Chapter 1

Mobility

Introduction

The Vision

A transportation **system that reduces the need to own a car** by **providing safe, convenient, connected, affordable options** for every trip.

On a typical weekday morning, the familiar challenges of getting around Toronto can be seen and felt across many downtown street corners.

Commuters huddle at transit stops, waiting for a bus snarled in traffic or a streetcar packed with riders. Drivers inch forward in frustration, many already an hour into their trip. Delivery trucks make their way towards a curb or dock to off-load a growing number of packages. Cyclists navigate through narrow lanes or alongside moving traffic, with the added obstacle of slush or snow in the winter. Pedestrians hurry across wide streets before the light turns.

The daily scene captures a fundamental urban tension: the more success that growing cities like Toronto experience, the harder it can be for transportation networks to fulfill their core mission of helping people get around easily, efficiently, and at a price that everyone can afford. The strain extends to local streets and sidewalks, which cannot reach their potential as safe, vibrant spaces for people.

The costs — social, physical, and environmental — are high. Across the Greater Toronto Area (GTA), traffic congestion costs more than $11 billion a year[1] in lost productivity, according to the C.D. Howe Institute. Sidewalk Labs estimates that, at the household level, Torontonians who live downtown and have a car spend, on average, over $10,000 a year in car-ownership,[2] a total that reflects monthly payments, parking, gas, insurance, and maintenance. That cost is often the second largest household expense after rent or a mortgage, but unlike owning a home, cars quickly depreciate in value over time.

For many families, there is little choice: on average, Toronto area residents who commute by public transit spend nearly 100 minutes travelling each day,[3] according to Statistics Canada. As a result, roughly 70 percent of households[4] in Toronto, and 84 percent of households across the GTA, own at least one car, according to the 2016 Transportation Tomorrow Survey. Even in downtown neighbourhoods served by public transit, roughly half of all households own a car.[5]

But the need for an effective transportation system is more than just an urban statistic. It can be the difference between making a business meeting or losing an opportunity, spending more time with family or sitting alone on the freeway, forking over money for car payments or using it for savings or vacations. It can be the difference between arriving at work feeling calm and prepared — when the trip has been fast, relaxing, and convenient — or already exhausted, having battled traffic, delays, and breakdowns.

The innovation plan.
Sidewalk Labs has a comprehensive vision to integrate street design and placemaking, innovative policy, and transportation technologies — new and old — to provide a broad menu of affordable choices for every trip, reducing the need to own a car and setting a bold new course for urban mobility.

The first step towards achieving this vision of balanced mobility is to focus on expanding traditional public transit. No other transportation mode can carry as many people, as efficiently and affordably, through a dense urban environment. Sidewalk Labs proposes innovative financing mechanisms that do not rely solely on public funding and can accelerate existing plans for light rail expansions.

The next step is to make neighbourhoods like Quayside even more pedestrian- and bike-friendly than comparable downtown areas, stitching the waterfront back into the city and connecting people to a range of jobs and essential daily needs through walking or cycling. Taken together, transit extensions and walking and cycling improvements should allow almost all residents of Quayside to meet their daily travel needs without a car.

The critical third step is to help households make the occasional car trip without owning a car. A new generation of ride-hail services makes it possible to serve these trips at a far lower cost than privately owned cars do today, without adding more vehicles to city streets, through pricing that encourages sharing. These services are poised to become even more convenient and affordable with the prospect of self-driving technology.

Self-driving vehicles could become both widely available and demonstrably safer than today's drivers over the next 15 years.[6] Their ability to operate as fleets or shared services could enable cities to recapture most of the street space once devoted to parking, and to repurpose this space for bike lanes, wider sidewalks, transit services, or pick-ups and drop-offs that would make it easier to live comfortably in the city without owning a car.

Cities all over the world will need to figure out how to adapt to self-driving vehicles, and may defer significant decisions until after the vehicles are widespread. At that point, many cities will look to whatever successes exist. Toronto's leadership in this area of urban policy could make the city a global model and a centre of expertise for generations to come.

Benefits of implementing the vision

An affordable set of trip options without the high cost of car-ownership

A self-financed public transit expansion that connects thousands of people to jobs

Safer, more vibrant streets that help the city eliminate traffic fatalities

A global model for integrating self-driving vehicles into street designs

Another set of benefits would come from freight and management innovations. To help keep trucks off local streets, Sidewalk Labs plans to create a logistics hub connected to neighbourhood buildings through underground delivery tunnels.

And to coordinate the entire mobility system, Sidewalk Labs proposes a new public entity that uses real-time traffic management tools, pricing policies, and an integrated mobility package to encourage transit, walking, cycling, and shared trips.

Finally, as a foundation for this entire system, Sidewalk Labs proposes a people-first street network specifically designed to keep traffic moving while enhancing safety, comfort, and street life for pedestrians and cyclists.

The impact.
Integrated at the scale of a development the size of Quayside, a neighbourhood of roughly five hectares with only a handful of intersections, Sidewalk Labs' mobility plan can lead to measurable but limited improvements to job access, household costs, safety, pollution levels, and public space for residents.

When these concepts are applied across a larger area, transformative change becomes possible. For instance, public transportation is key to making any new development accessible and affordable, but the costs of extending the waterfront transit line have proven prohibitive. Planning for a greater scale of development along the eastern waterfront enables a self-financed public transit expansion that can unlock the increased densities needed to accommodate population growth, setting an example for other parts of the city.

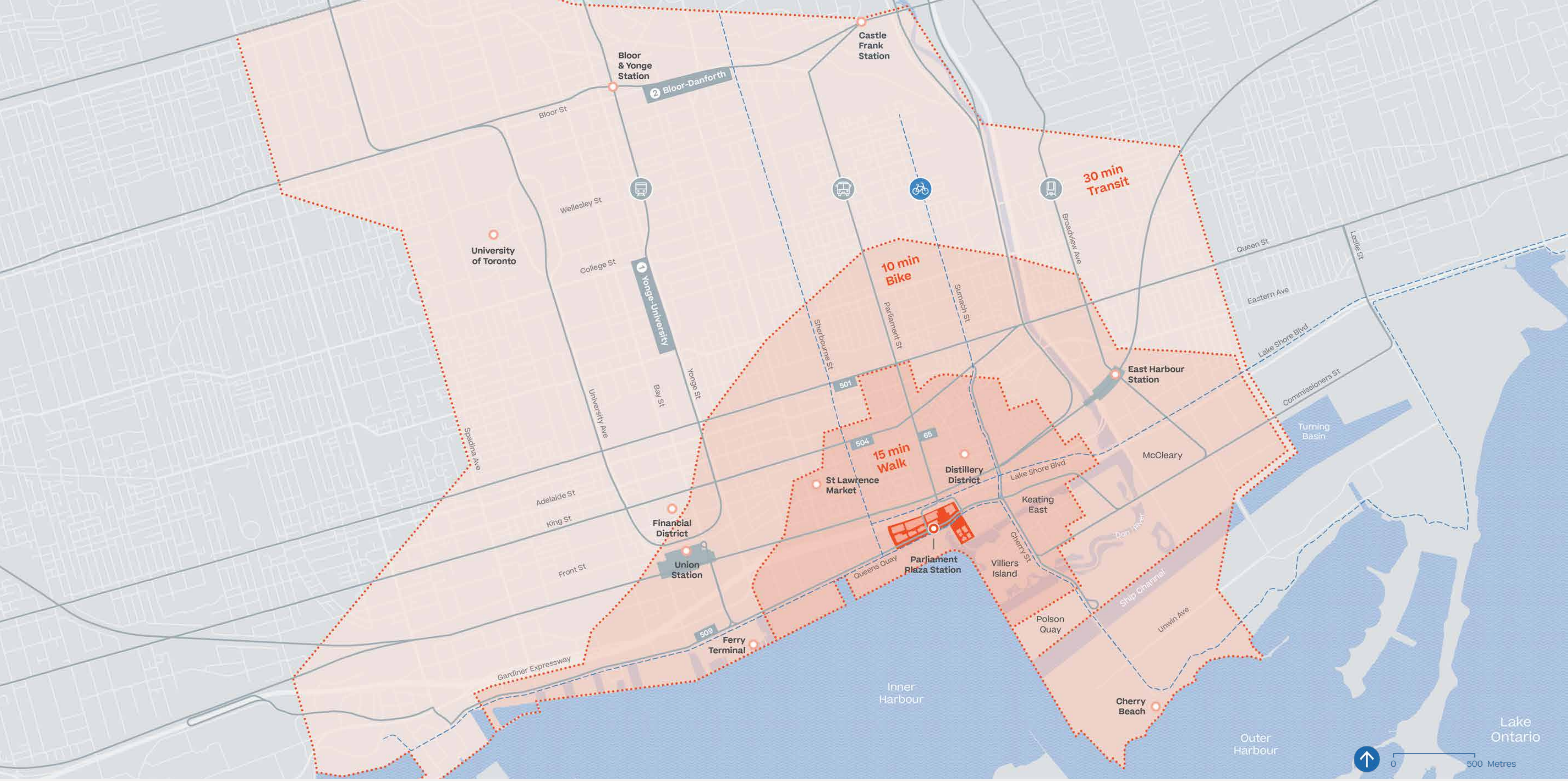
At this larger scale, a network of streets designed for the comfort, convenience, and safety of pedestrians and cyclists can not only help the city progress its Vision Zero objective of eliminating traffic fatalities and severe injuries, but provide new links between tens of thousands of housing options and jobs. A variety of options for shared mobility services can fill any remaining gaps, enabling visitors, workers, and residents to access much more of the city quickly and easily.

If this integrated vision were implemented across the full proposed IDEA District, Sidewalk Labs projects that just 10.7 percent of all trips would be made by private cars, far below the 27.2 percent made in comparable neighbourhoods, such as Liberty Village. The result would show the way forward for a truly balanced transportation system that helps the city grow and thrive.

This integrated vision would show the way forward for a truly balanced transportation system that helps the city grow and thrive.

IDEA District

The 77-hectare Innovative Design and Economic Acceleration (IDEA) District, consisting of Quayside and the River District, provides sufficient geographic scale for innovations to maximize quality-of-life impact and to become financially viable.



Map

Creating a balanced transportation network that connects to the city

- City transit
- Primary bike routes
- Quayside
- Travel times from Parliament Plaza Station (a new light rail station located near the centre of the neighbourhood)

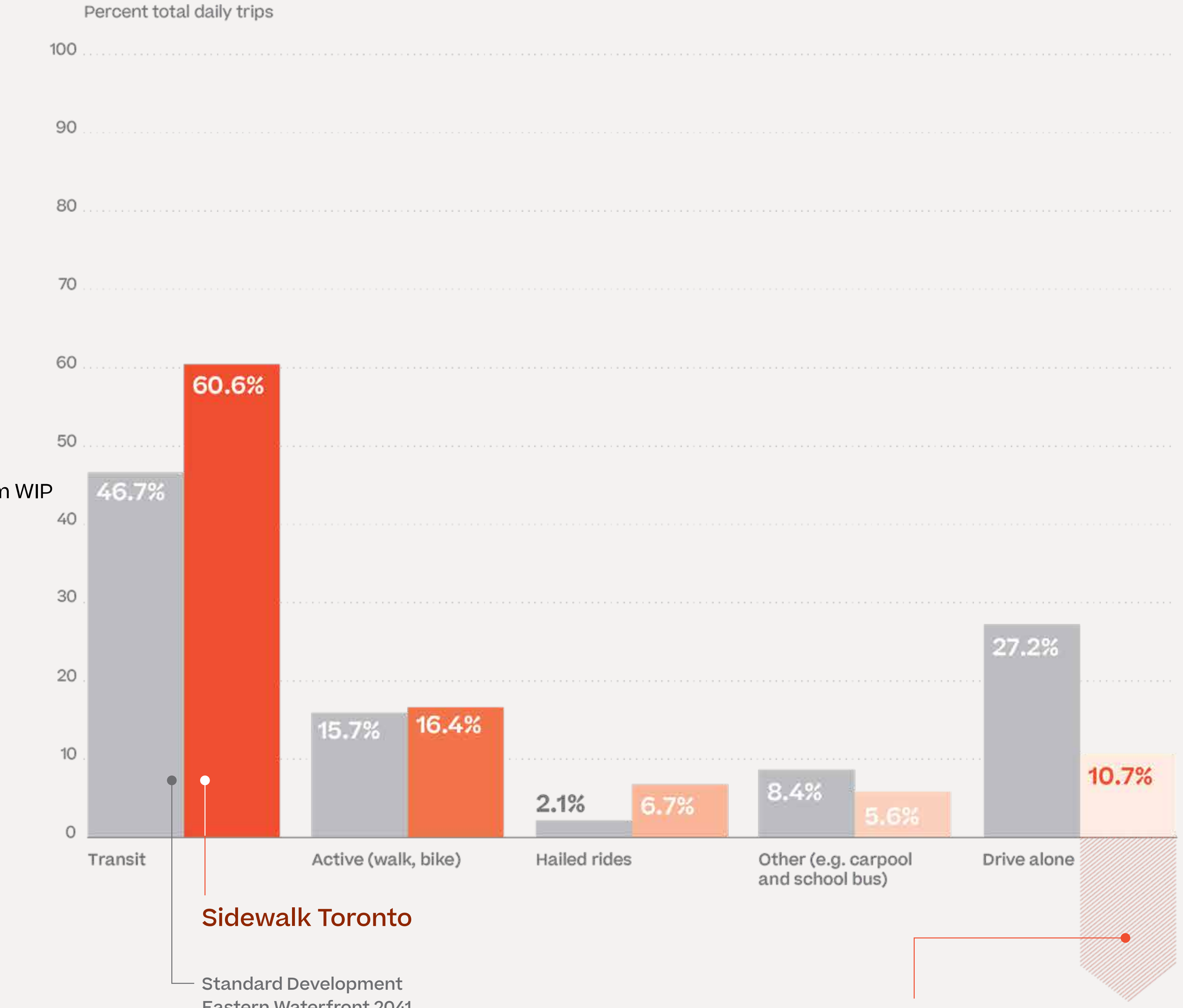
This map shows the time it would take to travel from Quayside to other parts of the city by walking, cycling, and taking transit. The mobility plan presented in this chapter aims to ensure that residents, visitors, and workers have convenient, affordable access to the rest of the city.

Source data:
Transit area data from Sidewalk Labs G4ST model
Walk and bike area data from Sidewalk Labs

How the mobility plan reduces private car trips

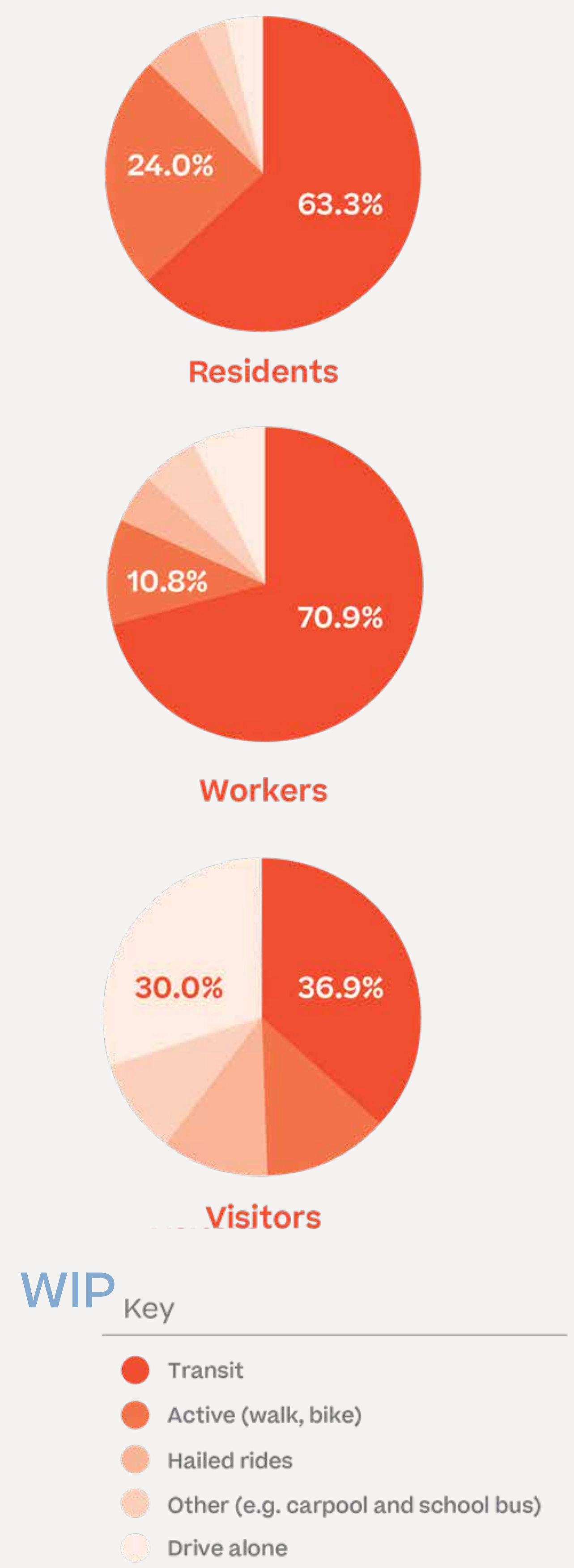
Taken together, the mobility improvements described in this chapter would reduce the percentage of trips made by private automobiles in Quayside (2025) to 13 percent, and to 10.7 percent in the full proposed IDEA District (2041).

The 2041 figure assumes a fully deployed mobility system, including self-driving fleets, traffic management, and the light rail extension. As a result, Sidewalk Labs would expect very few households in the IDEA District to feel the need to own a car.



% Total daily trips per type of traveller

Sidewalk Toronto Eastern Waterfront 2041



Residents and employees would have the highest use of transit and active transportation, while many visitors would likely arrive by private vehicle.

Sidewalk Labs analysis

A note on modelling

To help design its transportation network, Sidewalk Labs used a model called the Greater Toronto Area Model 4.0 for Sidewalk Toronto, or G4ST, in addition to more traditional analysis tools. This model builds on the official GTA Model 4.0 developed by the University of Toronto, which is used as the official model of the city to understand how new developments can impact the transportation system.

How it works.
G4ST uses a representative sample of travel behaviour to simulate the travel patterns of residents, workers, and visitors coming and going from Quayside, including trip modes (such as car, transit, cycling, and walking), routes, and origins and destinations.

What is new.
On top of these basics, G4ST incorporates some new elements specific to the Sidewalk Toronto project, such as the potential performance of transit service patterns, costs of self-driving fleets, and the effectiveness of parking and curbside pricing.

Its limitations.
All models are simplifications; for example, no one can predict the impact of new regulations on travel behaviour or the emergence of new technology with full accuracy. The G4ST model is an attempt to represent travel demand and decisions, but Sidewalk Labs recognizes that modelled mode shares and results are best seen as indicators of outcomes rather than perfect projections.

How it helps.
G4ST has helped inform planning decisions for some essential features of Quayside's mobility network, such as the number of curbside spaces, vehicle lanes, bike lanes, bike-share stations, and bike-parking spots, as well as the layout of roads.

What it shows.
Based on all these inputs, G4ST shows that private car usage would be 10.7 percent at the full scale of the IDEA District, down 17 percentage points from what would be expected from standard development, enabling the neighbourhood to devote more space to housing, public uses, cycling, and walking.

See the "Modelling and Transportation Analysis" section of the MIDP Technical Appendix for more details on G4ST.

Ch–1

Part 1

Expanding Public Transit

Key Goals

1
Design a neighbourhood with transit first

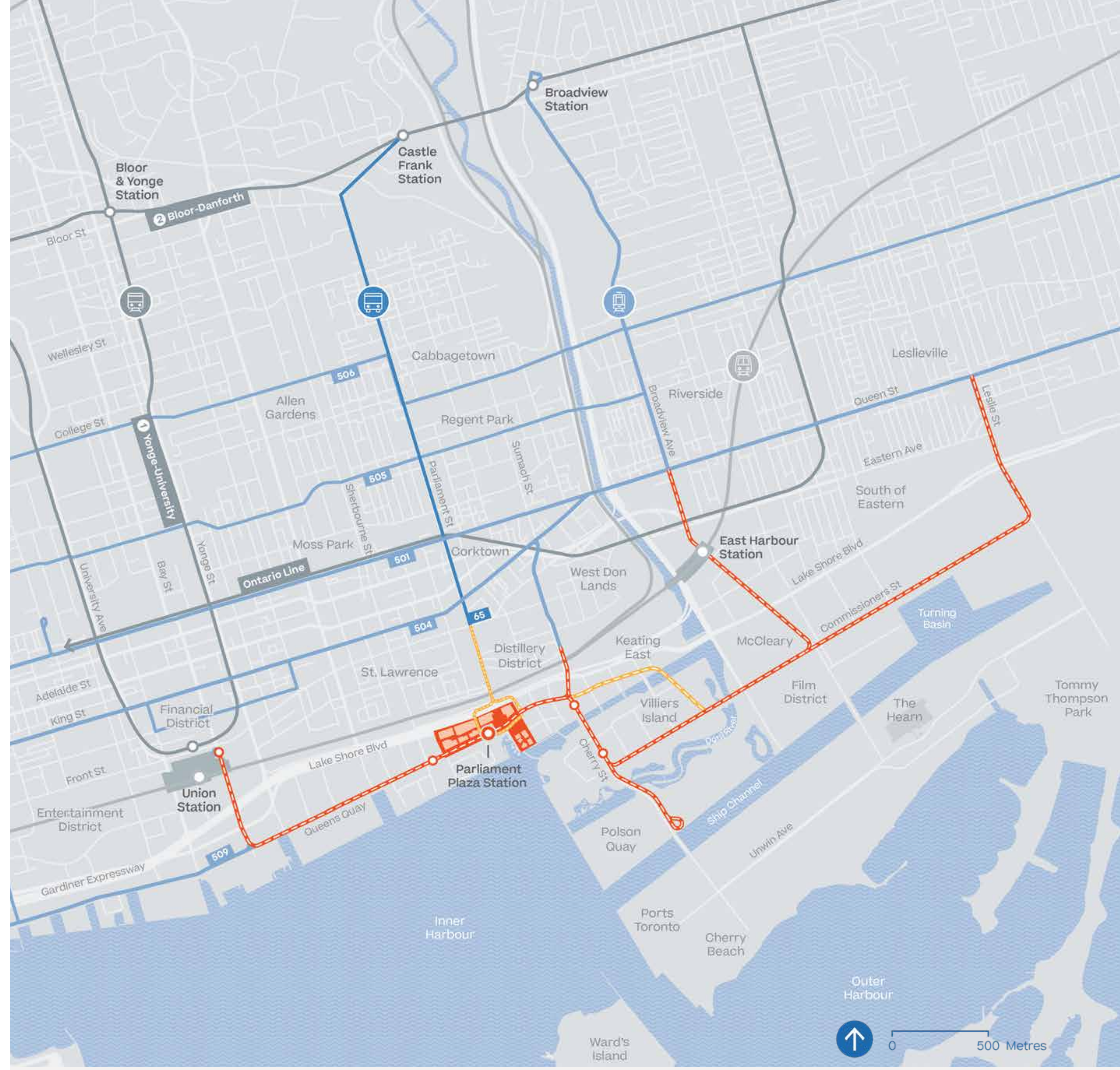
2
Encourage expansion through "self-financing"

The first step to mobility success for any new downtown neighbourhood is to connect into the existing transit system of the surrounding city — ideally before any residents move in.

It may seem odd for a 21st-century neighbourhood to embrace 19th-century technologies, such as urban rail transit. But public transportation is unmatched in its ability to carry the most people most efficiently, and at the most affordable price through cities. Those journeys, connecting tens of thousands of strangers every day and linking neighbourhoods across the region, help generate the economic activity and exchange of ideas that make cities great engines of personal prosperity and social advancement.

In Toronto, as in many major cities, the biggest challenge for public transit expansion is funding.[7] Reluctance to incur the debt necessary to offset the cost of new transit projects has bedevilled the GTA for many years. That aversion to spending on new transit poses a particular problem for the eastern waterfront, where a proposed 6.5-kilometre light rail expansion remains unfunded despite being discussed for more than a decade. Finding a way to build this system in advance of development is the key to sustainable growth; without it, the area will face increased traffic congestion and lock residents and workers into the need to own a car.

Sidewalk Labs' plan to address this challenge begins by advocating the construction of the 6.5 kilometres of light rail transit proposed in the Waterfront Transit Network Plan. A recent report commissioned by the Waterfront Business Improvement Association found that this addition alone would result in a 15 percent increase in public transit use by local workers and residents, and a corresponding 44 percent decrease in automobile use. It also found that accelerating the line's completion by 20 years would save 100 million hours of commuting time.[8] Beyond the approved plan, Sidewalk Labs further proposes an optional second phase of construction to add light rail infrastructure to the area north of the Keating Channel to serve future development.



Map

Extending the public transit network along the waterfront

GO Transit / SmartTrack
Subway (existing and planned)
Light rail: Existing; Approved extension; Optional
Bus: Existing; Proposed by Sidewalk Labs
Quayside
Parliament Plaza Station

See the "Innovation and Funding Partnership Proposal" chapter of Volume 3 for more details on transit financing.

Extending the LRT could generate
$22.8 billion
in additional tax revenue.

By 2041, the LRT extension could serve
72,900
riders daily.

The total cost of this investment to the public is approximately $1.2 billion[9] (see map on Page 38). Given the project's fundamental importance, Sidewalk Labs is prepared to provide assistance with the financing for the approved plan. As per the Waterfront BIA report, construction of the Eastern Waterfront LRT could provide $22.8 billion in additional tax revenue to the governments of Toronto, Ontario, and Canada over the 20 years following completion of the project.[10]

Construction of this light rail extension would lead to excellent financial outcomes for the public. These outcomes can be made even better through public use of the innovative funding mechanism of self-financing, sometimes referred to as "value capture," which would allow the light rail expansion to finance a portion of its own costs. The idea behind self-financing is to impose a future charge on real-estate development, and borrow in the present against that stream of funds to pay for part of the cost of construction of the transit system. Self-financing requires a large enough development area that real estate values can credibly reach sufficient levels to fund expensive transit projects, which means the government could only employ this tool if development expands east beyond Quayside along the waterfront.

The corresponding benefits would be immense: several new connected neighbourhoods, creating homes for thousands of people who would enjoy quick public transit connections to the rest of the city. The presence of high-quality light rail transit makes it possible to create an IDEA District where people of all incomes choose not to own a car. Sidewalk Labs estimates that by 2041 the light rail would serve roughly 72,900 Torontonians travelling to the IDEA District per day.[11]

An innovative self-financing mechanism could help build the long-desired LRT extension, unlocking the eastern waterfront's potential.

Goal 1

Expanding Public Transit

Design a neighbourhood with transit first

For many years, Torontonians have recognized that the key to unlocking the potential of the eastern waterfront is through public transit access. The existing plans include a series of light rail lines through the area, as well as the proposed downtown relief subway and the construction of the planned East Harbour SmartTrack and Metrolinx commuter rail station. While funding has failed to materialize, there is general consensus on the overall shape of such a system, as articulated in the Port Lands Planning Framework and the Waterfront Transit Reset efforts.

Sidewalk Labs believes this system should operate as light rail service. This service would be interoperable with the wider streetcar network, using the same vehicles on the same rails with the same electrical infrastructure. But it would operate in its own right-of-way, with priority at intersections and stops spaced farther apart than the stop-on-each-corner spacing common elsewhere in the city. These changes elevate the system from streetcar service to light rail service, which is faster and more reliable.

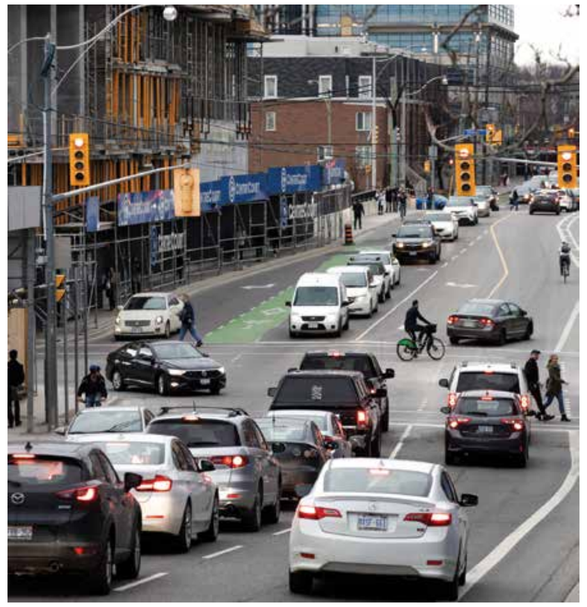
This expansion is vital to the waterfront's future. The existing plans (Segments 1 through 9) are even more important for the prospect of commercial development in the IDEA District than they are for Quayside. To build on these plans, Sidewalk Labs proposes an optional additional link (Segment 10) to extend the planned network and improve access to and from the IDEA District.

These expanded plans can be pursued at a total estimated cost of approximately $1.2 billion (roughly $1.3 billion if the optional Sidewalk Labs link were included). With this infrastructure in place, the full scale of the IDEA District could become home to tens of thousands of residents, jobs, and visitor destinations, while being fully integrated into the rest of the city — all without overloading local roads with traffic.

It is critical to ensure that these segments get built prior to the start of new development. There are many examples from around the world of what happens when a new development fails to link into the city's transit network. Three key lessons stand out:

1

New transit must connect into a system.
Sometimes a new development overlooks the need for neighbourhood transit service to connect with a larger existing network. London's Canary Wharf development filed for bankruptcy in 1992, due partly to its highly publicized lack of transit access, which made it impractical for commuters. The project rebounded following improvements to the Docklands Light Railway[12] and, later, after a subway extension to the site. As this case shows, the failure to integrate into an established transit network can isolate a development and stunt its growth.



Toronto's Liberty Village area initially lacked sufficient public transit access, leading to heavy traffic congestion, overcrowded streetcars, and widespread commuter frustration. Credit: David Pike

2

Ignoring transit worsens congestion.
Another oversight is the tendency to build a high-density development without any transit at all. Many fast-growing Asian cities have made this mistake, leading to the traffic gridlock and air pollution that characterize places like Mumbai[13] and Jakarta.[14] Liberty Village,[15] in Toronto, followed a similar path. In such cases, the initial result is absolute gridlock, because cars simply cannot carry the volume of people that a high-density place needs. Governments are then forced to retrofit a public transit system into the neighbourhood, which can often result in significant financial costs and travel disruptions.

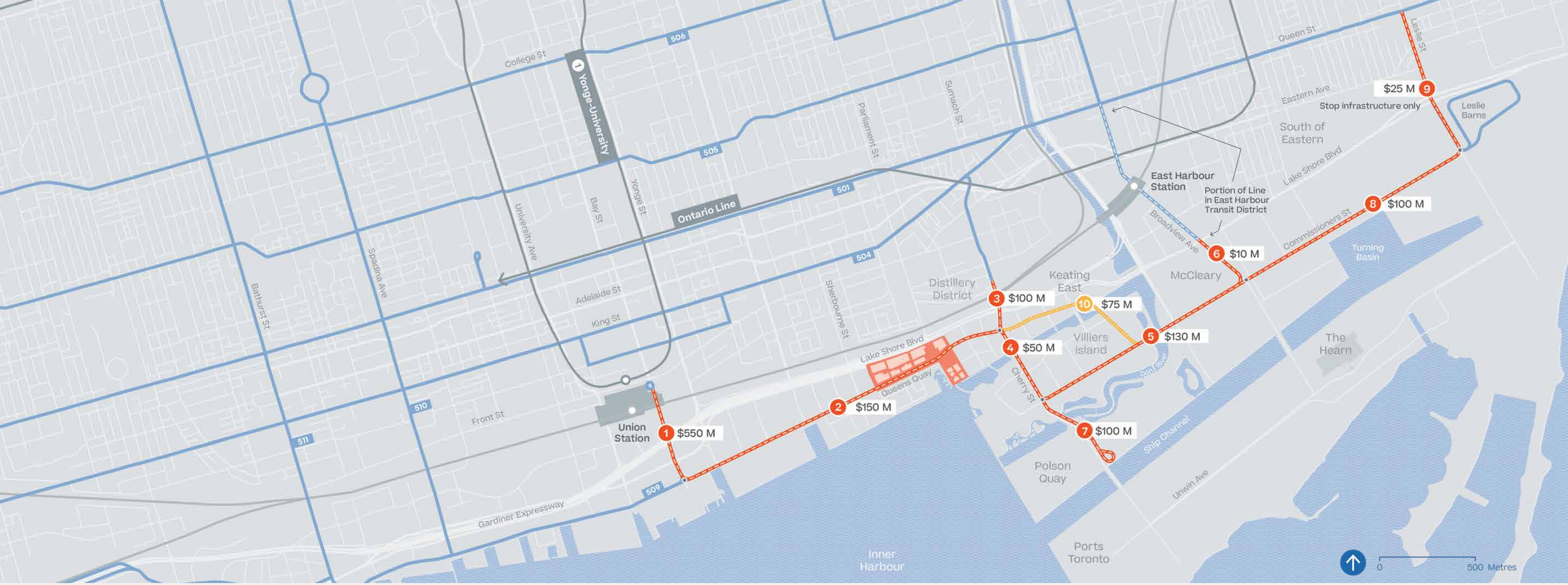
3

Delaying transit expansion locks in car use.
New developments will sometimes build extensive road and parking capacity to accommodate cars in the near term, while hoping that public transit will eventually arrive. This approach locks the area into a car-first orientation that is difficult to change even over decades. The mobility patterns established when a neighbourhood is first built are very difficult to change, and history has shown time and again that widening roads to relieve congestion is a temporary solution that requires enormous public funding and ultimately worsens the problem.

This mobility vision integrates street design, innovative policy, and transportation technologies to set a bold new course for urban mobility.

Map

A $1.2 billion plan to extend light rail along the waterfront



GO Transit / SmartTrack
Subway (existing and planned)

Light rail:
- Existing
- Approved extension
- Optional

Quayside

WIP

Toronto's current plan would provide a critical connection between Union Station and Queens Quay (1) and extend the waterfront light rail east beyond Bay Street to reach Quayside and the greater eastern waterfront at Cherry Street (2).

The plan would create a connection to the King Street transit corridor via Cherry Street, near the Distillery District (3).

New service would run along Cherry (4), Commissioners (5), and the Broadview extension (6) creating an essential connection between Quayside, Villiers, and the East Harbour SmartTrack Station, with the potential to connect to Broadview Station.

The plan would extend service along Cherry (7) to a turnaround on Polson Quay, replacing the current turnaround by the Distillery District.

Finally, to help connect the eastern part of the Port Lands to the greater system, the plan calls for extending the Commissioners line east (8) to Leslie Street, linking the new network to the Leslie Car Barns and to the broader streetcar network via Leslie (9).

Additionally, as part of the work to rebuild the Cherry underpass to accommodate the light rail, Sidewalk Labs proposes also rebuilding the Parliament underpass, to create a pleasant gateway into Quayside.

As part of a second phase of construction, Sidewalk Labs proposes an optional new connection, not part of the existing approved plan, to extend transit north of Villiers Island along the new extension of Queens Quay east of Cherry (10).

Goal 2

Expanding
Public Transit

Encourage expansion through "self-financing"

The LRT extension would increase land value by

$4.5 billion

between 2025 and 2045.

The LRT extension would increase transit trips by

60%

in the IDEA District.

Traditionally, transit projects like the waterfront light rail expansion have been funded equally by the federal, provincial, and municipal governments, but no level of government has currently committed to funding new rapid transit in the eastern waterfront. A large-scale development of the area could make a substantial contribution to funding the transit system this area needs via a self-financing approach — and in so doing, set an example for how to finance the essential transit extensions necessary for sustainable urban growth.

Self-financing, through a value-capture approach like the use of special assessments or tax-increment financing, has been used in transit projects around the world, such as London's Crossrail[16] and Calgary's Rivers District Community Revitalization Plan.[17] There is precedent for self-financing in Toronto as well: the City of Toronto has approved its use to pay for a portion of the forthcoming SmartTrack project.[18]

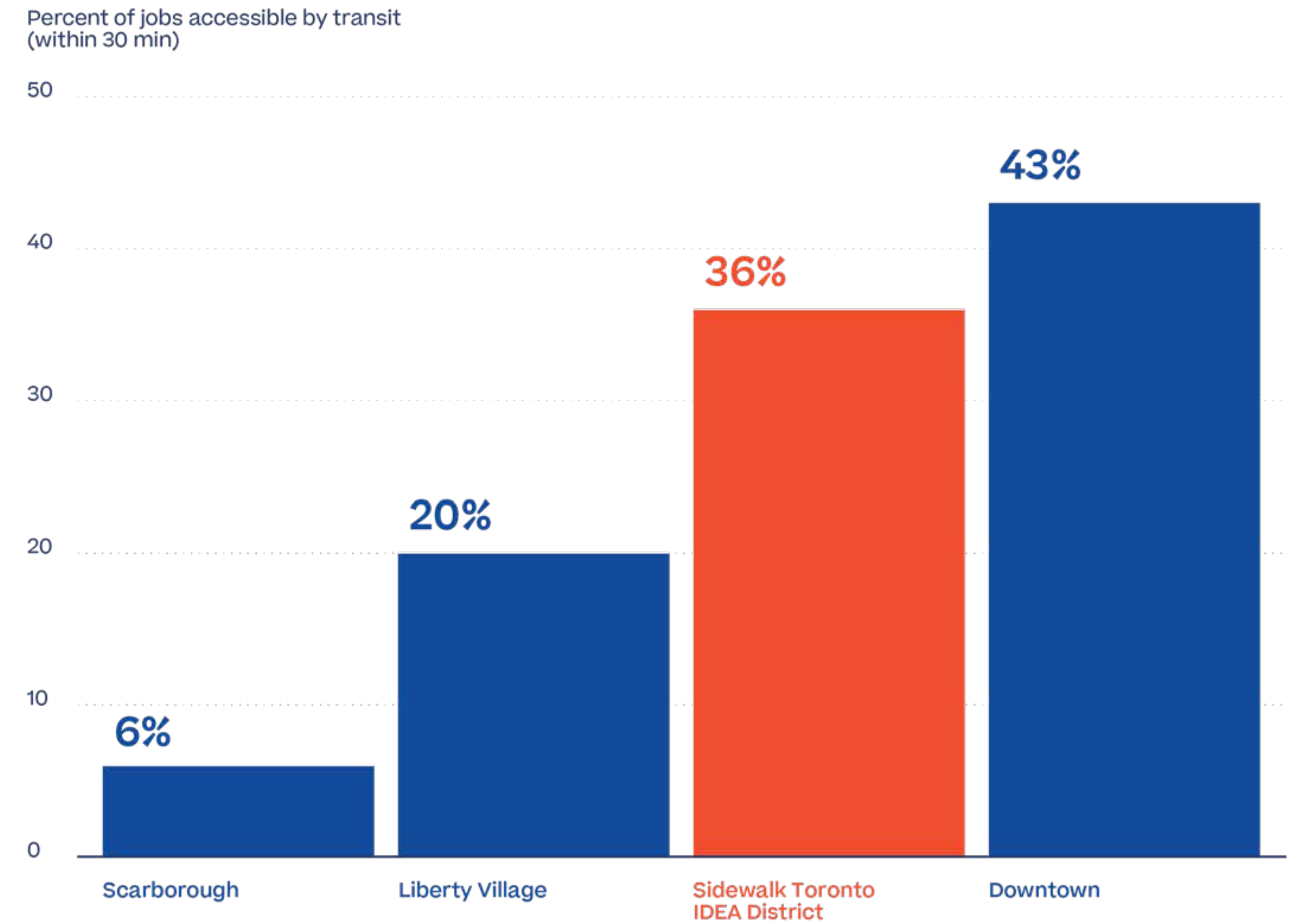
The key issue with any self-financing plan is whether the transit expansion will create enough value to meaningfully offset the cost of building that expansion. The strategy is often not viable where new transit will serve existing neighbourhoods, because those areas are already sufficiently valuable, meaning that new transit services do not add much. Likewise, the new construction required in a low-density development plan may be unable to generate sufficient incremental tax or other revenues to make a meaningful contribution to high transit costs. A small neighbourhood consisting of just a few blocks, like Quayside, cannot generate enough revenue to repay the investment.

But if the scale of the development is large enough, and that development can feature new construction at a high enough density, then a critical opportunity exists to design and fund a rapid transit system that can nourish a new neighbourhood and support its growth. Such an opportunity exists along the waterfront, where — as per the economic-impact report prepared by the Waterfront BIA for the city's approved plan — construction of the light rail would generate land value uplift of $4.5 billion between 2025 and 2045.[19] The feasibility of such a plan requires a commitment for enough new development at high enough densities to design and fund a rapid transit system that can nourish new neighbourhoods and support their growth.

In this event, public and public-private partners would need to finance some or all of the construction of the expanded light rail network, with an expectation that these partners would be paid back by future incremental tax revenues at a rate that is negotiated with the city. Construction of this network could be phased to keep pace with development. The light rail system would remain

A neighbourhood comparison of job access via public transit

The light rail extension would make 36 percent of Toronto's jobs accessible to residents of the IDEA District within 30 minutes, making it more transit-friendly than other comparable neighbourhoods and approaching the type of transit access that can be found downtown.



publicly owned and operated by the Toronto Transit Commission. A non-profit or new government entity could be created to oversee the implementation of this self-financing proposal; its role would be to manage the funds raised, which would be required by law to be used exclusively for the light rail expansion.

The light rail could serve more than 72,900 riders and make 36 percent of jobs accessible across Toronto within 30 minutes.[20]

Implemented across the full scale of the IDEA District, the extension — in conjunction with the other mobility improvements discussed in this chapter — could increase the number of trips taken by transit to 60.6 percent,[21] up from 46.7 percent with standard development.

Above all, extending the light rail via self-financing, beginning in Quayside, would demonstrate a new, financially sustainable way to create critical transit infrastructure with reduced taxpayer funding. Pioneering this approach could give Toronto-area governments a powerful tool to deliver the new transit infrastructure the city and region urgently require.

Ch–1

Part 2

Enabling Walking and Cycling Year-Round

Key Goals

1
Plan for a "15-minute neighbourhood"

2
Expand safe, comfortable walking and cycling networks

3
Provide signal priority for walking and cycling

4
Encourage bike-share, e-bike, and other low-speed vehicle options

5
Facilitate all-weather walking and cycling with heated pavement

Establishing a strong transit system connected to the wider region is the first step towards ensuring that a neighbourhood provides affordable, accessible alternatives to owning a car. The next step is creating a walking and cycling network that enables people to travel easily and comfortably within their neighbourhood and to adjacent neighbourhoods.

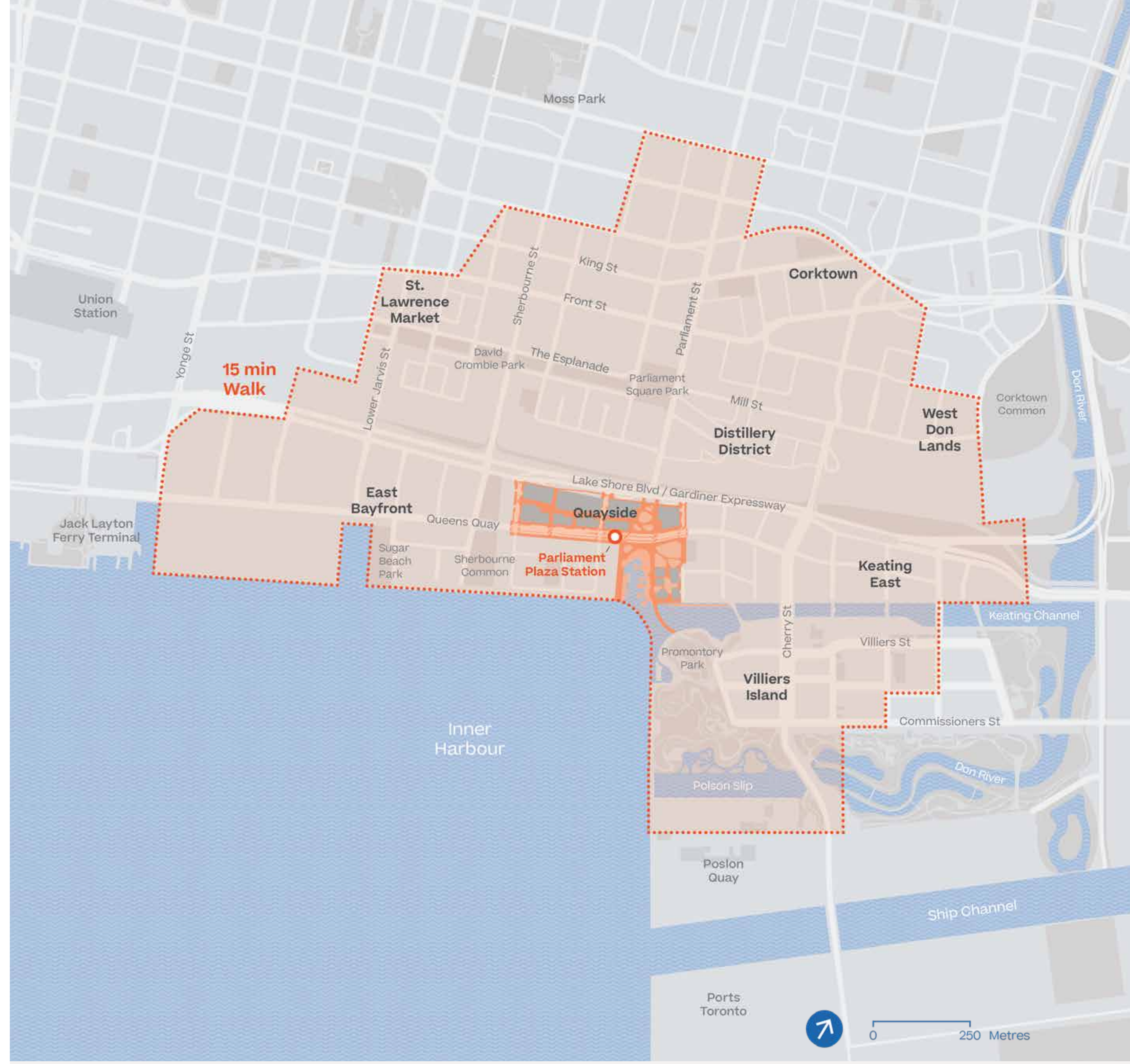
In recent years, Toronto has worked to improve its walking and cycling infrastructure. For example, the redesigned Queens Quay West demonstrates strong demand for protected bike lanes, as it hosts as many as 6,000 cyclists per day.[22]

But pedestrians and cyclists along the waterfront face steep challenges in the form of connectivity, safety, and comfort. The elevated Gardiner Expressway and the railway tracks present a barrier to walking or cycling between the waterfront and downtown, especially after dark. A general absence of bike lanes forces cyclists next to vehicle traffic, discouraging many would-be riders. Subfreezing temperatures, piles of snow, icy streets, and winds off the lake make cycling even more harrowing in winter.

Sidewalk Labs' plan for a comprehensive pedestrian-cyclist network integrates policy, design, and technological advancements that can make it dramatically easier to walk or bike within and around the IDEA District, and can serve as a model for walking and cycling in all types of downtown developments.

This approach would enable residents in the IDEA District to access all of their essential daily needs within a 15-minute walk; expand the walking and cycling network with people-first street designs and stronger links to adjacent neighbourhoods; give cyclists and pedestrians priority at intersections via adaptive traffic signals; encourage bike-share, e-bike share, and other low-speed vehicle options; and install heated pavement for year-round comfort and safety.

At the full scale of the IDEA District, Sidewalk Labs estimates that more than 16 percent of all trips to, from, and within this area would occur by foot, bike, or other low-speed vehicles — enabling households to meet daily needs without owning a car.[23]



Map
Neighbourhoods accessible to Quayside within a 15-minute walk

15-minute walk from Parliament Plaza Station

Quayside pedestrian access

Goal 1

Enabling Walking and Cycling Year-Round

Plan for a “15-minute neighbourhood”

Any strong, active transportation strategy starts with designing a walkable neighbourhood to enliven the streets, fill shops with customers, and create unexpected encounters. People walk even more if they can reach all their daily needs within about 15 minutes, or 1 kilometre.

Building on this insight means planning neighbourhoods where, within a 15-minute walk, an individual can find every service or good they are likely to need more than once a week. These include essential services such as schools, child care, and health care; necessities such as pharmacies and groceries; recreational destinations like restaurants, shops, and parks; and above all, plenty of jobs.

Sidewalk Labs proposes to address this challenge by planning for a far more robust mix of homes, shops, production spaces, and jobs than found in a comparable neighbourhoods, such as Liberty Village. While this approach to planning is holistic in nature, some of the key steps include:

See the “Buildings and Housing” chapter of Volume 2, on Page 202, for more details on adaptable buildings.

See the “Public Realm” chapter of Volume 2, on Page 118, for more details on stoa.

A mixed development program.
In contrast to conventional downtown developments in Toronto, which devote roughly 90 percent of space to residential use, Quayside’s development program calls for 67 percent of space to be devoted to housing, with roughly 33 percent devoted to office, retail, community, and maker spaces, as well as other non-residential uses. Achieving that balance would create far more jobs and recreational destinations in Quayside than typical of Toronto neighbourhoods, enabling more residents to walk to work or to the store. To support this mixed program, Sidewalk Labs plans to deploy an adaptable building structure called “Loft,” designed with flexible interior configurations to accommodate a range of residential, commercial, and even light industrial uses.

All-weather ground floors.
On the lower floors, these adaptable structures can house a variety of short-term, long-term, and seasonal tenants, allowing for a livelier mix of shops, services, community gathering spaces, and other destinations all within walking distance. Some of this “stoa” space would be designed with retractable awnings to invite foot traffic in all weather.

Last-mile transit connections.
Sidewalk Labs has paid special attention to ensuring high-quality pedestrian and bicycle connections to light rail and bus stops. As planned, cyclists would access these stations through either dedicated lanes or entire streets prioritized for bicycle travel, with ample bike parking and bike- and scooter-share access adjacent to stations. Pedestrians could access stations along pleasant sidewalks, and access platforms via wide crosswalks that prioritize safe crossing.

Access to social infrastructure.
To improve walkable access to essential services, Sidewalk Labs plans to provide space in Quayside for an elementary school co-located with a child care facility, health services co-located with supportive care programs, and community space for neighbourhood groups. The care and community spaces would also be included in the first phases of development to improve access from Day One.

In Quayside, the whole neighbourhood would be walkable within 15 minutes. When applied at the full scale of the IDEA District, Sidewalk Labs’ plan to encourage a vibrant mixture of homes, jobs, shops, and public spaces on every block would lead to 9 percent of all trips being made by walking.[24]

Impact spotlight

The health benefits of active neighbourhoods

Research shows that life is healthier in walkable areas.

The Canadian Physical Activity Guidelines recommends that all adults engage in at least 30 minutes of moderate-to-vigorous physical activity every day.[25] If their neighbourhood is designed for it, they can get that exercise in the course of their normal daily routines, by walking or cycling. And the research shows that people who live in more walkable neighbourhoods get more exercise, and are healthier for it:

Increased fitness.
People who routinely walk and cycle experience improvements in heart rate, lung capacity, and metabolic health. A study by Statistics Canada found that residents of urban neighbourhoods were more likely to be physically active and to engage in active transportation than residents of inner or outer suburbs.[26]

Decreased obesity.
A 2015 study by Statistics Canada looked at the prevalence of obesity among urban and suburban Ontario residents. The conclusion: “Residents of highly walkable areas engaged in more utilitarian walking and had a lower prevalence of obesity than did adults in low-walkability areas.” These basic findings — that active transportation correlates with lower obesity rates — are also borne out on a national and international scale.[27]

Lower blood pressure and heart rate.
A recent study in France found that living in a highly walkable neighbourhood is associated with improved cardiovascular health, including lower blood pressure and a lower resting heart rate.[28]

Lower disease risk.
A 2014 study cross-referenced a variety of health indicators against the street designs of 24 different California cities. The findings showed that more compact and connected street networks, with fewer lanes on their major roads, are correlated with reduced rates of diabetes and heart disease[29] (as well as lower blood pressure and reduced obesity rates) among residents.

Goal 2

Enabling Walking and Cycling Year-Round

Expand safe, comfortable walking and cycling networks

Among the main deterrents to walking and biking are the safety concerns and general discomforts that come with travelling beside big cars and trucks. While this concern may be true for any city, it is an increasing one in Toronto, where the number of street fatalities has been trending upwards over the past decade,[30] according to the Toronto Police Service. The vast majority of pedestrians and cyclists who reach their destination safely require vigilance to cross busy streets and to bike on unprotected lanes, which makes for an unpleasant experience, and is a steep barrier to walking or riding, especially with children.

Sidewalk Labs' redesigned street types ensure safe, convenient, and complete paths for people travelling by foot, bike, or other low-speed vehicles. This proposed network of streets would include Laneways, where traffic moves at pedestrian speeds, and Accessways, where traffic moves at cycling speeds. On Boulevards and Transitways, where traffic moves at vehicular speeds, the overall sense of safety and comfort for pedestrians and cyclists would be improved through the use of wider sidewalks and dedicated bike spaces. (See Page 92 of this chapter for more details on street types.)

In Quayside, this plan would only affect two streets; therefore, its impact would be limited. But applied across a larger area that covers most or all of a rider's route, this street network could transform the experience of cycling through a city. Within the IDEA District, cyclists would be able to reach 100 percent of buildings on a dedicated bike lane or roadway designed for bikes, compared to roughly 15 percent in a typical downtown Toronto neighbourhood today.[31]

A strong walking and cycling network does not end at the neighbourhood's limits. While the waterfront has easy walking and cycling proximity to the vibrant neighbourhoods of the Distillery District, Corktown Commons, and St. Lawrence, access to them is cut off by the need to cross under both the Gardiner Expressway and the railway lines leading to Union Station. Pedestrians and cyclists are subjected to loud noises, dark and narrow tunnels, confusing paths, and, occasionally, unknown liquid dripping from above.

To improve these connections, Sidewalk Labs proposes that the Parliament and Cherry underpasses be rebuilt. (The Cherry Street underpass must be rebuilt to accommodate the extension of the light rail line from the Distillery District in any case.) The rebuilt underpasses would separate pedestrians, bikes, cars, and public transit (consistent with the city's existing and planned bike and transit networks) to improve safety, add noise buffers and attractive lighting to enhance comfort and wayfinding, and install temporary display windows and digital art exhibits to make the walk fun and engaging.

Bike lanes or priority streets could connect to

100%

of IDEA District buildings.

Map

How the proposed bike plan expands opportunities for cyclists

Existing network
Primary separated lanes
Proposed
City of Toronto bike routes

Primary access
Secondary access
Improved underpass connection
Sidewalk Labs proposed bike routes

IDEA District

Quayside

This conceptual sketch of the reconstructed Cherry Street underpass shows decorative lighting, acoustic panels, bike lanes, and tree-lined walkways, which would create an appealing gateway between Toronto's downtown core and its emerging eastern waterfront.

Connections to the city's existing bike network are also critical. The Martin Goodman Trail, which runs through the waterfront, provides a natural cycling link to the rest of the city, and the underpass reconfigurations would provide an additional cycling link for Parliament and Cherry streets. The proposed connection to the existing on-street bicycle lane at Lower Sherbourne would allow riders to transition from a street where today bikes are given only a portion of the street to the bicycle-priority streets designed by Sidewalk Labs. In particular, Sidewalk Labs plans to connect to the existing and planned bicycle routes that would provide last-mile service to the future East Harbour station.

Finally, this emphasis on connections applies to developments along waterways, such as Keating Channel. In such a setting, Sidewalk Labs' approach aims to stitch together both sides of the waterway through a multitude of easily accessible, narrow bridges designed exclusively for pedestrians and cyclists, rather than funneling all types of traffic across one or two large bridges. This tapestry of connections reinforces the broader push for a walkable, "15 minute neighbourhood" and makes the waterway feel like part of the community, instead of a barrier.

Goal 3

Enabling Walking and Cycling Year-Round

Provide signal priority for walking and cycling

This bike lane in Copenhagen uses a "green wave": a signal coordination system, shown here through green pavement lights, that helps cyclists safely maintain higher speeds for longer distances. Credit: SWARCO

All proposed digital innovations would require approval from the independent Urban Data Trust, described more in the "Digital Innovation" chapter of Volume 2, on Page 374.

For trips that take pedestrians and cyclists onto faster-moving streets, Sidewalk Labs plans to help ensure safety and priority for these travellers using new traffic signal technology. These signals have the ability to detect when pedestrians need more time at a crossing and can adjust signals accordingly.

For example, consider an elderly woman with a cane who starts crossing a boulevard, which is designed to handle the most vehicle traffic. A typical crossing signal changes the light when the predetermined crossing time is up, whether or not this person has made it across safely. But an adaptive traffic signal can detect that the woman remains in the middle of the street — in an anonymous way that preserves privacy — and extend the crossing time until she is safely on the other side. (See Page 91 of this chapter for more details.)

Sidewalk Labs plans to provide cyclists with similar priority by deploying "green waves," a concept pioneered in Copenhagen that uses signal coordination to help cyclists avoid hitting red lights so long as they maintain a certain speed.[32] (Sidewalk Labs plans to indicate green waves via LED strips on pavement.) These waves not only improve travel time but also increase safety, both because green waves make cyclists more visible to drivers, and because the timing between the waves allows safe crossing opportunities for pedestrians.

Goal 4

Enabling Walking and Cycling Year-Round

Encourage bike-share, e-bike, and other low-speed vehicle options

Quayside's low-speed vehicle infrastructure would include:
3,800 bike parking spaces

190 bike-share docks

60 electric bikes

190 e-scooters

Some of the barriers to cycling — especially commuting by bicycle — are less about street design and more about access to bike options both at the start of a trip and when parking at a destination. The global trend of bike-sharing, including Toronto Bike Share, has made clear the value of using technology to make vehicles available on demand for one-way trips.

To encourage bike (and other low-speed vehicle) services in Quayside, Sidewalk Labs plans to create parking for nearly 3,800 bikes for residents and employees (20 percent more than required by regulation), 190 bike-share docks, 60 electric bikes, and 190 e-scooters. A neighbourhood of this size would typically have no more than 15 bike-share bikes (as per Toronto Bike Share criteria) and no dedicated space for e-bikes or scooters.[33]

Electric bikes and e-scooters help riders make their trips without the full exertion of traditional pedaling, expanding the distance someone might consider cycling. Both options are still emerging in North American cities, and e-scooters are currently not allowed in Toronto. Given Toronto's mobility objectives, Sidewalk Labs expects that e-scooter use will be adopted by the time Quayside opens; if not, Sidewalk Labs would seek to work with the city to use the neighbourhood to test how e-scooters could be used safely in Toronto.

Dockless vehicle shares — a new type of bike-share service that does not require fixed stations — are a recent addition to city streets. To provide this option while also preventing the disorder of bikes parked haphazardly across the public realm, Sidewalk Labs plans to designate parking areas for dockless vehicles.

To accommodate trips made on personal bikes, Sidewalk Labs proposes to require all buildings to create a minimum of one bike space per every two building residents and one bike space for every four employees. Given that studies show that arriving to work sweaty deters many would-be bike commuters, Sidewalk Labs plans to help provide on-site showers through agreements with fitness centres or a dedicated bike centre.

Sidewalk Labs small research grant

How bike counting tools help cities plan bike infrastructure

Credit: David Edgar

How much road space should new neighbourhoods reserve for bike lanes? What is the best way to balance the needs of cyclists, pedestrians, cars, and other low-speed vehicles? What is the ideal number of bike-share stations, and where should they be located?

Planners can estimate these needs, but bicycle-counting technology can provide the detailed data necessary to ensure the optimal use of road space for all users, and even to encourage cycling. A recent report from the Samuelson-Glushko Canadian Internet Policy and Public Interest Clinic (funded by a Sidewalk Labs' small research grant) laid out the benefits — and the privacy risks — of collecting bicycle data.[34]

A wide variety of technologies are available to count bikes, including inductive loops embedded in roadways, that measure the change in the magnetic field when metal passes over them. Some bicycle counters work with video footage, others with infrared light, still others with laser-pulsing LIDAR. And old-fashioned manual counts can help by tallying things like bicycle helmets.

These technologies are often used in tandem, and the information they collect can be stored, analyzed, and retrieved through civic open-data portals. But sequential photo or video counting can reveal individual routes and other sensitive information.

To address this challenge, the report points to counter-measures that de-identify data collection. One such process, known as "k-anonymity," reserves the release of bike information until every combination of variables can be matched with at least "k" individuals, allowing cities to set an appropriate threshold. Some technologies, such as sensors that count cyclists via changes in light intensity, preserve anonymity from the outset.

The City of Ottawa has a comprehensive system for bicycle counting that includes algorithm-enabled cameras, and anonymized-at-source technologies such as inductive loops, infrared, and manual counts. Any identifiable data is anonymized before it is made accessible through the city's open data portal: planners can see the number of users on a particular bike lane, but not individual routes.

Goal 5

Enabling Walking and Cycling Year-Round

Facilitate all-weather walking and cycling with heated pavement

See the "Sustainability" chapter of Volume 2, on Page 296, for more details on the thermal grid.

The climate presents a challenge to year-round walking and cycling in cold-weather cities like Toronto.

Many people report being "nine-month cyclists"; a Ryerson study found that only 27 percent of regular cyclists[35] continue to bike to work or school throughout the winter months. Meanwhile, icy or snowy streets can prove big obstacles to walking outside in winter. According to a City of Toronto report from 2016, roughly 3,000 Torontonians go to the emergency room every year after falling on ice or snow, and more than half of city residents over 65 report trouble moving around outdoors in winter, citing slippery sidewalks as their greatest concern.[36]

Only 27% of regular cyclists commute by bike in winter.

Sidewalk Labs plans to deploy heated pavement in some sidewalks and bike lanes to make walking and cycling more attractive all year. This pavement relies on modularity for easier access to the heating system, reducing maintenance costs and disruption, and takes advantage of new, efficient heating technologies that require less extensive piping systems to operate.

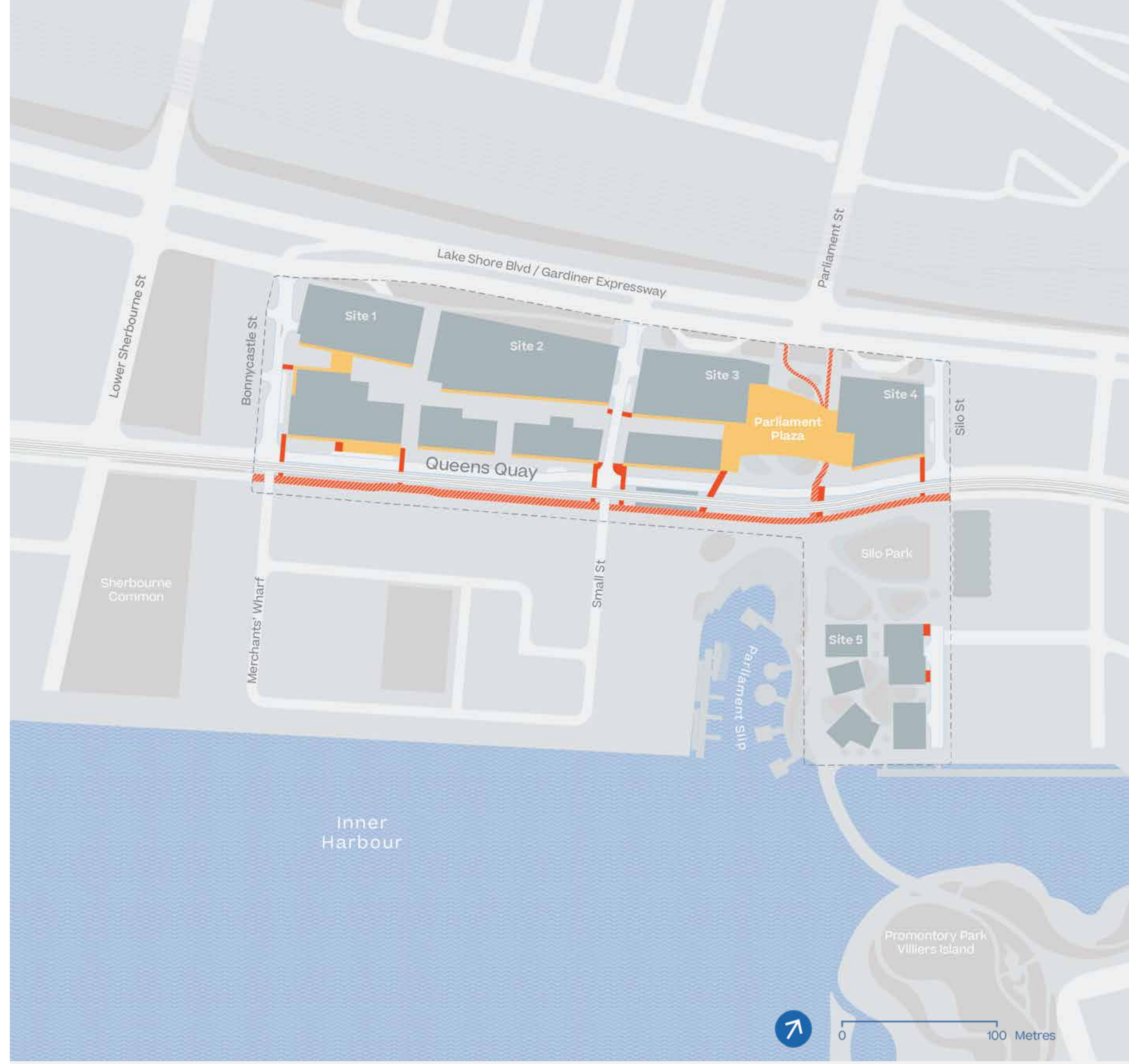
Sidewalks located near buildings would use hydronic heating, which circulates warm fluid just underneath the pavement surface, and can be powered by clean energy sources used by the neighbourhood's thermal energy grid. Pavers located towards the centre of the streetscape would rely on conductive heating, which involves embedding a thin film in or under the pavement, making it easier to maintain than heating that runs through thick pipes. Conductive heating can also run off clean electricity.

To conserve energy, heated pavement would connect to real-time weather forecasts programmed to automatically "power on" three or four hours in advance of a storm. The pavement would reach a maximum temperature of 2 to 4 degrees Celsius, which is capable of melting snow while remaining comfortable to walk on. The system would turn off automatically whenever the pavement is dry and no risk of black ice is present.

In Quayside, Sidewalk Labs plans to deploy 1,200 square metres of heated sidewalk and pedestrian zones and 1,590 square metres of heated bike paths.[37] The amount of power used to run the heating system would be closely monitored to ensure it supports the community's sustainability goals. All costs would be tracked to ensure that they meet modelled cost expectations for capital investment, ongoing maintenance, and associated costs.

See the "Public Realm" chapter of Volume 2, on Page 118, for more details on outdoor comfort systems.

Wind, rain, and even sun in warmer months can be significant barriers to walking along the waterfront. Sidewalk Labs plans to deploy an outdoor comfort system along sidewalks to shield pedestrians from wind and provide additional cover from rain and snow.



Map

Making it safer to walk and cycle year-round with weather mitigation

The weather mitigation strategies proposed by Sidewalk Labs include heated pavers that could melt snow and ice on sidewalks and bike lanes, and building Raincoats that could protect adjacent outdoor areas from sun, rain, and snow.

Ch—1

Part 3

Harnessing New Mobility and Self-Driving Technology

Key Goals

1
Encourage shared use of ride-hail services

2
Provide car-share and parking options for the occasional private car trip

3
Make all trip options available in discounted mobility packages

In any major city, there are lots of trips that walking, cycling, and public transit cannot accommodate in a convenient way. The airport trip with lots of luggage. A hospital trip with an elderly parent. The weekend getaway to cottage country. The big shopping trip to the outlet mall. The trip home after a night out, so late that the subway is closed. The trip home of a hospital worker whose shift ends at 3 a.m.

Faced with these occasional needs, nearly half of the households in downtown Toronto choose to own a car. Yet, of these households, roughly half leave their car at home on weekdays, because they walk, bike, or take public transit to work,[38] meaning they pay roughly $900 a month to own, park, maintain, and insure a car simply for occasional trips. Some save money by parking on the street, but this imposes a cost on their neighbours, as street-parking spots take up space that otherwise could go towards public spaces or bike lanes, and real estate developers are required to create parking spots — a steep cost often passed on to tenants.

Breakthroughs in technology are generating a host of new mobility options that give households the freedom to make an occasional car trip without needing to own a car. These include ride-hail (taxi-like) services, such as Lyft or Uber; "microtransit" (van or shuttle) services; and car-share services that are bookable on demand, such as Zipcar.

These same services will get substantially cheaper and more convenient once self-driving technology becomes widespread. Indeed, no transportation technology holds as much potential to transform car-ownership as the self-driving vehicle.

The potential benefits are substantial. Crash fatalities caused by speeding, drowsiness, and drunk or distracted driving — which accounted for 66 percent of all vehicle fatalities on U.S. roads in 2016,[39] according to the U.S. National Highway Traffic Safety Administration — could largely disappear. Car commuters will be able to use their time more productively, and groups who currently cannot drive, such as people with visual impairments,

may achieve greater mobility. Self-driving vehicles can be programmed to obey all traffic rules and defer to pedestrians. Early commercial operations of self-driving vehicles will likely occur through fleets, giving cities a tool to recapture significant amounts of public space devoted to parking.

Despite these upsides, the impact that self-driving vehicles will have on cities is unclear, and some observers warn about potential drawbacks that cities may need to guard against. These include increases in driving and vehicles on the road, if people overuse the ability to use self-driving cars to conduct errands without them.

Much of this outcome depends not on the technology itself, but on policy for how it is used. If self-driving vehicles are individually owned and free to roam the streets without a driver, then car-ownership — and congestion — might soar. But if self-driving vehicles are integrated into the urban environment and public transit network with thoughtful policies that encourage fleets of shared trips and people-first street designs, they can become part of a next-generation mobility system.

New mobility initiatives could save a two-person household
$4,000
annually.

Sidewalk Labs' new mobility plan integrates policy, design, and technology to harness the potential for fleets of self-driving vehicles and shuttles to provide the convenience of a car trip without the need to own one. This plan includes encouraging the shared use of ride-hail services through designated passenger zones and pricing, providing car-share and parking options for the occasional car trip, and making all trip options available in an integrated mobility package.

One of the Sidewalk Toronto project's most significant opportunities for innovation is to be the first to demonstrate how existing new mobility options — and the application of self-driving technology to these services — can meaningfully reshape cities for the better. Sidewalk Labs does not plan to operate new mobility services or self-driving vehicle fleets within the IDEA District, nor would it give any special prioritization to Alphabet sibling companies, such as Waymo. Instead, this new mobility plan is meant to lay the groundwork for an open ecosystem of third-party mobility services to operate in ways that benefit urban life, now and in the future.

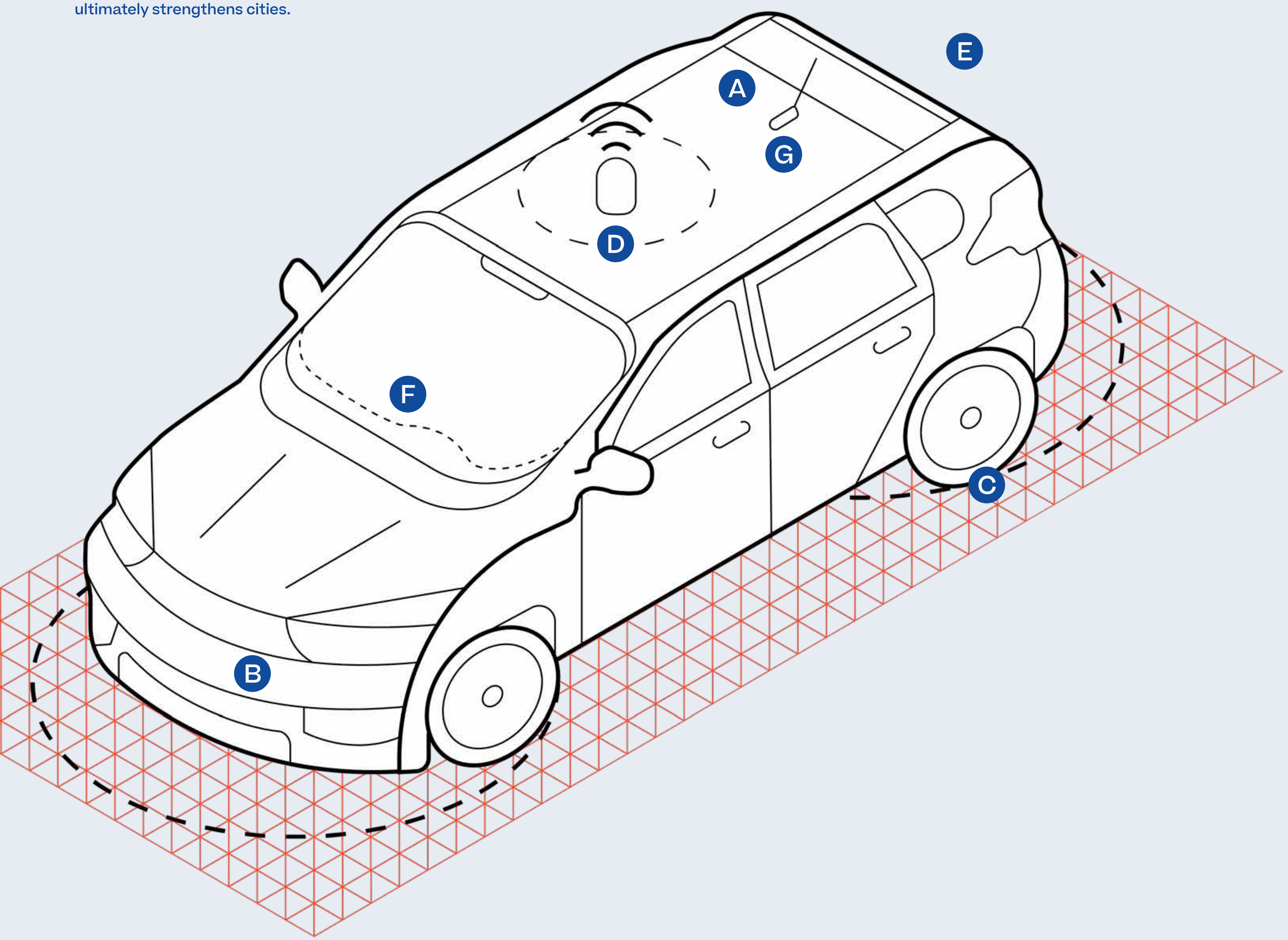
To that end, Sidewalk Labs supports research and stakeholder engagement initiatives that aim to improve the collective understanding of the effects of self-driving vehicles on urban transportation systems and to catalyze the consensus-building process to explore potential regulatory models. Sidewalk Labs was the funding partner of the MaRS Mapping the Autonomous Vehicle Landscape research initiative, which engaged government officials, industry leaders, and civic organizations, and mobility experts to identify regulatory priorities and dissect various governance models for the GTA.

With the arrival of self-driving technology, Sidewalk Labs' new mobility plan would lead to roughly 7 percent of all trips occurring by ride-hail options if applied at the full scale of the IDEA District and coordinated with the city, further helping households reduce the need to own a car. New mobility options such as self-driving ride-hail — combined with improved transit, cycling, and pedestrian options — form the basis of an integrated mobility package that could save two-person households roughly $4,000 a year if they choose to go car-free.[40]

In Focus

Self-driving vehicles have the potential to reshape cities

Sidewalk Labs believes that self-driving vehicles will become ubiquitous features of urban life within the next two decades. The next few pages explore how the technology works, summarize its evolution over the past half-century, and outline a series of principles to help ensure that self-driving technology ultimately strengthens cities.



Explainer: How self-driving vehicles drive

A breakdown of the technology behind this promising mobility advance

Roughly two-thirds of all crash fatalities are caused by speeding, falling asleep at the wheel, and drunk or distracted driving — hence the push to build cars that drive themselves. Self-driving vehicles never speed, fall asleep, drink alcohol, or get preoccupied with anything other than safely shuttling passengers to their destinations. Here is a look at how the technology[41] works:

A Planning a trip
Self-driving vehicles plan their route by accessing maps, traffic data, road and weather conditions, toll information, and more. They continuously refresh all that data throughout the trip, in real time, via an internet connection.

B Eyes on the ground
Front- and rear-mounted radar units determine the exact distances between the vehicle and other moving objects. Additional cameras and LIDAR sensors can also be mounted low on the vehicle.

C A game of inches
Existing vehicle GPS systems are typically accurate within one or two metres; a self-driving car requires greater precision than that. Its position estimators, mounted on wheels, can count tire revolutions and sense lateral movements. This data is layered atop detailed digital maps that include road grades, speed bumps, and curb-cut locations to determine the car's exact position.

D Eyes all around
A mini dome mounted on the car houses a LIDAR unit to help the vehicle "see." Using laser beams rather than radar waves, LIDAR generates dynamic, three-dimensional imagery for as far as 60 metres in every direction. The mini-dome also contains video cameras that recognize traffic lights, signage, pedestrians, and cyclists.

E Back-seat driver
In the trunk of the vehicle lies the brains of the operation: the computer that processes all this data through algorithms and converts it into driving decisions (when to stop, back up, accelerate, slow down, change lanes, and more). It is a very powerful computer, akin to a mobile, multi-server data centre.

F Computer vision
A system called "computer vision" processes the combined data from the LIDAR, radar, and camera systems to identify street users; classify them as pedestrians, vehicles, or cyclists; anticipate their movements; incorporate road rules; and make driving decisions.

G Lessons learned and shared
All this data is cumulative, just like years of driving experience. As the car encounters and navigates new or unusual situations, it learns from them for the next time — and shares this learning with every car in its fleet.

Self-driving vehicle technology: A brief history

1957

First driverless car on a public road
RCA Labs successfully tests an autonomous vehicle on a 120-metre stretch of highway near Lincoln, Nebraska. The car's steering was controlled via electronic detector circuits embedded in the roadway.[42]

1968

A proposal for computer control
In a visionary essay, Stanford professor and AI pioneer John McCarthy envisions "automatic chauffeurs" consisting of onboard computers and television cameras. "A fivefold reduction in fatalities is probably required to make the system acceptable," he wrote. "Much better is possible since humans really are rather bad drivers."[43]

1986

The robot car is born
Munich-based engineer Ernst Dickmanns creates VaMoRs, a Mercedes Benz van with two cameras, eight 16-bit Intel microprocessors, and a dynamic vision program that can recognize features and abnormalities on the road. VaMoRs navigates 20 kilometres of autobahn at speeds of 90 kilometres per hour.[44]

1995

No hands across America
Carnegie Mellon University researchers build the Navlab 5 self-driving car, which successfully navigates a 5,000-kilometre highway journey from Pittsburgh to San Diego. Navlab 5's guidance system,[45] nicknamed Ralph, steered the car while its passengers controlled acceleration and braking.

2004 to 2007

The original DARPA challenges
In 2004, the U.S. Defense Advanced Research Projects Agency (DARPA) offers a $1 million USD prize for autonomous vehicles that can navigate a 240-kilometre course in the Mojave Desert. None of the entries are successful, but a year later, with obstacles disclosed in advance, five vehicles succeed. In 2007, DARPA issues an urban challenge: complete a 95-kilometre city course in less than six hours. Four entries succeed.[46]

2009

Google's autonomous vehicle project
Under the banner of Google X, the company's then-research arm, Google begins developing and testing self-driving technology. In 2016 the project became the company Waymo.[47]

2012

Google's testing moves to the city
Having tested its driverless technology for more than 480,000 kilometres of highway, Google moves to city streets. While city streets have lower speed limits, their abundance of pedestrians, cyclists, signals and signage[48] makes them a greater challenge for computer-based vision and decision-making.

2016

Autonomous taxis hit the road
NuTonomy, an MIT spin-off that builds self-driving software systems, begins trials of its driverless technology[49] as a taxi service in Singapore. The following year, NuTonomy partners with Lyft[50] to provide driverless taxi service in Boston (though the service is later discontinued).

around 2035

Self-driving taxis become ubiquitous in Toronto
Sidewalk Labs' mobility plan is designed to evolve with the assumption that self-driving vehicles can form the backbone of the ride-hail system by roughly 2035. Self-driving fleets can enable cities to eliminate curbside parking, among other street design changes, reclaiming space for a safe and highly pedestrianized public realm.

Sidewalk Labs' 10 self-driving principles

Sidewalk Labs has identified a set of core principles and assumptions about the future of urban mobility to guide planning for the Sidewalk Toronto project.

Technology

1. Self-driving vehicles, drones, and robots will likely be commercially feasible and regulatorily viable in the next 10 years. Therefore, Sidewalk Labs' focus is not on fostering the adoption of these technologies but on shaping service patterns to optimize for urban quality of life.
2. The marginal cost of transportation will head towards zero as robotics eliminate labour costs associated with mobility. As a result, policies that charge a price for road use will be a powerful tool to shape travel decisions and alleviate congestion.
3. As freight vehicles become self-tracking and self-loading, delivery systems will require shipping containers themselves to have advanced capabilities, such as location awareness and security.
4. It will be increasingly important to take emerging travel technologies, such as low-powered vehicles, into account when planning a neighbourhood, to ensure they can be accommodated in a way that improves quality of life.

Design

5. Design that improves walking and biking will be especially powerful in a dense urban neighbourhood, given the benefits of active transportation on individual health, the environment, and public space.
6. Cars and vans will never be able to replace high-volume transit on key routes in dense areas. In lower-density areas that cannot justify frequent rail and bus transit, the use of low-cost, on-demand systems that encourage shared rides could be prioritized.
7. Ride-hail and delivery services will continue to displace vehicle ownership and traditional retail patterns. Because these services thrive on point-to-point operation, managing curb space will be critical to the overall efficiency of the street network.

Policy

8. Personal car ownership will persist, even if self-driving technology radically lowers the cost of hailed rides, because owning a car in a major city is not a decision people make based on a detailed cost-benefit calculation; thus, policy will need to shape car-ownership patterns.
9. New vehicle technologies — from scooters to self-driving cars — will challenge existing government policies and infrastructure. Governments need policy tools that give them a measure of control over these technologies.
10. Self-driving vehicles will not necessarily be electric or connected when introduced by the market, so policies that encourage these features may be needed to fulfill the overall promise of new urban mobility.

Encourage shared use of ride-hail services

By many measures, ride-hailing services have been a major advance. By making high-quality taxi service available across the city, even in areas of medium or low density, ride-hailing enables more households to cut car trips or give up a car entirely, eliminates traffic related to searching for a parking spot, and reduces drunk driving. The technology can also match multiple riders along the same route, making it easier to share rides, which saves riders money while reducing environmental and congestion impacts.

But the rise of ride-hailing has been controversial. Many large cities[51] are reporting declines in transit ridership, a trend that some researchers attribute to increased ride-hailing trips. Studies have suggested that the enormous fleet of ride-hail vehicles generate new traffic congestion from the proliferation of pick-ups and drop-offs, creating another problem that cities need to solve. And the promise of sharing rides as an antidote to urban congestion has lagged, because shared-ride users often switch from non-auto modes of transportation.

With self-driving fleets,

6.7%

of all IDEA District trips would be hailed rides.

As self-driving technology improves, the per-trip cost of a taxi service will be no more expensive than the per-trip cost of travelling in a private car, since the largest cost of existing taxi service is paying the driver. While the labour implications of this shift should not be minimized, it also means that people will be able to hail a ride for a much lower price than they can today and will experience shorter wait times. Researchers in Europe and the U.S. have estimated that self-driving fleet services could cost the equivalent of $0.23 to $1.27 per kilometre,[52] making them more affordable than existing ride services. At the same time, cheaper rides could also induce new ride-hail demand at the expense of more sustainable modes of transportation.

Sidewalk Labs seeks to maximize the mobility benefits of ride-hailing through staging areas, pick-up and drop-off zones, and shared-ride pricing. These initiatives aim to ensure that self-driving technology achieves the goals of expanding access to the city without a car, reducing household costs, and recapturing parking space for more vital public uses.

Priority pick-up/drop-off zones

Sidewalk Labs' approach to ride-hailing begins by designing staging areas for shared fleets or taxis. By providing a known hub where drivers and passengers can meet, drivers would be discouraged from cruising local streets for hails, without impacting passenger wait times.

As a related effort, Sidewalk Labs plans to design streets with passenger pick-up and drop-off spaces, which would facilitate ride-hailing and minimize the congestion that occurs when for-hire vehicles block traffic or double-park. These flexible spaces — or "dynamic curbs" — can respond to real-time traffic conditions. For example, during times of heavy traffic, dynamic curbs can be priced high, encouraging travellers to make other trip choices, such as public transit or bike-share. A real-time mobility management system (described on Page 84) can coordinate pick-up and drop-off spaces and set prices based on congestion.

During light traffic, dynamic curbs can be repurposed for community space or gatherings, with these changes indicated via lighted pavement. Lights in pavement are not a new technology. Airports have used lights inserted in their runways[53] to direct plane traffic since the 1940s. More recently, as the price of LEDs has dropped, cities have begun to experiment with how lights can help direct pedestrian[54] and cyclist[55] activity. Pavement lighting enables dynamic curbs to communicate changing street space allocations on-the-fly, helping neighbourhoods recapture flexible street space for public use in a clear and safe way.

These benefits increase with self-driving technology. A self-driving fleet can be directed by a mobility management system to a remote staging area, then summoned in appropriate quantities to meet real-time demand in local pick-up zones. This approach would save valuable space for buildings and the public realm, keep the streets clear of unnecessary traffic, and help eliminate cruising while maintaining a reliable supply of on-demand vehicles.

Priced to share

The other key piece of Sidewalk Labs' ride-hail strategy is to propose the use of charging and subsidies to encourage alternate trip choices and shared rides. This proposed pricing would take two forms: dynamic curb pricing for all vehicles, and charges and incentives for ride-hail vehicles using the Sidewalk Toronto project's specially designed local streets.

Technical spotlight

How Sidewalk Labs plans to encourage electric vehicles

A key part of the Sidewalk Toronto project's sustainability strategy is to shift to electric vehicles for as many trips as possible. The mobility plan would encourage a transition to electric vehicles (EVs) in several ways.

Electric light rail.
The first and most important is to reduce automobile use overall. The extension of the light rail would ensure that about 60 percent of travel to and from the IDEA District occurs by an all-electric light rail vehicle, which is even less energy-consuming per ride than an electric automobile.

Shared vehicles.
The second approach is to deploy a fleet of shared automobiles on the site, available to residents and on-site workers who have the neighbourhood's integrated mobility package. Travel models project that up to half of all resident auto use would involve these vehicles. Since the provision of these vehicles would be curated by the proposed Waterfront Transportation Management Association (see Page 86), it could be required that all such vehicles be electric.

Pricing and charging incentives.
For those residents who still own cars in Quayside, the WTMA could promote EV adoption in several ways. The off-site parking would offer EV charging, which can easily be managed because the lots will have attendants and most vehicles using those lots will not be used every day. Because it would control parking, the WTMA could offer discounts to parking fees for EVs owned by residents and employees, providing an incentive for drivers to switch.

For employees, visitors, and ride-hail vehicles, the WTMA could also use both pricing and charging to encourage EV adoption. In the hourly parking spaces at the mobility hub, 25 percent of all spaces would be equipped with chargers, with the ability to increase that number with demand; most of these charges would be fast chargers (Level 2 and 3). The WTMA could also choose to offer discounts on parking and curbside charges to EVs.

Self-driving vehicles.
The full scale of the IDEA District offers several additional opportunities to further increase EV adoption. One is the transition to self-driving vehicles, which should be all-electric; as use of these vehicles increases, the number of electric self-driving vehicles should increase as well.

A second opportunity is the area's greater size, which enables the WTMA to encourage changes in the ride-hail vehicles that serve the area. At that scale, WTMA could require that all ride-hail vehicles that want to be part of the mobility subscription package be EVs.

Finally, WTMA could adopt an approach that Waterfront Toronto suggested in the Villiers Island Precinct Plan: to prohibit non-EVs from entering the island.

A key remaining challenge to widespread EV adoption is that chargers themselves are difficult to site. One game-changing solution to charging would be to embed inductive chargers into the pavement, turning streets and parking spaces themselves into charging stations. A future evolution of Sidewalk Labs' paver technology is envisioned to include inductive charging.

1

Dynamic curb pricing.
As proposed, dynamic curb pricing would apply to all vehicle services and vary based on congestion in pick-up or drop-off spaces. These charges would include a low one-time charge to access the curb space and higher time-based charges for vehicles that wait longer than five minutes at the curb. The goal is to encourage people to consider alternative trip options or to share a ride and split the cost, as well as for vehicles to use the curb quickly and move on. Passengers who prefer not to pay a curb charge could be picked up or dropped off for free at a designated underground drop-off and pick-up area with access to numerous transport options.

2

Per-kilometre pricing.
Sidewalk Labs believes that a public mobility management entity should have the power to impose a per-kilometre charge on ride-hail vehicles using the Sidewalk Toronto project's specially designed local streets, if necessary to encourage people to share rides and to discourage operators from allowing vehicles to cruise streets without passengers.

A public entity that includes representation from the city would be responsible for proposing and administering any fees and would issue exemptions for riders with disabilities, the elderly, and low-income groups. (See Page 86 for more on this entity.) Additionally, the public entity could experiment with tools to ensure that ride-hailing vehicles work to support public transit; possibilities include offering subsidies for rides that begin or end at transit stations.

Sidewalk Labs could partner with the city and the Toronto Transit Commission on their upcoming pilot to design a meaningful test in Quayside. At the full scale of the IDEA District, Sidewalk Labs estimates that the increased convenience and affordability of self-driving fleets would result in nearly 7 percent of trips occurring by hailed rides.[56]

Goal 2

Provide car-share and parking options for the occasional private car trip

From the daylong shopping trip to the long weekend away, there are some trips where even the best public transit systems and a variety of new mobility and ride-hail options are not sufficient. These types of trips are typically infrequent, but they place downtown households in a bind that often leads them to own a car they rarely use.

In Toronto, downtown households drive less on average than Ontarians overall — 5,600 kilometres versus 16,000 per year[57] — but most of the costs of owning a car are fixed regardless of how much a household drives; these include depreciation, insurance, and routine maintenance. The cost of parking is also very high[58] in downtown Toronto, ranging from $225 to $400 per month on average, and sometimes more. On the low end, for a family that drives only 5,600 kilometres per year, the cost of driving an owned car works out to roughly $2 per kilometre, which is about the same as an Uber or Lyft charge.

Car-share.
To help households use a private car on certain occasions without the need to own one, Sidewalk Labs plans to partner with a variety of on-site car-sharing and car-rental providers. It also plans to encourage a variety of vehicle types, such as minivans (helpful for tasks like buying used furniture) and cars equipped with car seats for children. Sidewalk Labs plans to require these vehicles to be electric; in exchange, these car-sharing services would have access to some of the few parking spaces within Quayside, making them convenient to residents.

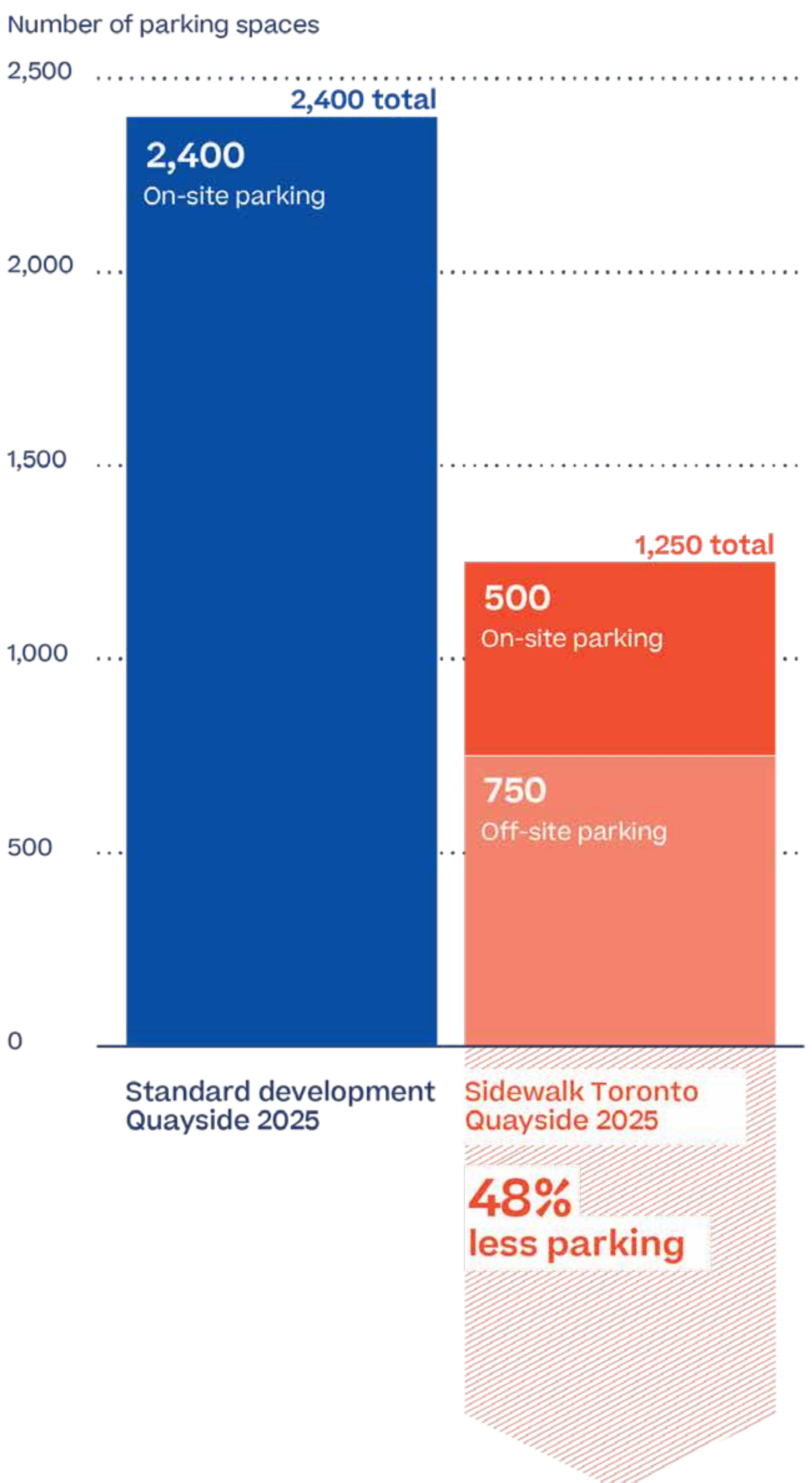
On- and off-site parking.
As with any neighbourhood, there will likely be some visitors, employees, and residents who still need to drive private cars into and out of Quayside, including people arriving from parts of the GTA that do not have easy transit connections to the neighbourhood. And while residents in Quayside should be able to meet almost all their daily travel needs without a car, some may have weekend travel needs that lead them to continue owning one.

To meet these needs, Sidewalk Labs proposes two approaches to parking:

In Quayside, short-term parking would be available in a 500-space underground garage. Roughly 100 spaces would be reserved for car-share vehicles; the remaining spaces would be priced to manage demand and discourage long-term use. This short-term garage would provide 15 percent of spaces with Level 3 electric-vehicle charging stations on opening day and would have the infrastructure to increase to 100 percent of spaces over time as electric vehicles become more common in Toronto. This approach stands in contrast to the nearly 2,400 parking spaces that would normally be provided in a residential development of this size.

48% less parking in Quayside compared to a typical development

Typical developments require significant on-site parking. By ensuring that Quayside residents, workers, and visitors can make nearly every trip without a private car, Sidewalk Labs can dramatically reduce the amount of parking required and shift the majority of spots to an off-site location.



For longer-term parking for employees and residents, Sidewalk Labs plans that off-site facilities be leased on available parcels very close to Quayside. These facilities would provide about 750 spaces, with on-demand pick-up and drop-off service between the off-site parking facilities and the proposed interchange near the intersection of Queens Quay and Small Street. Residents and employees would need to pay for this parking. The intention of this approach is to make off-site parking a reasonably priced option for people who occasionally use their cars without providing the on-site parking that encourages people to drive every day.

These parking facilities are also part of Sidewalk Labs' electric vehicle strategy. Owners of electric vehicles would pay a significantly discounted rate, and battery chargers would be provided at these off-site facilities. Based on current best practices, Sidewalk Labs' goal is for 30 percent of residents who own cars to switch to electric vehicles.

The switch from private car-ownership to electrified ride-hail fleets would not be meaningful at the Quayside scale; however, Sidewalk Labs expects personal car-ownership to be reduced significantly at the larger IDEA District scale. At such a scale, both of these parking facilities would be converted to accommodate the maintenance and staging of self-driving ride-hail vehicles.

The benefits to neighbourhoods would also be substantial, as off-site parking would dramatically reduce or eliminate the number of spaces normally located in buildings, freeing up space for housing or shared amenities.

Goal 3

Harnessing New Mobility and Self-Driving Technology

Make all trip options available in discounted mobility packages

Urban mobility services tend to be operated by a patchwork of public agencies and private companies, but city residents just want to get around. On any given week, a typical household in downtown Toronto uses a mixture of streetcar, subway, taxi, ride-hail, bike-share, and other services.

Some cities have started to tackle this fractured system with integrated fare technologies that enable people to pay for a variety of trip types. For example, Toronto's Presto card works on both GO commuter trains and TTC subways, streetcars, and buses, while in Tokyo, travellers can use a Suica card[59] to pay for a subway fare and a taxi (as well as purchase goods from station shops). Meanwhile, some digital navigation apps have started to display scheduling or purchasing options across many services, from bike-share to buses.

Sidewalk Labs' mobility vision includes ensuring that people see all their trip options at any given moment and pay for them using the same service. One component of this goal would be an integrated mobility package that includes a monthly subscription covering a wide range of services — a concept often called "mobility as a service" — including a TTC monthly pass, an unlimited Bike Share Toronto membership, access to electric scooters and other low-speed vehicles, and credits for rides with ride-hail or car-share providers. Sidewalk Labs expects a version of this package to be available to residents at a cost of $270 per month.[60]

Sidewalk Labs' mobility vision includes ensuring that people see all their trip options at any given moment and pay for them using the same service.

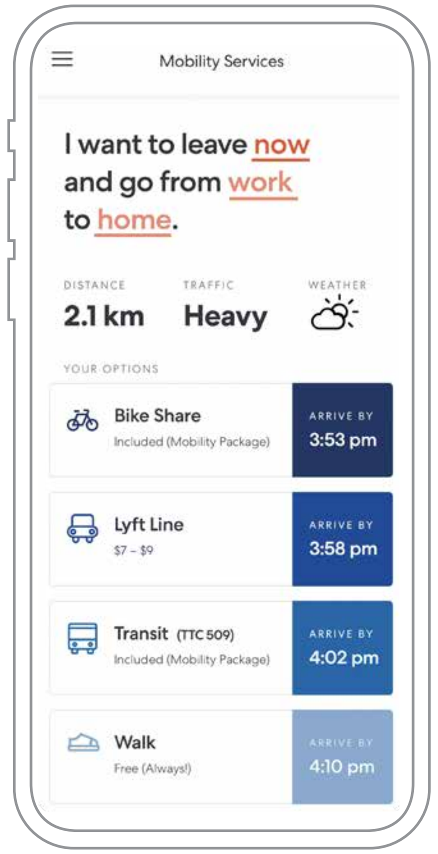
All proposed digital innovations would require approval from the independent Urban Data Trust, described more in the "Digital Innovation" chapter of Volume 2, on Page 374.

Another key component is making real-time information about mobility services and the transportation system available in open, standardized formats. This approach could result in a new integrated mobility app created specifically for the IDEA District that features all mobility choices in one place. Or, it could encourage existing third-party apps (such as Transit App or Citymapper) to offer their users services based on much more accurate and relevant information.

Critically, Sidewalk Labs' data integrations would allow third-party mobility apps to understand the real-time price for each service. For example, residents with an integrated mobility package could see a light rail trip as "free," instead of showing the standard fare. The result would be a personalized, accurate representation of transportation options that encourages people to make trips that do not require a private car.

A development the scale of Quayside could help test and refine the capabilities of an integrated mobility service — and more importantly, present Quayside residents with an attractive new mobility package during move-in, a transition period when studies have found people are most open to new travel behaviours.

When deployed across the full scale of the IDEA District, an integrated mobility service would provide access to all the new and traditional mobility options that make it far easier for households to avoid owning a car in a downtown neighbourhood, and the more than $10,000-a-year cost associated with it.

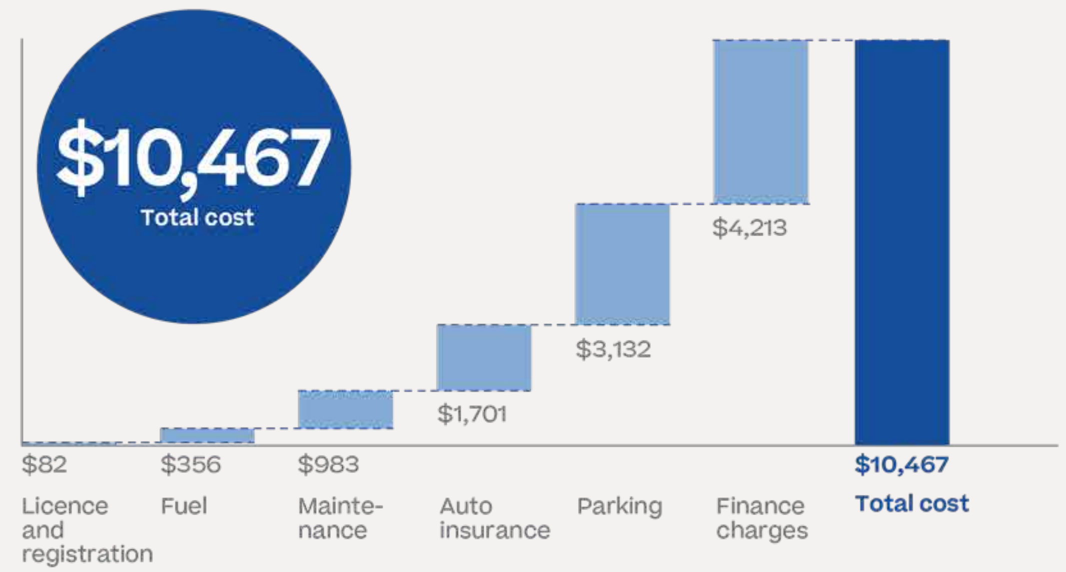


The integrated mobility package could be used through a new mobility app that shows travellers all their options in real time (above, an illustrative interface).

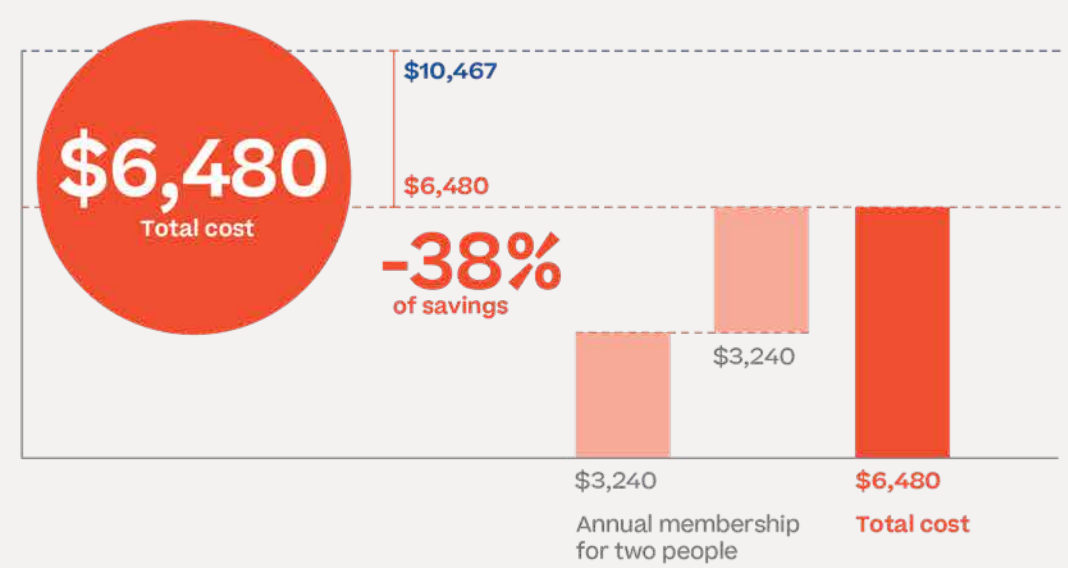
Saving $4,000 a year with new mobility options

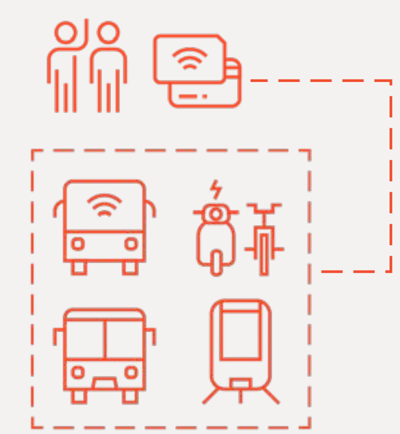
Sidewalk Labs' proposed integrated mobility package includes a discounted TTC pass, unlimited bike share, ride-hail credits, and other options for $270 a month. A two-person household that switched from owning a car to subscribing to this mobility package would save at least 40 percent on annual transportation spending, or roughly $4,000 per year — while still meeting projected travel needs. The actual savings would likely be greater, as households that own a car in downtown Toronto also currently consume some additional mobility services, such as public transit and hailed rides.

Annual cost for a two-person household that owns one car



Annual cost for a two-person household that owns zero cars and subscribes to the integrated mobility package





The integrated mobility package includes a discounted TTC pass (trains and buses), an unlimited Bike Share Toronto membership, access to e-scooters and other low-speed vehicles, and credits for rides with ride-hail or car-share providers for $270 a month.

Ch–1

Part 4

Reimagining City Deliveries and Freight

Key Goals

1
Establish a neighbourhood logistics hub for delivery, waste, storage, and borrowing services

2
Design a smart container for last-mile shipping

3
Deploy electric, self-driving delivery dollies

4
Connect underground delivery tunnels into buildings

The ability to have goods delivered quickly and reliably is an essential component of urban living — especially for households that do not own a car or have much storage space. And this ability is getting easier every day in cities like Toronto, thanks largely to online shopping. But the result is that there are now far more trucks on city streets. Canada Post's total domestic parcel volumes[61] rose 63 percent from 2007 to 2017, jumping 22 percent from 2016 to 2017 alone.

While delivery *feels* easier than ever to consumers, the delivery system itself is anything but simple. It is very difficult and expensive for shipments to go from a distribution centre to someone's door — a challenge often known as the "last mile" problem. These deliveries are almost exclusively made by trucks, many of which are too big for narrow city streets. Daytime customer demand means delivery trucks cannot simply travel overnight, but adding these vehicles to the road during peak travel times leads to traffic congestion and delayed deliveries, as trucks spend time looking for curb space. When no space is available and delivery timing is tight, they often double-park and incur a ticket.

Often, the least efficient part of the last mile is the final 50 feet. In urban areas, this final 50 feet covers the distance and time it takes for a truck driver to unload goods and complete the final handoff. Depending on where the delivery vehicle is parked, the last 50 feet can include the movement of goods by hand cart across a city's streets and sidewalks and can also involve elevator rides to a variety of recipients in tall buildings.

For all that trouble, people living in buildings without mailrooms or door service often miss deliveries — resulting in failed first, second, and even third delivery attempts, with the traffic congestion, pollution, and inconvenience that comes with them.

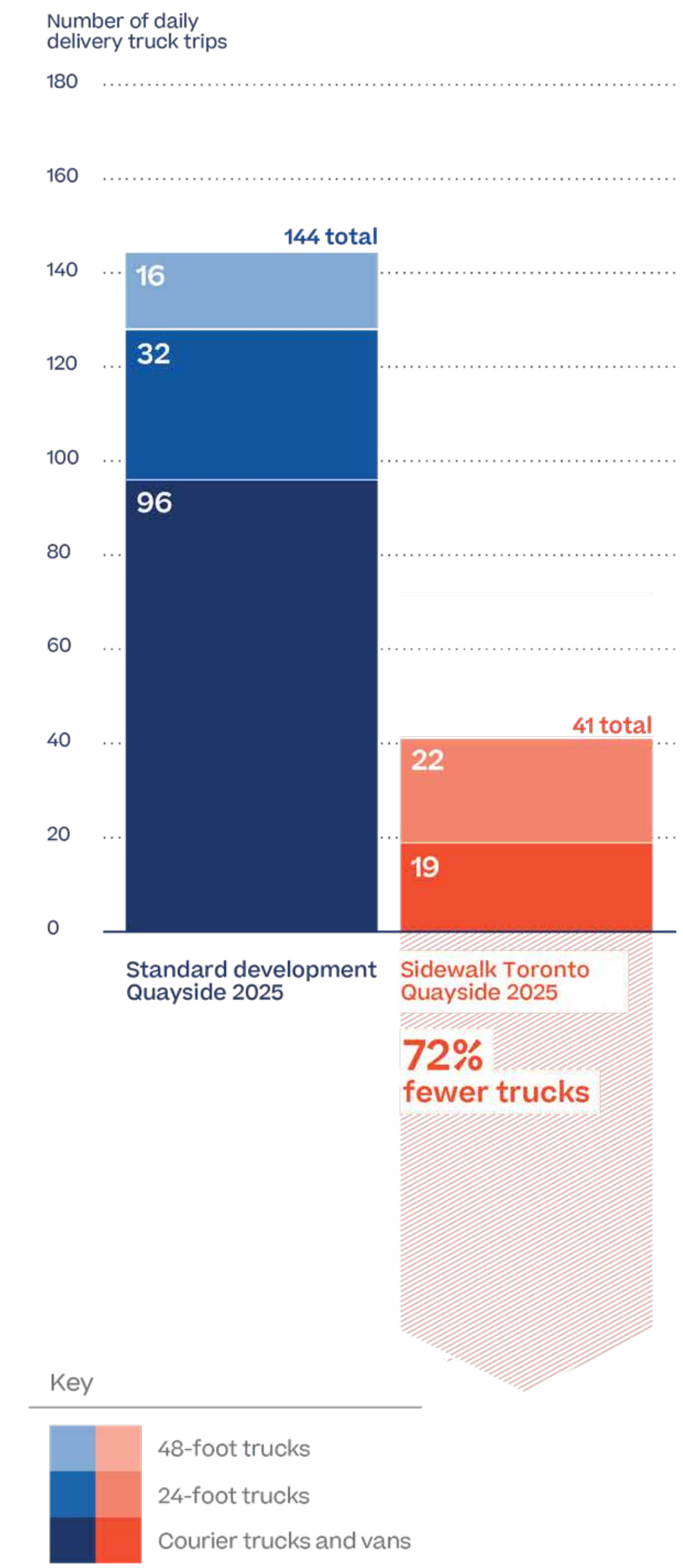
Sidewalk Labs has a comprehensive plan to address the "last-mile" challenges of urban logistics by creating a 24-hour neighbourhood freight system that dramatically reduces the negative impact of goods movement on city streets.

The plan begins by proposing to coordinate all deliveries (along with waste, storage, and borrowing services) at a new logistics hub on the perimeter of a neighbourhood to reduce unnecessary truck traffic on local streets. At this hub, nearly all packages would be transferred into new "smart containers" designed specifically for last-mile shipping, with these containers then travelling via electric, self-driving delivery dollies in a system of underground tunnels. This approach would enable all-hour delivery that avoids street disruptions and improves customer convenience at a lower cost to carriers, thanks to less time spent looking for parking, fewer tickets, and the opportunity to deliver full truck loads to the hub.

In Quayside, Sidewalk Labs proposes to implement several aspects of this system, including a local logistics hub, smart containers, and a tunnel network. But the neighbourhood's size prevents the system from generating enough revenue to sustain itself. Implemented at the full scale of the IDEA District, the system could become financially self-sustaining through a combination of shipment, storage, and waste-related hauling charges.

In Quayside alone, this system would reduce truck trips into the neighbourhood by 72 percent, along with reducing disruption to local roads and surrounding areas. These savings are achieved primarily through the consolidation of shipments into a single neighbourhood location. The beneficial impact would only get bigger when deployed at the full scale of the IDEA District.

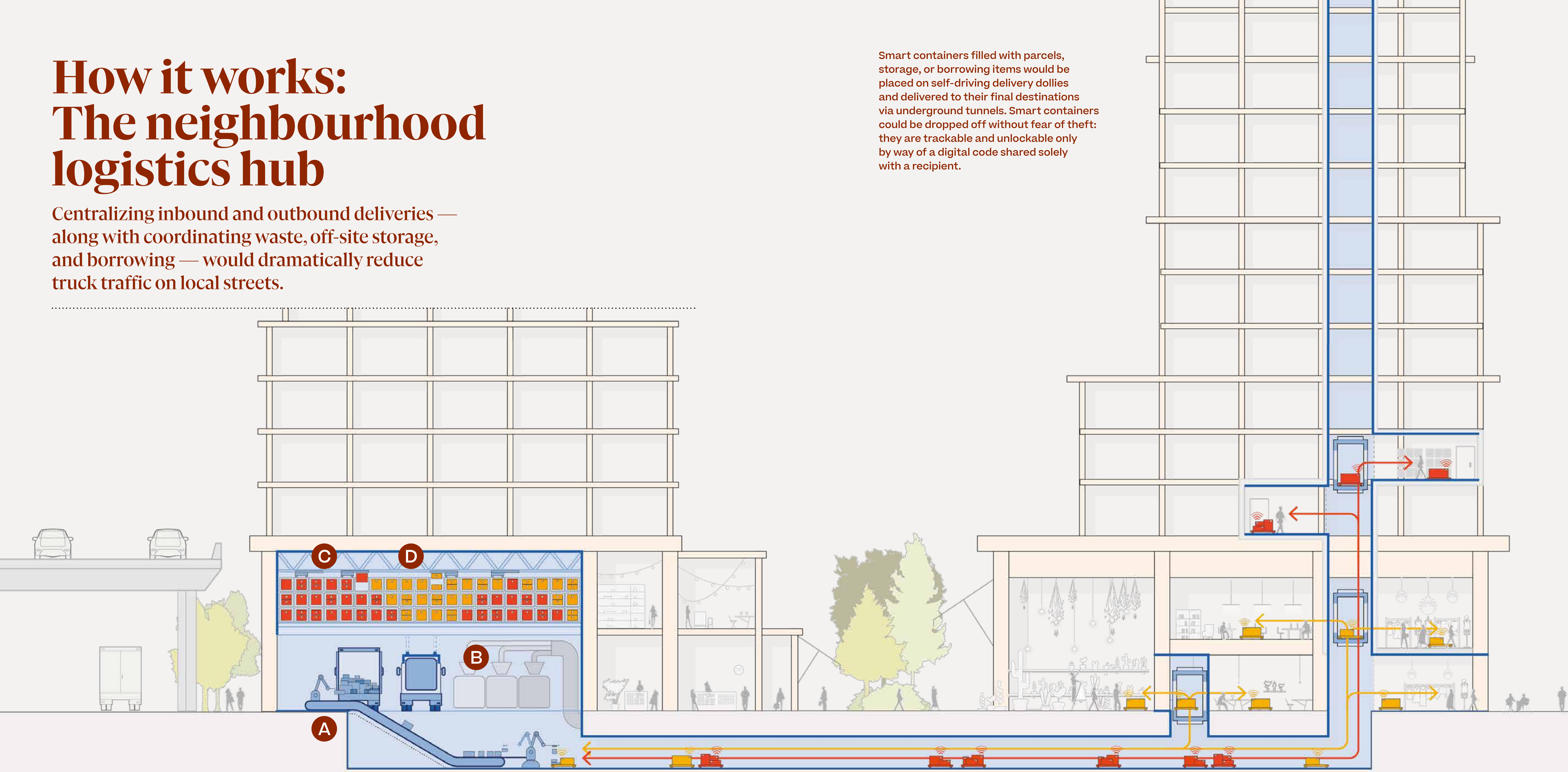
An underground freight delivery system could reduce truck traffic by 72%



How it works: The neighbourhood logistics hub

Centralizing inbound and outbound deliveries — along with coordinating waste, off-site storage, and borrowing — would dramatically reduce truck traffic on local streets.

Smart containers filled with parcels, storage, or borrowing items would be placed on self-driving delivery dollies and delivered to their final destinations via underground tunnels. Smart containers could be dropped off without fear of theft: they are trackable and unlockable only by way of a digital code shared solely with a recipient.



A The hub's **urban consolidation centre** would collect deliveries and prepare them for last-mile transport via underground tunnels that connect into buildings.

B **Waste** from three streams (organics, recycling, and landfill) would be transported via pneumatic tubes to the hub, making it the only neighbourhood stop for garbage trucks.

C **Off-site storage space** enables residents and businesses to store goods (such as seasonal items or inventories) and have them delivered on demand.

D A **borrowing library** of helpful items (such as power tools or sound systems) would be available for delivery across the neighbourhood.

The many ways to use a smart container

Delivery lockers

An efficient delivery locker system would act as a mailroom, offering a space where tenants could easily access mail and packages.

Off-site storage

Residents could use storage facilities for things such as seasonal clothing and equipment, with smart containers retrieving and delivering stored items on demand.

Door-to-door convenience

For people with accessibility needs, or for items that are large or heavy, smart containers could travel directly to a door for drop off or pick up.

Goal 1

Reimagining City Deliveries and Freight

Establish a neighbourhood logistics hub for delivery, waste, storage, and borrowing services

In Quayside,

95%

of deliveries would go through the urban consolidation centre.

Sidewalk Labs' proposed freight system begins with a neighbourhood logistics hub for deliveries, waste, storage, and borrowing services.

A neighbourhood hub allows for carriers to bundle deliveries and drop them off at one neighbourhood location, saving time and reducing the impact of truck trips on local streets. A 2017 study of a delivery consolidation centre[62] in Copenhagen found that it reduced truck kilometres by roughly 65 percent and emissions by 70 percent. These systems also help small retailers compete with larger ones by reducing the cost of last-mile distribution through savings related to time, fuel, and parking tickets.

To date, many such centres have failed to generate sustainable revenue. One exception is in the Dutch city of Nijmegen, which has succeeded by becoming a logistics hub that offers additional paid services on top of freight consolidation, including storage,[63] home-delivery, online-order fulfillment, and clean waste collection. Building on this successful example, Sidewalk Labs' hub plans to house four types of freight-related facilities.

1

Urban consolidation centre.

Sidewalk Labs' proposed logistics hub would feature an "urban consolidation centre" that consolidates inbound and outbound deliveries in a single place, just as the mailroom at a large university campus might serve multiple buildings.

The urban consolidation centre would allow delivery carriers, such as UPS, to deliver to one location instead of to each door in the neighbourhood. All inbound parcels would be received at the centre and then, as in a traditional distribution centre, sorted by address. Finally, items would be placed into smart containers and sent to their final destination within the neighbourhood. The same would be true for inbound smart containers transporting parcels for pickup by carriers.

This centralization would significantly reduce the number of trucks coming into the neighbourhood because carriers would be able to consolidate all of their deliveries into fewer trucks. It would also improve conditions in and around the neighbourhood: no more trucks looking for parking, failed delivery attempts, excess fuel burning, or lost time. And with consolidation centres, carriers can unload an entire vehicle and collect multiple outbound deliveries, ensuring that trucks are moving as efficiently as possible and not driving empty.

In Quayside, roughly 95 percent of all residential and commercial deliveries could be handled by this facility.[64] Oversized and overweight cargo, such as a sofa or something requiring special handling, would be delivered directly to the destination. Sidewalk Labs proposes to require traditional trucks to pay for a special permit to enter Quayside, with discounts for making deliveries during the night, operating electric vehicles, and using loading docks instead of the curb. (A new public entity would manage these payments; see Page 86 for details.)

2

Waste.

The proposed neighbourhood logistics hub would also serve as the neighbourhood's waste consolidation site. Waste would arrive through a number of routes. Landfill, organics, and metal/glass/plastic would arrive via underground vacuum tubes. Recyclable cardboard and other items that do not travel through the vacuum tube system would arrive through the neighbourhood freight system. Providing a one-stop pick-up for waste would reduce the presence of garbage trucks on local streets. As with exceptional deliveries, oversized waste would require direct pick-up, triggering a permitting process.

See the "Sustainability" chapter of Volume 2, on Page 296, for more details on waste.

3

Off-site storage.

The logistics hub would also provide an on-demand storage service for residents who prefer not to keep certain items at home. Residents can store items at the storage facility just as they would in traditional city storage units, but they can order their items for immediate delivery using a digital app — with a standard of responsiveness that no current service offers. The app would allow users to see what items they have in storage by providing a personalized inventory list with photos or accessible audio descriptions for easy retrieval. This service could include short-term storage for bulky cookware, luggage, and other items used occasionally and longer-term storage for items used seasonally, such as winter clothes or skating equipment.

Businesses looking to reduce stockroom clutter can use this storage service as well. As a result, retail stores can act more like showrooms, with limited items inside the store and excess products stored off site. Because the storage facility would be co-located with the shipping centre, products can be immediately shipped out to customers who live in Quayside (via underground tunnels) or to those who live elsewhere (via trucks). That means people can shop throughout the neighbourhood without having to carry their purchases with them, freeing them to arrive via transit or bike instead of a car.

4

Borrowing library.

Finally, the logistics hub would contain a peer-to-peer “Library of Things” service for neighbourhood residents and small businesses who prefer to borrow or rent items rather than buy them. Similar services that exist today, such as the Sharing Depot, often rent out items that are expensive, bulky, or infrequently needed, such as power tools, sound systems, and grills. The library could house these items and rent them out for a fee. A true sharing economy would allow the IDEA District to be more convenient, sustainable, and affordable, enabling people to live comfortably in apartments with less storage space (and thus lower rent).

In Quayside, the entire logistics hub is planned to be 200,000 usable square feet, capable of accommodating over 18,000 daily parcels, with all activity other than loading docks located underground. The hub would be underneath the buildings on the northwest side of the neighbourhood. By having all the logistics activities take place below ground, the hub would seamlessly integrate into the neighbourhood, with a ground floor that features active “stoa” spaces. At the proposed full scale of the IDEA District, such a hub could be located at the northern edge of the Keating Channel area to facilitate access to other geographies.

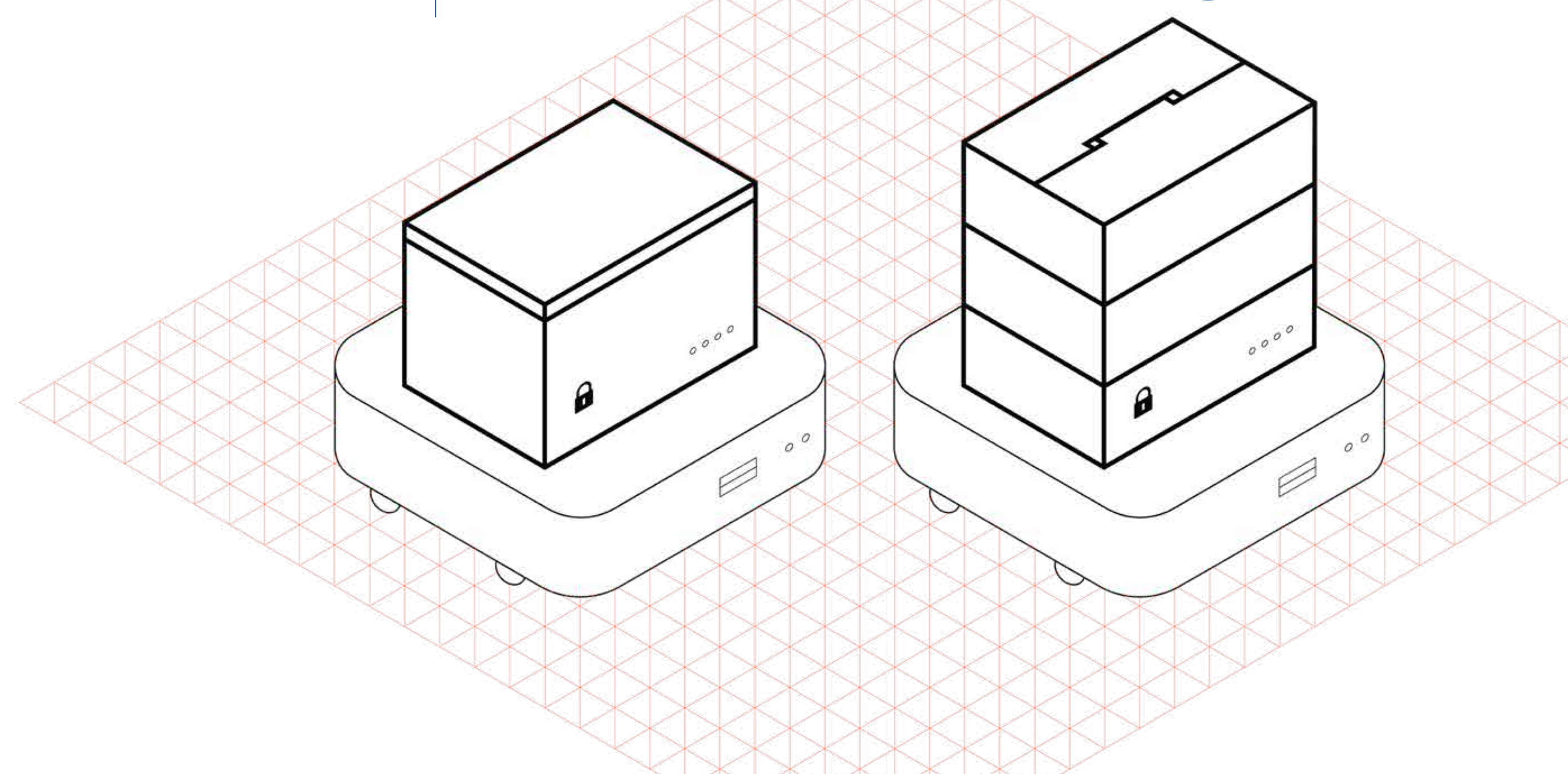
See the “Public Realm” chapter of Volume 2, on Page 118, for more details on stoa.

In Quayside, the entire logistics hub would be capable of accommodating over 18,000 daily parcels, with nearly all activity occurring underground.

Goal 2

Reimagining City Deliveries and Freight

Design a “smart container” for last-mile shipping



In the 20th century, the intermodal shipping container transformed the movement of global goods by standardizing the shape and size of an otherwise infinite variety of goods being shipped and by separating the cargo container from the vehicle itself. As a result, shipping containers can now travel around the world by truck, boat, or rail without unloading their contents.

While the shipping container solved many problems associated with long-haul freight, last-mile delivery still relies on the cardboard box. Various innovations are currently being tested, ranging from van-sized, self-driving trucks to robots that travel on sidewalks. But all of these ideas have incorporated the cargo into the vehicle itself, which misses the core insight of the long-haul shipping container: that the storage compartment should be separate from the vehicle, freeing each to evolve independently over time.

Inspired by the shipping container, Sidewalk Labs plans to develop standardized “smart containers” as the 21st-century urban equivalent for last-mile delivery.

At the neighbourhood logistics hub, goods would be scanned and sorted into smart containers, while still in their original packaging (nothing is opened). The smart containers would be designed to be able to carry the vast majority of standard-size packages. They can be filled with a single package or filled with several packages, depending on the destination and delivery urgency. If a receiver has multiple packages arriving in one day, the container would wait until it is filled up before making its way out of the logistics hub in order to be as efficient as possible. For urgent delivery of an item that may be perishable or that has other immediate delivery needs, a smart container would leave as soon as the package is placed inside.

Smart containers could be handled by a variety of delivery vehicles — from cargo bikes to traditional trucks to self-driving vehicles — so that cities that have not yet embraced self-driving transportation can still use them. These durable containers would be stackable, enabling them to function as lockers and to be placed easily onto delivery vehicles. They would also be embedded with location-based capabilities to track movements.

A smart container is not only for mail and package delivery; it can be used to move other items within the logistics hub, including waste, storage, and borrowing items. After a smart container delivers a parcel or stored item, recipients can send back the container filled with a new type of cargo; for example, after receiving a package, residents can then send out their storage items in the same container. This makes for a highly efficient "backhauling" system, which reduces the amount of time containers travel while empty. The design of these containers would allow for the safe and healthy handling of multiple types of cargo through the use of liners, inserts, and innovative cleaning methods.

In addition to improving package logistics, the smart container has a number of features that would empower residents and businesses to receive shipments on their own terms, thereby eliminating missed deliveries.

Flexible scheduling.
Using an associated delivery app, recipients can reroute containers if they prefer to have their items delivered to a location other than the one it has been scheduled to arrive at, all the while knowing exactly what is inside and where the container is located. The app also allows recipients to provide container access to approved friends, family, or associates, in case they need items to be received while they are unavailable. With an integrated app, users can also request a container for pick-up when outbound items are ready to go to waste, borrowing, storage, or delivery facilities.

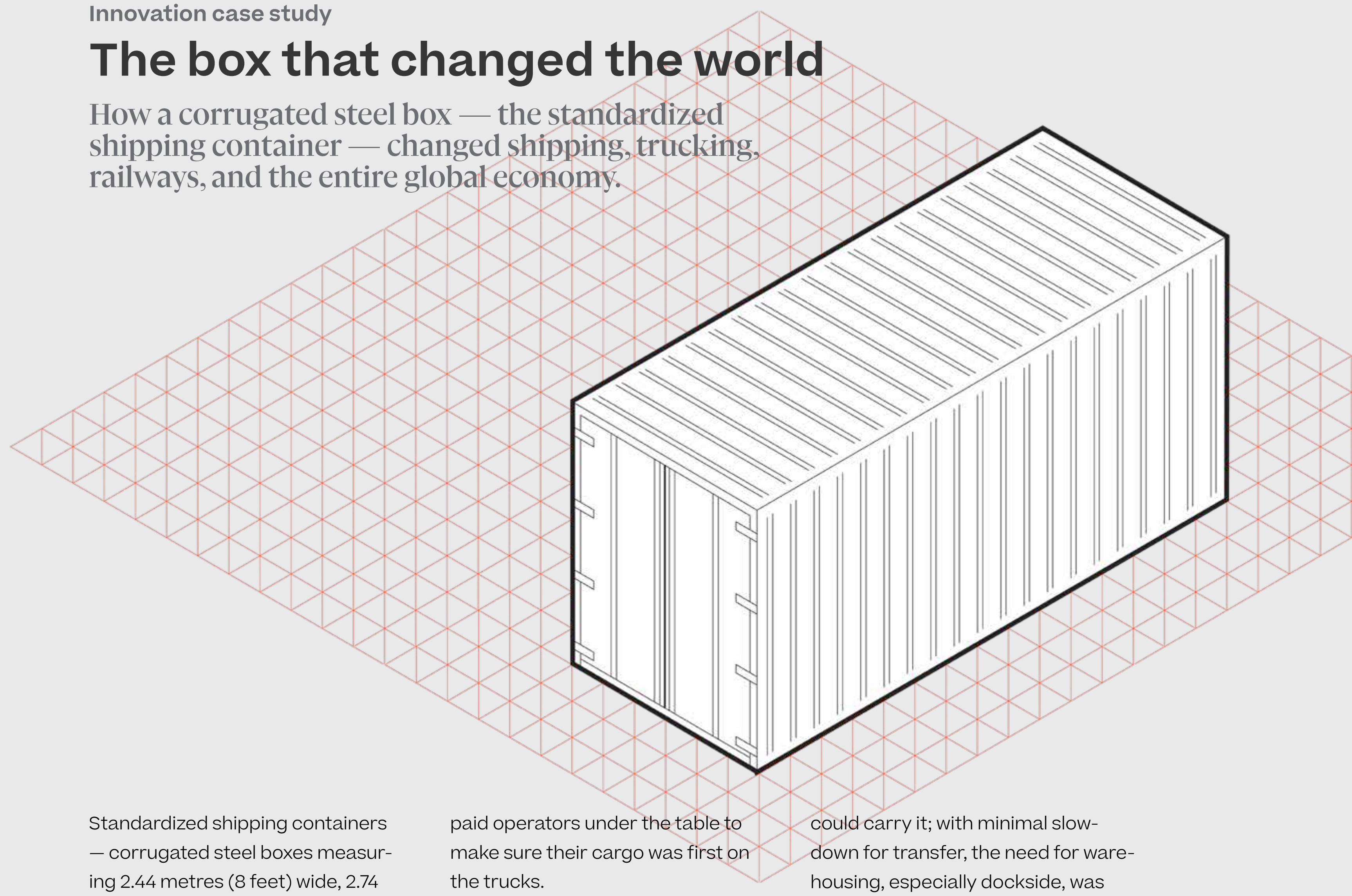
Delivery security.
The smart container's digital lock enables it to be safely left in a building's mailroom or locker system — or even at a recipient's door. Instead of needing someone to be present for a delivery, the container acts as a permanent receiver; all it requires is a space where it can be placed.

Package tracking.
Mail and package tracking would be managed through software that integrates with existing carrier software so receivers can track their items from origin to final destination. Confirmation signatures and other delivery requirements would be handled through a profile set up by the recipient. Package recipients can unlock the container with a code. And if the container makes an unauthorized movement, suggesting a theft, its location transmissions would alert the system.

Innovation case study

The box that changed the world

How a corrugated steel box — the standardized shipping container — changed shipping, trucking, railways, and the entire global economy.



Standardized shipping containers — corrugated steel boxes measuring 2.44 metres (8 feet) wide, 2.74 metres (9 feet) high and 12.19 metres (40 feet) long — can be seen everyday on highways, waterways, and railways. As unremarkable as they might seem today, shipping containers revolutionized global trade and the movement of goods, creating economies of scale like few other innovations ever have.

As late as the post-World War II period, freight arriving by ship into city ports was packed in barrels and crates and still had to be handled manually: shipments were first unloaded into dry dock and then loaded back onto trucks or trains (in appropriately named "boxcars"). The process required lots of people, time, and space (warehousing) to complete. And it was open to many forms of abuse. Theft was rampant. Bribery was also a problem, as firms paid operators under the table to make sure their cargo was first on the trucks.

The standardized container, introduced in 1956[65] by North Carolina trucking entrepreneur Malcom McLean, made it possible to move whole containers between sea, road, and rail simply by using a crane. No container ever needs to be unpacked until it reaches its final destination. The result has been a steep cost reduction and efficiency gain. McLean's first container ship cost just $0.16 USD per tonne to load compared with roughly $5.83 per tonne for a ship loaded by hand. In 1965, dock workers typically[66] transferred some 1.7 tonnes of freight per hour onto ships; within five years they were loading 30 tonnes per hour.

The containers ensured that freight always moved as fast as its vessels could carry it; with minimal slowdown for transfer, the need for warehousing, especially dockside, was dramatically reduced. The sight of dozens of trucks carrying standardized containers is really the sight of the economy's rolling, decentralized warehouse-on-wheels.

Ironically, the standardized container also represents the origin of the "last-mile problem," the challenge of efficiently dispersing individual packages to their final destinations, currently the most costly step. Containerization successfully solved all the middle-mile challenges. If containerization principles were applied on a neighbourhood scale, they have the potential to help fix the "last-mile problem" as well.

Goal 3

Deploy electric, self-driving delivery dollies

Today, there are a growing number of electric vans and cargo bikes in urban areas, but these vehicles make up a small fraction of delivery fleets. Some companies have started to explore delivery robots, but as noted on Page 77, these vehicles are typically designed to act as a container on wheels — functioning as a single unit.

To transport its smart containers between the logistics hub and buildings, Sidewalk Labs plans to deploy electric self-driving delivery dollies that resemble a large Roomba. These dollies can transport individual smart containers or a set of containers stacked to form a mobile locker system.

The self-driving delivery dollies must have communication capabilities that help them navigate from Point A to Point B, reroute when necessary, and “call for help” if any issues arise. Like the smart container itself, the self-driving delivery dollies are connected to the recipient’s user interface for tracking the location of a container, scheduling pick-ups, and more.

Sidewalk Labs does not plan to create self-driving delivery dollies itself but rather plans to work with third-party vendors to identify or develop a design that meets the container’s specifications.

In Quayside, self-driving delivery dollies would transport smart containers via underground tunnels (described more on Page 82). The beauty of separating the container from the delivery vehicle is that the container can be left at its destination safely and securely without the receiver being present.

A 24-hour underground neighbourhood freight system would dramatically reduce truck trips and pollution — while maintaining customer convenience.

Goal 4

Reimagining City Deliveries and Freight

Connect underground delivery tunnels into buildings

To help improve the last 50 feet of urban freight, Sidewalk Labs plans to create an underground delivery network linking the logistics hub with the basements of residential and commercial buildings. The tunnel network would allow for 24/7 delivery activity and would help people and businesses get their shipments fast, without having a negative impact on neighbourhood street life.

In Quayside, as planned, these delivery tunnels would be two metres in diameter, allowing for multiple self-driving delivery dollies with a variety of smart container configurations to travel to and from the logistics hub. This system would help solve some of the biggest hurdles facing delivery robots today, such as bad weather conditions, uneven surfaces, and road or sidewalk congestion.

Sidewalk Labs proposes to require that each building be designed to connect with the tunnel system so self-driving delivery dollies carrying smart containers can enter. These dollies would have the ability to take freight elevators to common spaces, including first-floor lockers for package delivery.

In first-floor mailrooms, self-driving delivery dollies could stack smart containers together to form a type of delivery locker system. Receivers could collect or ship items at their convenience by removing or placing deliveries into the containers. In common refuse rooms, self-driving delivery dollies could collect smart containers with outbound waste not capable of using the pneumatic tube system. For deliveries that require direct-to-door transportation (for reasons such as weight, accessibility concerns, or type), as well as for storage and borrowed items, self-driving delivery dollies would be able to transport containers via freight elevator to a recipient's door.

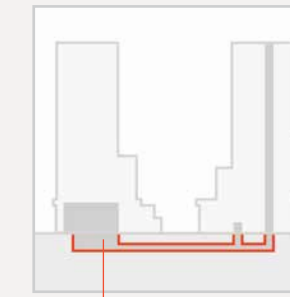
In addition to freight tunnel access, all buildings would have a traditional loading dock, which would only be used in occasional circumstances to allow exceptions for standard delivery trucks. As noted on Page 75, these exceptions would require a special permit.

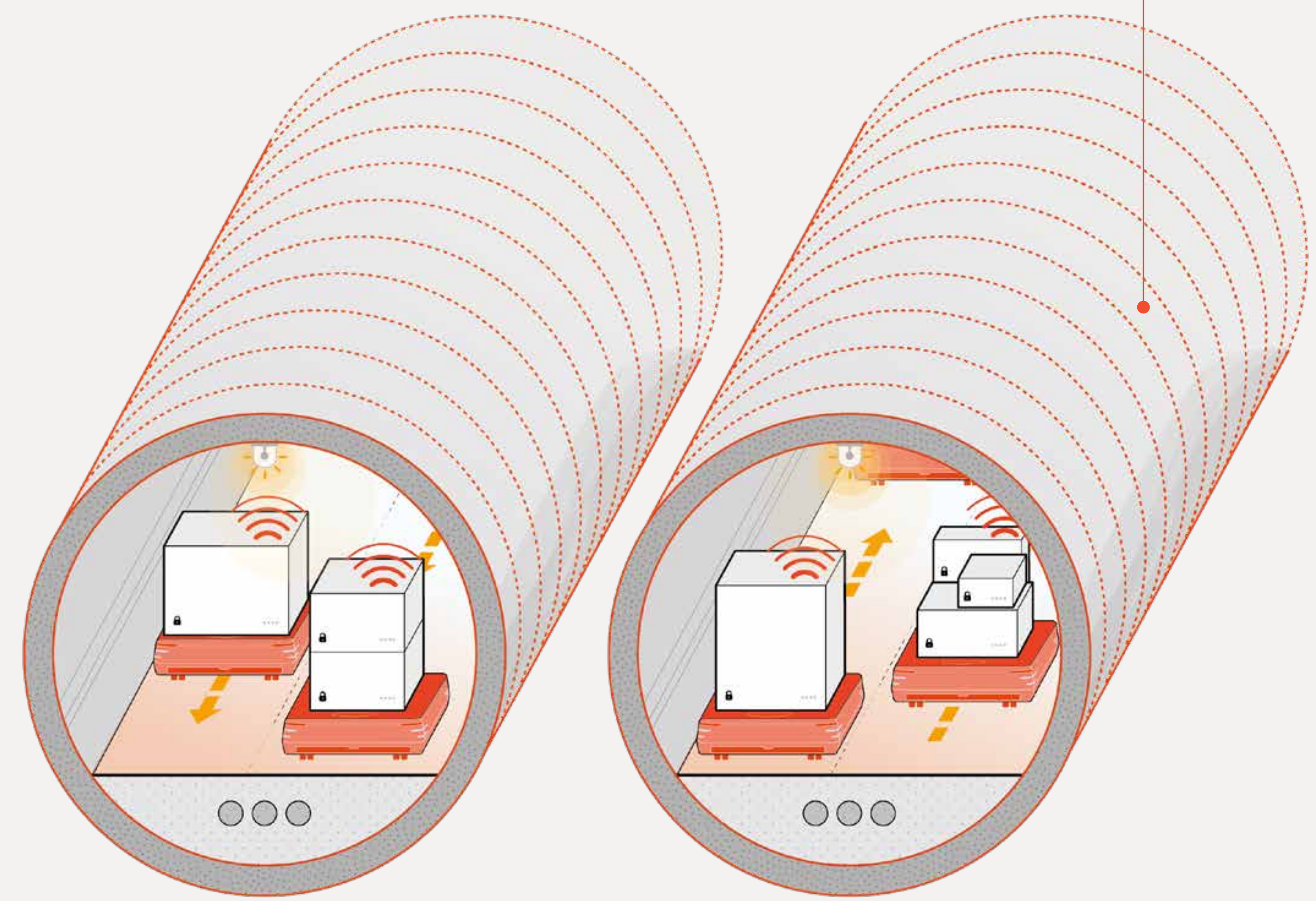
Drone delivery.

The most radical change to delivery services over the next decades is likely to be the use of drones for local deliveries, which is already showing promise for high-value deliveries in low-density areas. In dense downtown areas like Quayside, drones raise a number of issues, from noise to collisions to interference with flight paths (such as those of the planes coming in and out of Toronto's Billy Bishop Airport). It is likely that over time these issues will be addressed, although given the novelty of this innovation, the time frame is impossible to predict. To make it possible to use this technology when it is safe and ready, Sidewalk Labs proposes to require that each building rooftop be designed with landing pads for drones,

A tunnel system for 24/7 delivery

Bi-directional freight tunnels could connect directly to buildings, allowing self-driving dollies to deliver packages, carry storage items back and forth, and collect waste.





making sure the designs are flexible so they can evolve along with drone technology. When they are ready for use in Quayside, drones could be incorporated into the delivery system for urgent or premium deliveries.

Management and economics.

Making a neighbourhood logistics system work is not just a technological challenge but also a managerial one. The freight service would need to be managed as an integrated system, operating the urban consolidation centre, vehicle fleets, and storage facilities. The proposed freight system would obtain revenues from several sources: residents would pay to use its off-site storage; building managers would pay for any waste removal using its services; local retailers would pay it to make deliveries and store inventory; and, at the full scale of the IDEA District, shippers would also pay it to make deliveries because it would save them the cost of the last mile.

The freight-system manager would need to pay building owners rent for the space used (such as the logistics hub or mailroom space), although that rent would take into account the overall value the system creates for the neighbourhood, including both convenience and reductions in truck traffic. The proposed freight system would operate under a contract to the entity that would oversee overall mobility management for the neighbourhood.

Ch–1

Part 5

Improving Mobility Management

Key Goals

1
Establish a new entity to coordinate the entire mobility system

2
Deploy a real-time mobility management system

The initiatives described so far in this chapter outline fast, comfortable, and affordable ways of traveling without a private car for nearly every trip. In practice, however, things can play out very differently, with small disruptions having the potential to multiply into systems-wide upheaval.

A concert or event might flood transit with additional passengers for a single hour, leading to overcrowding and delays that impact rides throughout the evening. A fierce storm might cause some bike commuters to choose ride-hail options, creating a sudden influx of users. Extending a "walk" signal so a pedestrian can safely cross the street in one location might cause traffic congestion somewhere else.

Cities typically struggle to tackle these daily challenges because each trip mode is controlled by a different agency or company, each with its own data and priorities. City transportation departments are in charge of the streets; a separate mass transit agency usually runs the subways, buses, and streetcars; and private companies might operate bike-share programs, taxi fleets, or ride-hail services.

To add to the challenge, the decision to implement policy tools that might improve coordination, such as curb pricing, often rests with yet another agency. New infrastructure advances that could also help, such as adaptive traffic signals, are often beyond an agency's budgetary reach.

The result is that in cities around the world, fundamentally interdependent systems have become fragmented, leading to widespread frustrations and costs. For all of the mobility initiatives laid out in this chapter to succeed in reducing car trips and providing safe, convenient, and affordable options, they must work in concert.

Sidewalk Labs proposes that a new public entity called a Waterfront Transportation Management Association (WTMA) coordinate the transportation system in the IDEA District by deploying a mobility management system.

Key Term
WTMA
Waterfront Transportation Management Association
A public entity coordinating the transportation system in the IDEA District.

In a small neighbourhood the size of Quayside, holistic management can have a meaningful but modest impact on mobility goals. Responsive traffic signals can hold a crossing signal for pedestrians or cyclists at isolated intersections. Trip data can inform traffic decisions, such as giving green priority on Queens Quay for the light rail. Curb pricing can encourage people onto vehicle alternatives, such as bike-shares.

But to ensure that people have convenient and reliable alternatives to private cars, a mobility management system must be able to evaluate a substantial number of routing and trip options. For example, if a street is clogged, a real-time mobility management system can direct vehicles to an emptier parallel street. These small variations in route can add up to big time savings. Such improvements could increase further with the arrival of self-driving vehicles, which can receive information directly from mobility management systems.

As a result, in Quayside, the effect of management would be limited, as there are simply not enough intersections to balance safety, congestion and trip choices. But when deployed at the full scale of the IDEA District, this comprehensive mobility management system can process travellers with greater efficiency. The benefits include processing six times as many curbside pick-ups and drop-offs as a typical one-hour metered curb, managing adaptable pavement to create an expandable network of bike lanes to meet year-round demand, and setting parking prices that decrease the number of private car trips.

A comprehensive mobility management system could balance safety, congestion, and trip choices to ensure that people have convenient alternatives to private cars.

Goal 1

Improving Mobility Management

Establish a new entity to coordinate the entire mobility system

The WTMA would:
Implement objectives

Oversee planning, operations, and maintenance

Manage daily movement patterns

To help Toronto's waterfront achieve its mobility goals around safety, affordability, and convenience, Sidewalk Labs proposes establishing the WTMA as a public entity tasked with coordinating the transportation system in the special innovation zone.

In keeping with Sidewalk Labs' objective of undertaking new approaches to urban problems, the WTMA would allow the overall mobility performance of a neighbourhood to be managed in an integrated way. In Toronto, as in most cities, this management is done piecemeal: one entity oversees parking, another manages traffic signals, and yet another sets the price of transit rides. But these efforts are all highly integrated, and all shape the way people are able to get to and from the neighbourhood.

The WTMA would be responsible for delivering mobility services and innovations in the IDEA District, including:

- Creating a mobility subscription package
- Deploying a holistic mobility management system
- Managing and setting prices for the curbside and parking systems
- Procuring and operating new technologies, such as adaptive traffic signals, dynamic pavement, freight and deliveries, or other third-party systems and apps
- Integrating systems with third-party navigation apps
- Allocating space across the needs of mobility, access, safety, and the public realm
- Reporting on performance targets related to congestion, mode share, and customer service

Sidewalk Labs proposes that the WTMA's operations be financed by fees in a way that ensures the entity is self-sustaining. Potential sources of revenue include parking fees, curbside pick-up/drop-off fees, road user fees for ride-hail vehicles using the Sidewalk Toronto project's specially designed local streets, and charges for mobility services to residents and employees (which could be paid by individuals or included in rents and home owner association fees).

Sidewalk Labs proposes that the WTMA have three primary tasks: implement the guiding objectives of the transportation system; oversee planning, operations, and maintenance; and manage the movement of people and goods on a daily basis using data about the system.

In Focus

The three roles played by the WTMA

By incorporating policy, planning, and daily management within a single entity, the proposed WTMA would enable the IDEA District to achieve Toronto's mobility goals around safety, affordability, and convenience.

1 Implementing policy objectives

Clear policy objectives are critical to a well-functioning transportation system, because the coordination of such a complex system inevitably requires numerous trade-offs at every moment. The WTMA would be tasked with determining transportation policy objectives, guided by the city, local agencies, large employers, and community groups. These policy objectives would be used to guide the mobility management system for the IDEA District.

Sidewalk Labs proposes that the WTMA apply several guiding principles to the system to achieve the objectives of a safer, more convenient transportation system that provides a range of options for all trips:

Vision Zero.
A Vision Zero safety policy prioritizes the safety of people over the movement of vehicles, consistent with the policy adopted by the City of Toronto.

Shared mobility.
Shared mobility prioritizes high-occupancy vehicles over single-occupancy car use. In practice, this type of approach could be implemented through road-pricing mechanisms, such as a subsidy applied to shared trips or through a congestion charge.

Person throughput.
Transportation experts refer to the total number of people going through an intersection as "person throughput." An objective based on person throughput could prioritize moving as many people as possible, agnostic of any particular mode. For example, a single packed transit vehicle would get signal priority at a traffic light over a line of empty taxis.

2

Overseeing planning, operations, and maintenance

The WTMA would handle a range of duties, such as administrative tasks (e.g. contracting with a microtransit shuttle operator and issuing fare subsidies to those who qualify), operations (such as operating traffic signals), and maintenance (such as replacing pavement or coordinating utility work).

The WTMA's essential duties include:

- **Maintaining and replacing** the modular pavement system (including heating or lighting)
- **Providing** travel credits or subsidies across all modes, including bike-share or ride-hail services
- **Operating** hardware and software for parking, curb, and traffic management
- **Setting and enforcing** parking, curbside, and road-usage fees
- **Setting** speed limits for speed-separated streets

Additional management duties that could be performed by the WTMA or covered via agreements with public-sector agencies or third-party contractors include:

- **Managing** street closures for construction or events
- **Handling** data in accordance with all applicable laws, and subject to the authority of the Urban Data Trust proposed for the area
- **Creating** a user interface or app for trip planning and subsidies (or integrating into third-party tools)
- **Clearing** snow and debris (beyond heated pavements)
- **Constructing and financing** roads or parking facilities

3

Managing the system

The WTMA's third primary role would involve using an advanced mobility management system to coordinate mobility across the waterfront in line with its policy objectives. The required capabilities of this system are described more in the following section.

Goal 2

Improving Mobility Management

Deploy a real-time mobility management system

To achieve core mobility goals of safety, affordability, opportunity, and convenience, the WTMA would need to deploy a mobility management system capable of coordinating all streets, signals, lanes, and trip options in line with local objectives. The essential functions of such a system would include:

- Understanding how people are using the entire system in real time via data on things like traffic volume, vehicle speed, transit delays, emergency dispatches, and even weather patterns
- Analyzing these travel patterns in real time to help the system coordinate operations of signals and curbs in line with core policy objectives, such as prioritizing safety and transit use
- Informing trip choices by providing real-time information to travellers and mobility services on things like pricing, scheduling, and route closures

To procure this system, the WTMA would publish its technical requirements in detail and survey the market for potential vendors. There are a number of local Canadian and global companies that might respond, including Miovision, Siemens, and GridSmart. If no vendors meet the comprehensive requirements for such a system, Sidewalk Labs would develop one, potentially in partnership with one or more existing companies.

Understanding real-time use. Cities have started to manage their streets and mobility systems with data-driven tools, from adaptive traffic signals to real-time bus trackers. In Toronto, the King Street pilot program[67] collected information on streetcar delays, car volume, and pedestrian activity to inform new traffic rules that have improved streetcar travel times for 65,000 weekday travellers.

To manage the streets in the neighbourhood well, the mobility management system for the Sidewalk Toronto project would need to be able to gather data on pedestrian and traffic flows as well as transit boarding patterns to understand how all travellers (not just vehicle traffic) are using the transportation system.

This new level of understanding should stretch across all aspects of the transportation system and across all trip modes, from the amount of available space in a loading zone, to the light rail schedule, to the routes of ride-hail vehicles, to the number of pedestrians waiting to cross a street. With a complete portrait of mobility activity, the WTMA would be able to manage the mobility performance in line with its objectives.

Analyzing real-time patterns.
The mobility management system for the Sidewalk Toronto project should use real-time modelling tools to respond to trip patterns, potentially deploying an advanced form of data analysis called "machine learning" to improve those responses over time.

Consider traffic at a typical intersection. The mobility management system would need to know the total number of pedestrians trying to cross, the schedule of light rail vehicles approaching the intersection, and the volume of ride-hail services routed in that direction. Based on that real-time activity, the system's modelling tools would tell the intersection what to prioritize in line with the WTMA's policy objectives. In this case, the pedestrian crossing would be prioritized and given the greatest amount of signal time, followed by light rail vehicles, followed by private cars or ride-hail vehicles.

Afterwards, the system would evaluate how it did in that scenario: How many pedestrians got stranded waiting? How much delay time did the light rail experience? How was the travel time of ride-hail vehicles impacted? If the system performed in line with objectives, it would apply the same response to similar scenarios in the future. If something should be tweaked — maybe the crossing signal needs to be held even longer — the system would make that adjustment and learn to improve.

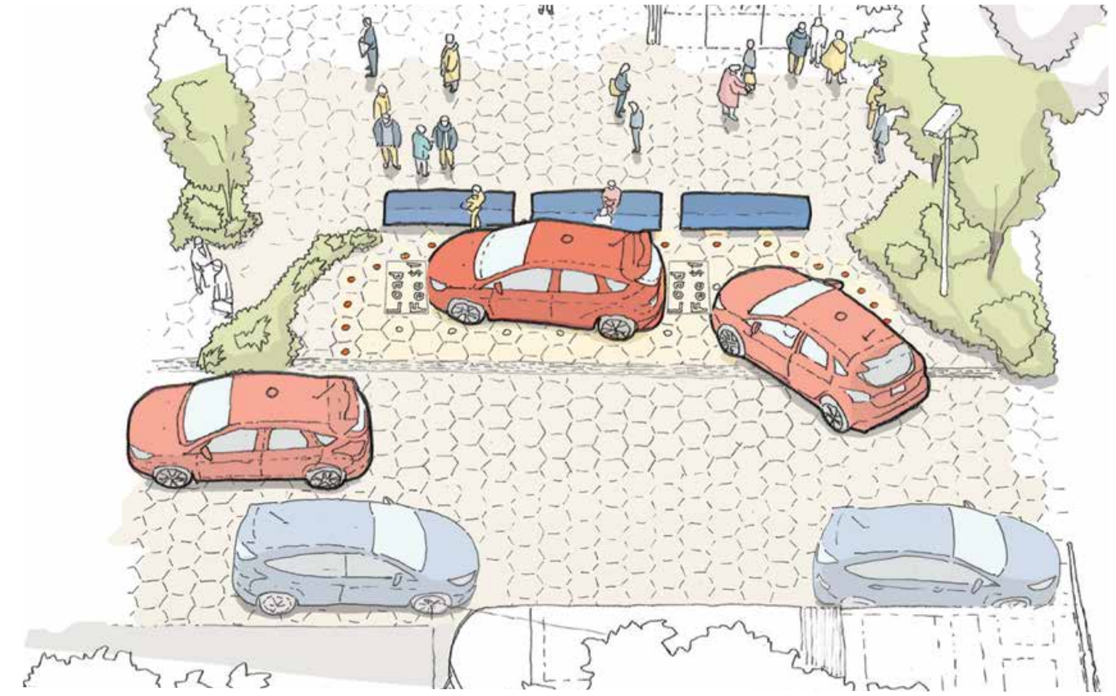
All proposed digital innovations would require approval from the independent Urban Data Trust, described more in the "Digital Innovation" chapter of Volume 2, on Page 374.

Informing trip choices.
With full knowledge of transportation conditions, a mobility management system would need to provide travellers — and the services they use — with the information needed to make trip choices or adjust travel behaviour. That information might include things like street closures, lane reallocations, public transit arrival times, ride-hail wait times, bike-share availability, or curb prices.
The system would need to provide that information to physical infrastructure, such as traffic signals and pavement, and to digital tools, such as third-party trip apps or ride-hail services.

For example, consider a street that is being closed down on a weekday afternoon for a community gathering. A responsive traffic signal could hold a green cycle longer on the next street over to avoid congestion. Lighted pavement and dynamic signs could be used to indicate that a bike lane is temporarily closed. Ride-hail services could consume information from the system to route vehicles around the closure, and navigation tools could use that information to provide travellers with accurate trip time estimates.

As part of its ability to inform trip choices, the WTMA would build on best practices for demand-based pricing to manage its parking garage and curbside spaces, raising and lowering rates to ensure that spaces are available and used.

In addition to these high-level capabilities, Sidewalk Labs believes there are two core tools that can help enable this coordinated mobility system to flourish: adaptive traffic signals and dynamic curbs.



The dynamic curb (shown here) can be designated as a passenger pick-up or drop-off zone through lighted pavement, then easily converted into pedestrian space during low-traffic periods.

Adaptive traffic signals.
Adaptive traffic signals leverage privacy-preserving sensing and analysis to ensure that intersections are efficiently managing the pedestrians, cyclists, and vehicle traffic in a neighbourhood.

Adaptive traffic signals typically incorporate mounted devices capable of identifying the number, speed, and trajectory of vehicles, pedestrians, and cyclists. Consistent with the proposed approach to responsible data use for the Sidewalk Toronto project, this data would need to be de-identified at the source by default — meaning that any counts or calculations would be processed on the device, deleting any raw footage and retaining only the aggregated numbers for analysis.

Adaptive traffic signals would then optimize signal timing to maximize person throughput at a given intersection, while giving priority to one mode versus another (for example, pedestrians over cars) based on the WTMA's policy objectives. The signals would communicate their status and imminent timing changes to connected vehicles or self-driving vehicles via short-range communication systems, and would make this data available via API to third-party navigation tools.

Dynamic curb.
The WTMA's approach to curb management would leverage real-time data and policies set by the WTMA to make the most efficient use of curb space based on actual demand — a concept that Sidewalk Labs calls the "dynamic curb."

As described earlier (on Page 61), the dynamic curb uses physical infrastructure, such as lighted pavement or signs, to designate available space for passenger pick-ups and drop-offs along streets — including at times when this space is not available to vehicles because it is being repurposed, such as for pop-up street fairs or sidewalk expansions.

The dynamic curb must also publish information about its availability, pricing, and scheduling to third-party trip apps or mobility services, so users can factor this information into their transportation decisions, make reservations, and be alerted to any changes or issues, such as a driver incurring a higher fee for waiting too long at the curb. This ability would reduce the negative impact of curb congestion and double-parking in cities today.

Ch–1

Part 6

Designing People-First Streets

Key Goals

1

Create four new types of streets to move people and make places

Many shortcomings of current city streets stem from a one-size-fits-all approach to their design. A typical downtown street has wide lanes for cars that want to drive at high speeds, and more lanes than necessary to accommodate rush-hour traffic. Curb space is dedicated to parked vehicles or delivery trucks. Cyclists typically ride in close proximity to these faster and larger vehicles. Pedestrians wait for their brief window to cross.

This general pattern leads to discomfort for pedestrians and cyclists at best and to dangerous conflicts at worst.

Rather than designing all streets for all uses at all times, Sidewalk Labs plans to create four street types designed for different speeds and primary uses. Two faster street types (Boulevards and Transitways) would move people and goods through vehicles and public transit and feature separated paths for cyclists and sidewalks for pedestrians. Slower street types (Accessways and Laneways) would provide a safe and comfortable environment for cycling and pedestrian activity.

This people-first street network would serve as a foundation for the mobility options and innovations described in the rest of this chapter to flourish — creating safe, convenient choices for getting around the city without the need to own a car. Sidewalk Labs' streets are also designed to be part of the public realm, with benefits to open space, public health, economic vitality, and social interaction. The network is designed to work on Day One of a neighbourhood like Quayside but reaches transformative potential with safe, reliable self-driving vehicles that can be programmed to follow the rules of the road.

The four street types share some fundamental principles. Each is tailored towards a specific mode. Each prioritizes safety either through speed restrictions or separated lanes. Each incorporates flexibility to make the most of limited street space, enabling quick conversions between transportation and public space purposes. Each reclaims space for pedestrians, buildings, and public uses.

This people-first street network would serve as a foundation for the mobility options and innovations described in the rest of this chapter to flourish.

What makes this approach to street design possible now is a combination of policy innovations, design advances, and new digital tools. These advances enable some key street design changes:

1

Tailor streets for different modes.
Typical streets aim to accommodate all uses at all times, even though each transportation mode is very different in size, top speed, and the vulnerability of the traveller. Harnessing navigation tools, adaptive traffic signals, and other new capabilities, Sidewalk Labs has designed four types of streets — each prioritizing a particular mode.

Laneways prioritize pedestrians. Accessways prioritize cyclists. Transitways prioritize public transit through dedicated lanes and signal priority. Boulevards are intended for all modes but primarily for vehicles.

These streets are narrower overall and tailored to the size and speed of their priority mode, with the goal of improving safety and comfort. This approach is consistent with "complete streets" principles, as space is provided on each street for every mode — except for traditional vehicles driven by people, which are restricted to streets specifically designed for their movement.

Mode-tailored streets become even safer with self-driving vehicles, which can be programmed to pursue the optimal route based on their destination.

2

Separate streets by speed.
On most streets, the difference in speeds among vehicles, cyclists, and pedestrians leads to discomfort or safety hazards. By integrating policy, design practices, and digital tools, Sidewalk Labs can safely separate streets by speed — enabling the network to move people in vehicles while making designated places for pedestrians.

On faster streets that permit vehicles, physical separations can provide comfort and safety for cars, bikes, and pedestrians. Navigation tools can guide faster traffic onto these streets and away from narrower streets meant for slower vehicles and pedestrian street life. Adaptive traffic signals can detect all types of travellers and hold crossing lights to ensure safety.

On slower streets, traditional vehicle access would be restricted; vehicles that must use these streets for accessibility purposes would have to travel at cycling or walking speeds. This approach would advance the principles of "shared streets," which shows that pedestrians, cyclists, and vehicles can coexist safely[68] so long as they are all going the same low speed.

Shared streets would also stand to get safer with self-driving vehicles, which can be programmed to defer to pedestrians and cyclists and to obey speed limits.

See the "Public Realm" chapter of Volume 2, on Page 118, for more details on reclaiming pedestrian space.

3

Incorporate flexibility into street space.
In order to handle rush hour, city streets often have more car lanes than they regularly need. During off-peak periods, these static lanes cannot easily be used for other purposes.

Sidewalk Labs plans to design lanes that are flexible throughout the day, enabling cities to make the most of existing street space. A morning rush-hour car lane could quickly become a bike lane by day and a loading zone by night. Curbside lanes typically devoted to street parking can become dynamic curbs that coordinate pick-ups, drop-offs, and deliveries — adjusting prices for curb access based on congestion.

This flexibility is possible thanks lighted pavement, digital signage, and to the ability to send vehicles information about new lane designations or street closures. Speed separation allows the safe elimination of raised curbs, which enables greater flexibility, allowing for the potential expansion of sidewalk space at off-peak periods.

(Sidewalk Labs also plans to explore better approaches to traditional street designs, such as intersections, using roundabouts instead of traffic lights.)

Flexibility could also improve dramatically with self-driving vehicles, which would automatically know which lanes are closed and would re-route accordingly.

4

Recapture street space for other uses.
By designing streets around shared mobility fleets instead of private car ownership, Sidewalk Labs can recapture curbside parking for wider sidewalks, new bike lanes, and passenger and freight loading zones. This design change is further made possible because expanded transit service and cycling options leads to fewer overall car trips. Remote parking facilities mean that remaining private cars can park off the street.

As self-driving vehicles become widely available, streets can recapture even more space through narrower lanes, since these vehicles can be programmed to stay reliably in the centre of lanes without veering.

All told, these designs can help capture at least 91 percent more pedestrian open space on major boulevards.

Goal 1

Designing
People-First Streets

Create four new types of streets to move people and make places

Based on these principles, Sidewalk Labs has designed four street types that together create a complete mobility network that balances the need to get people places with the needs for pedestrian safety and street life.

This network would be the first to be designed by leveraging the eventual capabilities of self-driving vehicles, with the knowledge that this technology must be thoughtfully integrated into future cities to improve — and not undermine — urban mobility.

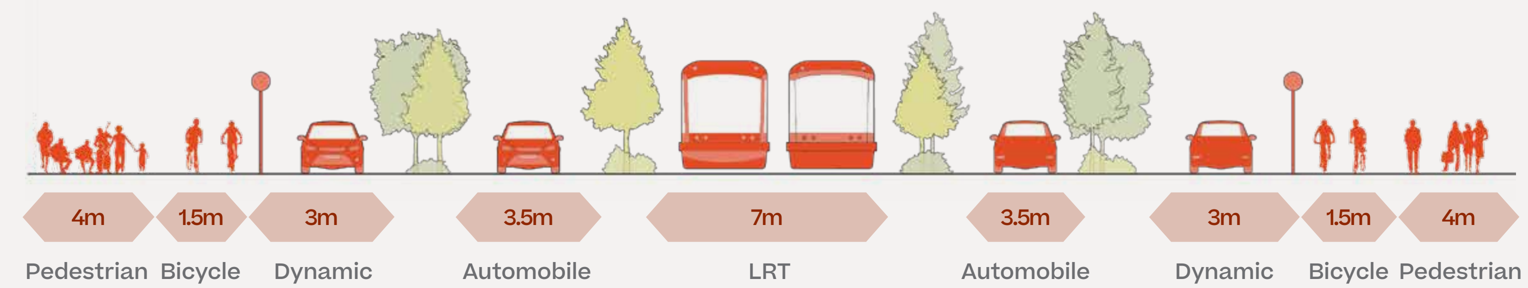
These street types are designed to operate safely and effectively in existing cities with traditional vehicles but reach their peak potential in a world of self-driving vehicles that can be programmed to follow traffic rules, rerouted by a mobility management system, programmed to defer to pedestrians.

These street types are: Boulevards, Transitways, Accessways, and Laneways.

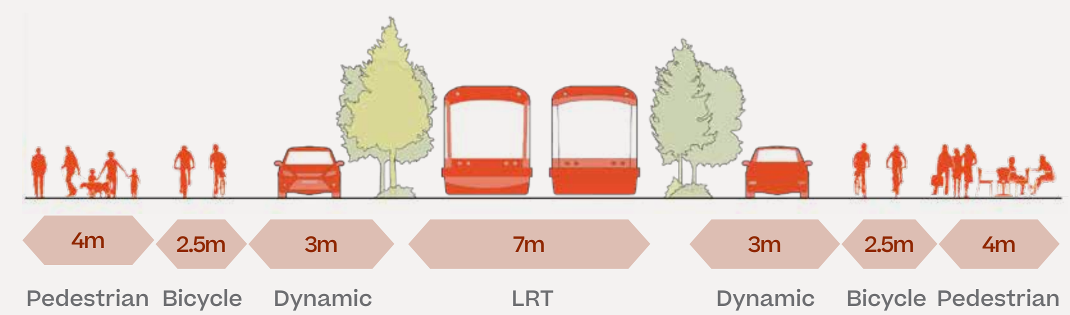
This network would be the first to be designed by leveraging the capabilities of self-driving vehicles.

Street type section views

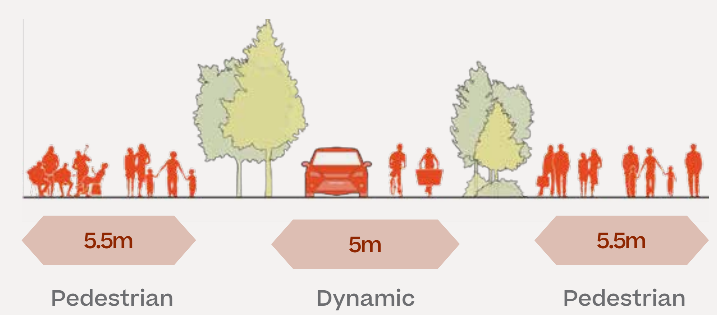
Together these streets can be combined to create a complete mobility network.



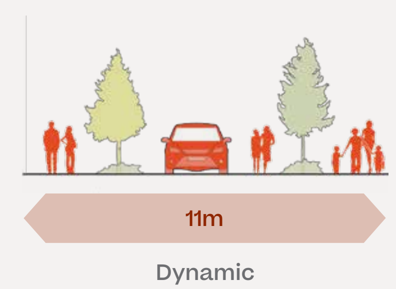
Boulevard: 31 metres
Priority mode: All modes
Priority speed: 40 km/h
Boulevards are designed primarily to accommodate longer-distance car trips and faster traffic. In the IDEA District, they could account for 10 percent of the total road network length.



Transitway: 26 metres
Priority mode: Public transit
Priority speed: 40 km/h
Transitways are designed to prioritize public transportation in designated lanes. In the IDEA District, they could make up roughly 6 percent of the total street network length.



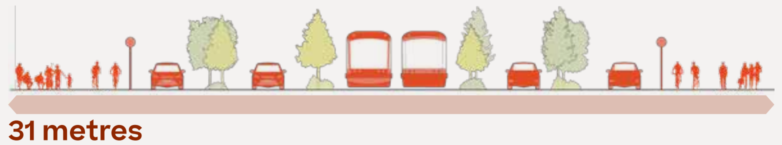
Accessway: 16 metres
Priority mode: Cyclists
Priority speed: 22 km/h
Accessways are designed primarily for cyclists, with traffic moving at bike speeds. In the IDEA District, they could make up a third of all street types.



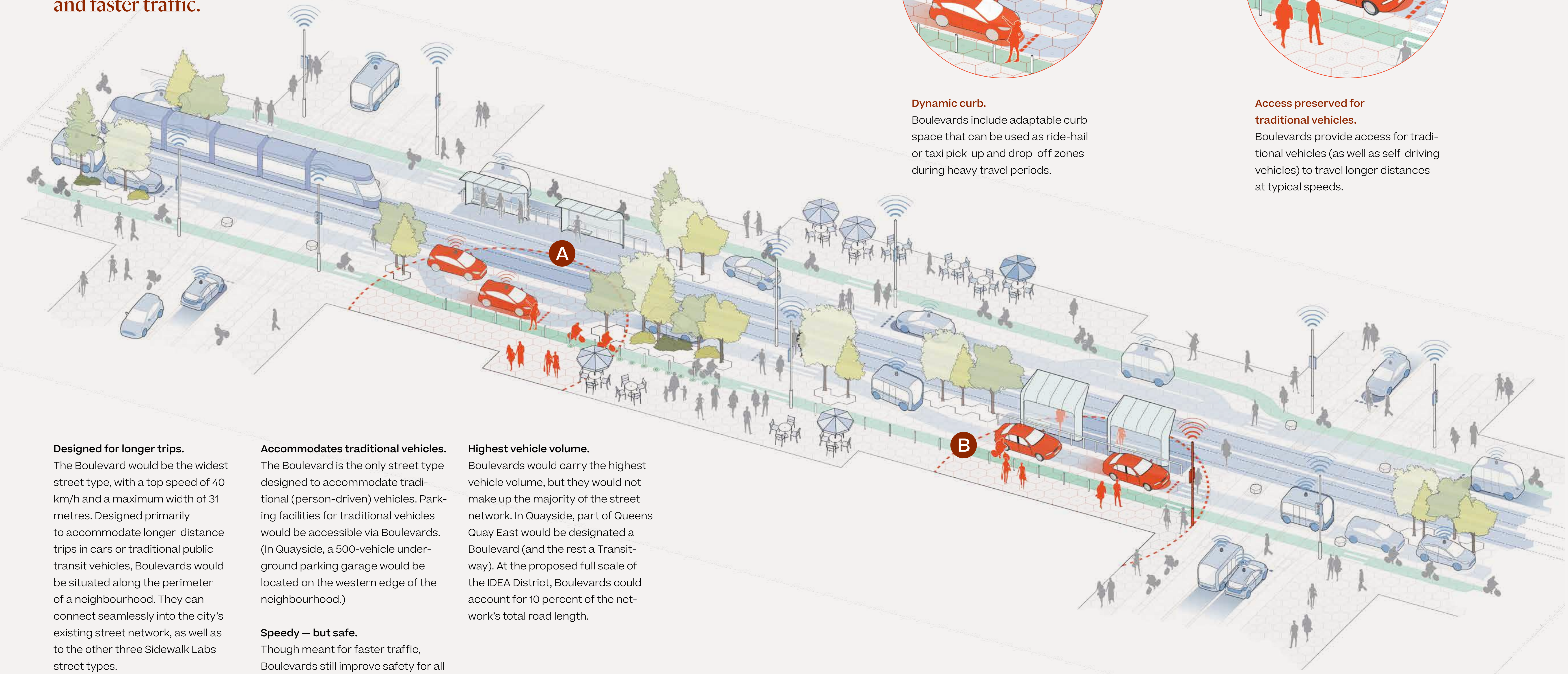
Laneway: 11 metres
Priority mode: Pedestrians
Priority speed: 8 km/h
Laneways form the foundation of the pedestrian network. In the IDEA District, they would be the most common street type.

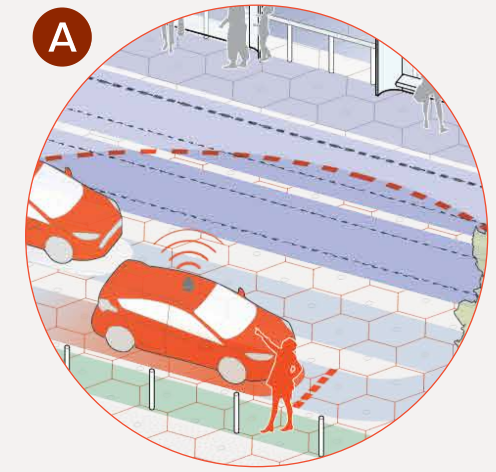
Street Type 1

Boulevard

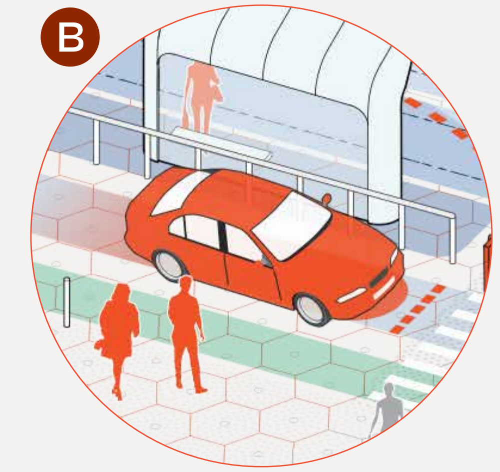


Boulevards are designed primarily to accommodate longer-distance car trips and faster traffic.





Dynamic curb.
Boulevards include adaptable curb space that can be used as ride-hail or taxi pick-up and drop-off zones during heavy travel periods.



Access preserved for traditional vehicles.
Boulevards provide access for traditional vehicles (as well as self-driving vehicles) to travel longer distances at typical speeds.

Designed for longer trips.
The Boulevard would be the widest street type, with a top speed of 40 km/h and a maximum width of 31 metres. Designed primarily to accommodate longer-distance trips in cars or traditional public transit vehicles, Boulevards would be situated along the perimeter of a neighbourhood. They can connect seamlessly into the city's existing street network, as well as to the other three Sidewalk Labs street types.

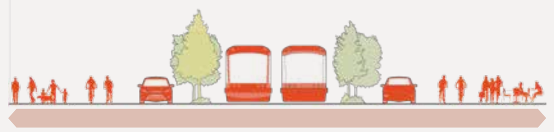
Accommodates traditional vehicles.
The Boulevard is the only street type designed to accommodate traditional (person-driven) vehicles. Parking facilities for traditional vehicles would be accessible via Boulevards. (In Quayside, a 500-vehicle underground parking garage would be located on the western edge of the neighbourhood.)

Speedy — but safe.
Though meant for faster traffic, Boulevards still improve safety for all street users by featuring separated bikeways for cyclists and traditional (though curbless) sidewalks for pedestrians. At intersections, responsive traffic signals can detect safety risks and adjust lights to protect pedestrians accordingly.

Highest vehicle volume.
Boulevards would carry the highest vehicle volume, but they would not make up the majority of the street network. In Quayside, part of Queens Quay East would be designated a Boulevard (and the rest a Transitway). At the proposed full scale of the IDEA District, Boulevards could account for 10 percent of the network's total road length.

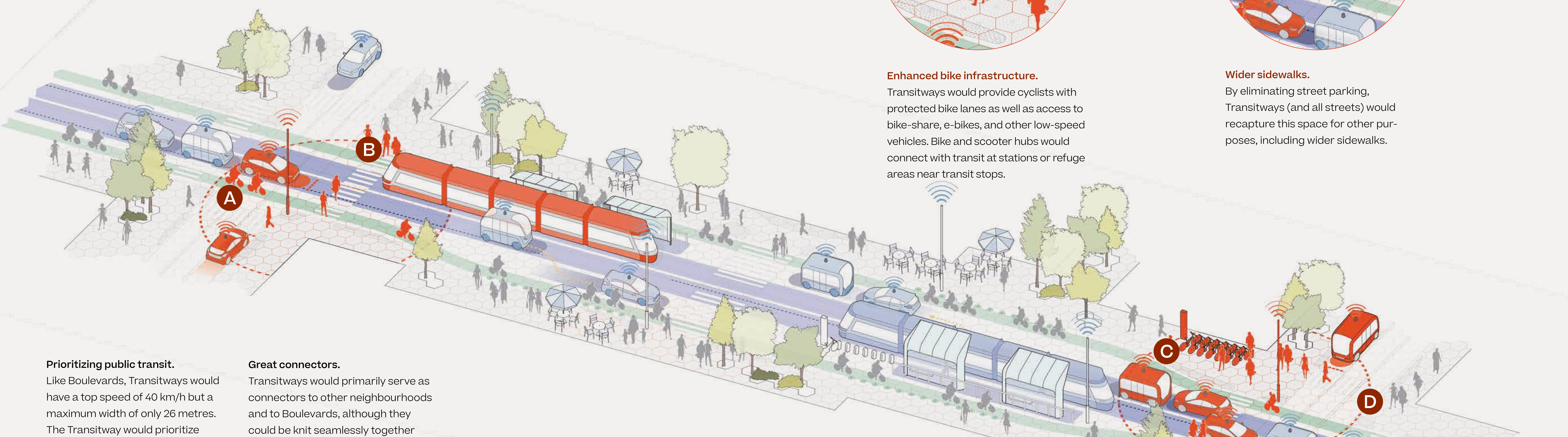
Street Type 2

Transitway



26 metres

Transitways are designed to prioritize public transportation in designated lanes.



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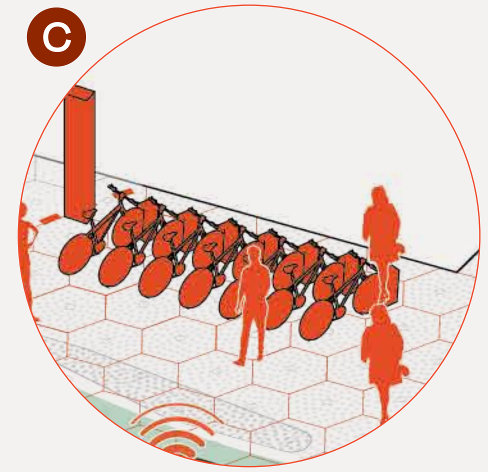

Enhanced bike infrastructure.
Transitways would provide cyclists with protected bike lanes as well as access to bike-share, e-bikes, and other low-speed vehicles. Bike and scooter hubs would connect with transit at stations or refuge areas near transit stops.

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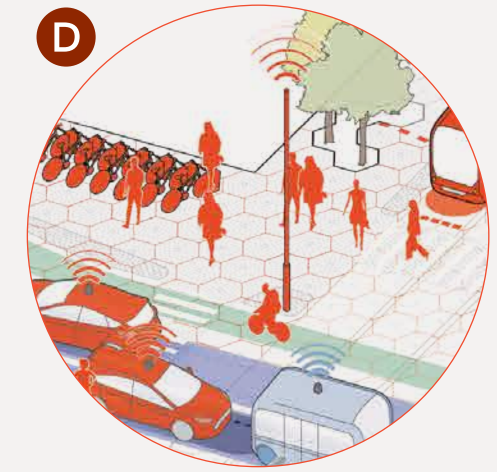

Wider sidewalks.
By eliminating street parking, Transitways (and all streets) would recapture this space for other purposes, including wider sidewalks.

Prioritizing public transit.
Like Boulevards, Transitways would have a top speed of 40 km/h but a maximum width of only 26 metres. The Transitway would prioritize public transportation over all other modes, with emphasis given to the light rail, and links the neighbourhood to the city's greater transit system.

Adaptable by design.
Transitways would also provide space for pedestrians, cyclists, deliveries, and self-driving ride-hail vehicles or shuttles. The amount of space available for street life, curbless sidewalks, bike lanes, and passenger loading zones can contract or expand based on demand thanks to dynamic curbs. These changes could be communicated to travellers through digital signage, navigation tools, or lighted pavement.

Great connectors.
Transitways would primarily serve as connectors to other neighbourhoods and to Boulevards, although they could be knit seamlessly together with all the other street types. Sidewalk Labs expects Transitways to be more common than Boulevards. In Quayside, part of Queens Quay East would be a Transitway.

In Quayside, part of Queens Quay East would be a Transitway. At the proposed full scale of the IDEA District, they could make up roughly 6 percent of the street network's total length.

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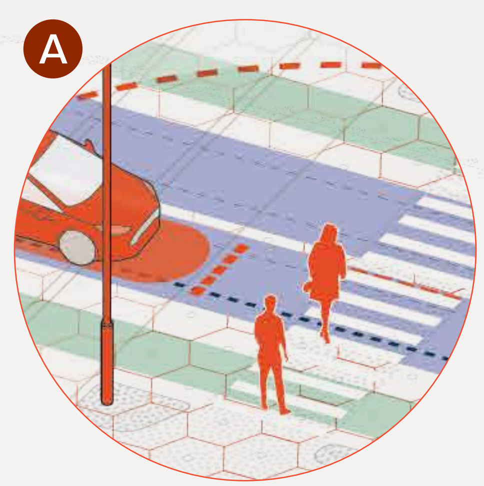
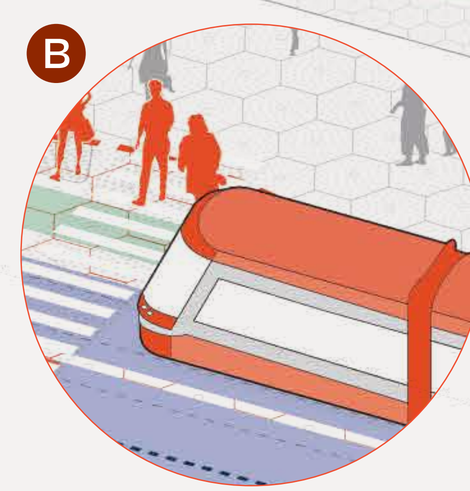


Shorter, safer crosswalks.
Adaptive traffic signals can prioritize pedestrians at crossings that are now shorter due to narrower roadways and wider sidewalks.

B

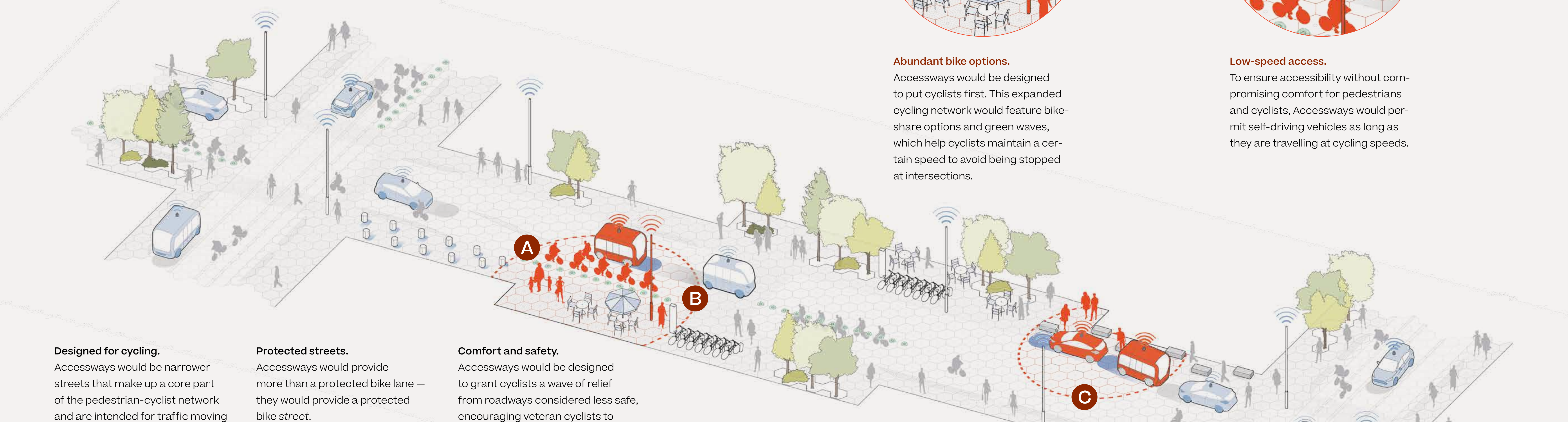


Transit priority.
Public transportation vehicles would get priority on Transitways through adaptive traffic signals that give them the green light and lanes where self-driving vehicles can pull off to let transit vehicles pass. A two-stage crossing that uses dynamic pavement technology would allow pedestrians to cross unimpeded when the light rail is not present and would pause pedestrians in a refuge area when the light rail has received priority.

Street Type 3

Accessway

Accessways are designed primarily for cyclists, with traffic moving at bike speeds.

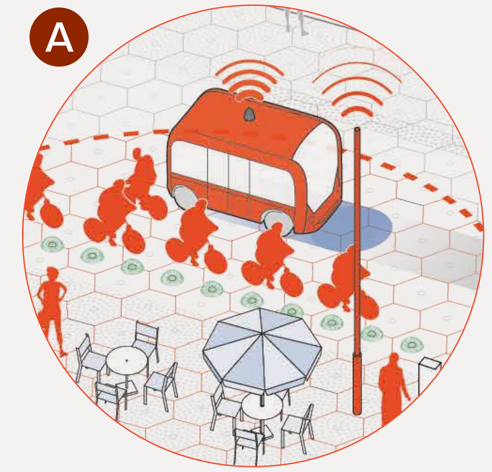


Designed for cycling.
Accessways would be narrower streets that make up a core part of the pedestrian-cyclist network and are intended for traffic moving no faster than cycling speeds. The streets would be designed for top speeds of 22 km/h with a maximum width of 16 metres. Self-driving vehicles (including delivery vehicles) would be permitted on Accessways if travelling at bike speed.

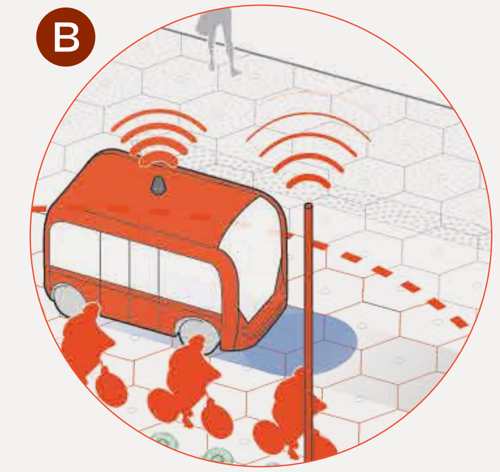
Protected streets.
Accessways would provide more than a protected bike lane — they would provide a protected bike *street*.

Sidewalk Labs expects Accessways to be more common than Boulevards or Transitways. This expanded bike network would mean that cyclists no longer have to look at maps for routes that go as close as possible to where they want to go. Applied to a street network at the full scale of the IDEA District, Accessways (and protected bike lanes on Boulevards or Transitways) would enable cyclists to reach 100 percent of buildings on a dedicated bike lane or roadway designed for bikes. Accessways would not have separated sidewalks, instead guiding cyclists and pedestrians via lighted pavement or digital signs.

Comfort and safety.
Accessways would be designed to grant cyclists a wave of relief from roadways considered less safe, encouraging veteran cyclists to make more bike trips and drawing new riders as well. New rules for interactions between self-driving vehicles and people ensures safety, comfort, and pedestrian priority. In Quayside, there would be two Accessways. At the full scale of the IDEA District, they could make up roughly one third of the street network's total length.



Abundant bike options.
Accessways would be designed to put cyclists first. This expanded cycling network would feature bike-share options and green waves, which help cyclists maintain a certain speed to avoid being stopped at intersections.



Low-speed access.
To ensure accessibility without compromising comfort for pedestrians and cyclists, Accessways would permit self-driving vehicles as long as they are travelling at cycling speeds.

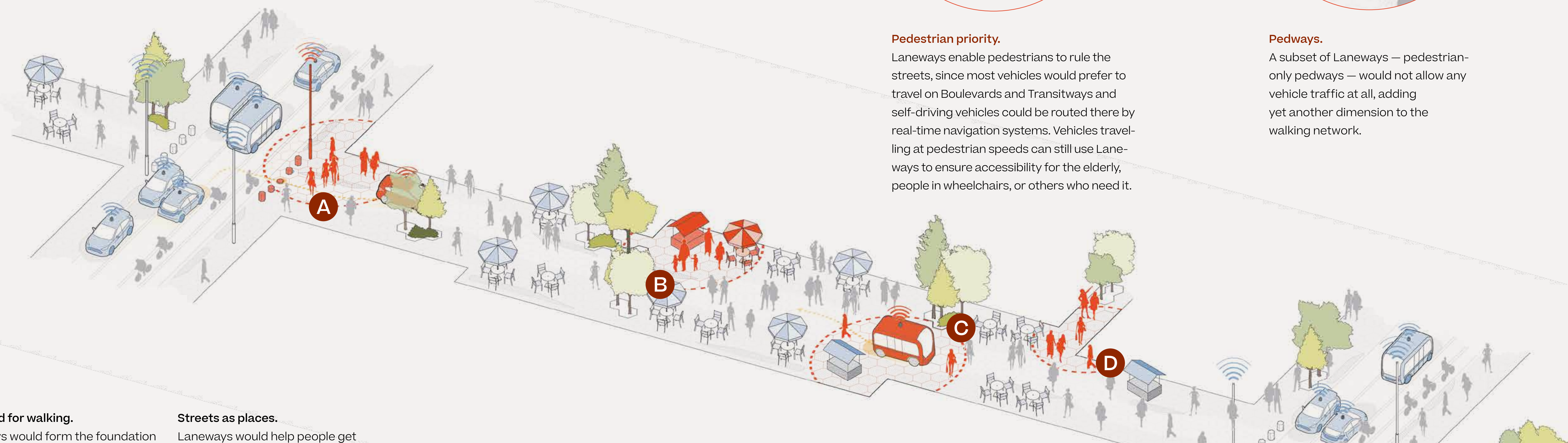
Reinforcing safety.
Movable street furniture can be used to reinforce safe site zones in a mixed curbless environment.

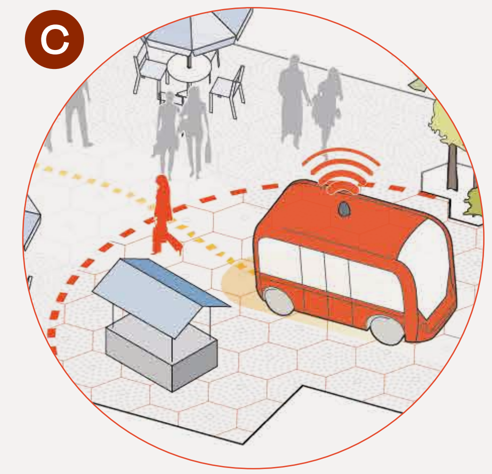
Street Type 4

Laneway

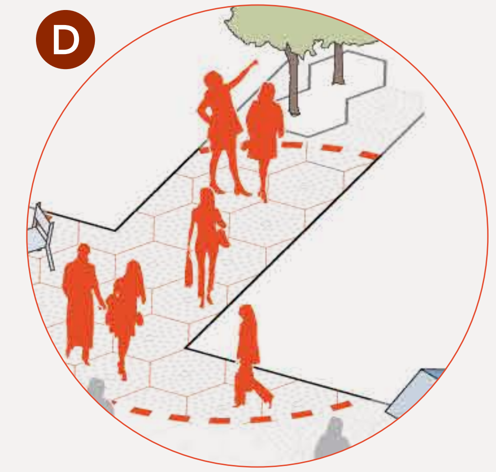
11 metres

Laneways form the foundation of the pedestrian network. In the IDEA District, they would be the most common street type.





Pedestrian priority.
Laneways enable pedestrians to rule the streets, since most vehicles would prefer to travel on Boulevards and Transitways and self-driving vehicles could be routed there by real-time navigation systems. Vehicles travelling at pedestrian speeds can still use Laneways to ensure accessibility for the elderly, people in wheelchairs, or others who need it.



Pedways.
A subset of Laneways — pedestrian-only pedways — would not allow any vehicle traffic at all, adding yet another dimension to the walking network.

Designed for walking.
Laneways would form the foundation of the pedestrian network and would be the most common type of street.

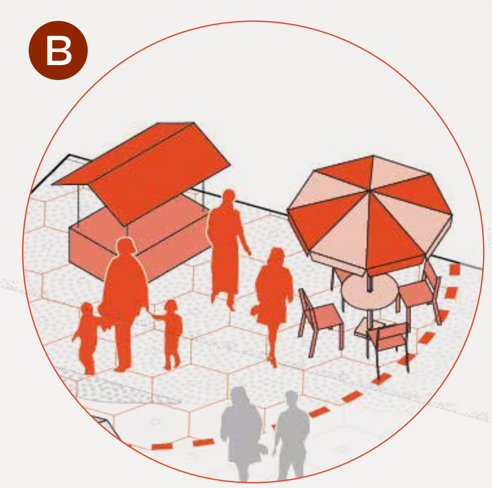
These streets would be designed for pedestrian speeds, with a top speed of 8 km/h and a maximum width of 11 metres. Bikes and low-speed, self-driving vehicles for people with accessibility needs would be permitted on laneways if travelling at the proper speed.

Streets as places.
Laneways would help people get places, but also to be places unto themselves, filled with pop-up shops, street fairs, and other types of community gatherings.

All space on the Laneway would be shared. Heated pavement would create a welcoming pedestrian atmosphere year-round, and moveable street furniture would encourage a vibrant and ever-changing streetscape.

The most common street type.
In Quayside, there would be one Laneway. At the full scale of the IDEA District, Laneways and pedways could make up roughly half of the street network's total length.

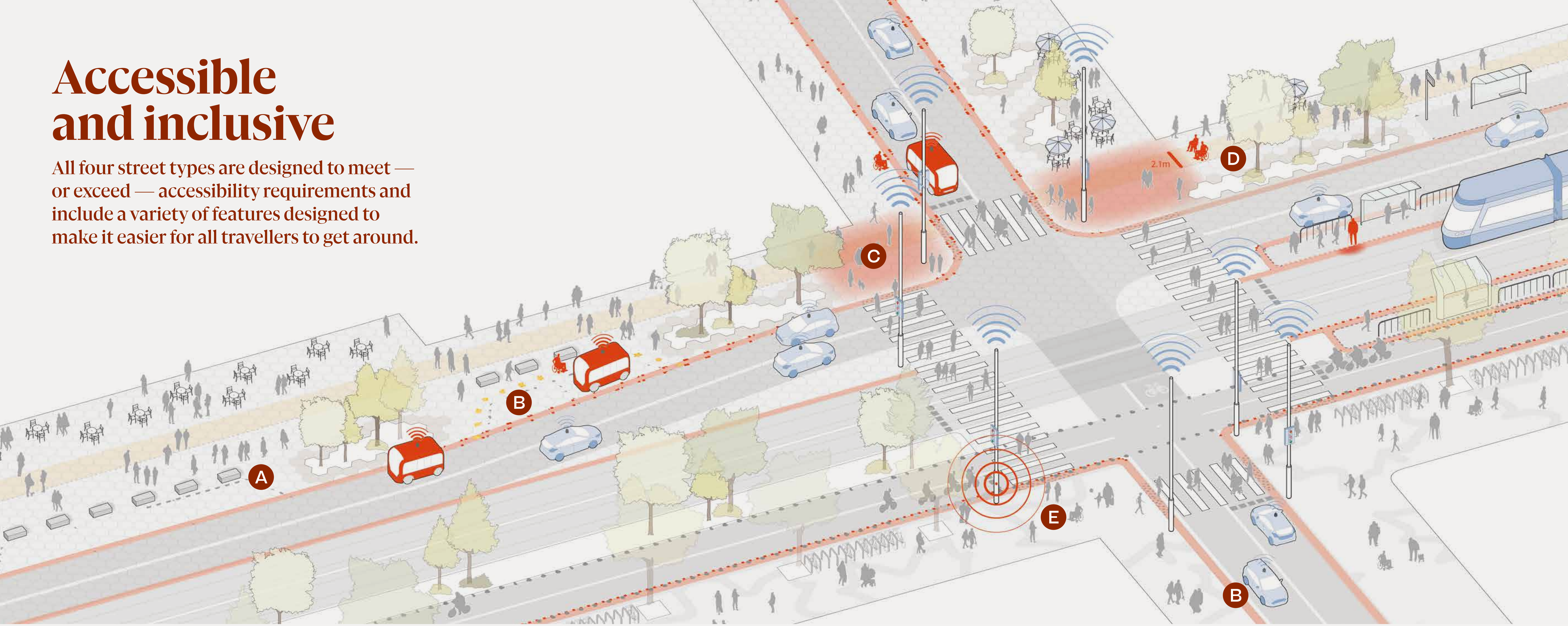
Maintaining pedestrian speeds.
Street furniture and landscaping design would encourage cyclists to walk bikes especially when streets are filled with pedestrians.



Active street life.
A suite of street amenities, such as heated pavement and movable furniture, would help people use Laneways for shops, gatherings, fairs, and other lively uses.

Accessible and inclusive

All four street types are designed to meet — or exceed — accessibility requirements and include a variety of features designed to make it easier for all travellers to get around.



Travelling freely and safely at street level is a cornerstone of an accessible city. With this goal in mind, Sidewalk Labs would design streets that put people first, including those using wheelchairs and other mobility devices, those travelling with service animals, and those with varying levels of sensory perception and attention. Every street would be designed to meet all the requirements of the 2005 Accessibility for Ontarians with Disabilities Act (AODA), including low-to-no curbs, textured pavement at pick-up and drop-off points, and pedestrian crossing controls. Wherever possible, Sidewalk Labs would aim to exceed these requirements. Emergency vehicles would be able to access every building, in accordance with the City of Toronto's Roadway Design Considerations Summary Memo. The aim is to be fully accessible across all aspects of daily life.

A Curbless streets.
In Quayside, instead of a vertical step separating the vehicle right-of-way from pedestrian paths, tactile indicators will indicate the line between pedestrian-only areas and spaces shared between pedestrians, bikes, and low-speed vehicles.

B Accessible vehicles.
Self-driving vehicles promise a revolution in personal mobility, with particular benefits for people experiencing different levels of mobility and sensory perception. Sidewalk Labs plans to strongly promote end-to-end accessibility for self-driving and ride-hailing vehicle services.

C Modular heated pavement.
Sidewalk and road maintenance can be a common impediment to accessibility. In Quayside, pavers would be modular, meaning that if one cracks or breaks, it can be quickly replaced. Pavers at key street crossings and intersections would include heating elements that can help to prevent snow and ice buildup on pedestrian throughways. Heated pavers coupled with building awnings that protect from rain and snow would make streets more passable for people using wheeled mobility devices and more comfortable for service animals year-round.

D Sidewalk width.
All thoroughfares in Quayside would have at least enough room for two people using mobility devices (such as wheelchairs, scooters, and white canes) to ride or travel side by side in each direction, or for two people to sign while walking. Even more room will be provided wherever possible.

E Wayfinding beacons.
Wayfinding beacons can broadcast information about the environment to people who are blind or partially sighted to help them navigate the area. In Quayside, beacons would enable the use of BlindSquare and other wayfinding apps as part of the default street-level experience.

Public Engagement

The following summary describes feedback related to **mobility** and how Sidewalk Labs has responded in its proposed plans.

As part of its public engagement process, members of Sidewalk Labs' planning and innovation teams talked to thousands of Torontonians — including members of the public, expert advisors, civic organizations, and local leaders — about their thoughts, ideas, and needs across a number of topics.

1 Put pedestrians and cyclists first

What we heard

From the very beginning of Sidewalk Labs' public engagement process, one mobility note kept coming up time and again across workshops, advisory working groups, and special reports: prioritize pedestrians and cyclists. Safety and the management of conflicts among road users were top of mind. As one roundtable participant put it: "Greater access to pedestrian laneways and safer bike lanes would make me more likely to even bike — and not think I may turn into roadkill!"

The Mobility Advisory Working Group pushed Sidewalk Labs to innovate when it came to road design, speed limits, and curb space, stressing the need to consider the unpredictability of shared streets; where and how pedestrians cross the street; and cycling infrastructure (for bikes as well as e-bikes and scooters) that is accessible in all conditions. The Sidewalk Toronto Fellows similarly advocated for safe, all-weather active transportation.

Participants at Roundtable 4 supported the decision to restrict vehicles, especially in Parliament Plaza, and were enthusiastic about water transportation modes, such as kayaks. Roundtable participants, as well as participants in co-design sessions pushed Sidewalk Labs to meet and surpass AODA compliance when designing for pedestrians and cyclists.

307 is home to the very first Bike Share Toronto station in Quayside. Credit: David Pike

How we responded

Designing people-first streets.
Sidewalk Labs proposes a people-first street network designed to enhance safety, comfort, and street life for pedestrians and cyclists. Lower-speed streets would require vehicles to travel at pedestrian or cyclist speeds, and boulevards that permit higher-speed traffic (up to 40 km/h) would contain dedicated bike lanes with physical separations (see Page 92).

Providing mobility choices.
Sidewalk Labs proposes a cost-effective, integrated mobility package that makes cycling and walking easier and more convenient. For example, a monthly subscription could cover a discounted TTC pass, an unlimited Bike Share Toronto membership, access to e-scooters and other low-speed vehicles, and credits for rides with ride-hail or car-share providers (see Page 65).

Improving bike infrastructure.
Sidewalk Labs proposes to include bicycle "green waves," which use signal coordination to help cyclists maintaining a certain speed avoid stopping at red lights, improving travel time and increase safety (see Page 49).

Creating all-weather infrastructure.
Sidewalk Labs proposes heated pavement in sidewalks and bike lanes, as well as an outdoor comfort system to shield pedestrians and cyclists from wind, rain, ice, and snow (see Page 52).

Planning walkable neighbourhoods.
Sidewalk Labs proposes a truly walkable neighbourhood, where residents and workers can access jobs, homes, and daily goods or services within a 15-minute walk (see Page 44).

Ensuring accessibility.
Sidewalk Labs commits to physical and digital accessibility principles that require streets to be accessible for people of varying abilities. This plan would include curbless streets with sidewalks wide enough to accommodate pedestrians moving side by side in wheeled devices or walking and signing; consistent visual, auditory, and tactile cues to guide people through spaces; and special vehicle permissions for accessible ride-hail vehicles (see Page 106).

A member of the public provides feedback on mobility "issues and opportunities" during a Sidewalk Toronto Public Roundtable. Credit: David Pike

2 Improve transit, expand it, and make it inclusive

What we heard

Participants expressed frustration with the current transportation system, particularly traffic congestion, and excitement about the opportunity to rethink mobility in Toronto.

Torontonians felt strongly that public transit must be a central focus of any mobility plan, especially if the project aims to reduce levels of private vehicle ownership, and that the transit experience in Quayside must be efficient and easy to use. As one roundtable participant explained: "Personally, if transit were more accessible and affordable, I would use my car less."

The inclusivity of transit was also a key theme. The Mobility Advisory Working Group and the Sidewalk Toronto Residents Reference Panel encouraged the Sidewalk Labs mobility team to apply a user-experience lens to its plan, while co-design participants emphasized design and signage that would be accessible across visual, auditory, and cognitive abilities.

But public transit cannot be efficient, convenient, or inclusive if it is isolated from Toronto's greater systems. The Mobility Advisory Working Group encouraged Sidewalk Labs to build on the city's existing plans and research. This need to integrate public transit in Quayside into city and regional transit — and to plan in step with the city — was particularly important to Roundtable 4 participants and to those on the Residents Reference Panel.

How we responded

Expanding transit.
Sidewalk Labs proposes connecting Quayside with Toronto's existing transit system before any residents move in and accelerating the financing of a light rail expansion that builds on the extensions identified as critical by existing planning initiatives, such as the Port Lands Planning Framework and Waterfront Toronto's Transit Reset efforts (see Page 40).

Designing transit-friendly streets.
Sidewalk Labs proposes street designs with speed limits that encourage pedestrian travel, electric bikes, and other low-speed vehicles as attractive commuting options, improving last-mile connections and making public transit more attractive (see Page 92).

Offering integrated mobility options.
Sidewalk Labs proposes an integrated mobility package that would give residents and workers a real-time understanding of the real price of each transportation option, encouraging the choice of public transit via discounts and credits (see Page 65).

Ensuring accessibility.
The TTC's stated policy is to create step-free transit stops for streetcars and buses, and to provide the most updated, accessible vehicles available at present to serve Quayside. Sidewalk Labs plans to collaborate with city transit partners and commit to ensuring this reality (see Page 106).

Coordinating bus service.
Sidewalk Labs plans to ensure that bus service is well-integrated into other modes, making it easier and more convenient for riders to transfer across mobility options (see Page 45).

3 Be ambitious — but allow for transition

What we heard

"We've been designing roads the same way for 100 years. Maybe it's time to rethink how we do that, so that roads are more responsive and fluid," said one of the Reference Panel residents. Other engagement participants agreed. At Roundtable 3, when Sidewalk Labs presented five types of potential Quayside streets, Torontonians pushed for ambition in the plan's mobility aspirations.

At the same time, participants noted that any new technology must be introduced carefully. On this topic, no subject generated more excitement — and concern — than self-driving vehicles.

Roundtable participants and the Mobility Advisory Working Group were vocal about the potential upsides of this technology. The Advisory Working Group was not only intrigued by the ability of self-driving fleets to reclaim street space typically devoted to curbside parking, but they also saw self-driving vehicles as an exciting solution to the challenge of first- and last-mile trips — for people as well as for the delivery of goods.

Many Torontonians also expressed concern with the cost, safety, and accessibility of self-driving vehicles, as well as their relationship with public transit.

Both the Mobility Advisory Working Group and the Residents Reference Panel emphasized the need to learn from leading experts; to take time to transition to self-driving vehicles; and to ensure that alternative transportation options are available, the public is educated, and proper regulation is in place. Reference Panel and Roundtable 4 participants cautioned that some parking and vehicle access in Quayside could be necessary to prevent the community's isolation from the GTA and to allow for TTC WheelTrans (an accessible paratransit service in Toronto) and emergency vehicles.

How we responded

Designing streets for the future.
Sidewalk Labs proposes streets that anticipate self-driving vehicles but that can also be successful without them. The streets in Quayside can easily adapt to "make room" for these vehicles as they become more commonplace (see Page 96).

Providing occasional car access.
Sidewalk Labs proposes to provide access to a variety of on-site car-sharing and car-rental providers, helping residents make the occasional car trip while relying less on traditional private vehicle ownership (see Page 63).

Ensuring accessibility.
Sidewalk Labs proposes special permissions so accessible ride-hail, WheelTrans, and emergency vehicles can access any street (see Page 106).

Offering parking.
Sidewalk Labs' plans include an underground on-site parking garage offering 500 spaces to private vehicles using demand-based pricing. The plan also would include off-site parking facilities that feature charging stations to encourage use of electric vehicles (see Page 64).

Working with regulatory experts.
Sidewalk Labs has collaborated with MaRS, one of the world's largest urban innovation hubs, and is working with various branches of the Canadian government to determine a regulatory framework for self-driving vehicles that would ensure public safety. Sidewalk Labs is also pursuing future pilots that would incorporate a public focus (see Page 55).

4 Infrastructure and transportation systems that stand the test of

What we heard

The importance of infrastructure, and the importance of maintaining aging infrastructure in particular, came up frequently in public engagement events.

Participants of Roundtable 4 wanted to know more about the nature of the funding and governance models for Quayside's infrastructure, and the Mobility Advisory Working Group stressed the importance of plans that are financially feasible over the long term. While the group supported a private-public mobility governance model — provided jurisdiction is clear — they also cautioned Sidewalk Labs to be practical about what the city could provide in terms of infrastructure development and maintenance. Roundtable 4 participants similarly echoed this governance concern, particularly in relation to extending the light rail system and working with the TTC. The Mobility Advisory Working Group also recommended that any mobility management system oversee both design and operations.

How we responded

Financing responsibly.
To pay for some of the significant transportation infrastructure needs of Quayside, including the expansion of the light rail and upgrades to the Parliament Street and Cherry Street underpasses, Sidewalk Labs proposes a self-financing system that pays for part of the costs of construction by borrowing capital against funds generated by a future tax on real estate development (see Page 40).

Working with the TTC.
Sidewalk Labs proposes that light rail infrastructure, vehicles, and service remain publicly owned and operated by the TTC, and that a non-profit or government entity manage funds and transfer them to the TTC (see Page 40).

Using parking fees for maintenance.
Sidewalk Labs proposes that demand-based parking fees contribute to the maintenance of infrastructure (see Page 86).

Proposing holistic transportation management.
In accordance with the recommendation that a mobility management system oversee design and operations in Quayside, Sidewalk Labs proposes that a public entity called the Waterfront Transportation Management Association coordinate the transportation system (see Page 86).

Torontonians explore the 307 main hall exhibits — including the modular pavement demonstration — during the first Open Sidewalk, on June 16, 2018. Credit: David Pike

Engagement spotlight

The Sidewalk Toronto Fellows suggested that the project use the type of bike path foot rests they found during a research trip to Copenhagen, Denmark. Credit: Sidewalk Labs

When the Sidewalk Toronto Fellows presented their findings at the end of 2018, Sidewalk Labs Director for Streets Willa Ng was in the audience, paying close attention. As the Fellows discussed their many takeaways from their travels around the world, they began talking about Amsterdam and Copenhagen, cities that make cycling not only safe, but easy and delightful. They showed one small example: a foot railing that cyclists could rest upon at red lights.

The idea of having foot railing had also come up a few weeks before, at a project design jam focused on the theme of "People on Wheels." Willa had heard that feedback, too.

"It's so beautiful in its simplicity," she says. "It just goes to show that ideas don't always have to be technological — innovation comes in a lot of forms." Sidewalk Labs intends to include foot railings in future street designs, and these simple amenities will hopefully be a daily reminder that, in Quayside, cyclists and pedestrians come first.

By providing a broad menu of affordable options for every trip, this comprehensive plan reduces the need to own a car and sets a bold new course for urban mobility.

Acknowledgements

Sidewalk Labs would like to extend special thanks to the participants of the Sidewalk Toronto Mobility Advisory Working Group, and to the staffs of the City of Toronto, Province of Ontario, and Government of Canada for their time and guidance.

Endnotes

General note: Unless otherwise noted, all calculations that refer to the full proposed IDEA District scale are inclusive of the entirety of its proposed geography, including all currently privately held parcels (such as Keating West). Unless otherwise noted, all currency figures are in Canadian dollars.

Charts note: Sources for the charts and figures in this chapter can be found in the accompanying copy for a given section; otherwise, the numbers reflect a Sidewalk Labs internal analysis. Additional information can be found in the MIDP Technical Appendix documents, available at www.sidewalktoronto.ca/midp-appendix.

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