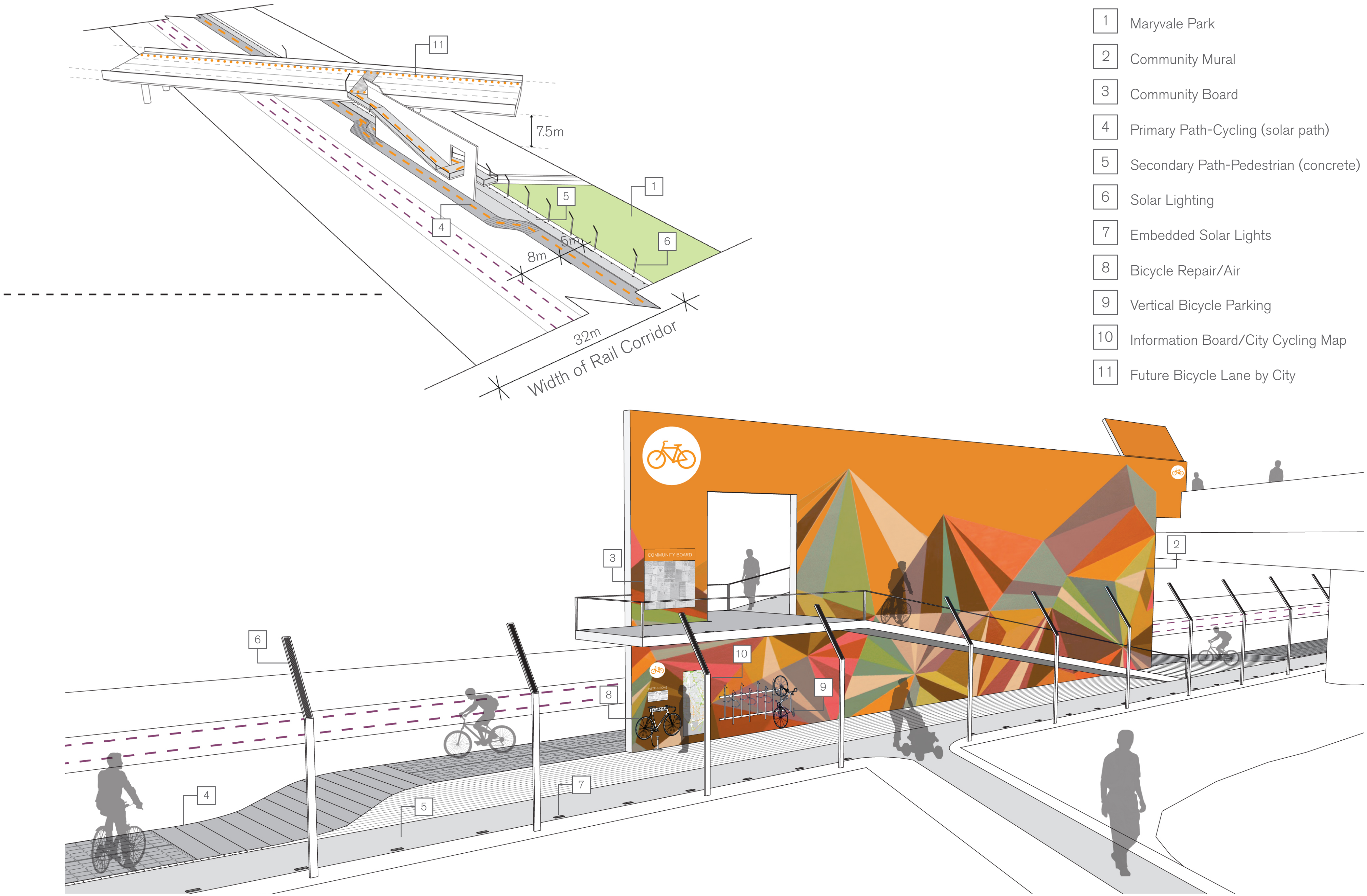


Fig.4.41 A switchback ramp connects the rail corridor to Pharmacy Ave where, future bicycle lanes are proposed by the City of Toronto. Connections to Maryvale Park from the hub increase neighbouring communities access to public amenities, while the proposed community mural (maintained by the School of Art) provides a visual link.

6.0 TRANSVERSE LINK
MEDIUM

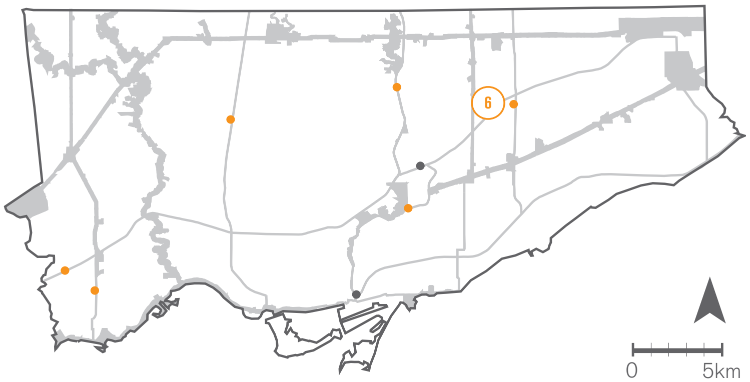


Fig.4.42 Key map, similar Medium Transverse Links (rail corridor underpass with a highway) are shown dotted in orange, grey represent overpasses.

EXISTING
Public Amenity

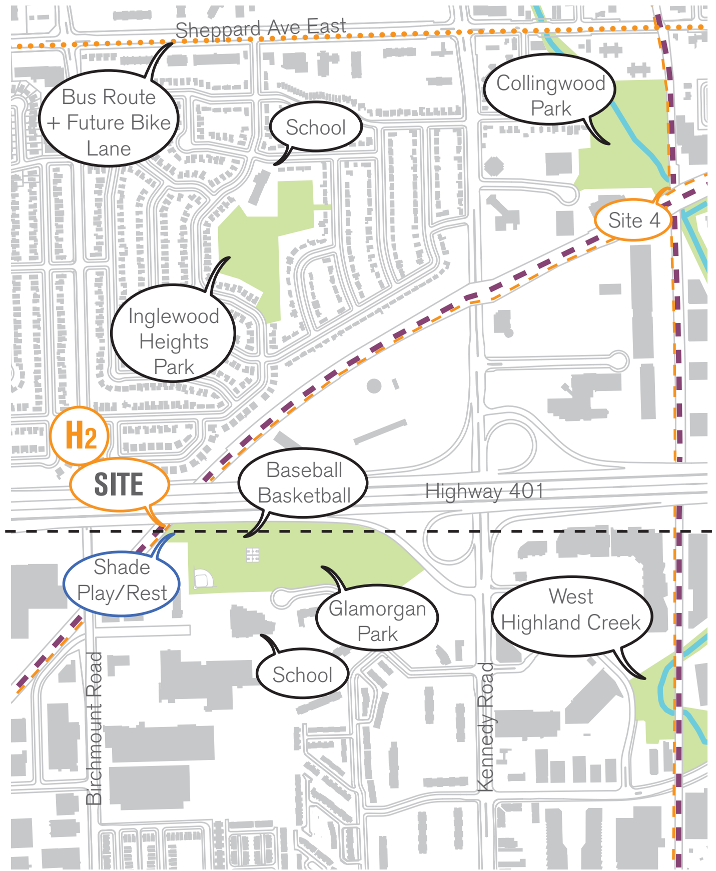
- Park Land
- Recreational Field
- School

PROPOSED
Bicycle Hub

- Information
- Air
- Repair
- Bicycle Parking

PROPOSED
Public Amenity

- Shade
- Rest
- Play-Transverse Climbing Wall



- Park/Recreational Field
- Rail Corridor
- Mobility Path (dashed-proposed, dotted-future bicycle lane by City)

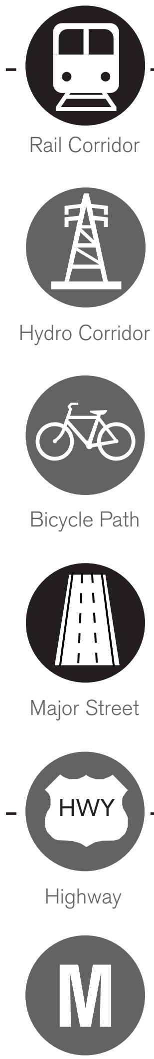


Fig.4.43 Site six is located adjacent to Glamorgan Park, a public school, and beneath highway 401, within a rail corridor. The extensive length of the underpass and limited width alongside the active rail corridors requires physical separation from the proposed mobility paths.

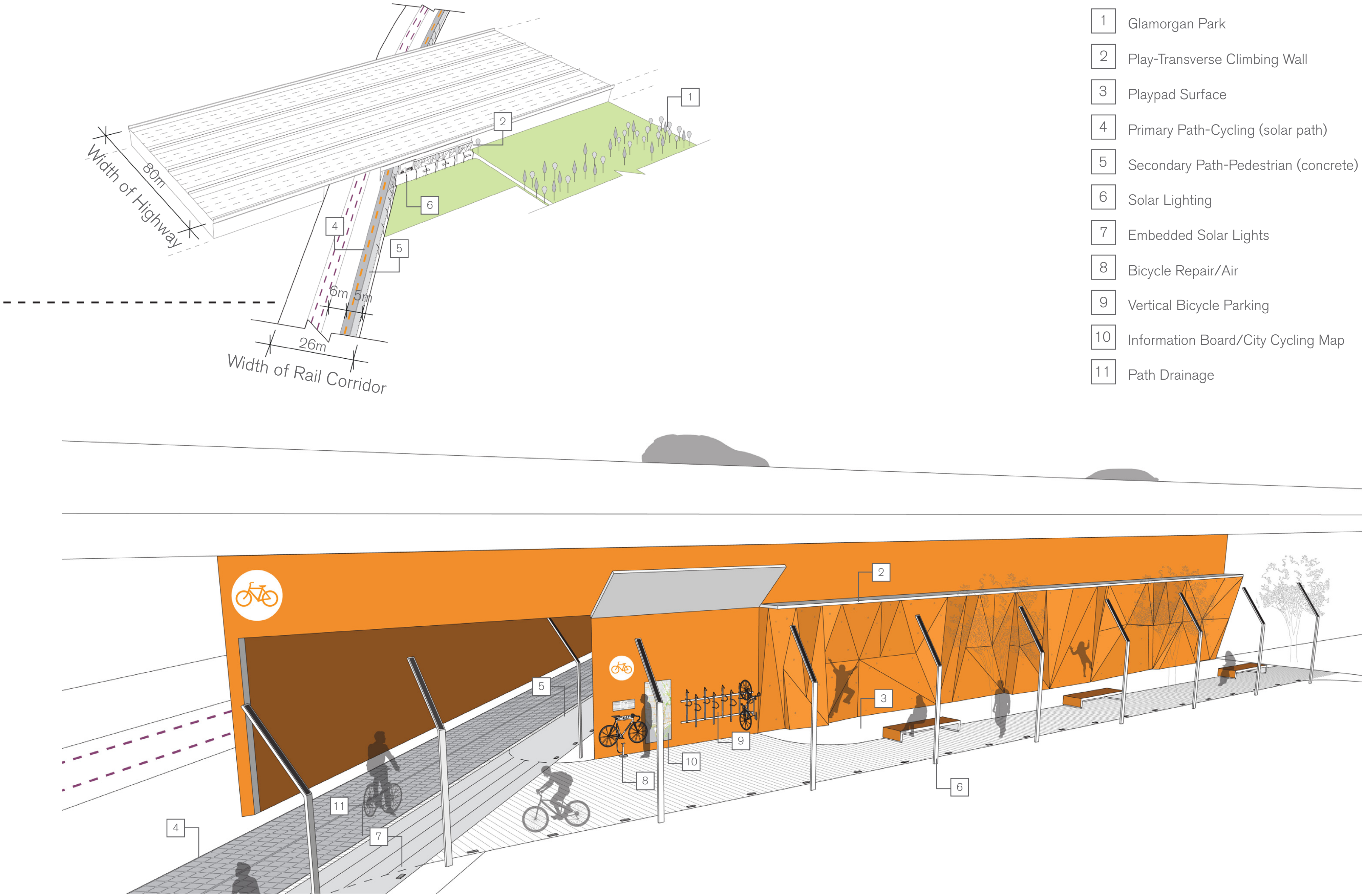


Fig.4.44 A wall provides separation between the existing and proposed infrastructure and folds to become a vertical public amenity (transverse climbing wall) and commuter cycling repair hub.

7.0 JUNCTION BOX
HEAVY

Fig.4.45 Key Map, Junction Box Heavy.

EXISTING
Public Amenity

- Park Land
- Recreational Field
- Public Library
- School
- Community Centre
- Bicycle Path

H7 PROPOSED
Bicycle Hub

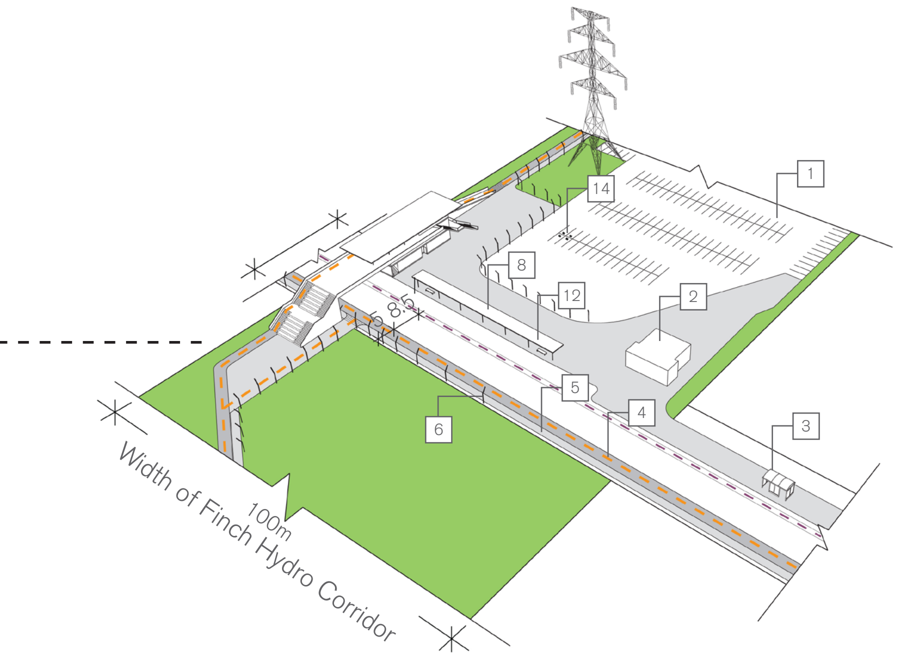
- Information
- Air
- Repair
- Bicycle Parking
- Washroom
- Shower
- Locker
- Transit Station
- Cafe
- Bicycle Rental
- Car Share

PROPOSED
Public Amenity

- Cafe
- Market

- Park/Recreational Field
- Rail Corridor
- Hydro Corridor
- Mobility Path (solid-existing, dashed-proposed)

Fig.4.46 Site seven is located along the GO Transit line adjacent to Old Cummer Station within Finch Hydro Corridor. Mobility paths are proposed along the rail and hydro corridors and require both a vertical and transverse infrastructure to connect the paths.



1	Existing Parking Lot
2	Existing Metro Station
3	Existing Platform Shelter
4	Primary Path-Cycling (solar path)
5	Secondary Path-Pedestrian (concrete)
6	Solar Lighting
7	Embedded Solar Lights
8	Informal Market Space Shelter
9	Infill Cafe Space
10	Bicycle Rental/Full Service Repair
11	High Density Stacked Bicycle Parking
12	Bus Shelter/Seating
13	Bicycle Gutter with Tube Lighting
14	Reserved Car Share Parking Spots
15	Washroom/Shower/Locker (Male A/Female B)

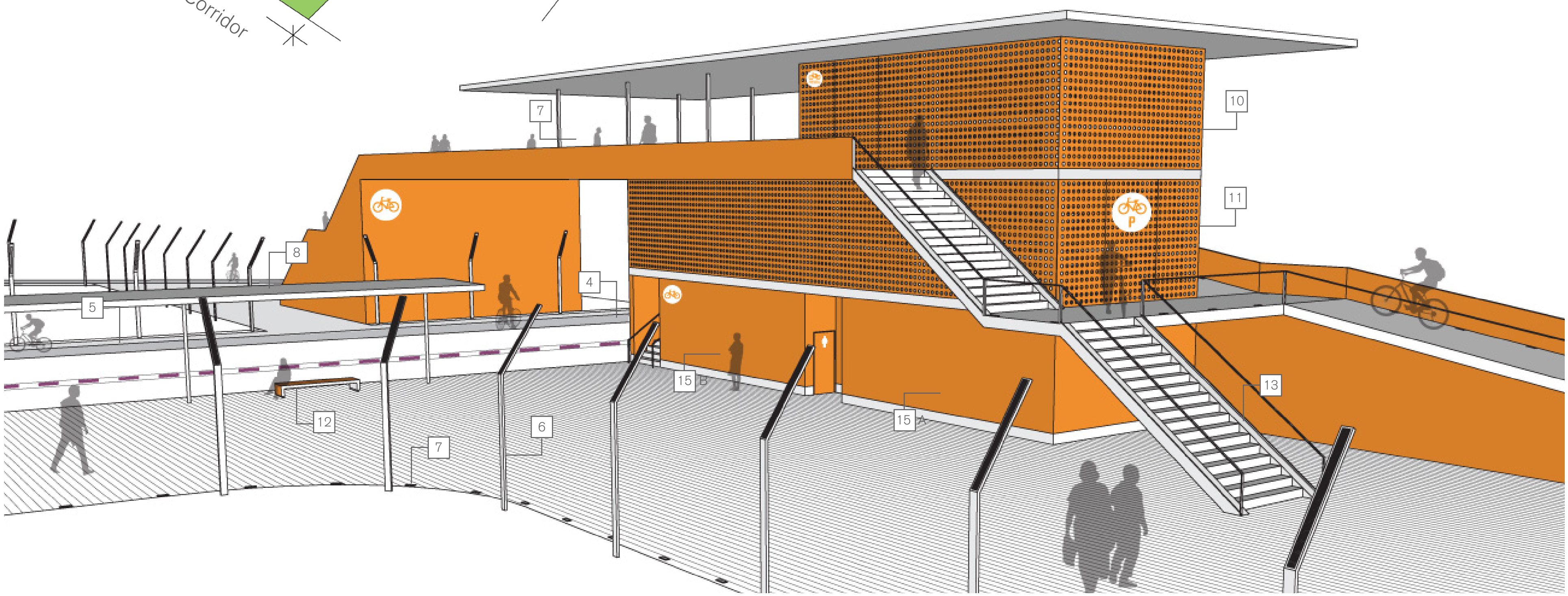


Fig.4.47 Ramps and stairs with bicycle gutters connect the proposed paths through the existing infrastructure, while commuter/recreational hub H7 provides amenities for both cyclists and the neighbouring communities. Site seven will develop further in phase two (landscaping) to become part of a linear parkway system.

8.0 VERTICAL SLIP

HEAVY

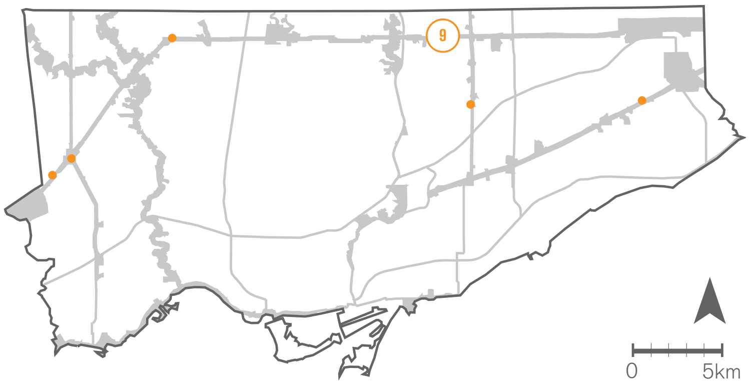


Fig.4.48 Key map, similar Heavy Vertical Slips (raised intersection of a major street and rail corridor) are shown dotted.

EXISTING
Public Amenity

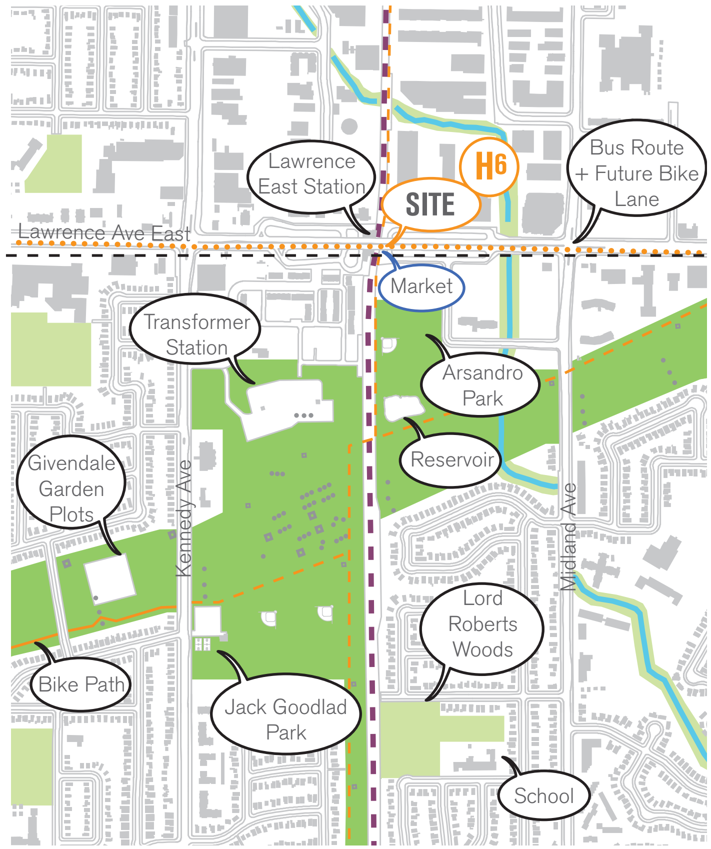
- Park Land
- Recreational Field
- Allotment Garden
- School
- Bike Path

H6 PROPOSED
Bicycle Hub

- Information
- Air
- Repair
- Bicycle Parking
- Washroom
- Shower
- Locker
- Transit Station
- Vending

PROPOSED
Public Amenity

- Market



- Park/Recreational Field
- Rail Corridor
- Hydro Corridor
- Mobility Path (solid-existing, dashed-proposed, dotted-future bicycle lane by City)

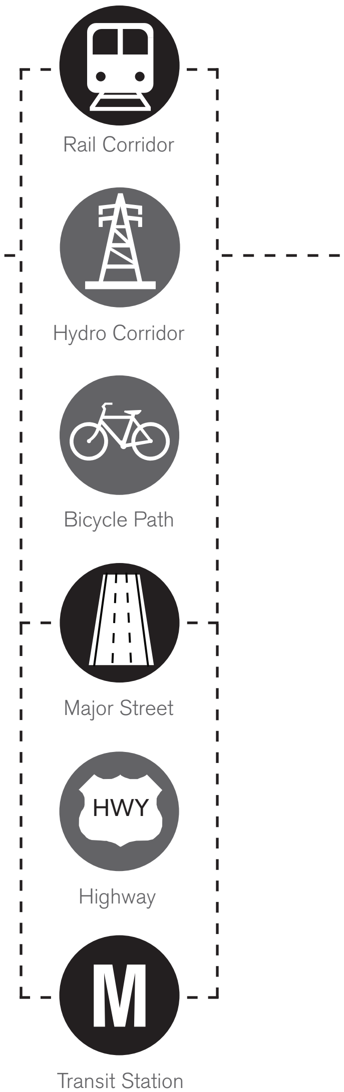
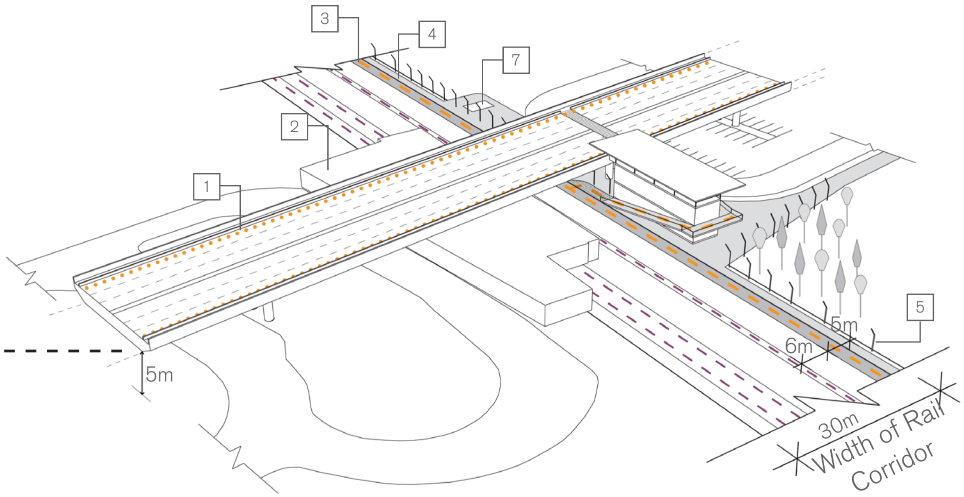


Fig.4.49 Site eight is located along an active rail corridor within the Lawrence East Metro Station's parking lot near the Gatineau hydro corridor. The site requires vertical infrastructure to mend the two networks.



1 Future Bicycle Lane by City
2 Existing Metro Station
3 Primary Path-Cycling (solar path)
4 Secondary Path-Pedestrian (concrete)
5 Solar Lighting
6 Embedded Solar Lights
7 Existing Access to Metro Station
8 Bicycle Repair/Air/Vending
9 High Density Stacked Bicycle Parking
10 Informal Market Space
11 Washroom/Shower/Locker (Male A/Female B)

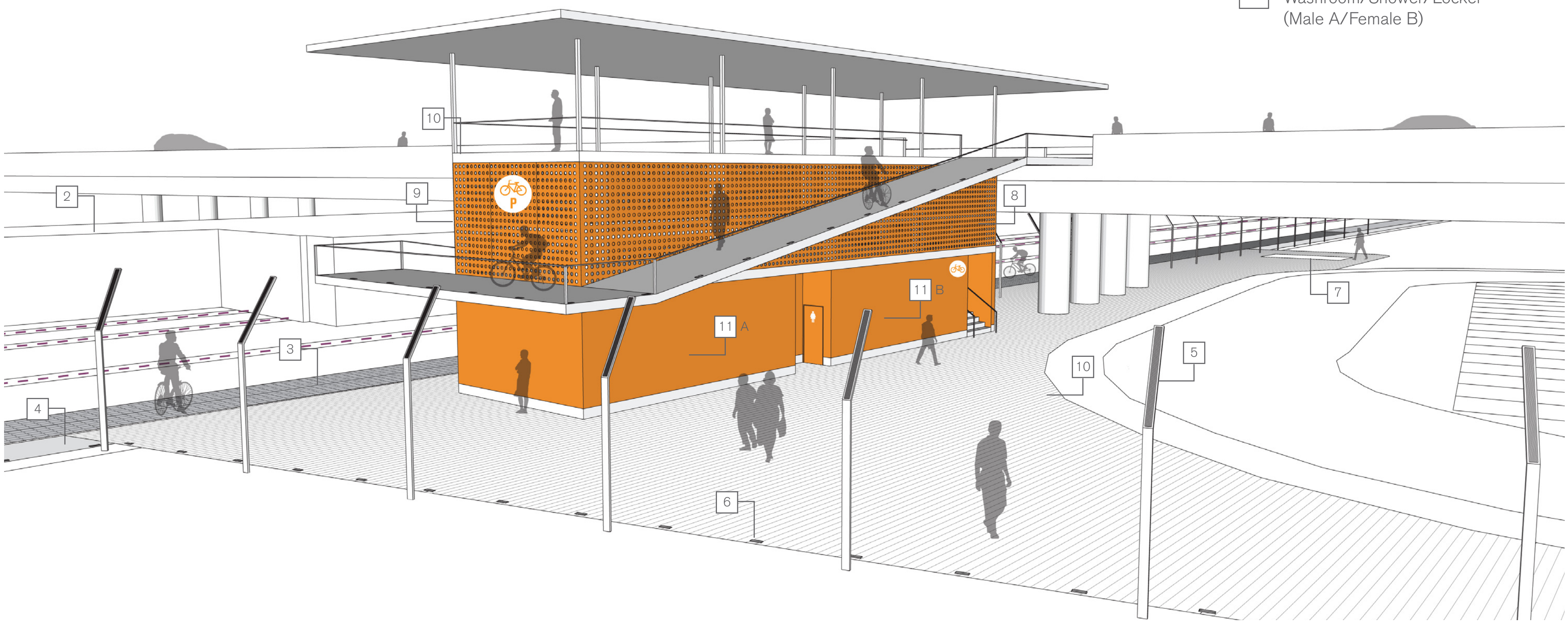


Fig.4.50 A switchback ramp connects the rail corridor to Lawrence Ave East where future bicycle lanes are proposed by the City. Commuter hub H6 provides cyclists with one-hundred and twenty bicycle parking spots, a self service repair station, lockers, showers, and washrooms. A plaza at grade acts as additional market space to the covered street level informal market. Existing underground stairs connect the network users across the rail corridor to the existing transit station.

9.0 TRANSVERSE LINK
HEAVY

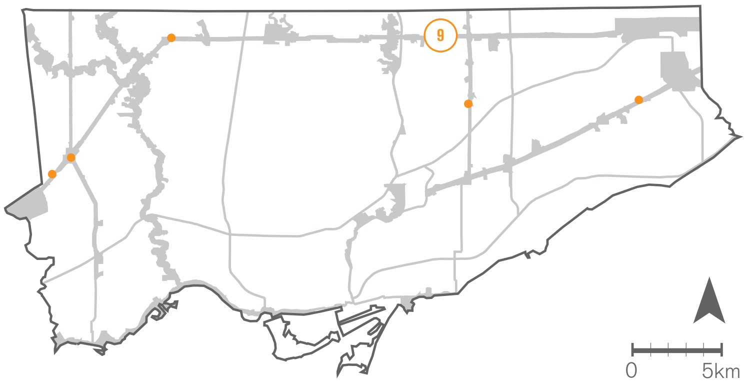


Fig.4.51 Key map, similar Heavy Transverse Links (intersection of hydro corridors and highways) are shown dotted.

EXISTING
Public Amenity

- Park Land
- Recreational Field
- College/University
- School

H5 PROPOSED
Bicycle Hub

- Information
- Air
- Repair
- Bicycle Parking
- Washroom
- Cafe

PROPOSED
Public Amenity

- Cafe
- Event Space

Park/Recreational Field

Hydro Corridor

Mobility Path (dashed-proposed)

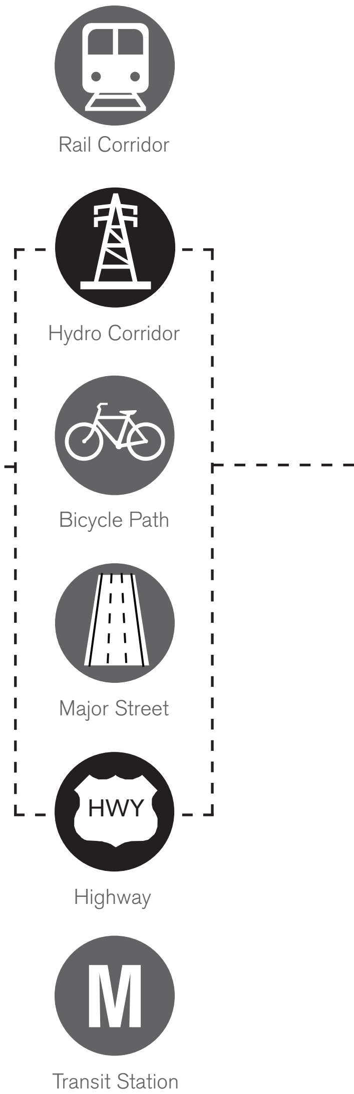


Fig.4.52 Site nine is located in one of Seneca College's parking lots within the Finch Hydro Corridor. Mobility paths are proposed along the hydro corridor and require substantial infrastructure to negotiate over highway 404.

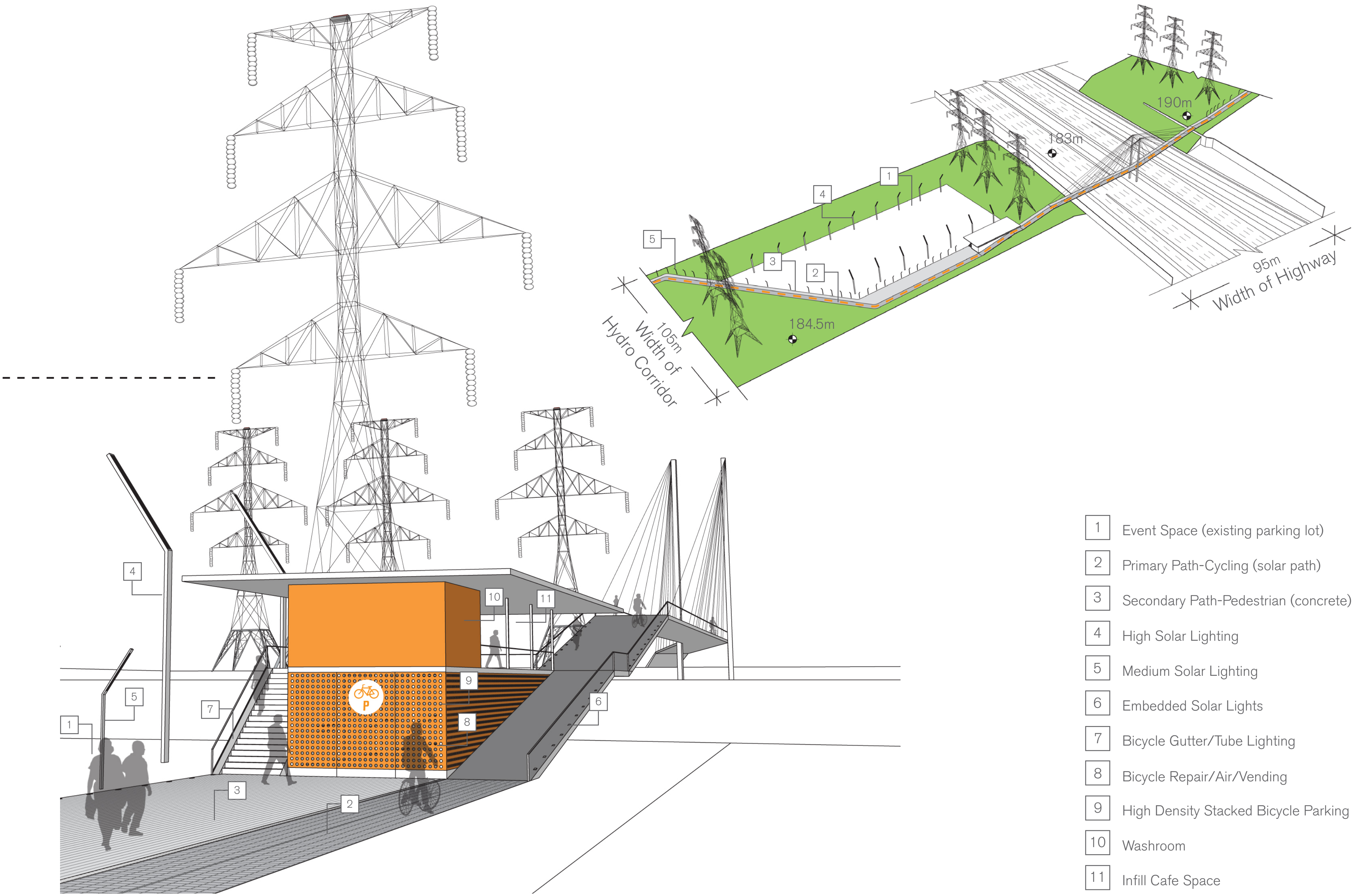


Fig.4.53 A pedestrian/cycling bridge connects the proposed mobility paths across the existing highway allowing the hydro corridor to become a continuous long-haul network. The existing parking lot functions as a large multi-purpose event space for the city (concerts/CAN-BIKE courses/fairs/movies/ball hockey etc.). Hub H5 provides parking and a cafe for Seneca College and the proposed event space. Site nine will develop further in phase two (landscaping/skatepark) to become part of a linear parkway system.


BMO
Sherbourne St.
Jarvis St.
GREEN DAY
21ST CENTURY BREAKDOWN
SAMSUNG
Endless possibilities.
One touch.
OMNIA

"Dull, inert cities … contain the seeds of their own destruction and little else. But lively, diverse, intense cities contain the seeds of their own regeneration, with energy enough to carry over for problems and needs outside themselves."

Jane Jacobs, *The Death and Life of Great American Cities (1961)*

Facing page:
Fig.5.1 2009 Ride for Heart and Stroke along the Gardiner Expressway.

CONCLUSION

As urban environments continue to increase in density, infrastructure "[…] can no longer be viewed as a purely autonomous object, separated from the urban environment."[1] Mobility spaces have the ability to address more than just traffic flows; they can also provide spaces for the exchange of ideas and physical interaction. Infrastructure has a vast social dimension that has been long overlooked by traffic planners, city officials, and engineers alike.

There is currently a growing trend and need for architects to become involved in the conception and design of mobility networks in congested cities worldwide. As space for urban growth becomes limited, architects are increasingly sought after to redefine the multiple uses of public space within the developed urban environment. By expanding the uses and relationships that infrastructure networks have with their urban environment, design can be the medium through which public space and personal mobility can be reclaimed.

Urban Pathways creates a mobility plan that has the potential to generate both the economic and urban benefits that would be necessary to raise political momentum and funding from all three levels of government. The revitalized public mobility corridors will aid in reconnecting the communities currently divided by existing utility corridors and create new frontages for existing and future developments. This could potentially increase land value for adjacent properties that were once deemed less attractive. New addresses could also generate additional building developments alongside utility corridors while supporting an increase in density of existing public programs. The incremental redevelopment of existing utility corridors would allow mobility, public space, and social interaction opportunities to increase in the city without requiring any additional real estate. *Urban Pathways* provides Toronto with a multivalent mobility system that would provide a richer urban life and experience to its current and future generations.

This thesis seeks to view infrastructure as part of the urban environment, allowing for social interaction and multiple uses of mobility space (movement, public space, meeting space, park space). The question is then raised: How can designers capture the experiential multiplicity of urban life into the practice of urban design and architecture? Looking to current global mobility trends (reincorporating the bicycle into transportation planning), urban design theory, practice and case studies, this thesis explores the potential for new urban mobility infrastructure within congested cities, re-establishing architecture's relationship to transportation networks.

The design introduces a set of principles that enable the utility corridors to act as *long-haul* mobility routes that connect distant parts of the city while acting as a feeder network to the city's existing transit system. The strategy of categorizing infrastructural challenges associated with co-opting existing underperforming hydro and rail corridors, creates a series of design solutions that can be applied to various sites throughout the network. Once the infrastructural conditions are mended, both cycling and public amenities can be layered onto the newly connected *long-haul* network. Nodes that provide connections to existing transit stations are the networks first priority, as this would promote the bicycle to act as a feeder system. Once amenities for commuters are in place, nodes that are to be placed adjacent to existing public amenities, such as, schools, recreational fields and parkland would be developed next. Finally, infill nodes along both the hydro and rail corridors at various sizes would complete the networks re-development of the utility corridors by creating continuous 'places' for social interaction within the suburban areas of Toronto. Phasing of the mobility network into a linear parkway further transforms the corridors into a continuous and multi-functioning civic amenity.

This thesis assumes political and financial support from all levels of government and strong leadership and co-ordination from officials who believe in the long-term benefits of sustainable transportation. Co-opting hydro and rail corridors requires a strong partnership between Hydro One, City of Toronto, Canadian National Railways, Toronto Transit Commission and GO Transit as the thesis proposes mobility paths within privately owned land that would require substantial changes to current land use planning and zoning policies. The success of *Urban Pathways* involves a change in lifestyle for many Toronto citizens, however the growing trend to support a sustainable urban environment enables cycling to become a viable alternative to traditional commuting options.

The design addresses *long-haul* mobility paths as the priority for including a much broader urban and suburban population, and relies on the City of Toronto's current and future on-street bicycle lanes to provide the feeder *short-haul* routes. This thesis takes the assumption that the popularity and success of the *long-haul* mobility network will provide the necessary political momentum to promote a balanced approach to future street re-configuration. Further research into developing strategic on-street *short-haul* bicycle lanes would be required, as the current pairing remains inconsistent across the city. By positioning infrastructure as public space, Urban Pathways proposes a new form of transportation system would enhance the urban fabric, expand the public realm, and complement alternative modes of mobility.

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FROM FOOTPATHS TO CORRIDORS OF CONCRETE

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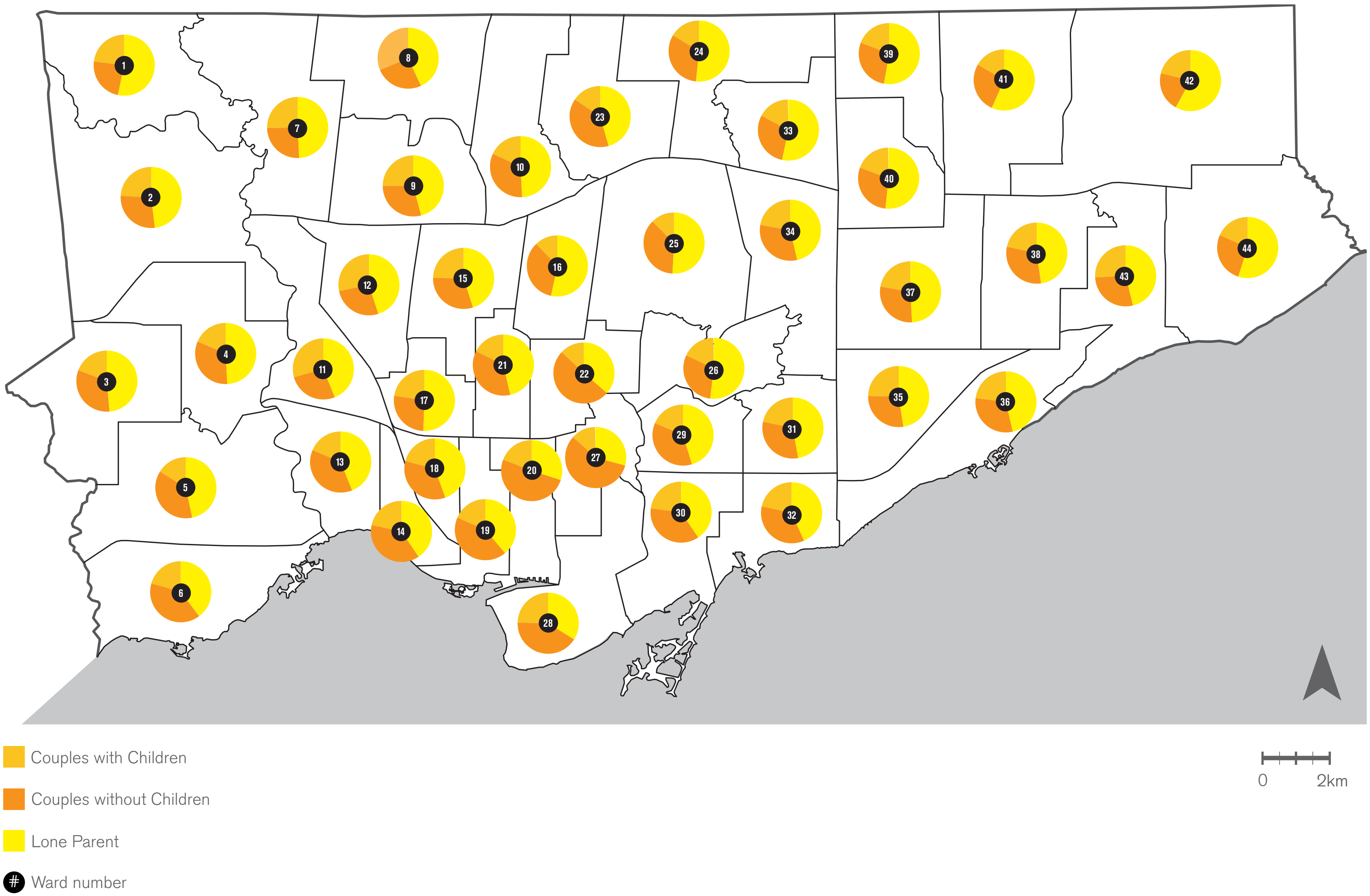
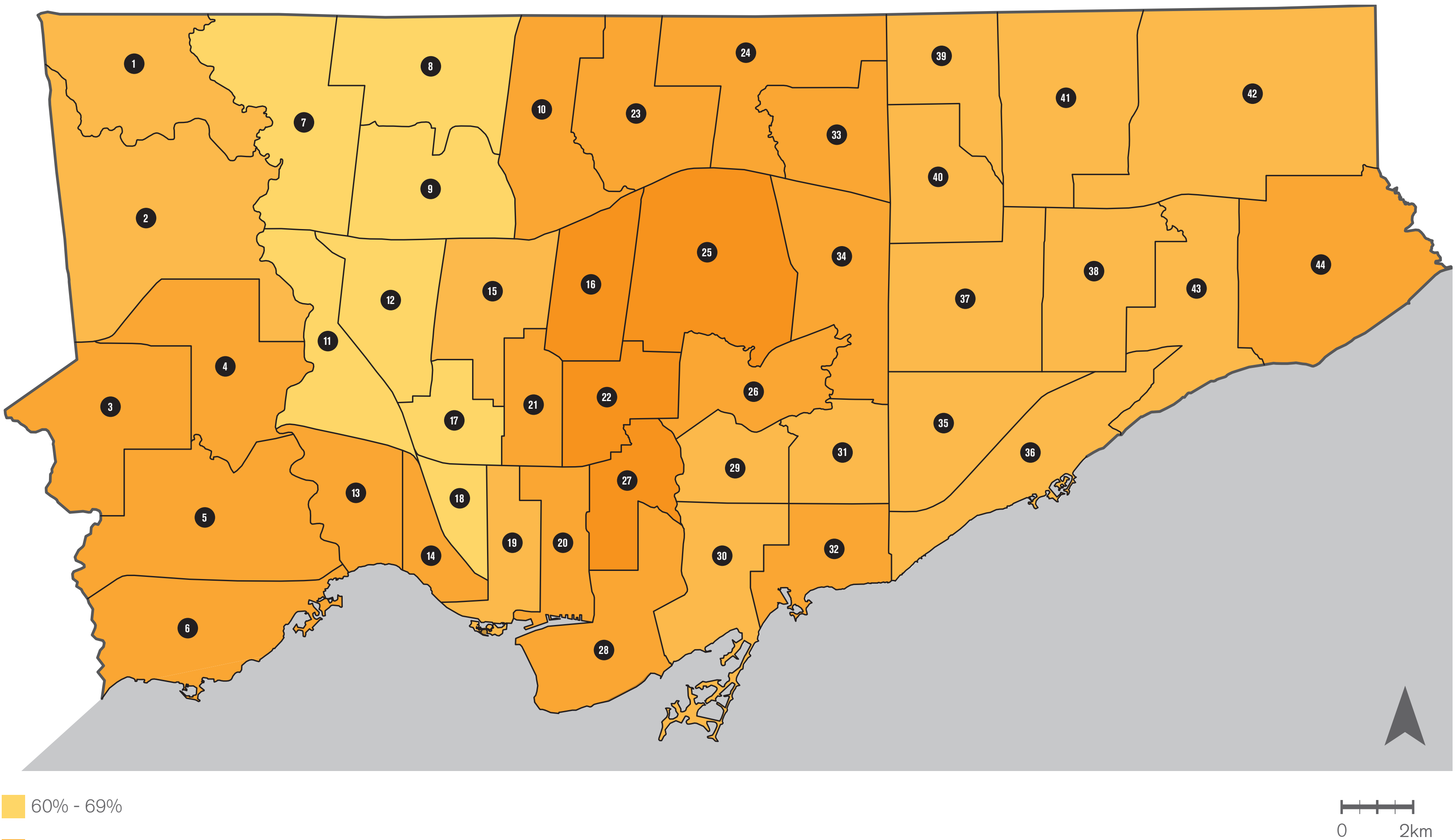
APPENDIX
TORONTO DEMOGRAPHICS

FAMILIES BY TYPE



A.1 2006, City of Toronto Ward Profile, Families. As you move away from the city centre couples without children decreases, while single parents with children increases.

EDUCATION



60% - 69%

70% - 79%

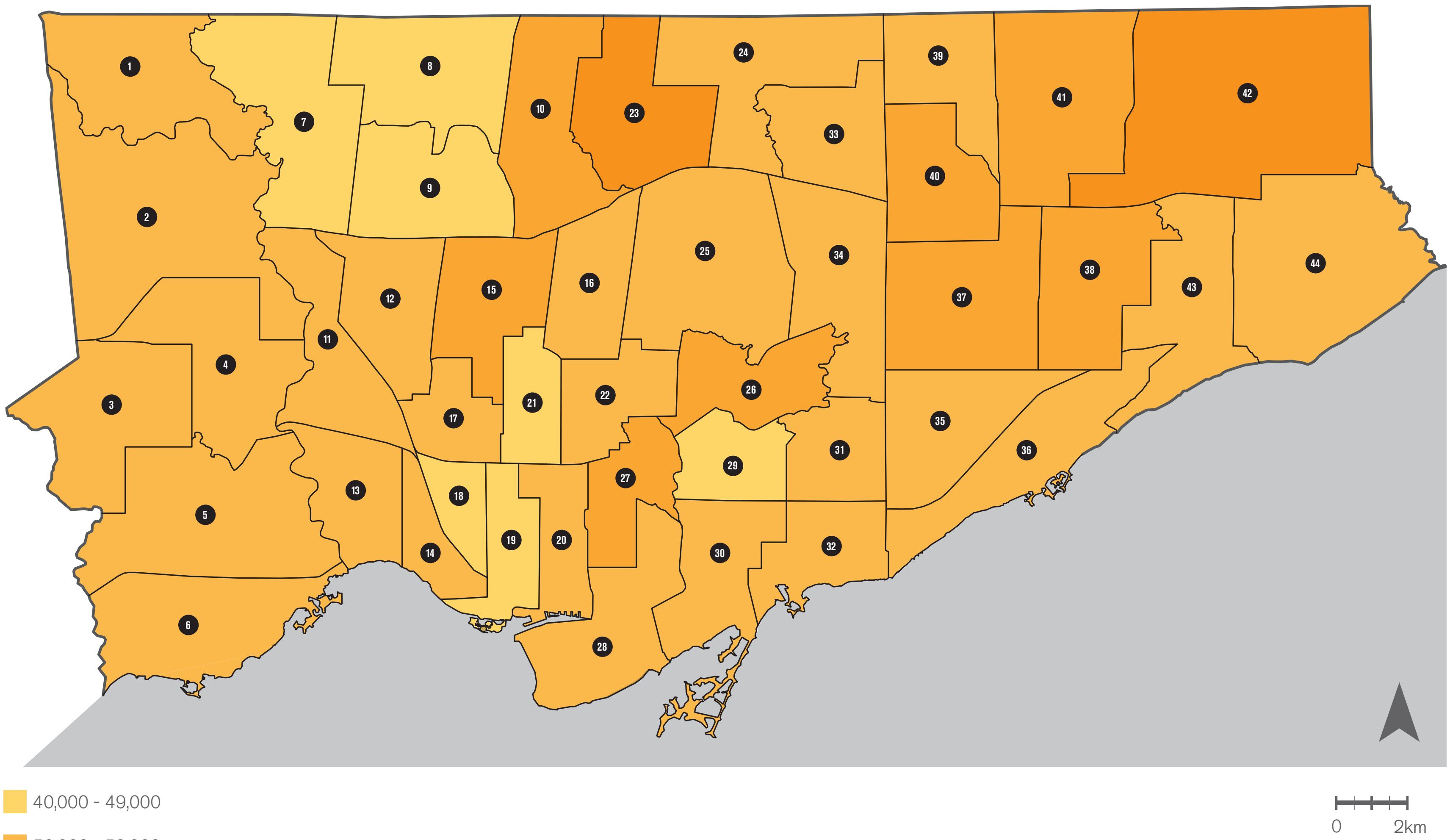
80% - 89%

90% +

Ward number

A.2 2006, City of Toronto Ward Profile, Education. Total population fifteen years or older who earned a certificate, diploma or degree typically live within the downtown core, as well as along the Yonge subway line.

POPULATION



40,000 - 49,000

50,000 - 59,000

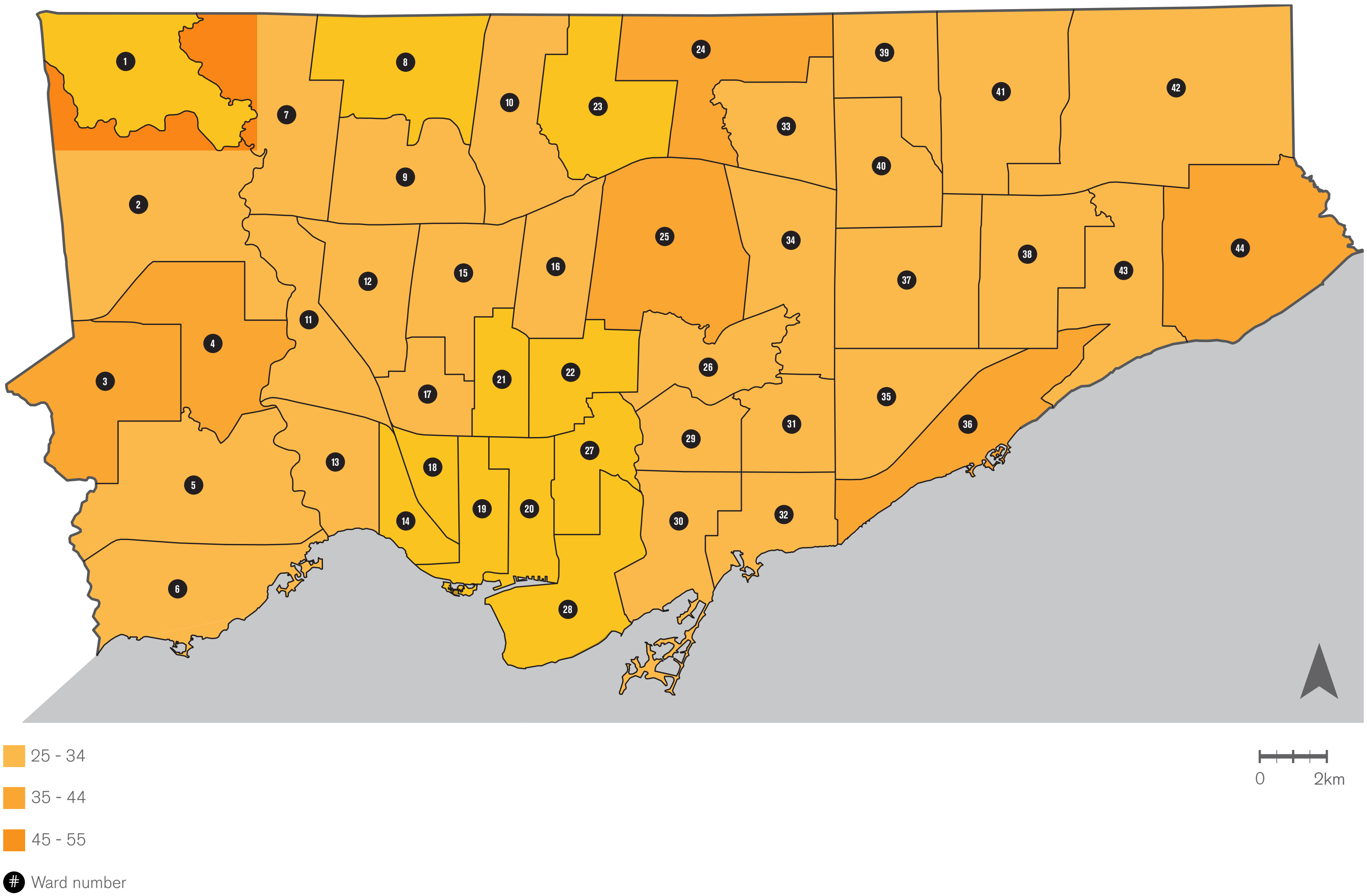
60,000 - 69,000

70,000 +

Ward number

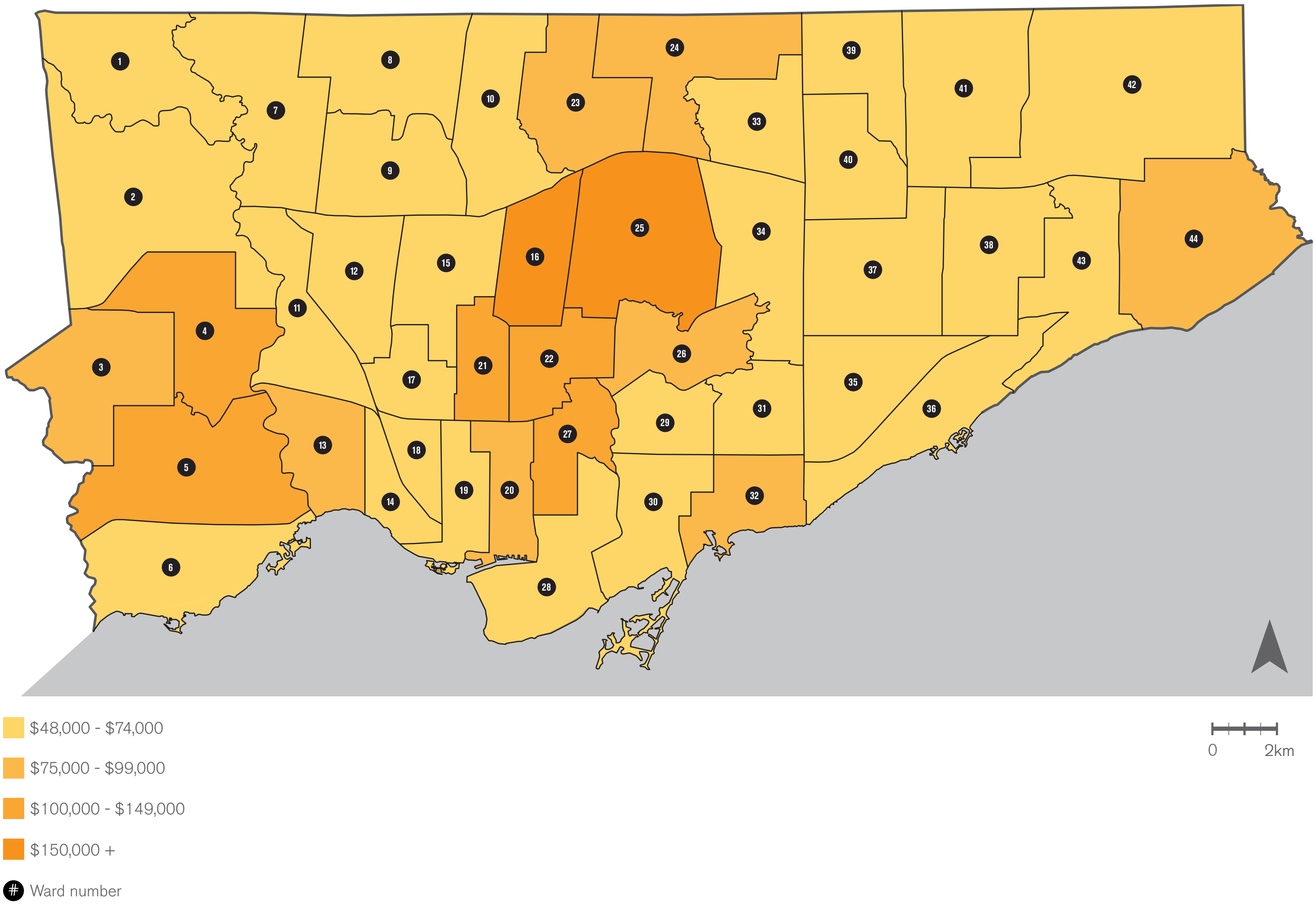
A.3 2006, City of Toronto Ward Profile, Population. As you move away from the city centre, population tends to increase while density decreases.

AGE



A.4 2006, City of Toronto Ward Profile, Age. Highest percent of population within an age group are shown in each ward. Young adults tend to live within the downtown core, typically as age increases, so does the distance to the downtown core.

INCOME



A.5 2006, City of Toronto Ward Profile, Income. Wards with the highest education percentages typically also have the highest income levels. As you move away from the city centre, average household incomes begin to drop drastically.