Agenda
Integrated Transportation Community Advisory Committee

The 2nd Meeting of the Integrated Transportation Community Advisory Committee

January 18, 2023, 3:00 PM

Advisory Committee Virtual Meeting - Please check the City website for current details

The City of London is situated on the traditional lands of the Anishinaabek (AUh-nish-in-ah-bek), Haudenosaunee (Ho-den-no-show-nee), Lūnaapéewak (Len-ah-pay-wuk) and Attawandaron (Add-a-won-da-run).

We honour and respect the history, languages and culture of the diverse Indigenous people who call this territory home. The City of London is currently home to many First Nations, Metis and Inuit people today.

As representatives of the people of the City of London, we are grateful to have the opportunity to work and live in this territory.

The City of London is committed to making every effort to provide alternate formats and communication supports for meetings upon request. To make a request specific to this meeting, please contact advisorycommittee@london.ca.

Pages

1. Call to Order

1.1 Disclosures of Pecuniary Interest

2. Scheduled Items

2.1 3:00 PM - J. Dann, Director of Construction and Infrastructure Services - Neighbourhood Connectivity Plan Update 2

2.2 3:15 PM - J. Kostyniuk, Traffic and Transportation Engineer - Connected and Automated Vehicle (CAV) Plan 15

a. CAV Plan Background DRAFT 31

b. CAV Plan Detailed Actions DRAFT 91

c. CAV Plan Executive Summary DRAFT 231

3. Consent

3.1 1st Report of the Integrated Transportation Community Advisory Committee 243

3.2 Public Meeting Notice - Official Plan and Zoning By-Law Amendment - 600 Third Street 245

4. Sub-Committees and Working Groups

4.1 Request for a Study on Pedestrian and Cycling Infrastructure Based Upon Planning of New Subdivisions

4.2 Concerns Regarding Entrances and Exits of New Subdivisions

5. Items for Discussion

6. Adjournment

Connecting Neighbourhoods

Neighbourhood Connectivity Plan Update

ITCAC – January 18, 2023

Why we're here

- The Issue:
  - London Plan sidewalk policies have led to street-by-street debate over the past few years resulting in gaps in the pedestrian network.
- Council Direction:
  - Civic Administration BE DIRECTED to develop a Neighbourhood Connectivity Plan (NCP) approach, including a community engagement strategy on a trial basis in 2022 to inform the 2023 Renew London Construction Program.
- Today:
  - Provide an update on NCP engagement and what's next

London Plan
Active Mobility Policy 349

London Plan Active Mobility Policy 349 now in full force and effect.

ACTIVE MOBILITY

346_ Active mobility, with a key focus on walking and cycling, is recognized as a mode of transportation that can play a positive role in improving mobility and quality of life as part of a balanced mobility system.

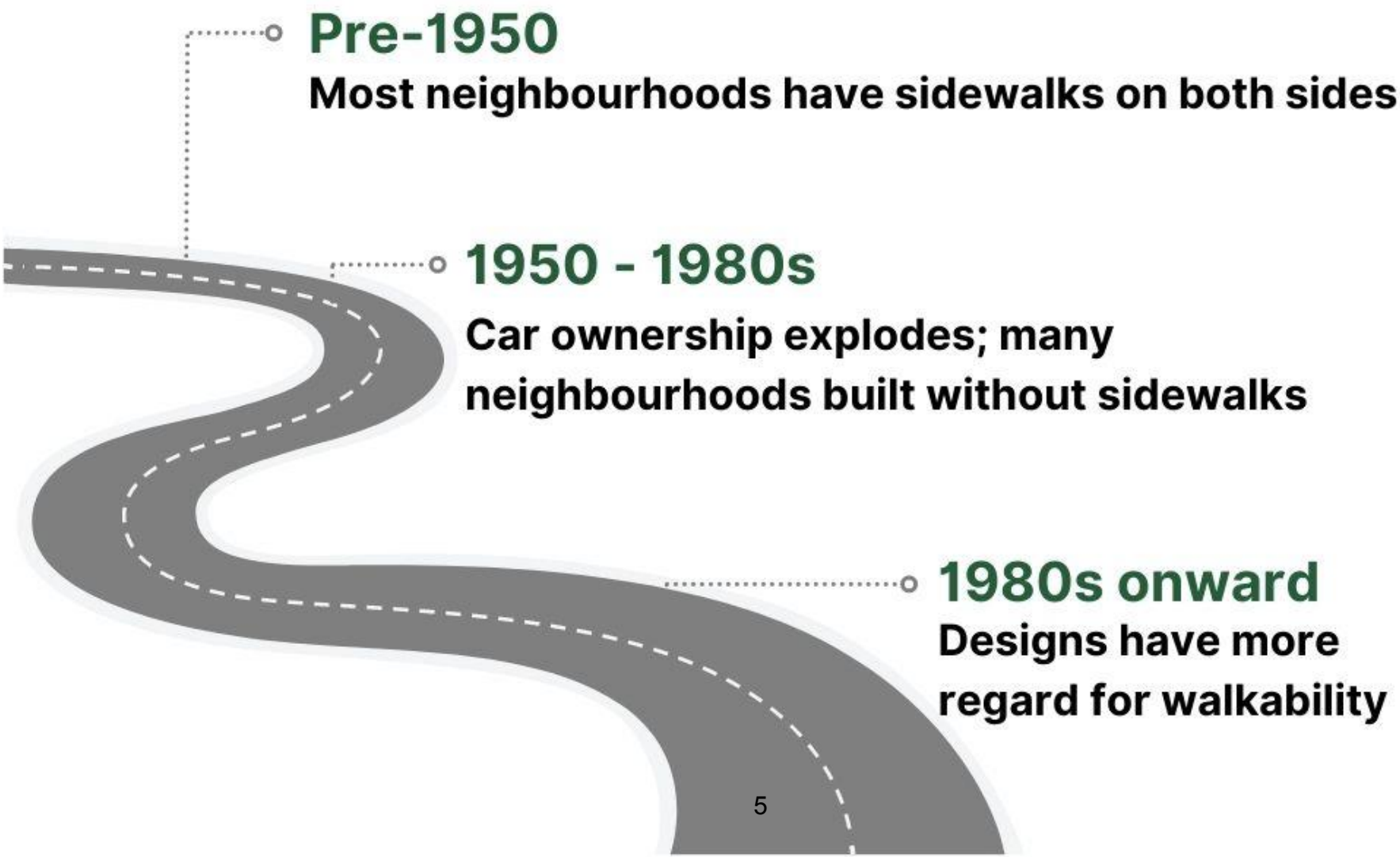
347_ The active mobility network is shown on Map 4 of this Plan. This planned network will be considered in the evaluation of all planning and development applications.

348_ Active mobility features will be incorporated into the design of new neighbourhoods and, where possible, enhanced in existing neighbourhoods to ensure connections to the street and transit system.

349_ To support walkability, sidewalks shall be located on both sides of all streets, with possible exceptions in the following instances. In most of these instances a sidewalk will be required on one side of the street.

1. Cul-de-sacs, dead-end streets, or crescent-shaped streets that extend less than 250 metres, do not make connections between streets, and do not connect to neighbourhood features or amenities.
2. Portions of streets flanking natural heritage features or areas.
3. Portions of streets flanking a Green Space that includes alternative active mobility infrastructure parallel to the street.
4. Window streets adjacent to arterial roadways where sidewalk extensions join a boulevard sidewalk on the arterial road.
5. Portions of streets that have a designated multi-use pathway within the boulevard on one side.
6. Streets classified as Expressways or Rural Thoroughfares.
7. Street reconstruction or retrofit projects, where the existing conditions such as mature trees, right-of-way widths, or infrastructure would impede sidewalks on both sides of the street.

Sidewalk history



Pre-1950

Most neighbourhoods have sidewalks on both sides

1950 - 1980s

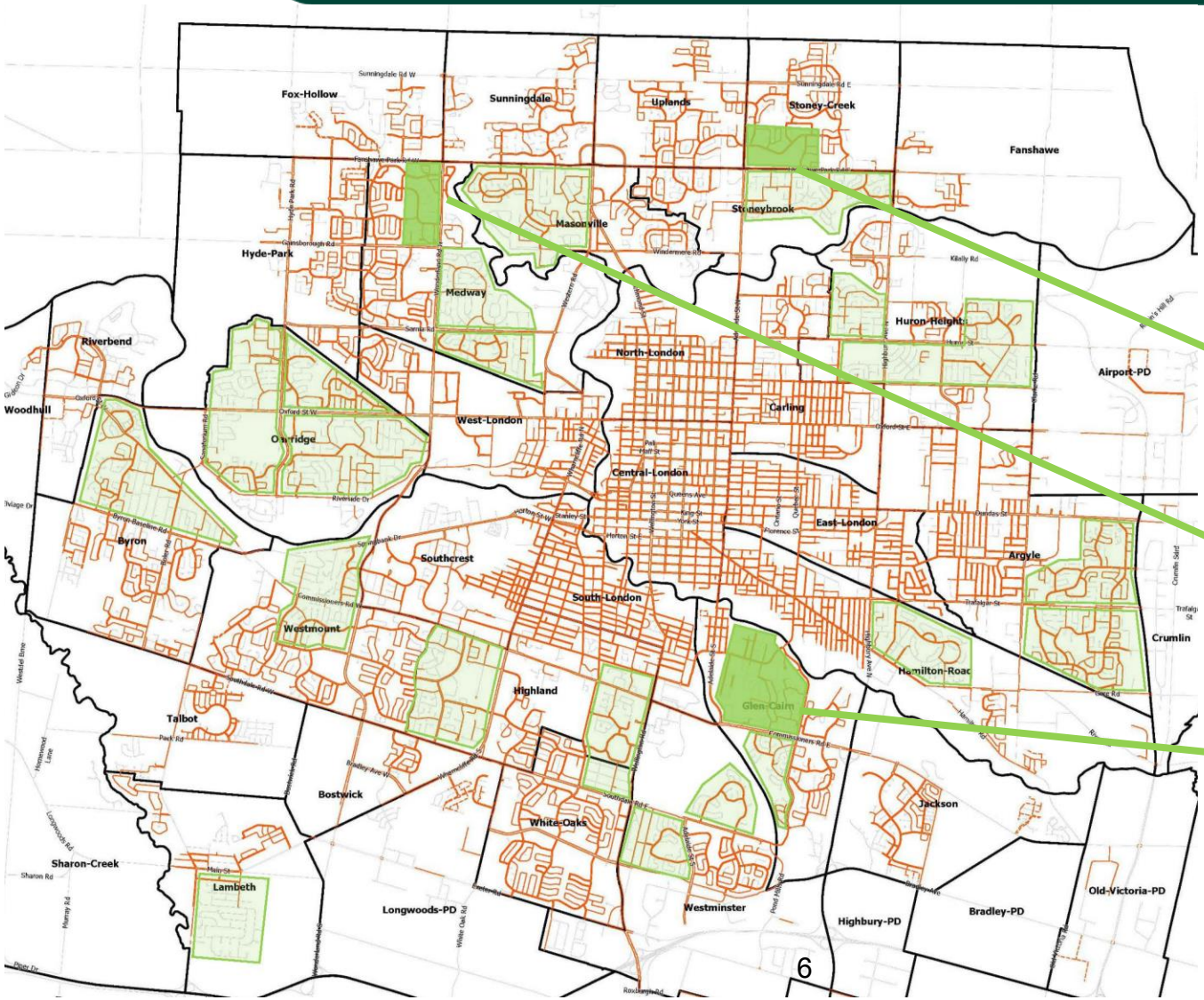
Car ownership explodes; many neighbourhoods built without sidewalks

1980s onward

Designs have more regard for walkability

2022 NCP communities

(and Legacy neighbourhoods with poor connectivity)



2022 NCPs

Grenfell

Whitehills

Glen Cairn

2022 NCP engagement

Developed standardized tools and templates that can be tailored to each neighbourhood

Several options were provided for residents to give feedback:

- **Get Involved webpages:**
  - Online survey
  - Community map tool
- **Virtual webinars**
- **Library drop-in sessions**
- **Reaching out to the project team directly**
  - Contact details provided in all materials

Community Engagement

There were 720 visits to the three Get Involved websites.

74 people answered the online survey and even more providing general comments or providing input through the map tool.

Between 25-60 residents came out to each of the library drop-in sessions where we received another 32 paper surveys.

Webinar attendance was lower than expected, however recordings were posted on the websites for viewing later.

What we heard:

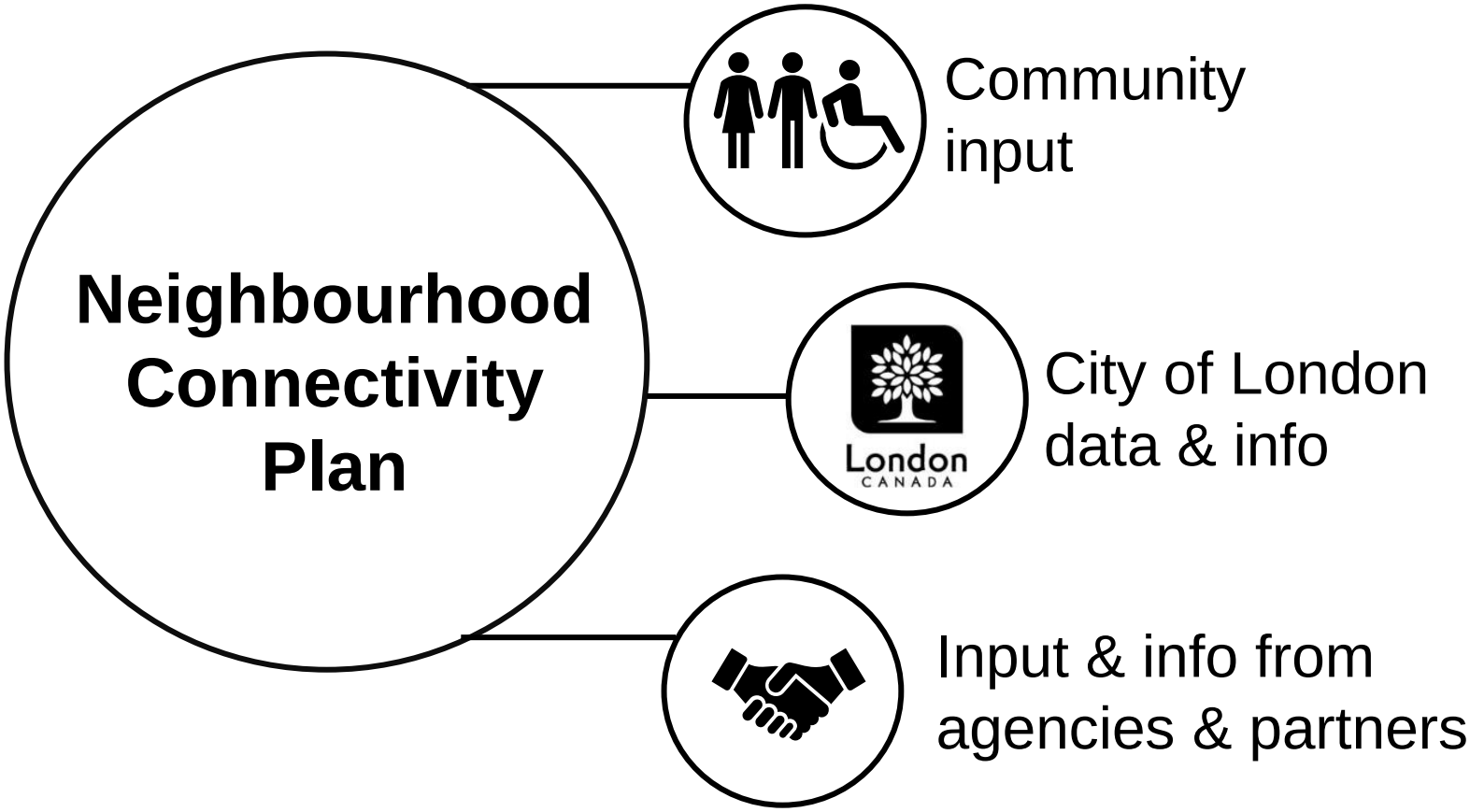
Top rationales for why sidewalks should not be considered in a given area or on a given street included:

- Residents felt that there was not enough foot or car traffic on the street to warrant the addition of sidewalks, and expressed that walking on the road was acceptable and safe for themselves and their neighbours
- Many residents indicated they were concerned about potential loss of trees
- Impacts to landscaping and driveways were key concerns
- Some residents expressed concern about sidewalks not being adequately maintained during the winter, making it more hazardous to walk on a sidewalk than to walk on the road

Staff did speak to some people who voiced their support for more sidewalks:

- Some residents highlighted the need for more sidewalks in their area overall
- Residents noted concerns for pedestrian safety, especially during busy times around the schools, parks, the community centre and churches when cars park on both sides of the street and people are forced to walk down the middle of the road
- Feedback highlighted places with high pedestrian volume but no sidewalk.

Creating the plans



Reporting to Council

- January 10th Civic Work's Committee:
  - Information report with update on NCP engagement strategy
  - Continue NCP trial into 2023
  - Set the stage for PPMs
  - Provide advance notice to residents
- January 31th CWC:
  - 3 scheduled PPMs
  - Companion report: 2023 Sidewalk list
  - Easier resident participation

Residents are being informed of upcoming meetings and what to expect.

The process

WE ARE HERE!

STAGE 1: NEIGHBOURHOOD CONSULTATION
Staff gather input from community and stakeholders to create a "NCP"

June 2022 / Spring Annually

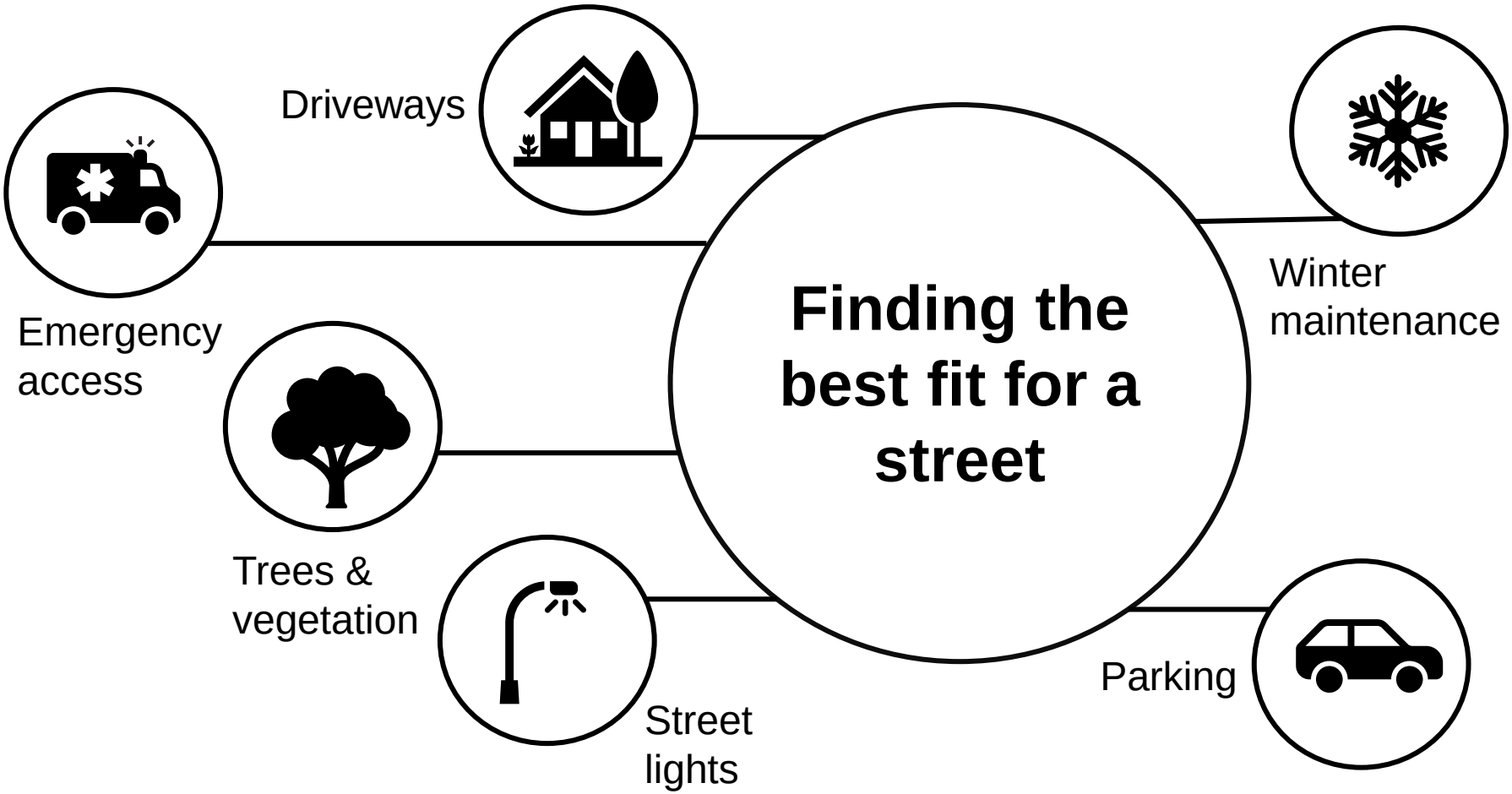
CITY COUNCIL REVIEWS RECOMMENDATIONS
Council considers recommendations made in the "Neighbourhood Connectivity Plan"

January 2023

STAGE 2: STREET-LEVEL ENGAGEMENT
Staff consult at the street level in places where sidewalks were recommended

Timed to coincide with planned road work

Stage 2 consultation



What's next

January 20

- Recommended locations for new sidewalks will be posted to the Get Involved websites for Grenfell, Glen Cairn and Whitehills neighbourhoods

January 31

- City staff will be bringing a report with recommendations on where new sidewalks should be implemented to City Council's Civic Works Committee.
    - This meeting includes a public participation component, meaning you can speak directly to the Civic Works Committee at this meeting.
    - This staff report will be available to preview online on the City of London's website at noon on January 26.
- To register or learn more about the public participation process, contact the City Clerk's Office by email **PPMClerks@london.ca** or phone (519- 519-661-2489 ext. 7100).

Connected and Automated Vehicle Plan

DRAFT Review

January 2023

ITCAC Meeting, City of London

How will this CAV Plan be used?

This Connected and Automated Vehicle (CAV) Plan will be used by decision makers who are responsible for the implementation and maintenance of public infrastructure which will be impacted by the emergence of CAV technology.

This CAV Plan has been prepared in a way that can communicate the City of London's context and unique approach to CAV technology to interested external stakeholders, industry players, and the public.

How will this CAV Plan be used?

Part I: Background explains the current realities of CAV technology in London and explores anticipated timelines associated with the technology development. Given the emerging nature of CAV technology, information is subject to change.

Part II: Detailed Actions presents the core areas of focus and actions that may be available to the City of London to consider in response to CAV technology. This Plan is proactive, based on the needs to prepare the City for the arrival of CAV technologies. The action items within will need to be developed as part of a future Implementation Plan.

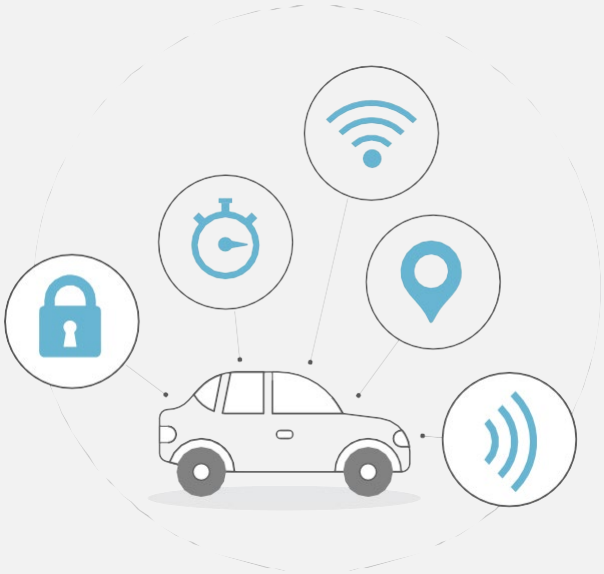
Vision

What? A sustainable community that integrates connected and automated vehicles into city-building and daily activities by pursuing improved safety, environmental stewardship, and travel mobility options.

Purpose

Why? To better understand and prepare for the introduction of connected and automated vehicles in our community to improve the lives of our citizens and minimize the environmental impact of this technology as it becomes more commonplace.

Mission



How? To engage internal and external stakeholders, identify potential implications of connected and automated vehicles, and provide a plan and actions that will proactively prepare for the introduction of connected and automated vehicles.

Values

Alignment with the 2019-2023 Strategic Plan for the City of London	Alignment with the London Plan	Climate Emergency Action Plan
Driven by Community	Human Health and Community Safety	Information Security and Privacy
Integrated Mobility	Proactive Leadership	Responsible Governance
Social Equity	Supporting Innovation	Stakeholder Collaboration

Strategic Areas of Focus

1. Road Safety and Security

The City will encourage the adoption of CAVs that are supportive of improved road safety. A net benefit to road safety will be achieved through actions that focus on protecting vulnerable users, preventing collisions, updating infrastructure, and improving emergency response. Actions will address both the knowns and unknowns of CAVs and will look at the ideal policies, technology, standards, and training required to achieve improved safety.

1. Prevent Collisions
2. Update Infrastructure
3. Update Emergency Response

Strategic Areas of Focus

2. Mobility Integration and Efficiency

The City will incorporate CAV technology and encourage its adoption within the City's mobility network. Increased infrastructure efficiency will be achieved through an enhanced ability to manage traffic in real-time, allowing individual mobility needs to be served at any given time.

1. Increased Space Efficiency
2. Design Complete Streets
3. Increase System Integration
4. Urban Goods Movement
5. Mobility Network Efficiency and Performance
6. Transportation Demand Management

Strategic Areas of Focus

3. Environmental Sustainability

The City will encourage the adoption of CAVs in a manner that incentivizes environmental sustainability across a vehicle's entire lifecycle. Reducing vehicle emissions and waste through incentivizing or promoting zero emission vehicles and sustainable use practices.

1. Reduce Vehicle Emissions
2. Reduce Vehicle Waste

Strategic Areas of Focus

4. Social Equity and Health

The City will encourage the adoption of CAVs in a manner that improves accessibility, social equity, and prioritizes health and safety for all Londoners.

1. **Ensure Barrier Free Access for All**
2. **Increase Mobility Equity**
3. **Promote Health and Safety**

Strategic Areas of Focus

5. Data Privacy, Security, and Governance

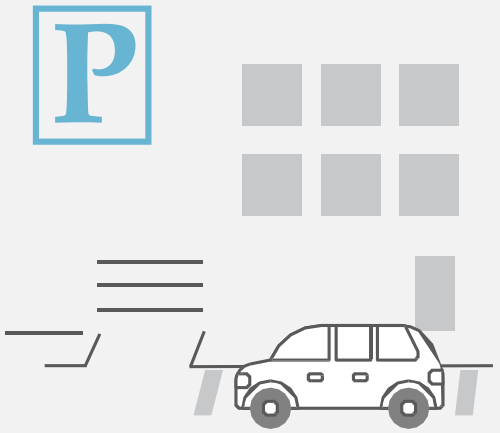
The City will support and enhance data privacy and transportation network security with a particular focus on the City's collection and use of information generated by CAVs and related systems where authorized by law. Actions will focus on protecting privacy and security through policy and by-law, providing oversight and evaluation, and incorporating privacy principles into any potential collection and use of information generated by CAVs. Further, data gathered should be used to inform the implementation and evaluation of this plan and to improve how the City delivers services.

1. **Protect Public Privacy**
2. **Business Intelligence**

Strategic Areas of Focus

6. Land Use and Urban Form

The City will plan for the potential impacts and implications of CAVs in the context of sustainable urban form, land use, growth, development, placemaking, and the approved London Plan.

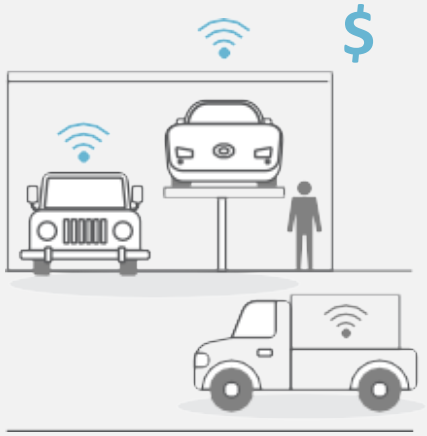


1. Integrate CAV Infrastructure Elements with Land Use
2. Protect Urban Structure Integrity
3. Resilient CAV Policy Development and Implementation
4. Reclaim Surplus Land

Strategic Areas of Focus

7. Economic Sustainability

The City will support and enhance sectors related to the development and use of both CAVs and associated technology, with a particular focus on retaining and attracting industries, investment, and employment. Actions related to Economic Sustainability will aim to expand London's regional position as it relates to CAVs.



1. Develop a Top-Quality Workforce
2. Attract New Jobs and Investments
3. Create a Supportive and Thriving Environment

Strategic Areas of Focus

8. City Fleet and Services

The City will enhance its fleet and services through CAVs and related systems for the purpose of improving safety and public service delivery. Actions will evaluate the transformation of fleet vehicles and City services as well as potential impacts to employment and labour needs.

1. City Services and Fleet Vehicles
2. Future-Proofing
3. People Services and Labour

Thank You!

For more information and to provide feedback, please visit https://getinvolved.london.ca/cav

Connected and Automated Vehicle Plan

Part I: Background DRAFT

Prepared by the Corporation of the City of London
September 2022

London
CANADA

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ACKNOWLEDGEMENTS

The City of London wishes to acknowledge the following individuals and organizations that contributed to the development of this Connected and Automated Vehicle Plan:

City of Toronto

Dr. Amer Shalaby, PhD, University of Toronto

Dr. Bruce Hellinga, PhD, University of Waterloo

London Transit Commission

Middlesex-London Health Unit

National Research Council Canada

DISCLAIMER

The Connected and Automated Vehicle Plan was developed through collective input from variety of public and private agency stakeholders. Information was gathered through research, discussions, and presentations. The report does not necessarily reflect the views or opinions of any single agency discussed herein.

INTRODUCTION

This Connected and Automated Vehicle (CAV) Plan will be used by decision makers who are responsible for the implementation and maintenance of public infrastructure which will be impacted by the emergence of CAV technology. This CAV Plan has been prepared in a way that can communicate the City of London's context and unique approach to CAV technology to interested external stakeholders, industry players, and the public.

> **Part I: Background** provides an explanation of the current realities of CAV technology in London and elsewhere and explores anticipated timelines associated with the technology development. It is important to note that given the emerging nature of CAV technology, information provided within this section is subject to change.
>
> **Part II: Detailed Actions** presents the core areas of focus and actions that may be available to the City of London to consider in response to CAV technology. To implement the actions that have been identified, a subsequent Implementation Plan will need to be developed. The future Implementation Plan will consider each action and identify what is needed to proceed with implementation including triggering events, timelines, and required additional staff and financial resources.

This CAV Plan is proactive in nature, based on the needs to prepare the City for the arrival of CAV technologies in a timely manner. The action items identified in this plan will need to be further developed as part of a future Implementation Plan and looked at through a lens of deliverability, resourcing, and sustainability.

The future Implementation Plan and any proposed programs, projects, and sub-projects will need to be carefully considered in alignment with Council's CAV Plan including Corporate priorities and resourcing.

This document, **Part I: Background** is broken down into four primary sections:

What are connected and automated vehicles? provides the basic definitions of what connected and automated vehicle technologies are and how they work.

The arrival, challenges, and opportunities of CAVs presents key development factors such as technological, policy, economic, and human behaviour including major development categories for the various types of CAVs anticipated to be available.

London's local and regional context provides a snapshot of CAV programs and agencies in both the public and private sectors regionally, provincially, and federally that are currently there to support the emergence of CAV technologies.

Public opinion provides a preliminary look of known attitudes – both positive and negative – the public currently holds towards CAV technologies in the London area and more broadly, servicing as a "snapshot" in time where we are today.

The next document in the CAV Plan, **Part II: Detailed Actions** details the strategic areas of focus and related, specific actions for consideration in preparing London for the emergence of CAV technologies.

1 WHAT ARE CONNECTED AND AUTOMATED VEHICLES?

Connected and Automated Vehicles (CAVs) are driverless or self-driving vehicles that can detect the surrounding environment using artificial intelligence (AI), a variety of sensors, connected networks, and a global positioning system (GPS) coordinates among other means to navigate a mobility network successfully and safely with little or no human input.

These vehicles can be broken down into two primary components[1]:

Automated Vehicles

These vehicles make use of sensors and computer analytics to assess their environment and perform varying degrees of driving tasks. There are five levels of automation that range from driver-assistance systems that can help with steering to fully automated, self-driving vehicles in which passengers need pay no attention to the road.

Connected Vehicles

For connected vehicles, there are two types of connected technologies: consumer convenience and infotainment, and vehicle-to-vehicle and vehicle-to-infrastructure communications. Practical examples of this technology could include, your car receiving restaurant recommendations for a given route, getting a countdown for when the next traffic light is turning red, or having the car ahead of you provide a warning that you are following too closely.

For the purposes of this plan, both Automated Vehicles and Connected Vehicles are considered integral with one another, meaning that while automated and connected technologies can operate independently of one another, they are often integrated together in how they operate on a practical level. Therefore, they are referred to jointly as Connected and Automated Vehicles or CAVs for short in this plan.

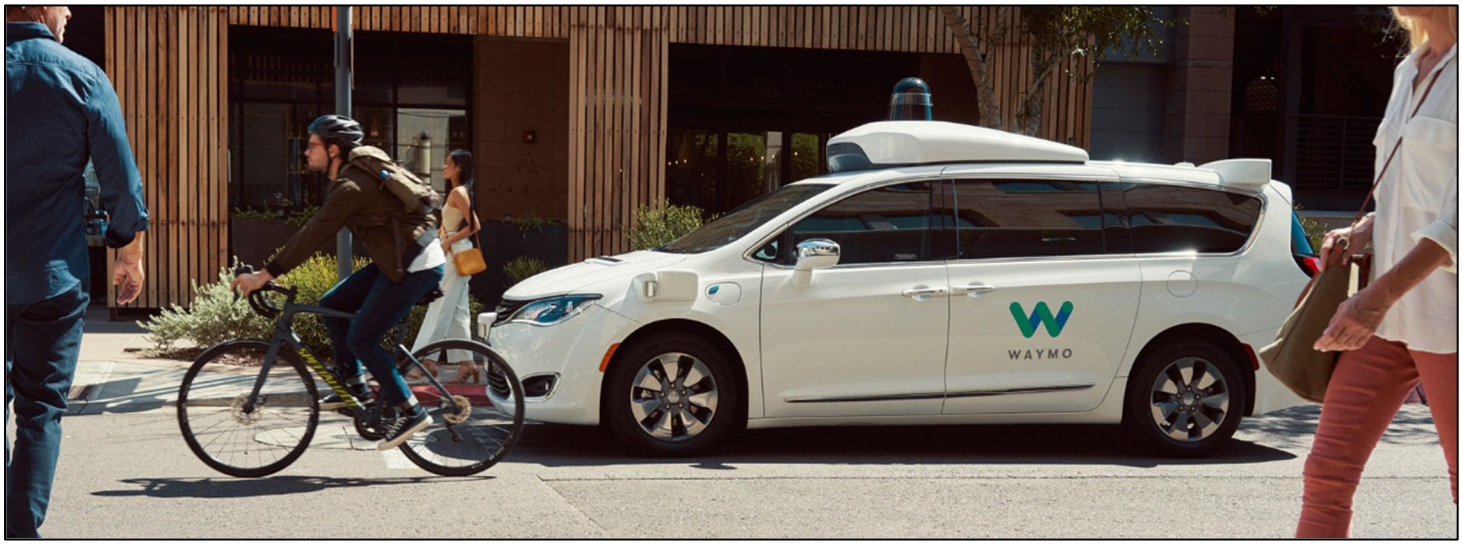
[1] Canada. Parliament. Senate. Standing Committee on Transport and Communications. Driving Change: Technology and the Future of the Automated Vehicle. 2018. P.29. Available from: https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf

CAVs have the potential to deliver the following if properly managed:

- Environmental benefits;
- Economic prosperity;
- Societal equity;
- Safety improvements;
- Traffic congestion management; and
- Improved flow of goods and services.

One of the major improvements to road safety is the elimination of human driver error and distraction, due to the CAV technology taking over the driving operation. However, this expectation needs to be tempered with lower levels of vehicle automation where the attention of the human driver to maintain safe vehicle operations remains critical and driver errors remain possible. Further details on levels on automation are discussed in the next section.

Figure 1: Example of Waymo's Automated Vehicle[2]



[2] Waymo. Waymo One. 2022. Available from: https://waymo.com/

1.1 AUTOMATION TECHNOLOGIES

All vehicles exist on a scale of automation, even the ones available on the roads today or from decades past (e.g. basic cruise control). However, as auto manufacturers release new models with different feature packages, it can be hard to know where precisely a vehicle falls along the spectrum of automation.

1.1.1 LEVELS OF DRIVING AUTOMATION

The Society of Automotive Engineers (SAE) has defined the Levels of Driving Automation[3] (see **Figure 2**) that are a widely used set of definitions for indicating the level of driving automation present in a vehicle. There are six levels of automation where the higher the level, the more the vehicle can handle all aspects of driving without human intervention[4].

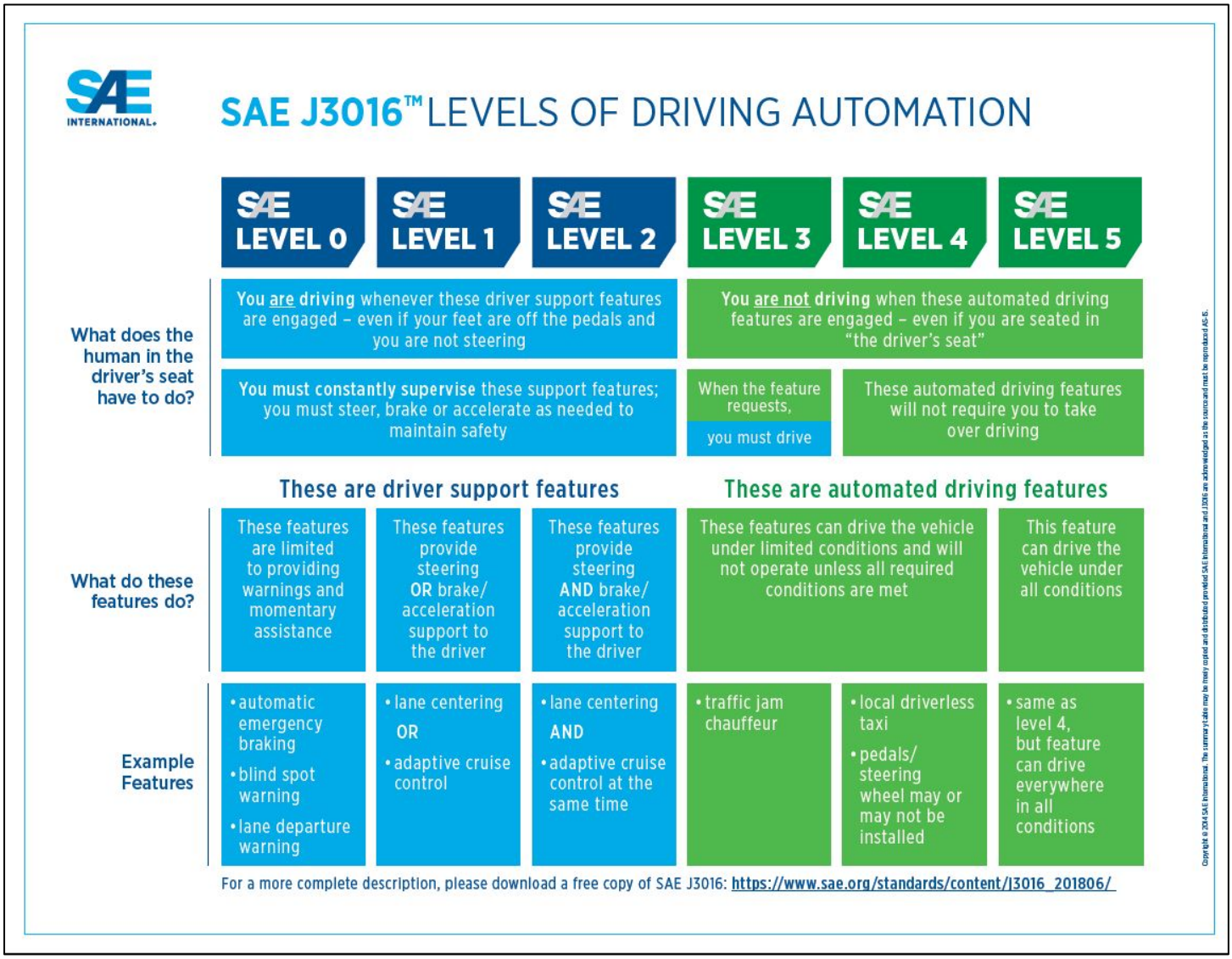
Considering the SAE Levels of Driving Automation, for SAE Levels 0-2 the focus is on driver support features, meaning that the human driver is in control but automated features support and enhance the vehicles operations. In contrast, SAE Levels 3-5 focus on automated driving features meaning that the vehicle itself is generally in control of the driving operation with the support of human intervention, depending on the level of automation.

However, it should be emphasized the SAE Level 3 is of particular interest and concern given that this is the "gap" level of automation between driver support and automated driving features. This makes SAE Level 3 a particular challenge since human drivers may tend to over-estimate the ability of automation and may use this automation in a more careless, less safe manner.

From a level of automation perspective, the main focus of this CAV Plan is on SAE Levels 3-5 where more transformational change is likely and the City will be required to more actively prepare for the emergence of CAV technologies. However, were connected vehicle technologies precede automated vehicle technologies the CAV Plan can be considered where applicable.

[3] Society of Automotive Engineers International [SAE]. SAE J 3016-2018: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. 2018.
[4] Smith BW. Automated Driving Definitions. Law of the Newly Possible. 2018.

Figure 2: SAE J3016 Levels of Driving Automation[5]



[5] Society of Automotive Engineers International [SAE]. SAE Standards News: J3016 automated-driving graphic update. 2019. Available from: https://www.sae.org/news/2019/01/sae-updates-j3016-automated-driving-graphic

The following two subsections further discuss the SAE Levels of Driving Automation.

Driver Support Features

- **Level 0:** The human driver is operating and controlling the vehicle and must constantly supervise steering, braking, and acceleration to maintain safety. Other vehicle systems may provide warnings or support, such as automatic emergency braking or lane departure warnings.
- **Level 1:** The human driver is operating and controlling the vehicle when these features are turned on, but is assisted with either steering or braking and acceleration (e.g. lane centering, adaptive cruise control, etc.).
- **Level 2:** The human driver is operating and controlling the vehicle when these features are turned on, but is assisted with steering, braking, and acceleration (e.g. lane centering and adaptive cruise control).

Automated Driving Features

- **Level 3:** The human driver is not operating or controlling the vehicle when these features are turned on (e.g. traffic jam chauffeur), but must drive if prompted in order to maintain safety.
- **Level 4:** The human driver is not operating or controlling the vehicle when these features are turned on, but will either:
    - Need to drive if prompted to reach the destination (in a vehicle that can be manually driven); or
    - Not be able to reach every destination (in a vehicle that does not have a steering wheel or pedals).
- **Level 5:** The human driver is not operating or controlling the vehicle when these features are turned on and can reach any destination.

The automated driving system (ADS) is engaged depending on SAE level of automation when the vehicle is within a specified operational design domain, e.g. defined by a mapped geographical area, certain weather conditions, etc.

1.1.2 DRIVING AUTOMATION SYSTEMS

Driving automation systems are made possible through numerous sensors that model and respond to the driving environment. Automakers, suppliers, technology developers, and other industry players have developed systems using one or more of the following sensor technologies including:

- Accelerometer (i.e. speed and acceleration);
- Cameras (i.e. monocular, stereo, infrared, or a mix of these);
- Lidar (i.e. laser measurements);
- Radar (i.e. short range, long range, or both);
- Satellite positioning systems (i.e. GPS); and/or
- Ultrasonic Sensors (i.e. sonar).

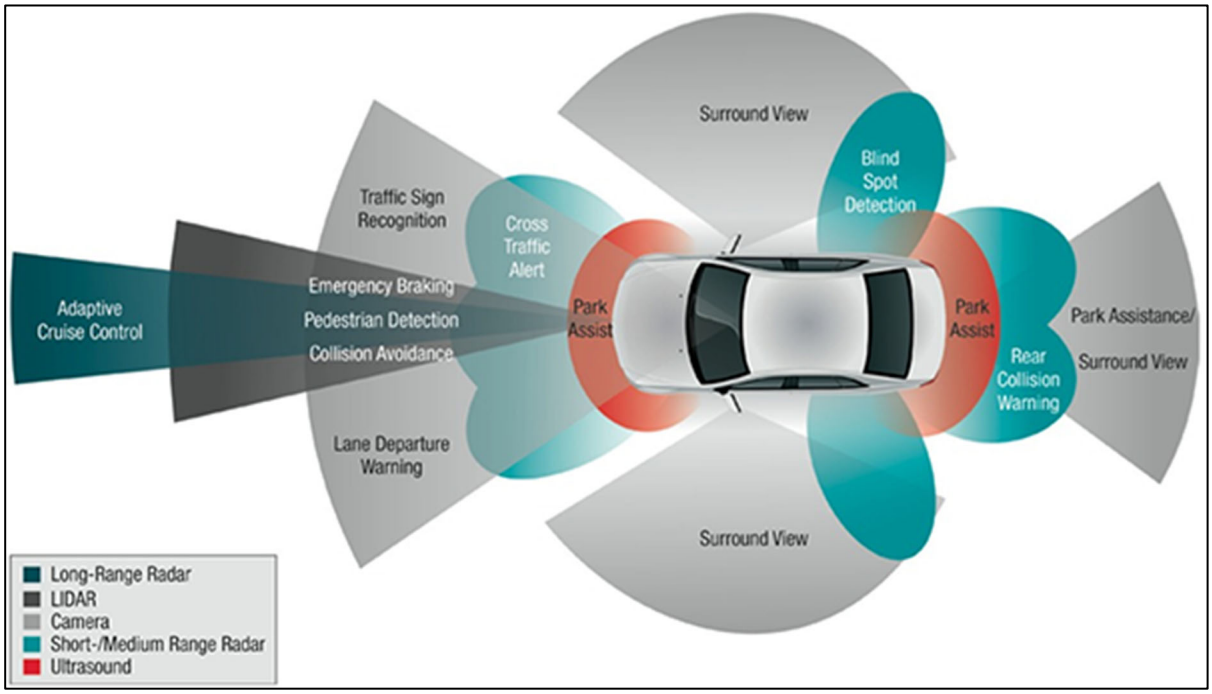
Most CAV system developers utilize a mix of these technologies to ensure that these systems are aware of their surroundings. For SAE Level 4 and 5 ADS, the industry has not yet created a standard understanding of what mix of sensors (illustrated below in **Figure 3**) will be required, and currently develop their technology based on the performance of these sensors (i.e. speed detection, sensitivity to colour, robustness to weather and time of day, resolution, range, etc.), cost, market segment, and visual appeal[6].

1.2 CONNECTED TECHNOLOGIES

Londoners already live with some intelligent transportation technologies – such red light cameras and automated speed enforcement – and the City is in the process of upgrading the traffic signal systems[7] to support rapid transit and eventually CAV technologies. Wireless, connected technologies could further unlock the transformative potential of driving automation by enabling individual CAVs to communicate both amongst each other and with transportation infrastructure.

[6] Michigan Tech Research Institute. Benchmarking Sensors for Vehicle Computer Vision Systems. 2019. Available from: https://www.mtu.edu/mtri/research/project-areas/transportation/sensors-platforms/benchmarking-sensors/
[7] City of London. Intelligent traffic signals. 2020-10-22. Available from: https://london.ca/living-london/roads-sidewalks-transportation/traffic-management/intelligent-traffic-signals

Figure 3: Sensors for Vehicle Computer Vision Systems[8]



1.2.1 TELEMATICS

Telematics refers to telecommunications, sensors, and instruments technology which allow for the sending, receiving, and storing of information to provide driver information and control vehicles on the move. Vehicle-to-Vehicle (V2V) technology allows for the wireless exchange of information about a vehicle's speed and position with surrounding vehicles, helping to avoid crashes and manage traffic congestion[9]. Vehicle-to-Infrastructure (V2I) and Vehicle-to-Everything (V2X) technology uses wireless technology to broadcast and receive information and messages about upcoming road conditions, construction zones, traffic lights, weather, emergency alerts, and more.

[8] Same as previous.
[9] National Highway Traffic Safety Administration. Vehicle-to-Vehicle Communications: Readiness of V2V Technology for Application. 2014-08. Available from: https://www.nhtsa.gov/sites/nhtsa.gov/files/readiness-of-v2v-technology-for-application-812014.pdf

There are currently two major communication technologies that make this possible[10]:

- **Dedicated short-range communications (DSRC)** is a wireless communication technology enabling vehicles to communicate with each other and other road users directly, without involving cellular or other infrastructure. Every vehicle broadcasts its location, heading and speed securely and anonymously ten times per second. All surrounding vehicles receive the message, and each estimates the risk imposed by the transmitting vehicle[11]. Similarly, nearby infrastructure (e.g. traffic signals) could communicate with CAVs using these DSRC messages.

- **Cellular V2X (C-V2X)** technology uses mobile networks provided by private carriers just like mobile phones. While cellular communications do not consistently provide high enough transmission speeds required for critical safety applications, they can carry longer-range communications for data transfers to support some mobility and environmental applications, along with supporting data collected and disseminated by transportation agencies, such as traffic and pavement data. The next iteration of cellular V2X technology is 5G communication – which brings promise of greater interoperability, wider bandwidth, increased cybersecurity, and a decentralized network that runs on private cell towers[12].

There is still uncertainty around precisely which wireless communication protocols will be widely adopted, perhaps both DSRC and C-V2X may ultimately completement each other rather than compete. However, the vision of CAVs connected using both V2V and V2I technologies that maximize the safety and efficiency of trips is powerful. Together, telematics technologies could make urban mobility networks more connected and responsive than ever.

[10] USDOT. Connected Vehicle Impacts on Transportation Planning. 2016-06. Available from: https://www.itskrs.its.dot.gov/its/benecost.nsf/ID/6367c692a4c49b85852583a90062c6fe
[11] Autotalks. DSRC technology. 2021. Available from: https://auto-talks.com/technology/dsrc-technology/
[12] Wassom B. DSRC vs. 5GLTE: Which will it be for Connected Vehicles? WardsAuto. 2018. Available from: https://www.wardsauto.com/industry-voices/dsrc-vs-5glte-which-will-it-be-connected-vehicles

1.2.2 DATA COLLECTION AND ANALYSIS

A vehicle equipped with sensors, communication technology, and computing power is a mobile "big data" collecting machine. Big data has five main characteristics, collectively known as the "5 Vs":

- **Volume:** There are vast numbers of individual data points generated every second;
- **Velocity:** Data entering the system and moving around in both real-time or near-real-time;
- **Variety:** Data about many different objects, individuals, and conditions in numerous formats (e.g. text, audio, picture, video, etc.);
- **Veracity/Validity:** Data quality, credibility of the data source, or trustworthiness; and
- **Value:** Data value that the City can provide to users or vice-versa.

In the case of CAVs, this data is generated from inputs that are both inside and outside the vehicle. Outside the vehicle involves: data on congestion, road safety, street and curbside usage, travel demand, air quality, noise, and more. Inside the vehicle collects data about its own performance, as well as its passengers' movements and activities – which raises new and unique considerations about data privacy and usage.

This data is mobilized in a variety of ways, such as through data analysis, modelling, visualization, and mapping. For example, instead of a simple count of on-street parking space inventory, location data broadcast by CAVs could allow for the visualization of real-time, historical, and anticipated pickup and drop-off patterns throughout the day, week-to-week, and seasonally, and for all points on a network. Better predicting demand could allow for more efficient management of transportation infrastructure.

As driving automation technology becomes more common on new vehicles, the large amounts of data generated could be valuable not only for improving the vehicle's operation, but also for gaining more profound insights into urban conditions and helping decision-makers develop evidence-based policy, also known as data-driven decision making[13].

[13] Bloomberg Philanthropies, Aspen Institute. Taming the Autonomous Vehicle: A Primer for Cities. 2017-03. Available from: https://www.planning.org/knowledgebase/resource/9137796/

With the advent of machine learning and artificial intelligence, algorithmically governed systems will be able to continually tweak and optimize themselves without any human intervention. However, this automation creates both opportunities and risks. On the one hand, it can reduce human error, reduce costs, increase productivity, and create openings for new services and products. On the other hand, depending on the quality of data and assumptions used to train the algorithms, automation can increase human error and bias in data outputs.

1.3 ELECTRIC VEHICLE TECHNOLOGIES

While not a central feature of the Connected and Automated Vehicle Plan, electrical vehicle (EV) technologies are worth noting as CAVs could be a potential catalyst for transitioning away from fossil fuels (e.g. through Tesla or similar types of vehicles). The City's recent Climate Emergency Action Plan (CEAP) includes a CAV action item to discourage zero-occupancy use, encourage shared ownership and service models, complements London's public transportation system, prioritizes active transportation road users' safety, and uses zero-emission vehicles[14].

The extent to which CAVs are zero-emissions will in part depend on the extent to which CAVs are shared or fleet vehicles. Ride-hailing and transit vehicles typically drive significantly more kilometres per year than the average vehicle. For this reason, converting fleets to low or zero-emission technologies is essential for maximizing the economic and environmental returns on investment[15]. Passenger and freight CAVs – if powered by low or zero-emission technologies – could significantly reduce GHG emissions and critical air pollutants associated with transportation[16].

Despite this, EVs currently come with challenges including a higher upfront cost for consumers and a lack of charging infrastructure in the public and private domain. Beyond a certain point, the power grid could have further upstream impacts, depending upon how the electricity is generated and how innovation in electricity storage proceeds.

[14] City of London. Climate Emergency Action Plan. A-31. 2022-04. Available from: https://getinvolved.london.ca/climate
[15] Peter Slowik, Pavlenko N, Lutsey N. Emerging Policy Approaches to Electrify Ridehailing in the United States. International Council on Clean Transportation. 2019. Available from:
[16] Bloomberg Philanthropies, Aspen Institute. Taming the Autonomous Vehicle: A Primer for Cities. 2017-03. Available from: https://www.planning.org/knowledgebase/resource/9137796/

Furthermore, CAVs may increase commuter tolerance for longer commutes – as they could watch entertainment or even sleep while the vehicle drives itself. This could lead to energy-intensive urban sprawl, offsetting potential environmental benefits from the vehicles themselves[17]. Additionally, waste streams arising from the disposal of rare-earth minerals used in electric motors and especially lithium-ion batteries may pose new waste management challenges[18].

[17] Same as previous.
[18] Taiebat M, Brown AL, Safford HR, Qu S, Xu M. A review on energy, environmental, and sustainability implications of connected and automated vehicles. Environ Sci Technol. 2018;52(20):11449–65.

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2 THE ARRIVAL, CHALLENGES, AND OPPORTUNITIES OF CAVS

It is anticipated that CAVs will be widely available and market-ready in the coming decades with some lower-level automation vehicles already on the market and in use today (i.e. SAE Levels 1 and 2). Despite all the activity around CAVs, there is still uncertainty around how and when CAV technology at higher levels will be launched (i.e. SAE Levels 3, 4, and 5), and if CAVs will live up to the hype.

2.1 KEY DEVELOPMENT FACTORS

There is uncertainty in the key development factors of CAV technologies from several sources including:

- **Technological factors** may include vehicle performance, security, and infrastructure requirements;
- **Policy factors** may consist of infrastructure investments, liability, allocation of right-of-way, and incentive programs;
- **Economic factors** may include scalability of commercial deployment, changes in the cost of materials and energy, and business case impacts from new regulations and competing innovators; and
- **Human factors** may consist of personal comfort levels with riding in a CAV, willingness to share rides with other passengers, ability to adapt driving skills when both conventional vehicles and CAVs share the road, and individual willingness to share data.

While fully autonomous vehicles (i.e. SAE Levels 4 and 5) are already being tested and in some cases deployed (such as Waymo ride-hailing in Phoenix, Arizona[19]), a 2021 study published last year in AI and Ethics reported that 74% of survey respondents said they do not trust CAVs nor believe CAVs can perform better than a normal driver[20]. The interactions between these factors will affect when highly automated vehicles are launched in the market, how much of the driving task the CAV will perform, the rate of

[19] Waymo. Waymo One. 2022. Available from: https://waymo.com/waymo-one/
[20] Smart Cities Dive. These 3 technologies could make self-driving cars safer. 2022-05-11. Available from: https://www.smartcitiesdive.com/news/av-technologies-self-driving-car-safety/623471/

CAV adoption, cost of CAV technology, and the split between different transportation modes[21].

Recent reports and analyses exploring the impacts of CAVs and their implications for transportation planning have investigated how quickly such vehicles are likely to be deployed based on[22]:

- The previous emergence of vehicle technologies;
- Likely costs and benefits;
- How they will affect travel activity; and
- Their impacts on road, parking, and public transit planning.

This indicates that SAE Level 5 CAVs, able to operate without a driver, may be commercially available and legal to use in some jurisdictions by the late 2020s, but will initially have high costs and limited performance. Some benefits, such as independent mobility for affluent non-drivers, may begin in the 2030s but most impacts, including reduced traffic and parking congestion, independent mobility for low-income people (and therefore reduced need for public transit), increased safety, energy conservation and pollution reductions, will only be significant when CAVs become common and affordable, probably in the 2040s to 2060s, and some benefits may require dedicated CAV lanes, which raises social equity concerns[23].

It has been suggested that while automakers are actively developing automated driving systems (ADS) and advanced CAV technologies are still emerging, automakers will offer limited CAV functionality within defined situations[24]. Driving automation technology exists today (i.e. SAE Levels 2 and 3) in the form of advanced driver assistance systems (ADAS) including adaptive cruise control, blind spot monitoring, forward collision warning, and lane assist.

While SAE Level 2 and 3 driving automation systems may be able to handle certain driving tasks in limited circumstances, they carry the danger that drivers will overestimate the vehicle's abilities, leading to unsafe situations. Significant improvement

[21] United States. Department of Transportation. Benefits Estimation Model for Automated Vehicle Operations: Phase Two Final Report. 2018. Available from: https://rosap.ntl.bts.gov/view/dot/34458
[22] Litman T. Autonomous Vehicle Implementation Predictions: Implications for Transport Planning. Victoria Transport Policy Institute. 2022-08-09. Available from: https://www.vtpi.org/avip.pdf
[23] See previous.
[24] Gartner. Hype Cycle for Connected Vehicles and Smart Mobility, 2018. Report No. G00356056.

will therefore be necessary before full operation of vehicles is passed from humans to artificial intelligence.

Regulatory regimes at the federal and provincial/territorial levels may also require time to ensure the safety of CAV technologies. Even if SAE Level 4 and 5 CAVs appear on the market as they are suggested to do this decade, it will still likely take decades before most vehicles on the road are capable of automated driving.

It should be noted from recent observations and experience that these timeframes are subject to change based on the progress and emergence of CAV technologies. In some cases, breakthroughs can occur quickly and have more immediate impacts whereas other CAV technical challenges continue and limit technological progress.

2.2 MAJOR DEVELOPMENT CATEGORIES

SAE Level 4 and 5 CAVs are anticipated to have the most disruptive impact on urban mobility and associated services, not just in terms of moving people, but in many other applications as well. However, these technologies are currently at different stages in their development, and some may appear on City streets before others.

Here are four major categories of CAVs currently being developed:

2.2.1 PASSENGER VEHICLES

> Passenger vehicle CAVs are smaller-scale CAVs that may resemble one or two person pods or the more familiar four to six person vehicles (i.e. similar to family cars or mini-vans). They may be personally owned, part of a shared fleet, or deployed as part of a larger ride-hailing service.

In contrast to public transit and public service vehicles – for which the timing of deployment is within the control of municipalities – the introduction of CAVs to the general passenger vehicles fleet is subject to much more uncertainty. Companies are setting targets for a “minimum viable product” which may include automated features but could be limited to certain conditions such as well-maintained highways and fair weather. These products could be available for commercial sale but will not have a

significant impact on overall mobility networks[25].Anticipated timelines for CAVs are changing year-to-year based on the continuing development of the technology.

Depending upon the balance of CAV ownership models (i.e. how many are privately owned vs. how many are shared ownership), cities could experience a range of disruptive impacts to their infrastructure and built form.

For the time being, Canadian consumers will likely continue to buy cars, although at a reduced rate, as the millennial population cohort opts for a more urban, less car-focused lifestyle. This may lead to the emergence of two parallel vehicle markets: privately owned automobiles with an increasing array of automated features, and higher level CAVs deployed under a shared, on-demand model[26].

Personally Owned CAVs

In the short term, vehicle manufacturers are likely to introduce SAE Level 2-3 features (e.g. traffic congestion chauffeur, highway automated pilot, etc.) first into their premium models and later in their volume models. While SAE Level 2 has become more widely available (e.g. Tesla Autopilot, etc.) to common users over time, SAE Level 3 may not be implemented as readily given the human behaviour to over-estimate the ability of some technologies.

In this scenario, personally owned SAE Level 2-3 CAVs could enjoy market dominance for the foreseeable future until Level 4-5 CAVs are developed and consumer-ready, with sales expected to reach their peak in the mid-2030s[27]. SAE Level 2-3 CAVs could make driving more convenient and free up drivers to do other activities which could lead to longer and more frequent journeys. In this scenario, the status quo is extended – with continued urban sprawl and road congestion – and the positive transformative potential of CAVs has not yet been fully realized[28]. In contrast, this could also significantly improve safety and mobility for a subset of the population including the elderly.

[25] Eno Center for Transportation. Beyond Speculation 2.0: Automated Vehicles and Public Policy: An Update to Eno's Action Plan for Federal, State, and Local Policymakers. 2019. Available from: https://www.enotrans.org/wp-content/uploads/2019/04/4-1-AV-Paper-FINAL-with-Cover.pdf
[26] Grush B, Niles J, Baum E. Ontario Must Prepare for Vehicle Automation: Automated Vehicles Can Influence Urban Form, Congestion, and Infrastructure Delivery. Residential and Civil Construction Alliance of Ontario. 2016. Available from: https://rccao.com/research/files/RCCAO_Vehicle-Automation_OCT2016_WEB.pdf
[27] See previous.
[28] See previous.

Shared CAVs

Ridesharing services (e.g., Uber and Lyft) are making up an ever-increasing share of trips in cities around the world. However, future shared CAVs may not be restricted to company-based models, but may include neighbourhood-based sharing models, whereby one or more CAVs would be shared by multiple households in the same neighbourhood, like residential condo corporation models we see today.

A recent study prepared by the City of Toronto's Big Data Innovation Team in partnership with the University of Toronto found that due to the substantial travel time savings for most trips, ridesharing services may compete with transit, but can also fill gaps in service[29].

Shared CAV fleet companies (i.e. using SAE Level 4-5 vehicles providing either single trips back-to-back or pooled with one or more other passengers) could continue this trend, beginning to provide on-demand service in some urban areas at the same time as SAE Level 2-3 personally-owned vehicles become available in the consumer market. A study from the World Economic Forum and the Boston Consulting Group forecasts that low-cost, convenient CAV Mobility-as-a-Service (MaaS) could account for more than 40% of trips in urban areas by 2030, decreasing personal car and mass transit use by 14% each[30].

Shared CAV fleets could provide a significant return on investment as they can operate and generate revenue around the clock[31]. This business model could see substantial growth, as car ownership continues to decline and ridesharing apps like Uber and Lyft continue to gain in popularity.

Depending upon how quickly shared fleets are deployed and how comfortable people become using them, the popularity of human driven vehicles could begin to decline. With appropriate policies, SAE Level 4-5 shared CAVs could potentially drive down congestion and parking demand, as well as increase mobility choices. However, with the emergence of COVID-19, people may conversely be resistant to shared fleet use until hygienic improvements and comfort levels improve, which could well last several years.

[29] City of Toronto Big Data Innovation Team, UTTRI. The Transportation Impacts of Vehicle-for-Hire in the City of Toronto. 2019. Available from: https://www.toronto.ca/wp-content/uploads/2019/06/96c7-Report_v1.0_2019-06-21.pdf
[30] World Economic Forum and the Boston Consulting Group. Reshaping Urban Mobility with Autonomous Vehicles: Lessons from the City of Boston. 2018. Available from: https://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf
[31] The Economist. Self-Driving Cars Will Require New Business Models. The Economist. 2018-03-01. Available from: https://www.economist.com/special-report/2018/03/01/self-driving-cars-will-require-new-business-models

In the scenario that CAVs are successful, this technology could contribute to the creation of new business and service delivery models, shifting job markets, transforming industries, altering energy consumption, and reshaping the urban form[32].

2.2.2 TRANSIT VEHICLES

> Transit vehicle CAVs are larger-scale shuttles that could hold anywhere from eight to 25 people or more and may complement more conventional public transit networks and services by providing first-and-last mile connections in lower-demand areas.

Transit vehicles with driving assistance or automation technologies could help improve the safety and efficiency of public transit service. A SAE Level 1 or 2 transit bus with Advanced Driver Assistance System (ADAS) could provide: smooth acceleration and deceleration, automatic emergency braking and pedestrian collision avoidance, curb avoidance, precision docking, narrow lane/shoulder operations, and platooning. Higher level automation packages could be deployed in maintenance and yard operations, as well as shuttle, bus rapid transit, and mobility-on-demand services[33].

CAVs could both support and challenge existing public transit systems. On one hand, a technology that could strengthen transit networks is the low-speed automated shuttle[34]. These vehicles, capable of carrying eight to 25 people at speeds of around 25-30 km/h, could provide feeder service in neighbourhoods and employment areas where higher-order transit service is impractical and providing first-and-last mile connections to major transit routes or other important destinations is a challenge[35]. Automation and platooning of shuttles could lead to a new form of bus rapid transit (BRT) with CAV buses operating on busways or high occupancy vehicle lanes[36].

On the other hand, without proper planning, other CAV services and vehicles could draw away riders from the transit system which would undermine its viability and create more

[32] Grush B, Niles J, Baum E. Ontario Must Prepare for Vehicle Automation: Automated Vehicles Can Influence Urban Form, Congestion, and Infrastructure Delivery. Residential and Civil Construction Alliance of Ontario. 2016. Available from: https://rccao.com/research/files/RCCAO_Vehicle-Automation_OCT2016_WEB.pdf
[33] U.S. Department of Transportation. Federal Transit Administration. Strategic Transit Automation Research Plan. 2018-01. Available from: https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/114661/strategic-transit-automation-research-report-no-0116_0.pdf
[34] National League of Cities Center for City Solutions. Autonomous Vehicles: Future Scenarios – Weaving a Microtransit Mesh. 2018. Available from: http://avfutures.nlc.org/sustainability
[35] Cregger J, Dawes M, Fischer S, Lowenthal C, Machek E, David Perlman. Low-Speed Automated Shuttles: State of the Practice Final Report. U.S. Department of Transportation. 2018. Available from: https://rosap.ntl.bts.gov/view/dot/37060/dot_37060_DS1.pdf
[36] National Association for City Transportation Officials. Blueprint for Autonomous Urbanism. 2017. Available from: https://nacto.org/publication/bau2/

congestion. In a Toronto area study[37], it was found that increased subway ridership was associated with higher first-and-last mile ride-hailing trips to and from subway stations while "feeder" surface transit ridership declined along corridors where ride-hailing trips increased.

2.2.3 GOODS MOVEMENT, DELIVERY, AND FREIGHT VEHICLES

> On the distribution and long-haul side of CAVs, semi-trucks are being tested to follow one another in platoons (nearly bumper-to-bumper) in a line resembling a train. The close spacing reduces air-drag friction, lowers fuel consumption (and therefore lowers GHG emissions and air pollution), and allows goods to be transported more efficiently. For delivery and short-haul, smaller vehicles could travel on sidewalks, campuses, or indoor commercial spaces, delivering everything from packages to restaurant take-out deliveries right to customers' doors.

CAVs could significantly change how goods are moved between and within cities. CAVs may be a tool for responding to overlapping trends in the goods movement sector that are presenting challenges for the industry: the emergence of crowd shipping; a driver labour shortage, particularly for long-haul operations; increasing congestion, particularly in dense urban environments; increasing volumes of goods to be shipped; and changing consumer behaviour, including a rapid shift to e-commerce and pressure for just-in-time deliveries[38][39]. Since fuel costs represent a significant portion of the cost to deliver goods, any opportunities to reduce fuel use will also be of interest to the industry.

Long-haul tractor-trailers are expected to be among the first vehicles to use CAV technology on a large scale on public roads and are already being tested by various companies in the United States and Europe. Long-haul CAV tractor-trailers could potentially drive in platoons (i.e. like a train) with the driver acting as a "chaperone" rather than a dedicated driver and operator using V2V systems such as cooperative adaptive cruise control. Eventually, the platoons could travel without on-site human involvement through remote monitoring. CAV technology could enable freight services to increase productivity, from 13 hours per day of driving time (the current daily limit for

[37] City of Toronto Big Data Innovation Team, UTTRI. The Transportation Impacts of Vehicle-for-Hire in the City of Toronto. 2019. Available from: https://www.toronto.ca/wp-content/uploads/2019/06/96c7-Report_v1.0_2019-06-21.pdf
[38] Wiginton L, Smith C, Ewing M, Batista G. Fuel Savings and Emissions Reductions in Heavy-Duty Trucking: A blueprint for further action in Canada. 2019. Available from: https://www.pembina.org/reports/freightclimateblueprints.pdf
[39] Lee J, Kim C, Wiginton L. Delivering Last-Mile Solutions: A feasibility analysis of microhubs and cyclelogistics in the GTHA [Internet]. 2019. Available from: https://www.pembina.org/reports/delivering-last-mile-solutions-june-2019.pdf

a human driver in Ontario) to 20 hours with CAVs[40]. However, platooning may also introduce other safety and operational challenges for other non-commercial vehicles and best practices will likely need to be developed and regulated.

On a smaller scale, delivery robots are being designed to travel on sidewalks or in other public and private environments, delivering items such as packages and restaurant takeout deliveries right to customers' front doors. In the United States, companies like Amazon, FedEx, Domino's, and others are actively piloting this technology as a way of reducing costs and increasing convenience for customers[41]. However, consideration will need to be given to pedestrian safety and the impacts of such small-scale CAV technologies sharing sidewalks with pedestrians and vulnerable road users.

2.2.4 PUBLIC SERVICE VEHICLES

> Different levels of automation are being tested in public service vehicles such as waste collection trucks and snowplows to help improve their efficiency and safety.

CAV technologies are being developed not only for the passenger and freight sectors, but also for the delivery of public services. Many companies are exploring how automation can contribute to improved traffic safety, worker conditions, efficiency, and a lower environmental impact. For example, self-driving street cleaning vehicles are being developed internationally that can automatically trace and pick up garbage, as well as trim roadside bushes, while sensing and monitoring the vehicle's vicinity to avoid people and obstacles in its path. These technologies can also be mass produced allowing for significant cost savings in service delivery[42].

CAV features are being tested in numerous types of service vehicles to help improve their efficiency and safety. Waste collection trucks could automatically travel their routes, lifting and emptying bins, and reducing the risk of occupational injuries in workers[43]. CAV snowplows – already being tested at some airports – could be deployed quickly after a major snowfall to clear streets and sidewalks[44].

[40] Ticoll D. Driving Changes: Automated Vehicles in Toronto. Munk School of Global Affairs. University of Toronto. 2015-10-15. Available from: https://munkschool.utoronto.ca/ipl/files/2016/03/Driving-Changes-Ticoll-2015.pdf
[41] Wong JC. Delivery robots: a revolutionary step or sidewalk-clogging nightmare? The Guardian. 2017-04-12. Available from: https://www.theguardian.com/technology/2017/apr/12/delivery-robots-doordash-yelp-sidewalk-problems
[42] Xinhua. Chinese firm develops self-driving street cleaning vehicles. ChinaDaily. 2018-04-27. Available from: http://www.chinadaily.com.cn/a/201804/27/WS5ae2b5e4a3105cdcf651aeb2.html
[43] Volvo Group. Volvo pioneers autonomous, self-driving refuse truck in the urban environment. 2017-05-17.
[44] Mogg T. Daimler aims to bring its self-driving snowplows to airports. Digital Trends. 2017-10-19. Available from: https://www.digitaltrends.com/cars/snowplows-driverless-daimler/

Since many services provided by the City occur along fixed routes (e.g. snow clearing, street cleaning, waste and recycling collection, etc.), there could be an opportunity to deploy non-passenger CAVs to supplement the existing suite of City services. Automating service vehicles to improve the safety and efficiency of public service delivery could consist of just automating certain driving functions or deploying full CAV solutions. For example, the City of Toronto has engaged in initiatives such as the Autonomous Snowplow Competition[45] and the Micro Utility Devices challenge[46].

Learning from the Past

Throughout history, successive transportation innovations have enabled humans to reach more places faster. While CAVs could represent the newest wave, it is worthwhile to look back at the lessons learned from the last time North American cities underwent such a transformation: the transition from horse-drawn carriage to the automobile.

The horse dominated nineteenth century urban and rural life in North America and Europe[47]. However, by the end of the nineteenth century new transportation options appeared on the scene and the transition away from the horse began.

Parallel developments in steam power, electricity, and the internal combustion engine led to a "widening up" of new mobility options – the bicycle, omnibus, horse-drawn streetcar, electric streetcar, cable car, railway, steam-powered car, electric car, and the automobile[48].

Of course, not all these options lasted. Public hygiene issues associated with horses, namely manure and carcasses contributed to their decline.

[45] Institute of Navigation. 2019 Autonomous Snowplow Competition. 2019. Available from: https://autosnowplow.com/2019_Event_and_Results.html
[46] City of Toronto. Transportation Innovation Challenge: Micro Utility Devices. 2022. Available from: https://www.toronto.ca/wp-content/uploads/2022/03/8c9b-TSTransportation-Innovation-Challenge.pdf
[47] Nikiforuk A. The Big Shift Last Time: From Horse Dung to Car Smog. The Tyee. 2013-03-06. Available from: https://thetyee.ca/News/2013/03/06/Horse-Dung-Big-Shift/
[48] Dr. Ir. F. W. Geels. The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). Technology Analysis & Strategic Management. 17:4, 445-476. DOI: 10.1080/09537320500357319. 2005.

Figure 4: Talbot Street, north of King Street, circa 1900

Image Source: Western University Archives

Electric streetcar systems were widespread across North America for a time – fostering tremendous growth in "streetcar suburbs" like the neighbourhoods of Springbank, Old North, Wortley Village, and Old East Village – before these lines were largely torn up in favour of new bus fleets.

Early automobiles were specialty items, used only by innovators, the wealthy, racers, and hobbyists, as well as military applications. While the introduction of the Model T Ford made the automobile widely accessible, broader social and scientific developments over the span of about 100 years (1830s to 1930s) played roles in advancing and accelerating the transition to the automobile.

As the complex infrastructure that had developed around the horse-based economy began to decline, a new infrastructure emerged, enhancing the benefit of the automobile. Early barriers, such as buying fuel in cans from pharmacies and cars that required repair on route, were overcome with innovation and development of support networks. New professions and business models began to emerge including mechanics, traffic engineers, parking garages, gas stations, car washes, and taxi companies[49].

Based on historical experience, here is what might be expected with regards to CAVs:

- While there may be an initial explosion in new technologies, not all options in the current mobility marketplace will last.
- Early regulation will be focused on ensuring the safety and effectiveness of CAVs, until the public is sufficiently comfortable with them.
- Later, the regulatory focus will likely shift to removing restrictions and supporting CAVs in reaching their full potential, which could mean restricting older technologies, such as human-operated vehicles.
- Infrastructure lasts for a long time so future-proofing it is essential to avoid a state of technological lock-in.
- The evolution of safety, standards, and formats will be a gradual, iterative process.
- There will be unanticipated uses of CAVs, resulting in unintended consequences (e.g. the development of the drive-through for automobiles).
- The full potential of the technology will not be realized in a mixed environment. CAVs, like conventional automobiles, may require segregation and purpose-built infrastructure to maximize their benefit.

Eventually, everything from what streets look like to how traffic is managed to the types of vehicles used for transporting people and goods may change dramatically, like the early-1900s.

[49] Smith B, Browne CA. The Day the Horse Lost its Job. Microsoft Today in Technology. 2017-12. Available from: https://blogs.microsoft.com/today-in-tech/day-horse-lost-job/

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3 LONDON'S LOCAL AND REGIONAL CONTEXT

London's local and regional context includes entities that support the development of both connected infrastructure and automated vehicles as this technology continues to emerge in the coming decades. **Table 1** below lists a scan of some of the CAV key stakeholders within London's local and regional context but is not an exhaustive list and subject to change. The subsections herein further expand upon some of these key stakeholders.

3.1 GOVERNMENT

In Canada, the regulation of vehicles and road safety is a shared responsibility among all levels of government. Transport Canada establishes safety regulations for the manufacturing, importation, and shipment of motor vehicles and motor vehicle equipment through the Motor Vehicle Safety Act (MVSA)[50]. The provinces and territories are responsible for the licensing of drivers, vehicle registration and insurance, and regulation for the safe operation of vehicles on public roads. For the Province of Ontario, these regulations fall under the Highway Traffic Act[51].

Transport Canada's Guidelines for Trial Organizations encourages those who are testing CAVs in Canada to engage with municipal and provincial authorities regarding local traffic laws, infrastructure, safety considerations, and preparations for local emergency services[52]. Despite the distinct roles and responsibilities of each level of government, all jurisdictions are encouraged to work together to ensure that there is continued learning and knowledge transfer throughout the development of this technology for its safe testing and deployment.

As illustrated in **Table 2** below, the roles and responsibilities of the various levels of government in Canada are broken down as they are related to CAV technologies. Further, while classified under specific sections, it should be noted that through funding,

[50] Government of Canada. Motor Vehicle Safety Act. Consolidated as of 2022-08-08. Available from: https://laws-lois.justice.gc.ca/eng/acts/m-10.01/
[51] Government of Ontario. Highway Traffic Act. Consolidated as of 2022.07-01. Available from: https://www.ontario.ca/laws/statute/90h08
[52] Transport Canada. Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations. 2021-08-06. Available from: https://tc.canada.ca/en/road-transportation/innovative-technologies/connected-automated-vehicles/guidelines-testing-automated-driving-systems-canada

partnerships, collaborations, etc. between both public and private entities, there is a lot of "blurring the lines" between these various stakeholders.

Table 1: Key Stakeholders in London's Local and Regional Context[53]

Government	• City of London • ESCRYPT • London Transit Commission • Middlesex-London Health Unit (MLHU) • Ministry of Transportation Ontario (MTO) • Transport Canada
Academia and Research	• Fanshawe College • National Research Council (NRC) Canada • Western University
Economic Development, Entrepreneurial Accelerators, and Industry	• Canadian Automated Vehicles Centre of Excellence (CAVCOE) • Canadian Urban Transit Research and Innovation Consortium (CUTRIC) • London Chamber of Commerce • London Economic Development Corporation (LEDC) • MaRS Discovery District • Municipal Alliance for Connected and Autonomous Vehicles in Ontario (MACAVO) • Ontario Centre of Innovation (OCI) • Ontario Vehicle Innovation Network (OVIN) • TechAlliance

[53] OVIN. Ecosystem Map. 2022. Available from: https://www.ovinhub.ca/ecosystem-map/

Table 2: Levels of Government and Respective Responsibilities[54]

Federal Government	• Setting and enforcing motor vehicle safety standards for new or imported motor vehicles and motor vehicle equipment. • Investigating and managing the recall and remedy of non-compliances and safety-related motor vehicle defects nationwide. • Public education on motor vehicle safety issues. • Monitoring and developing rules on privacy and cybersecurity. • Setting and enforcing compliance with technical standards related to wireless technologies integrated into vehicles and roadside infrastructure. • Relevant legislation including the Motor Vehicle Safety Act.
Provincial and Territorial Governments	• Testing and licensing human drivers and registering motor vehicles in their jurisdictions. • Enacting and enforcing traffic laws, regulations, and trials. • Conducting safety inspections. • Regulating motor vehicle insurance and liability. • Planning for future transportation projects (e.g., highway management, transit, etc.). • The development, adaption, and use of provincially owned infrastructure to support CAV deployment. • Public education on motor vehicle safety. • Relevant legislation including the Highway Traffic Act.

[54] Council of Ministers Responsible for Transportation and Highway Safety. Automated and Connected Vehicles Policy Framework for Canada: Report of the PPSC Working Group on Connected and Automated Vehicles. 2019-01-21. Available from: https://www.comt.ca/Reports/AVCV%20Policy%20Framework%202019.pdf

Municipal Governments	• The creation and enforcement of by-laws on vehicle movement. • Enforcing traffic laws and regulations. • The development, adaption, and use of infrastructure to support CAV deployment. • Public education on motor vehicle safety. • Transportation planning, operations, and managing passenger transportation including public transit. • Regulation or delivery of passenger transportation in the form of transit, taxis, and ride-hailing services. • Managing and creating new logistics for traffic control and parking enforcement. • Policies to integrate transportation with land use. • Relevant legislation including the Municipal Act, 2001.

3.1.1 CAV TESTING IN ONTARIO

In 2016, Ontario was the first province in Canada to launch a pilot program to allow the testing of CAVs on its roads. This 10-year program allowed for eligible participants (i.e. auto manufacturers, technology companies, academic and research institutions, and parts manufacturers) to apply for a permit to test SAE Level 3, 4 and 5 automated vehicles under strict requirements outlined in MTO's Regulation 306/15: Pilot Project – Automated Vehicles of the Highway Traffic Act[55].

As of the last update in 2019, changes to the pilot program included:

1) Allowing for driverless CAVs under certain testing conditions.

2) Allowing for cooperative truck platoons under certain testing conditions.

[55] Ministry of Transportation Ontario. Automated Vehicle Pilot Program. Updated 2022-04-06. Available from: https://www.ontario.ca/page/automated-vehicle-pilot-program

Select key requirements for participants testing driverless testing of SAE Level 4 and 5 CAVs under the pilot program include[56]:

- Declaring that the technology is safe and effective based on previous testing and testers may be asked for proof of this.
- Accepting full liability.
- Informing the MTO of the environment and limits the CAV is designed to work in (i.e. its operational design parameters).
- Being able to monitor and control the vehicle if required.
- Being able to bring the CAV to a safe stop if necessary and explain how a safe stop will be done.
- Placing a copy of the signed approval form in a visible place in the CAV and keep a copy with the remote operator.
- Providing a "work zone and first responders' interaction plan" to affected authorities, such as law enforcement and municipalities, that explains how the CAV will interact with emergency responders and construction zones.
- Informing affected municipalities where the testing will happen.
- Having signage on the vehicle clearly showing that it is a CAV being tested.

Given the Province of Ontario's roles and responsibilities as listed in **Table 2**, it is important to highlight the importance of the City of London to proactively prepare for CAV technologies on our infrastructure.

[56] Ministry of Transportation Ontario. Automated Vehicle Pilot Program. Updated 2022-04-06. Available from: https://www.ontario.ca/page/automated-vehicle-pilot-program

3.1.2 PROVINCIAL SUPPORTS

The Ministry of Transportation of Ontario is also leading a CAV readiness initiative with funding from Transport Canada. This initiative brings together government and other stakeholders to facilitate capacity building within the Greater Toronto and Hamilton Area (GTHA) and Kitchener-Waterloo corridor and to establish a common and consistent planning horizon and framework for CAVs. Metrolinx, the Region of Peel, the City of Toronto, and WSP are partners in this initiative including the recent development of a CAV Readiness Plan[57].

As part of this plan, Detailed CAV Program Sheets[58] were developed that included scope for regional government involvement in the preparation for CAV technologies. The City of London will likely benefit from the lessons learned through these partnerships and reports prepared by other key implementation areas within Ontario and Canada such as the GTHA and the Ottawa Area that we can apply locally and in our own region.

Further, the CAV Readiness Plan and Detailed CAV Program Sheets may be a useful resource in the development of the City of London's future Implementation Plan for CAVs.

3.1.3 FEDERAL SUPPORTS

The federal government through Transport Canada has similarly made some significant investments in CAVs including $2.9 million through the Advance Connectivity and Automation in the Transportation System (ACATS) program over the 2018-2019 period. The Program aimed to prepare the country for wider use of CAVs on roads through[59]:

- Research, studies, and technology evaluations;
- The development of codes, standards, and guidance materials; and
- Capacity-building and knowledge-sharing activities.

[57] Ministry of Transportation Ontario. CAV Readiness Plan. 2020-04-03. Available from: https://www.ovinhub.ca/wp-content/uploads/2020/05/CAV-Readiness-Plan-Final-Report-2020-04-03-1.pdf
[58] Same as previous.
[59] Transport Canada. Program to Advance Connectivity and Automation in the Transportation System. 2019. Available from: https://tc.canada.ca/en/road-transportation/innovative-technologies/connected-automated-vehicles/projects-funded-program-advance-connectivity-automation-transportation-system

Fifteen projects were funded from a variety of partners through ACATS, including: the City of Toronto, the Canadian Automobile Association, the Canadian National Institute for the Blind, the City of Calgary, the City of Vancouver, the Intelligent Transportation System Society of Canada, and the Ministry of Transportation Ontario amongst others[60].

In addition to the funding provided by the federal government, Innovation, Science and Economic Development Canada (ISED) and Transport Canada have established five Vehicle of the Future Advisory Groups to engage experts on issues associated with CAVs and inform a whole-of-government approach for this technology. These advisory groups address topics including safety, innovation, competitiveness, and data privacy and security. Transport Canada, the Standing Senate Committee on Transport and Communications, and the Canadian Council of Motor Transport Administrators have also released a series of guidelines and policy documents for the safe testing and deployment of automated vehicles in Canada including:

- **Driving Change: Technology and the future of the automated vehicle** that outlines the regulatory and technical issues related to the deployment of CAVs[61].
- **Canadian Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles** that provides a series of considerations and recommendations that support Canadian jurisdictions in their planning and rollout of CAVs[62].
- **Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations** that highlights Canada as a destination for research and development, clarifies the role of each level of government for CAV trials, and establishes minimum safety requirements for trial organizations operating in Canada[63].

[60] Same as previous.
[61] Canada. Parliament. Senate. Standing Committee on Transport and Communications. Driving Change: Technology and the Future of the Automated Vehicle. 2018. P.29. Available from: https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf
[62] CCMTA. Canadian Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles. 2018-06. Available from: https://ccmta.ca/web/default/files/PDF/CCMTA-AVGuidelines-sm.pdf
[63] Transport Canada. Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations [Internet]. 2018-06. Available from: https://tc.canada.ca/sites/default/files/migrated/19_ah_01_automated_vehicles_layout_en_r13.pdf

- **Safety Assessment for Automated Driving Systems in Canada** that is a voluntary tool to help CAV developers review safety of vehicles equipped with SAE Levels 3-5 features which they intend to manufacture, import, operate, and/or sell in Canada[64].
- **Canada's Safety Framework for Automated and Connected Vehicles** that informs stakeholders of Transport Canada's safety-focused approach to CAVs and sets a stable policy direction for safe deployment on Canada's roads[65].

Further, Transport Canada is leading the way to enhance the privacy and security of CAVs through a 2019 contract award to ESCRYPT valued up to $1.3 million to advance the development of a Canadian Security Credential Management System (SCMS) for CAVs[66].

The ESCRYPT project with Transport Canada sees connected infrastructure and vehicles as a means to improve the safety and efficiency of road transportation by enabling vehicles to communicate with smart infrastructure (e.g. traffic signals, rail crossings, traffic signs, etc.) and other road users (e.g. pedestrians, motorcyclists, cyclists, etc.) in a secure manner.

Potential applications of the SCMS include:

- Traffic signal priority for emergency response vehicles, like ambulances, police, and fire trucks.
- Real-time road condition advisories to warn drivers about potential hazards, like slippery surfaces, accidents, or construction.
- Warnings to advise commercial truck drivers about bicyclists, pedestrians, and motorcyclists.

The SCMS will help ensure that communications are secure and can be trusted. The SCMS incorporates privacy-by-design principles and enables communication without revealing personal information about the vehicle or the driver.

[64] Transport Canada. Safety Assessment for Automated Driving Systems in Canada. 2019-01. Available from: https://publications.gc.ca/collections/collection_2019/tc/T86-52-2018-eng.pdf
[65] Transport Canada. Canada's Safety Framework for Automated and Connected Vehicles. 2019-02. Available from: https://tc.canada.ca/sites/default/files/2020-05/tc_safety_framework_for_acv-s.pdf
[66] Transport Canada. Transport Canada awards contract to ESCRYPT to enhance the privacy and security of connected vehicles. 2019-03-14. Available from: https://www.canada.ca/en/transport-canada/news/2019/03/transport-canada-awards-contract-to-escrypt-to-enhance-the-privacy-and-security-of-connected-vehicles.html

As part of the contract, ESCRYPT is responsible for developing Canadian requirements for the system and recommending an operational model for how the technology may be deployed in Canada.

3.2 ACADEMIA AND RESEARCH

Southern Ontario is home to a wide range of developments in the CAV technology space. Networks among industry, local governments, academic institutions, and research organizations have created an environment in which to learn from one another and grow the next generation of advanced vehicle technologies and services. This network provides an opportunity for the City of London to support and help foster an area that can contribute lessons learned to the successful deployment of CAV technology.

3.2.1 FANSHAWE COLLEGE

Fanshawe College has comprehensive programs serving the greater London region by providing flexible learning arrangements and experiential education opportunities developed in response to labour market needs including the automotive industry[67]. In addition to their more conventional programs, Fanshawe College has other assets to help support the emergence of CAV technologies in cooperation with industry.

Fanshawe College has product testing areas using leading-edge technologies and equipment to help manufacturers discover problems early in the design cycle, which help prevent potential field issues. The creation of realistic, custom test protocols based on the application enables better predictions of product behaviour versus more traditional “test to failure” protocols. Designs are reviewed based on test results and recommendations made for areas of product improvement to ensure product quality[68]. Product testing areas include performance, thermal, mechanical, electrical, and environmental testing regiments.

[67] Fanshawe College. About Fanshawe. 2022. Available from: https://www.fanshawec.ca/about-fanshawe
[68] Fanshawe College. Product Testing. 2022. Available from: https://www.fanshawec.ca/cts/partners/product-testing

In additional, Fanshawe College has an entrepreneur centre, known as Leap Junction. Leap Junction provides services including the following [69]:

- Support start-ups with one-on-one business analysis and mentorship.
- Create and host entrepreneurial-focused workshops, pitch competitions, retail opportunities, and events geared towards networking and skill development.
- Provide co-working space and meeting rooms for clients.
- Act as a link for students and youth to access investors, industry, and other stakeholders in London.
- Integrate entrepreneurial activities into the local community and work with a vibrant ecosystem that supports local entrepreneurs.
- Summer incubator which provides seed funding, mentorship, programming, and co-working space.

3.2.2 NATIONAL RESEARCH COUNCIL (NRC) CANADA

The National Research Council (NRC) has a major research facility located here in London, Ontario and is, in part, engaged in Intelligent Mobility Research. Research activities include advanced driver assistance systems (ADAS), simulation and testing of automated driving hardware and software, 3D simultaneous localization and mapping, and image data classification. Intelligent Transportation System (ITS) research themes primarily focus on connected infrastructure including cybersecurity for vehicles and critical infrastructure, “smart” roads and corridors, Internet-of-Things (IoT) for transportation using V2X technologies, and intelligent systems for the movement of people and goods.

3.2.3 WESTERN UNIVERSITY

Western University is the local, major university within the London area and boasts several research and program areas related to CAV technologies that could be leveraged as CAVs emerge.

[69] Leap Junction. What is Leap Junction? 2022. Available from: https://www.leapjunction.ca/about-leap-junction

These include various relevant departments and research centres such as[70]:

- Fraunhofer Project Centre;
- Institute for Chemicals and Fuels from Alternative Sources (ICFAR);
- Particle Technology Research Centre; and
- Surface Science Western.

Further, Western University has automotive and mobility focus areas and capabilities such as[71]:

- Information engineering research and training;
- Wireless networks and cooperative communications;
- Modern data analysis and processing;
- Cybersecurity;
- Lightweight composite materials development and testing;
- Automotive paint properties, defects, and adherence;
- Advanced coatings and powders;
- Corrosion prevention and modelling; and
- Fuel cells and lithium-ion batteries.

[70] OVIN. Ecosystem Map. 2022. Available from: https://www.ovinhub.ca/ecosystem/ecosystem-map/
[71] Same as previous.

3.3 ECONOMIC DEVELOPMENT, ENTREPRENEURIAL ACCELERATORS, AND INDUSTRY

The development of CAV technology is generally occurring within three different groups of industry entities:

- **Original Equipment Manufacturers (OEMs)** including large automobile manufacturers and part suppliers;
- **New entrants and non-OEM companies** developing their own suite of CAV technology to design vehicles for deployment in a fleet context; and
- **Technology, telecommunications, and logistics companies** such as Amazon, Apple, Google, and others.

These efforts by OEMs, non-OEMs, technology, logistics firms, etc. represent an investment shift within the automotive industry to a focus more on software and services.

Although essential sensor hardware has decreased in cost, CAV technology is still relatively costly for individual consumers and is unlikely to see mass commercialization in the near term. Some companies have already begun to reposition themselves as mobility providers by making large investments and laying the groundwork for developing – and eventually deploying – their own CAV fleets.

Further, economic development organizations and entrepreneurial accelerators play key roles in supporting new industry players to develop a variety of CAV technologies.

3.3.1 ONTARIO VEHICLE INNOVATION NETWORK (OVIN)

The Ontario Vehicle Innovation Network (OVIN) is a Government of Ontario initiative, delivered through the Ontario Centre of Innovation (OCI). A key aspect of Ontario's automation plan, OVIN works to support subject matter experts, post-secondary institutions, and other industry stakeholders to commercialize new products and services in the automotive and transportation sector and support Ontario's readiness for the adoption and deployment of these technologies[72].

OVIN is comprised of funding programs, technology development sites, and a technology demonstration zone in Stratford, Ontario where CAV companies can test,

[72] WSP. Ontario CAV Ecosystem Analysis. 2019-04. Available from: https://www.ovinhub.ca/wp-content/uploads/2021/04/avin-ecosystem-analysis-final-report-2019.pdf

validate, and showcase their products. The technology development sites enable small and medium sized enterprises to develop, prototype, and validate new technologies, access specialized equipment (i.e. hardware and software), and obtain business and technical advice.

There are six OVIN technology development sites across Ontario (see **Figure 5**) to support the development of new technologies in their own unique area of focus[73]:

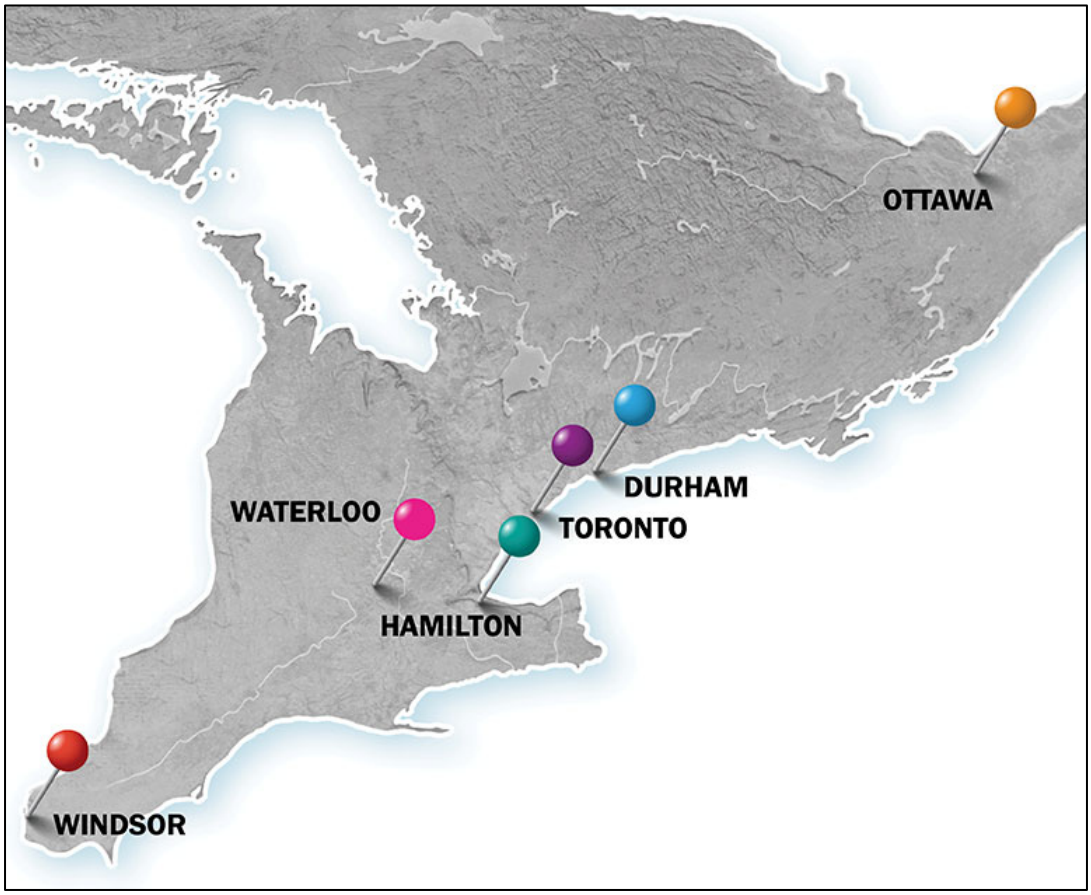
- **Durham Region:** Human Machine Interface (HMI) and User Experience;
- **Hamilton Region:** Multimodal and Integrated Mobility;
- **Ottawa Region:** Vehicle-to-Everything (V2X) Communications;
- **Toronto Region:** Artificial Intelligence (AI) for CAVs;
- **Waterloo Region:** High-Definition (HD) 3D Mapping and Localization; and
- **Windsor-Essex Region:** Cross-Border Technologies and Cybersecurity.

In Ontario, industry members range from Small-to-Medium Enterprises to large Multi-National Enterprises. The province has a well-established automotive and technology sector and has welcomed CAV development in a variety of forms[74].

The start-up space has experienced strong growth in recent years under OVIN with companies developing technologies in many aspects of the CAV sector. More recent examples of companies to watch in 2021 include AutoGuardian by SmartCone, LeddarTech, Sensor Cortek, Untether AI, Waabi, and more[75]. Further, London's proximity to automotive hubs (e.g. Windsor), technology hubs (e.g. Waterloo Region), artificial intelligence hubs (e.g. Toronto), and leveraging local industry potential (e.g. 3M, Brose Canada Inc., Leggett and Platt, etc.) give our community a unique opportunity to be at a crossroads of these hubs and the potential to contribute to their advancement.

[73] OVIN. Ontario's ecosystem. 2022. Available from: https://www.ovinhub.ca/ecosystem/
[74] OVIN. Ecosystem Map. 2022. Available from: https://www.ovinhub.ca/ecosystem-map/
[75] Invest in Ontario. 10 Self-driving companies to watch in 2021. 2021-09-22. Available from: https://www.investontario.ca/spotlights/10-self-driving-vehicle-companies-watch-2021

Figure 5: OVIN Technology Development Sites



Further, Ecopia received nearly $1 million through OVIN to match an industry contribution of over $2 million to develop a high-definition (HD) map for the City of Toronto that will be leveraged to accelerate the deployment of CAVs. This initiative strives to lay the foundation for a digital twin of the City of Toronto. This HD Map of Toronto will serve as a testbed for CAV applications and puts Ontario at the forefront of next-generation transportation systems[76].

[76] Ecopia. Ecopia AI Creates HD Map of Toronto for Autonomous Vehicles through Partnership with Government of Ontario. 2021-08-12. Available from: https://www.ecopiatech.com/news-post/ecopia-ai-creates-hd-map-of-toronto-for-autonomous-vehicles-through-partnership-with-government-of-ontario

3.3.2 ONTARIO CENTRES OF INNOVATION (OCI)

The Ontario Centre of Innovation (OCI) brings together industry, academic, and government stakeholders across Southern Ontario to capitalize on the economic opportunities of CAVs while supporting the province's transportation systems and infrastructure to adapt to these emerging technologies through the OVIN[77]. Specifically, OCI supports the commercialization of academic intellectual property, industry-academic collaborations, and the development of emerging technologies. This includes overseeing the execution of advanced technology platforms, as well as supporting and investing in early-stage projects with a probability for commercial success and return on investment[78].

3.3.3 MUNICIPAL ALLIANCE FOR CONNECTED AND AUTONOMOUS VEHICLES IN ONTARIO (MACAVO)

In late-2016, the Good Roads established the Municipal Alliance for Connected and Autonomous Vehicles in Ontario (MACAVO). The purpose of MACAVO is to provide a forum for municipal and regional staff to collaborate on research, facilitate vehicle testing with industry and academics, and share resources and knowledge on integrating connected, automated, and autonomous vehicles into municipal operations. As of mid-2019, MACAVO had over 80 participating municipalities across Ontario including the City of London.

MACAVO continues working with municipalities to identify and create a seamless, coordinated Preferred CAV Testing Corridor from Windsor to Ottawa[79]. The objective of this initiative – the first municipal coordination of its kind in the world – is to attract and retain talent within Ontario while working in partnership with private corporations, testing critical infrastructure technologies along the preferred corridor and working directly with CAV stakeholder groups to find innovative solutions to problems.

[77] OCI. Ontario Vehicle Innvation Network (OVIN). 2022. Available from: https://www.oc-innovation.ca/programs/ontario-vehicle-innovation-network-ovin/
[78] OCI. About. 2022. Available from: https://www.oc-innovation.ca/about/
[79] Good Roads. Municipal Alliance for Connected and Autonomous Vehicles in Ontario (MACAVO). 2022. Available from: https://goodroads.ca/technical-solutions/macavo/

3.3.4 CANADIAN AUTOMATED VEHICLES CENTRE OF EXCELLENCE (CAVCOE)

The Canadian Automated Vehicles Centre of Excellence (CAVCOE) provides consulting services, analyses, and recommendations to all stakeholders who are involved in the deployment of CAVs, or who will be impacted by their arrival. Stakeholders served include government, public sector agencies, private sectors companies, and industry associations. CAVCOE's expertise is on how CAVs will impact operational, business, and revenue models, allowing the organization to assist in the development of policies, strategies, and plans for CAVs as well as identify potential business models or strategies that can maximize benefits and mitigate consequences from CAV deployment[80].

3.3.5 CANADIAN URBAN TRANSIT RESEARCH AND INNOVATION CONSORTIUMN (CUTRIC)

The Canadian Urban Transit Research and Innovation Consortium (CUTRIC) supports projects that develop the next generation of mobility and transportation technologies for Canadians. These technologies help advance Canada's low-carbon and "smart" technology sectors, supporting job growth and economic development over the long term. CUTRIC's National Smart Vehicle Demonstration and Integration Trial plans to integrate semi-automated and (eventually) fully automated, connected, and electric vehicle shuttles, pods, and buses across up to 12 Canadian municipal jurisdictions as first-and-last mile applications[81]. The primary project objectives are the development of standards for V2V and V2I communication protocols, electric low-speed CAV shuttle (e-LSA) manufacturer equipment, and cybersecurity protocols[82].

The Zero Emission Transit Fund, announced in August 2021, includes $2.75 billion in funding over five years to support public transit and school bus operators' plan for electrification, support the purchase of zero emission buses (ZEBs) and build supporting infrastructure, including charging infrastructure and facility upgrades. This investment is being made in coordination with the Canada Infrastructure Bank's commitment to invest in zero-emission buses as part of its three-year Growth Plan[83]. The London Transit

[80] CAVCOE. Canadian Urban Transit Research and Innovation Consortium. 2022. Available from: https://www.cavcoe.com/
[81] CUTRIC. Automated and Connected Electric Vehicle Integration: Optimization Analysis & Techno-Economic Predictive Analysis. 2022. Available from: https://cutric-crituc.org/funded-projects/automated-and-connected-electric-vehicle-integration-optimization-analysis-techno-economic-predictive-analysis/
[82] CUTRIC. National Smart Vehicle Demonstration and Integration Trial. 2019. Available from: https://uttri.utoronto.ca/files/2019/05/UTTRI_April-26_KristyMlakar_Shareable-compressed.pdf
[83] CUTRIC. Canada's Zero Emission Transit Fund. 2021. Available from: https://cutric-crituc.org/zero-emission-transit-fund/

Commission (LTC) has engaged CUTRIC's Zero-Emission Bus Consulting Services to plan and implement its transit electrification strategy[84].

3.3.6 MARS DISCOVERY DISTRICT

The MaRS Discovery District provides a range of services from connections to talent, capital, and customers, to advisory services, and more. MaRS supports over 1,200 Canadian science and tech companies by providing them with tailored resources at every stage of their growth. The MaRS Solutions Lab works with Canadian cities to develop solutions for a range of complex challenges. This is done through three main service offerings – innovation labs, innovation procurement, and learning-by-doing. MaRS has produced several reports and provided support for the development of the future of cities – including involvement in OVIN, and research on CAVs, data interoperability, and the sharing economy[85].

3.3.7 LONDON CHAMBER OF COMMERCE

The London Chamber of Commerce is a politically independent, membership based, volunteer driven, not-for-profit organization whose mission is to lead and serve the London business community. The Chamber offers insightful and meaningful policy contributions, leading initiatives that positively influence London's social and economic landscape.

The Chamber facilitates opportunities for member businesses to promote themselves locally and regionally, do business with one another, enjoy savings and value through benefit programs, and gain knowledge through dozens of events and seminars each year. These events range from networking events such as quarterly speed networking events, monthly Business After Five events, Business between Business networking groups, annual Past President's Golf Tournament, annual Mayor's State of the City Address, annual Summit event, assorted seminars, special speaker events, and recognition events like the Business Achievement Awards gala[86].

[84] CUTRIC. London Transit Engages CUTRIC to Guide Zero-Emission Bus Rollout. 2021-04-29. Available from: https://cutric-crituc.org/news/london-transit-engages-cutric-to-guide-zero-emission-bus-rollout/
[85] MaRS Discovery District. MaRS. 2019. Available from: https://www.marsdd.com/
[86] London Chamber of Commerce. About the London Chamber of Commerce. 2022. Available from: https://www.londonchamber.com/about-us

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3.3.8 LONDON ECONOMIC DEVELOPMENT CORPORATION (LEDC)

The London Economic Development Corporation (LEDC) provides free economic development services to existing companies and foreign companies across five key sectors including food processing, manufacturing, digital media and tech, professional services, and health[87].

The LEDC provides leadership in the following areas:

- Attracting new business and foreign direct investment to London;
- Retaining existing business and assisting with local expansions;
- Advocating for improving the business environment in London;
- Providing workforce development leadership to connect businesses with education institutes and employment sector agencies;
- Marketing and promoting London for business opportunities in overseas markets;
- Establishing business support partnerships throughout the community; and
- Developing strategic plans.

3.3.9 TECHALLIANCE

TechAlliance supports Ontario's most promising start-ups and fastest growing tech companies, empowering world-class ventures that fuel growth in Canada's innovation economy. We champion and coach entrepreneurs and amplify businesses to foster a vibrant technology community. In pursuit of creating spaces where innovation thrives, TechAlliance engages with tech talent, industry leaders, and founders to drive economic prosperity and support the region's ventures to advance London's growing innovation economy[88].

[87] LEDC. About. 2022. Available from: https://www.ledc.com/about
[88] TechAlliance. Home. 2022. Available from: https://techalliance.ca/

4 PUBLIC OPINION

Public opinion on the arrival of any new, disruptive technology is challenging to understand and measure. In the case of disruptive innovations, individuals have no previous experience on which to base their expectations and opinions can be greatly influenced by marketing and advertising (especially during the early stages of adoption) as well as word-of-mouth among peers and broader social networks.

Despite research efforts in other jurisdictions – including the Greater Toronto and Hamilton Area (GTHA) – public opinion on the use of CAV technologies is still preliminary as most individuals are currently unlikely to have first-hand experience with more fully automated driving features (i.e. SAE Levels 4 and 5). Therefore, it is likely that public opinion will shift in attitudes towards CAV technologies as they emerge and become more prevalent in the coming decades.

More research and understanding is required on this topic and the potential, future educational approaches to help the public better understand CAV technologies.

4.1 GENERAL

A 2018 study from the University of Memphis found that, in general, the more barriers a person perceives around CAVs, the farther into the future they are likely to estimate both the availability of the technology and their willingness to adopt it[89]. Perceived negative impacts of CAV adoption include practicalities (e.g. inadequate infrastructure, perceived low value-to-cost ratio, safety concerns, etc.) and psychological barriers (e.g. disruption of routines and norms, perceptions and beliefs associated with the product, loss of control over driving, etc.). Perceived benefits include travel time and cost, social image among peers, environmental impacts, and greater mobility for those with mobility challenges. Taken together, these factors mean that public opinion regarding CAVs can be difficult to accurately measure at this time.

A study from the World Economic Forum and the Boston Consulting Group shows that willingness to adopt CAV technology varies depending on demographic factors and built environment factors (e.g. neighbourhood type, traffic, density of mass transit, etc.). Residents of countries with a strong, established car culture had the lowest level of

[89] Talebian A, Mishra S. Predicting the Adoption of Connected Autonomous Vehicles: A New Approach based on the Theory of Diffusion of Innovations. Transportation Research Part C: Emerging Technologies. 2018;95(August):363–80. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0968090X18307939

acceptance of CAV adoption, while residents of countries with rapidly developing economies with higher levels of congestion were most likely to accept CAVs[90].

An Emerging Transportation Technology (ETT) survey revealed that, in general, a high percentage of people have reservations about CAV technologies in reducing collisions. Further, some preferred owning lower-level CAVs (i.e. SAE Level 3 or lower) even though they trusted higher level CAVs to prevent collisions. The post-survey interview revealed this is because people viewed current CAV technology as not having undergone enough testing for general driving. Additionally, negative media reports were found to have exacerbated their discomfort and provoked fears about CAV technologies[91].

However, the results also showed that people were not only more comfortable with owning vehicles at higher CAV levels, but also more trustful of them in reducing the likelihood of a collision as their understanding about CAV technologies increased. These findings highlight the value of increasing public understanding of CAVs through a variety of education and training channels.

4.2 GTHA SURVEY RESULTS

In 2016, the City of Toronto partnered with Metrolinx to support a public opinion survey conducted by Toronto Metropolitan University's (TMU's) School of Urban and Regional Planning. The survey was intended to provide a base level of understanding around public support for CAVs and potential behaviour change associated with the adoption of CAVs. TMU re-administered this survey in 2018 with 3,200 residents of the Greater Toronto and Hamilton Area (GTHA) and added questions to reflect an updated context [92].

[90] World Economic Forum and the Boston Consulting Group. Reshaping Urban Mobility with Autonomous Vehicles: Lessons from the City of Boston. 2018-06. Available from: https://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf
[91] Kim W, Kelley-Baker T, Yang CYD. Public Understanding, Comfort, and Trust of Automated Vehicles. ITE Journal, Vol. 94, No. 1. 2021. P. 43. Available from: https://www.ite.org/ITEORG/assets/File/ITEJ%20Published/2021/ITE_ITE_Jan2021.pdf
[92] Olsen T, Laidlaw K, Sweet M. Automated Vehicles in the Greater Toronto and Hamilton Area: Overview from a 2016 Consumer Survey. Prepared for Metrolinx and the City of Toronto. 2018-03-09. Available from: https://transformlab.torontomu.ca/wp-content/uploads/2018/03/Laidlaw_Sweet_Olsen_Report3_scenarios_20180309.pdf

4.2.1 AUTOMATED VEHICLE ANTICIPATED ARRIVAL

Respondents were asked to anticipate when certain CAV milestones would take place and were asked the following:

Do you expect driverless cars to ever be available for use or purchase in Toronto at any time in the future?

- Approximately one-third of respondents (31.7%) answered "no." The remaining two-thirds (68.3%) who answered "yes" were asked three further questions and to select what year they expected it to become a reality.

There is a high degree of alignment between public expectations and expert forecasts, in the short-term horizon. On average, GTHA residents predicted they might be able to ride in a driverless car by 2025. Estimates for events occurring farther in the future are bound to be subject to a higher margin of error. With that in mind, looking to the market saturation of CAVs, where most vehicles in the GTHA would be CAVs, the public was slightly more optimistic in projecting 2035 compared to many industry experts, who forecast this may occur by the 2050s. Similarly, the public anticipates that human driving will be relegated to a hobby by 2040, which is more optimistic than expert forecasts.

4.2.2 KEY FINDINGS

Other key findings from the 2018 survey include:

What benefits and consequences do respondents expect from CAVs?

- Respondents (63.9%) expected distracted and impaired driving would be reduced because of CAVs.
- Of the potential impacts of CAVs, respondents were most unsure or neutral (49.4%) regarding the impacts on hacking and cybersecurity.
- Data privacy was cited by almost a third (31.8%) of respondents as being the most negatively impacted.

How might respondents' travel behaviour change, should CAVs be available?

- There is significant variation in CAV interest amongst consumers. While interest in CAVs remained largely the same between 2016 and 2018 (i.e. 48% vs. 52%), more respondents indicated they would be willing to pay more for a fully driverless vehicle in 2018 (48%) than in 2016 (25%).
- Younger respondents were significantly more interested (63%) in using CAVs than older respondents (i.e. aged 35-55: 47%; aged 55 and over: 35%).
- Many respondents did consider changes in their travel behaviour if CAVs became commercially available:
    - In 2018, approximately one-third of respondents indicated interest in extending their commutes if they did not have to drive, down from two-thirds in 2016.
    - When asked if respondents were willing to ride different forms of public transit (including small shuttle bus, regular-sized or articulated bus, streetcar, light rail train, subway train, commuter train) should they be driverless, willingness ranged from 50.4% for light rail and subway trains, to 37.9% for regular-sized buses, and 44.1% for shuttles.
    - Although not specific to CAVs, 20% more respondents had indicated that they had used ride-hailing services in 2018 (44.3%) compared to 2016 (24.9%).

How do CAVs relate to respondents' public policy priorities?

- Like 2016, half of all 2018 respondents (50%) indicated that the government should monitor the implementation of CAVs.
- A quarter of respondents reported that they were aware of provincial and municipal CAV planning initiatives.
- Road safety was most the most highly supported policy objective (81.3%) followed by unobstructed movement of emergency vehicles and better traffic management.

Overall, TMU researchers summarized their findings in that most consumers are still learning about CAV technology and ongoing CAV planning initiatives; and, largely due to an uncertain value proposition and evolving understanding about the technology, most consumers are reluctant to commit to using CAVs.

4.3 INITIAL LONDON PUBLIC CONSULTATION

Between December 18, 2019 and February 21, 2020 during the City's initial public consultation period, Londoners were asked three key questions regarding the arrival of CAVs in our neighbourhoods and roadways. During this period, 236 Londoners contributed to the conversation in the initial public feedback phase in the development of this Connected and Automated Vehicle Plan.

Further public consultation will be engaged in during the draft review stage of this Connected and Automated Vehicle Plan.

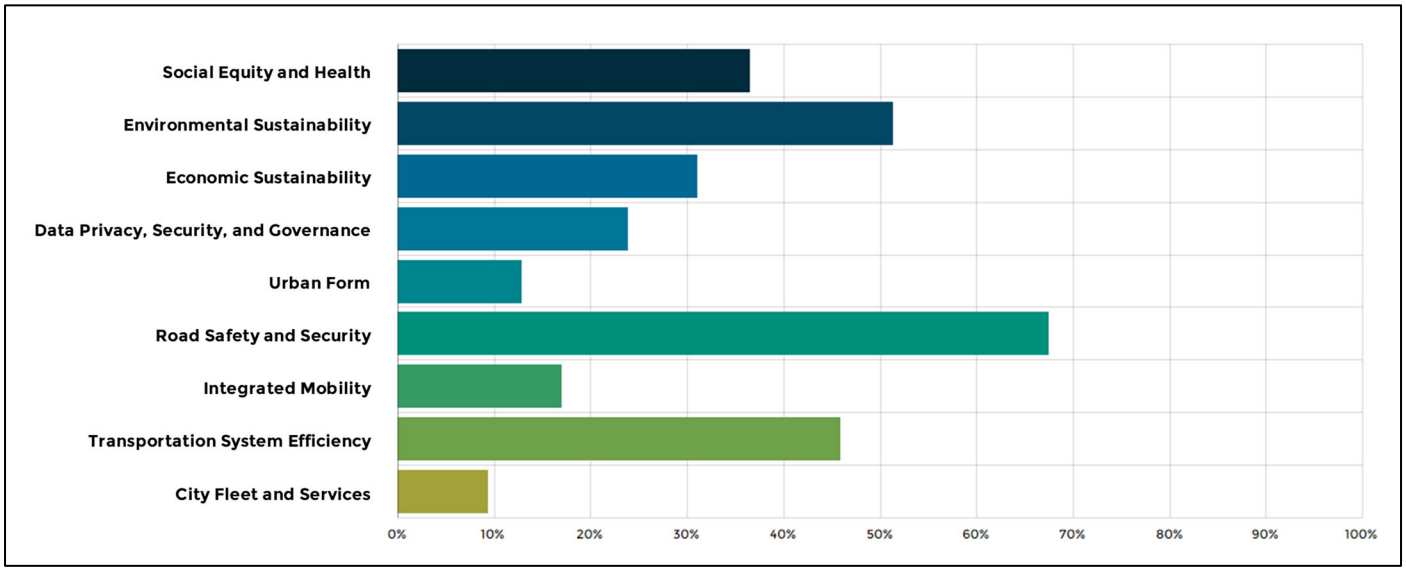
4.3.1 KEY STRATEGIC AREAS OF FOCUS

Identify the Top 3 Strategic Areas of Focus that are most important to you.

- While all Strategic Areas of Focus are important to the Strategic Plan in the preparation for the arrival of CAVs, the three key areas that were identified by more than 40% of survey respondents were **Roadway Safety and Security**, **Environmental Sustainability**, and **Transportation System Efficiency**.

More information on the Strategic Areas of Focus is detailed in **Part II: Detailed Actions** of this Connected and Automated Vehicle Plan as shown in **Figure 6**.

Figure 6: Key Interest in London Strategic Areas of Focus



It should be noted that in the further development of this plan since the initial 2020 public survey, the **Integrated Mobility** and **Transportation System Efficiency** sections have been combined into the new **Mobility Integration and Efficiency** section and the **Urban Form** section has been expanded to include **Land Use and Urban From**.

4.3.2 PREPARING FOR CAVS

What should the City of London do to prepare for the arrival of Connected and Automated Vehicles?

- Top preparation answers for CAVs included providing educational programs for the public (19%), performing more studies and testing on CAVs (19%), improving existing infrastructure (e.g. cycling, transit, street design, traffic signals, etc.) to prepare for CAVs (14%), and ensuring EV charging stations are more readily available for CAVs (13%).

4.3.3 CONCERNS ABOUT CAVS

What are your biggest concerns with the arrival of Connected and Automated Vehicles in London?

- Safety concerns regarding CAVs and their interactions with vulnerable road users including pedestrians, cyclists, and those with mobility aids and people abusing the use of CAVs (29%).
- Privacy and security concerns including computer glitches and cybersecurity (12%).
- Congestion concerns that CAVs will be largely single occupancy or zero occupancy and contribute to increased traffic, higher emissions, and less people cycling or walking (8%).
- Operational concerns that CAVs will respond poorly to bad weather, missing road signs, faded lane markings, construction, and emergency vehicles passing (8%).
- Liability concerns over who should be held responsible for collisions involving CAVs (6%).
- Other noteworthy concerns (less than 5% of respondents) included ensuring that public transportation still has a human operator present to allay safety concerns, that CAVs will have a negative impact and should be completely banned, and job loss impacts as CAVs impact the economy.

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Prepared by the Corporation of the City of London
September 2022

Connected and Automated Vehicle Plan

Part II: Detailed Actions DRAFT

Prepared by the Corporation of the City of London
September 2022

London CANADA

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ACKNOWLEDGEMENTS

The City of London wishes to acknowledge the following individuals and organizations that contributed to the development of this Connected and Automated Vehicle Plan:

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x

DISCLAIMER

The Connected and Automated Vehicle Plan was developed through collective input from variety of public and private agency stakeholders. Information was gathered through research, discussions, and presentations. The report does not necessarily reflect the views or opinions of any single agency discussed herein.

INTRODUCTION

Connected and Automated Vehicles (CAVs) are driverless or self-driving vehicles that can detect the surrounding environment using artificial intelligence (AI), a variety of sensors, connected networks, and a global positioning system (GPS) coordinates among other means to navigate a mobility network successfully and safely with little or no human input.

These vehicles can be broken down into two primary components[1]:

Automated Vehicles

These vehicles make use of sensors and computer analytics to assess their environment and perform varying degrees of driving tasks. There are five levels of automation that range from driver-assistance systems that can help with steering to fully automated, self-driving vehicles in which passengers need pay no attention to the road.

Connected Vehicles

For connected vehicles, there are two types of connected technologies: consumer convenience and infotainment, and vehicle-to-vehicle and vehicle-to-infrastructure communications. Practical examples of this technology could include, your car receiving restaurant recommendations for a given route, getting a countdown for when the next traffic light is turning red, or having the car ahead of you provide a warning that you are following too closely.

For the purposes of this plan, both Automated Vehicles and Connected Vehicles are considered integral with one another, meaning that while automated and connected technologies can operate independently of one another, they are often integrated together in how they operate on a practical level. Therefore, they are referred to jointly as Connected and Automated Vehicles or CAVs for short in this plan.

A more detailed definition of Connected and Automated Vehicles and their importance in the London context can be found in the **Part I: Background** document of this plan. This document, **Part II: Detailed Actions** provides the core actions of the CAV Plan.

[1] Canada. Parliament. Senate. Standing Committee on Transport and Communications. Driving Change: Technology and the Future of the Automated Vehicle. 2018. P.29. Available from: https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf

PURPOSE, VISION, MISSION, AND VALUES

The Purpose, Vision, Mission, and Values are the guiding framework for the Connected and Automated Vehicle Plan and the detailed actions within it. Through internal consultation, the Purpose, Vision, Mission, and Values were adopted by the City's internal working group on December 12, 2019 as follows:

PURPOSE **Why?**	To better understand and prepare for the introduction of connected and automated vehicles in our community to improve the lives of our citizens and minimize the environmental impact of this technology as it becomes more commonplace.
VISION **What?**	A sustainable community that integrates connected and automated vehicles into city-building and daily activities by pursuing improved safety, environmental stewardship, and travel mobility options.
MISSION **How?**	To engage internal and external stakeholders, identify potential implications of connected and automated vehicles, and provide a plan and actions that will proactively prepare for the introduction of connected and automated vehicles.
VALUES	• Alignment with the 2019-2023 Strategic Plan for the City of London • Alignment with the London Plan • Climate Emergency Action Plan • Driven by Community • Human Health and Community Safety • Information Security and Privacy • Integrated Mobility • Proactive Leadership • Responsible Governance • Social Equity • Stakeholder Collaboration • Supporting Innovation

STRATEGIC AREAS OF FOCUS

Initial, "living" Strategic Areas of Focus (SAFs) were developed through the internal City working group as initial guideposts to spur discussion in the development of the Connected and Automated Vehicle (CAV) Plan. The final SAFs constitute the core detailed actions of the CAV Plan as detailed in this document volume.

1. Road Safety and Security

The City will encourage the adoption of CAVs that are supportive of improved road safety. A net benefit to road safety will be achieved through actions that focus on protecting vulnerable users, preventing collisions, updating infrastructure, and improving emergency response. Actions will address both the knowns and unknowns of CAVs and will look at the ideal policies, technology, standards, and training required to achieve improved safety.

1.1 Prevent Collisions

1.2 Update Infrastructure

1.3 Update Emergency Response

2. Mobility Integration and Efficiency

The City will incorporate CAV technology and encourage its adoption within the City's mobility network. Increased infrastructure efficiency will be achieved through an enhanced ability to manage traffic in real-time, allowing individual mobility needs to be served at any given time.

2.1 Increased Space Efficiency

2.2 Design Complete Streets

2.3 Increase System Integration

2.4 Urban Goods Movement

2.5 Mobility Network Efficiency and Performance

2.6 Transportation Demand Management

3. Environmental Sustainability

The City will encourage the adoption of CAVs in a manner that incentivizes environmental sustainability across a vehicle's entire lifecycle. Reducing vehicle emissions and waste through incentivizing or promoting zero emission vehicles and sustainable use practices

3.1 Reduce Vehicle Emissions

3.2 Reduce Vehicle Waste

4. Social Equity and Health

The City will encourage the adoption of CAVs in a manner that improves accessibility, social equity, and prioritizes health and safety for all Londoners.

4.1 Ensure Barrier Free Access for All

4.2 Increase Mobility Equity

4.3 Promote Health and Safety

5. Data Privacy, Security, and Governance

The City will support and enhance data privacy and transportation network security with a particular focus on the City's collection and use of information generated by CAVs and related systems where authorized by law. Actions will focus on protecting privacy and security through policy and by-law, providing oversight and evaluation, and incorporating privacy principles into any potential collection and use of information generated by CAVs. Further, data gathered should be used to inform the implementation and evaluation of this plan and to improve how the City delivers services.

5.1 Protect Public Privacy

5.2 Business Intelligence

6. Land Use and Urban Form

The City will plan for the potential impacts and implications of CAVs in the context of sustainable urban form, land use, growth, development, placemaking, and the approved London Plan.

6.1 Integrate CAV Infrastructure Elements with Land Use

6.2 Protect Urban Structure Integrity

6.3 Resilient CAV Policy Development and Implementation

6.4 Reclaim Surplus Land

7. Economic Sustainability

The City will support and enhance sectors related to the development and use of both CAVs and associated technology, with a particular focus on retaining and attracting industries, investment, and employment. Actions related to Economic Sustainability will aim to expand London's regional position as it relates to CAVs.

7.1 Develop a Top-Quality Workforce

7.2 Attract New Jobs and Investments

7.3 Create a Supportive and Thriving Environment

8. City Fleet and Services

The City will enhance its fleet and services through CAVs and related systems for the purpose of improving safety and public service delivery. Actions will evaluate the transformation of fleet vehicles and City services as well as potential impacts to employment and labour needs.

8.1 City Services and Fleet Vehicles

8.2 Future-Proofing

8.3 People Services and Labour

The detailed actions in the subsequent sections are the core of the Connected and Automated Vehicle Plan and further expand upon the eight Strategic Areas of Focus defined in the previous section. Each area is accompanied by the sub-areas breaking down their specific focus and further expanded upon with specific actions and explainers, detailing the general scope of each action.

These actions will need to be further developed as part of a future Implementation Plan resulting from this Connected and Automated Vehicle Plan. Specific background Guiding Principles and Strategies referenced in the development of this plan can be found in **Appendix A** of this document.

1 ROAD SAFETY AND SECURITY

The City will encourage the adoption of CAVs that are supportive of improved road safety. A net benefit to road safety will be achieved through actions that focus on protecting vulnerable users, preventing collisions, updating infrastructure, and improving emergency response. Actions will address both the knowns and unknowns of CAVs and will look at the ideal policies, technology, standards, and training required to achieve improved safety.

Most fatalities and serious injuries on Canada's roads are preventable with approximately 94% of serious collisions due at least in part to human error[2], such as paying insufficient attention to road conditions. In light of this, the City has committed to Vizion Zero, a bold vision of reducing all traffic-related deaths and injuries to zero[3].

If in the future, when higher-level CAVs become widely adopted, there is the potential to experience significant reductions in the number of collisions on Canadian roads. Longer term, it has been suggested that when CAVs make up at least three-quarters of vehicles on the road, there may be a dramatic reduction in traffic injuries and fatalities[4].

In the near term, newer base model vehicles have begun to include features such as lane-keeping, automatic braking, and blind spot detection which help identify safety risks that can assist drivers in avoiding a collision[5]. Other vehicles (i.e. CAV Level 2-3) have highway pilot features which allow the driver to give up control of steering and braking under certain conditions while the driver supervises, ready to take over when needed. However, there is always the risk that drivers will become distracted when they need to pay attention and overestimate the abilities of CAV technologies which are very much still under development.

Improved road safety and security will be highly dependant on these CAV technological advancements and the way in which drivers choose to use them.

[2] Canada. Parliament. Senate. Standing Committee on Transport and Communications. Driving Change: Technology and the Future of the Automated Vehicle. 2018. P.29. Available from: https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf
[3] https://london.ca/roadsafety
[4] Ticoll D. Harnessing the mobility revolution to build the Canada that we want. Written evidence submitted Senate Standing Committee on Transport and Communications on April 11; 2017.
[5] United States. National Highway Traffic Safety Administration. Automated Vehicles for Safety.

Table 1: Road Safety and Security – Goals and Actions

Goals	Actions
1.1 Prevent Collisions	1.1.1 Manage the transition to CAVs by educating the public on how to appropriately use and interact with CAVs and by updating regulatory and enforcement mechanisms to address vehicles without human drivers. 1.1.2 Manage the transition of transit to CAVs by educating transit operators and riders on how to appropriately use and interact with these vehicles and by updating vehicle specifications to include automation that is proven to increase safety. 1.1.3 Support the development and adoption of CAV technology that is proven to positively contribute to realizing the City's road safety and Vision Zero goals. 1.1.4 Support the development and adoption of CAV technology that is proven to reduce injuries and deaths from vehicle collisions resulting from vehicle collisions within the environmental conditions experienced in London. 1.1.5 Develop and implement a policy of providing real-time and up-to-date data on traffic controls (e.g. traffic signals, PXOs, etc.) to improve road safety and network efficiency. 1.1.6 Support the development and adoption of CAV technology that is proven to increase detection of vulnerable road users and the ability to communicate with them. 1.1.7 Develop and implement a policy and mechanism to manage CAV traffic infiltration on local streets and in residential areas. 1.1.8 Develop and implement a policy regarding safety provisions for shared CAV fleet companies.

Goals	Actions
1.2 Update Infrastructure	1.2.1 Manage the transition to CAVs by identifying and focusing investment on corridors or areas for early integration of and potential exclusive use by CAVs and automated transit vehicles. 1.2.2 Develop and implement a policy and mechanism to securely integrate connected vehicles into the mobility network. 1.2.3 Develop and implement maintenance and design standards that integrate the use of CAVs while increasing the safety of the mobility network for all users.
1.3 Update Emergency Response	1.3.1 Identify and implement a mechanism to improve the yielding of CAVs to emergency vehicles. 1.3.2 Develop and implement protocols and training addressing emergency response in a CAV environment. 1.3.3 Develop and implement operating procedures addressing CAVs when responding to infractions. 1.3.4 Support opportunities for shared CAV fleet companies to develop a coordinated response to major city emergencies.

1.1 PREVENT COLLISIONS

The City will harness the widespread adoption of CAVs to ensure that traffic-related injuries and deaths from CAVs are in support of Vision Zero goals, initiatives, plans, and strategies.

TRANSITION TO CAVS

> Action 1.1.1: Manage the transition to CAVs by educating the public on how to appropriately use and interact with CAVs and by updating regulatory and enforcement mechanisms to address vehicles without human drivers.

During the transition period when roads will be shared by both human-driven vehicles and CAVs, public education campaigns will play a key role in shaping positive outcomes. Safety concerns may arise from overreliance by drivers on low levels of automated technology (i.e. SAE Level 3 or similar transitional technologies), as well as an increased likelihood of drivers, pedestrians, cyclists, and other road users of taking risks that they would regularly avoid. Further, as drivers become more reliant on CAV technology and less on human-driven vehicles, their driving skill levels will likely diminish over time. This may lead drivers to over-estimating their own abilities, resulting in more severe collisions, especially when they are forced to drive during more inclement weather to which they are not accustomed, should CAV technologies not be able to perform.

It will be particularly important to educate the public on the need to be attentive around partially automated vehicles (i.e. SAE Level 3 or similar). The City will need to update enforcement protocols for regulating interactions between CAVs and human-driven vehicles. By taking a proactive approach toward tackling anticipated challenges, the City will focus on road safety and security priorities during this transition period.

TRANSITION TO AUTOMATED TRANSIT

> Action 1.1.2: Manage the transition of transit to CAVs by educating transit operators and riders on how to appropriately use and interact with these vehicles and by updating vehicle specifications to include automation that is proven to increase safety.

Transit agencies around the world are currently determining how to integrate appropriate levels of automation into their operations. These technologies will increase the safety of operations, provide a better and more accessible service to customers, and/or improve driving performance in terms of fuel economy, network efficiency, and other metrics. The City supports updating vehicle specifications to include this technology as a means of improving safety. Proactive education for operators and riders

on how to appropriately interact with and use these vehicles will be essential during this transition period. However, any proposed CAV improvements to transit services by LTC need to first and foremost consider the customer experience and define how this will be a net positive to each rider. Even partial automation has the potential to aid the bus driver's experience, reducing stress thus improving the driving experience and retaining operators.

VEHICLE COLLISIONS – HUMAN FACTORS

> Action 1.1.3: Support the development and adoption of CAV technology that is proven to positively contribute to realizing the City's road safety and Vision Zero goals.

The City's Road Safety Strategy and adopted Vision Zero principles have resulted in the implementation of safety measures that include infrastructure improvements, enhanced data collection and analysis, automated enforcement strategies, education and awareness initiatives, reduced speed limits, automated pedestrian detection, and more[6]. With the creation of this plan as a supplement to strategies like the Road Safety Strategy, CAVs have the potential to provide the opportunity to contribute positively to the Vision Zero goals and work productively with road safety measures.

CAVs introduce the potential to greatly reduce the human-error contribution to collisions if designed and managed with this intent where the City has the influence to do so. The CAV technology has the potential to improve traffic law compliance – even prior to full adoption – as behaviours like speed limit, pedestrian crossover, and traffic signal compliance could have a positive halo effect on drivers of human-driven vehicles.

VEHICLE COLLISIONS – ENVIRONMENTAL CONDITIONS

> Action 1.1.4: Support the development and adoption of CAV technology that is proven to reduce injuries and deaths from vehicle collisions resulting from vehicle collisions within the environmental conditions experienced in London.

London experiences four distinct seasons including winters with heavy snowfall; however, environmental conditions remain a major challenge for deployment of CAVs. This problem is a well-known concern within the field, as CAVs rely on numerous sensors including GPS, traditional cameras, radar, and LIDAR technology to detect other vehicles,

[6] https://london.ca/roadsafety

cyclists, and pedestrians. The performance of these sensor technologies can be negatively impacted by Inclement weather, including fog, heavy rain, or snow

Many manufacturers are creating new ways to address these environmental problems – such as high-definition maps to navigate more easily in the snow even when road markings are not visible, redundant cameras and sensors to continue running even if they are covered in dust or road salt particles, protective coatings to keep some sensors free from debris, and other innovative approaches.

Considerable progress is needed before CAVs can operate reliably not only in mixed traffic, but with heavy rain or snow, unmapped roads, and where wireless communication access is unreliable. London's unique environmental conditions provide an opportunity for innovation and the City can capitalize on this by advocating for and supporting the development of environmentally appropriate technology.

VEHICLE COLLISIONS – DATA REDUNDANCY

> Action 1.1.5: Develop and implement a policy of providing real-time and up-to-date data on traffic controls (e.g. traffic signals, PXOs, etc.) to improve road safety and network efficiency.

CAVs are generally equipped with vital safety technologies including LIDAR that can draw a real-time 3D image of its surroundings, radar sensors that can measure the size and speed of moving objects, and high-definition cameras that are able to read signs and signals to establish their location[7].

The City will seek to improve these capabilities by promoting a practice of triple redundancy (minimum) in the data that governs the movement of CAVs and in accordance with higher-level government standards. CAVs should have at least three sources of information on traffic regulations – in-field control devices that are detected in real-time by the vehicle (e.g. signage, pavement markings, signals, etc.), connected open data on in-field devices (e.g. pavement markings, signal timing, etc.), and up-to-date high-definition mapping conducted by mobility service providers, OEM, etc. This will better inform the movement of CAVs and potentially contribute to the increased safety of London's residents.

[7] Calderone L. Autonomous Cars – Safety and Traffic Regulations. Robotics Tomorrow. 2018-10.

VULNERABLE ROAD USERS

> Action 1.1.6: Support the development and adoption of CAV technology that is proven to increase detection of vulnerable road users and the ability to communicate with them.

In the absence of an active human driver, there needs to be a method to easily convey a driverless car's behaviour and intentions in various traffic conditions[8]. Until such a method is achieved, CAVs will likely contribute to confusing and inconsistent interactions between various users on the road – especially in a mixed traffic setting. Urban settings with less-predictable pedestrian and bicycle behaviour will be particularly challenging for CAVs to navigate and will need to be considered both through OEMs and in the information the City conveys to CAVs through processes such as mapping and geofencing.

Existing programs, such as area speed limit programs (i.e. 40 km/h speed limit zones in residential neighbourhoods, the downtown, and other key areas), will help to enforce the posted speed limit where CAVs may act as "pace car" vehicles and set the tone for other automated and manual vehicles alike, improving safety. Further, area speed limit programs achieve the added benefit of improving data capture and redundancy. Lower speed limit conditions provide vehicle sensors with an improved opportunity to capture their surrounding environment, resulting in both higher quality data and increased reaction time to respond to unexpected events (e.g. a pedestrian stepping into traffic).

REDUCING TRAFFIC INFILTRATION

> Action 1.1.7: Develop and implement a policy and mechanism to manage CAV traffic infiltration on local streets and in residential areas.

With the proliferation of smartphone apps and increased use of GPS-navigation, more commuters may be turning to local streets to ease their travel time during peak hours. These apps use real-time traffic data to re-route drivers around long delays, which may take vehicles through relatively unknown bypasses or residential streets. The City actively aims to address some of these impacts by incorporating traffic calming measures on its residential streets to build and maintain a safe and efficient road system

[8] Merat N, Louw T, Madigan R, Wilbrink M, Schieben A. What externally presented information do VRUs require when interacting with fully Automated Road Transport Systems in shared space? Accident Analysis and Prevention 118 (2018) 244-252

for all its road users. When applied appropriately, these measures can have a positive general impact on travel speeds, traffic volumes, and road safety.

Further, opportunities should be sought to work with the Province, OEMs, other municipalities, and navigation services to set "no go" cut-through zones through by-law implementation and programmed into CAVs (i.e. similar to how truck routes function) so CAVs adhere to appropriate corridors unless required to reach their destination.

SHARED AUTOMATED FLEET SAFETY STANDARDS

> Action 1.1.8: Develop and implement a policy regarding safety provisions for shared CAV fleet companies.

Shared CAV fleets may increase road safety in terms of avoiding collisions; however, CAV manufacturers and shared CAV fleet companies will need to consider ways to make people feel safe and secure with a driver no longer present (e.g. in a shared setting, late at night or other higher risk scenarios). Remote monitoring could alert emergency assistants when potentially hostile or dangerous situations are detected.

Passengers may feel safer if there are discreet "exit strategies" for uncomfortable situations. For example, include an option to allow passengers to choose to be dropped off in a "safe space" near their destination instead of directly in front of their home. The City could aid in this by considering "safe space" drop off and pickup locations around London (i.e. at more public and/or better lit areas) and wayfinding signage similar to what has been implemented in the Active and Safe Routes to School program.

It will be important to recognize that a person's sense of safety depends upon their particular social context. For example, lone travellers compared to groups and those of different genders, ages, race, and cultures will experience different senses of safety. By considering the diversity of users, the City can work with shared CAV fleet companies to support equitable safety provisions. For example, this may be like the City's existing bylaws governing conventional taxis that could be expanded to provide minimum in-vehicle security standards.

1.2 UPDATE INFRASTRUCTURE

The City will support the deployment of CAVs by investing in transportation infrastructure that meets the City's goals and priorities.

CAV INTEGRATION

> Action 1.2.1: Manage the transition to CAVs by identifying and focusing investment on corridors or areas for early integration of and potential exclusive use by CAVs and automated transit vehicles.

Many companies are developing CAV technologies with the intention that they use existing transportation infrastructure (as opposed to purpose-built). However, achieving the maximum potential benefits of CAVs will likely require enhanced infrastructure at some point in the future. In collaboration with external stakeholders, the City may identify routes that can be used for CAV testing or early integration as these technologies more readily emerge.

One possibility for safely integrating automated transit adjacent to mixed traffic is through operating in dedicated corridors or areas. Gradual deployment around automated transit could include the installation and management of CAV-based transit service for constrained public applications. The upcoming implementation of Rapid Transit in London will be an opportunity to explore dedicated right-of-way for automated transit vehicles.

CONNECTED INFRASTRUCTURE INTEGRATION

> Action 1.2.2: Develop and implement a policy and mechanism to securely integrate connected vehicles into the mobility network.

As connected vehicles and infrastructure exchange data with one another about traffic conditions, potential safety hazards, and construction zones, the flow of traffic can be improved, enabling people can get where they need to go faster. However, these connections may also create increased cybersecurity risks. Integration of connected vehicle technologies must be done in a secure manner to mitigate this potential vulnerability.

NEW AND REVISED STANDARDS

> Action 1.2.3: Develop and implement maintenance and design standards that integrate the use of CAVs while increasing the safety of the mobility network for all users.

A future in which CAVs are widespread will require rethinking basic assumptions of traffic operations and engineering as well as the built infrastructure. For example, this could include enhanced pavement markings and signage that are visible to humans and CAVs in any road condition and may include new snow clearing standards in the winter.

Geometric design standards (physical) could similarly be modified to suit CAVs and improve road safety. For example, reducing curb radii and road widths within residential areas. City Staff should look for opportunities to join national and provincial CAV committees to keep up to date on industry developments and provide guidance on standards development in this emerging area.

However, the City will need to take direction from the Province of Ontario on regulatory changes with respect to design guidelines, insurance, and maintenance standards that impact CAV technologies.

1.3 UPDATE EMERGENCY RESPONSE

The City will harness the widespread adoption of CAVs to support all emergency services in being equipped to address the unique needs of situations involving these vehicles, and that emergency vehicles receive priority in traffic for faster emergency response.

EMERGENCY VEHICLE PRIORITY

> Action 1.3.1: Identify and implement a mechanism to improve the yielding of CAVs to emergency vehicles.

Yielding to emergency vehicles often leads to confusion as vehicles attempt to move out of the way with limited space and little coordination between drivers. CAVs may one day provide a solution to this problem, as the sharing of information between vehicles (i.e. V2V technology) could allow them to become aware of an approaching emergency vehicle more quickly and coordinate with each other to move out of its path. For example, virtual lane closures could be broadcast to CAVs along an emergency vehicle's path in geofenced sections ordering them to physically create a travel path.

EMERGENCY RESPONSE PROTOCOLS AND TRAINING

> Action 1.3.2: Develop and implement protocols and training addressing emergency response in a CAV environment.

When hybrid vehicles were introduced, they posed new challenges for emergency responders due to the high-voltage battery packs they carry. As such, numerous safeguards were designed by vehicle manufacturers to help ensure that this high voltage battery pack was kept isolated from contact with anything other than the hybrid propulsion system in any situation in which this vehicle could find itself.

To assist emergency responders in dealing with this new technology, many vehicle manufacturers provided “Emergency Response Guides” that give instructions on the safe handling of hybrid vehicles when approaching at the scene of a collision. Similarly, emergency responders in London may need additional training for responding to the new technology included in CAVs.

ENFORCEMENT OF INFRACTIONS

> Action 1.3.3: Develop and implement operating procedures addressing CAVs when responding to infractions.

CAVs are expected to be capable of compliance with all traffic laws and control devices. However, liability in the event of a traffic infraction has yet to be determined by legislators due to these new elements. This will be especially important in interactions between CAVs and active mode users (i.e. pedestrians and cyclists) where CAVs will likely posses evidence and data of those interactions, especially where a potential legal violation has occurred, and can share that information with law enforcement.

The City will monitor Federal and Provincial legislation, regulations, and guidance as appropriate to ensure municipal enforcement staff are knowledgeable in appropriate responses to infractions.

EMERGENCY RESPONSE OF SHARED AUTOMATED FLEETS

> Action 1.3.4: Support opportunities for shared CAV fleet companies to develop a coordinated response to major city emergencies.

During emergencies, danger and panic can result from dense crowding, traffic disturbances, and slow human reaction times which limit the movement of people attempting to reach safety. To this end, the US Department of Transportation has been investigating how vehicle-to-vehicle (V2V) communications could allow vehicles to move closer, at higher speeds, to improve evacuation outcomes[9]. The City can support similar approaches within its jurisdiction.

[9] United States. Federal Highway Administration. Leveraging the Promise of Connected and Autonomous Vehicles to Improve Integrated Corridor Management and Operations: A Primer. U.S. Department of Transportation; 2017.

2 MOBILITY INTEGRATION AND EFFICIENCY

The City will incorporate CAV technology and encourage its adoption within the City's mobility network. Increased infrastructure efficiency will be achieved through an enhanced ability to manage traffic in real-time, allowing individual mobility needs to be served at any given time.

Actions will integrate space-efficient and active modes of travel, support public transit, improve connections within the existing system, and better manage the movement of goods. The focus of actions will also include Transportation Demand Management (TDM), curbside management, pricing mechanisms, and utilization of transportation-related data.

In the long-term, as improved management of vehicle movements becomes more feasible with higher adoption rates of CAVs, capacity may increase, and delays from incidents may be reduced. While individual traveller privacy shall be protected, advanced sensors in CAVs will be able to collect and distribute information at a faster and more accurate rate. The collected traffic information is anticipated to become an indispensable tool for informing CAV operators of traffic conditions and incidents along their route, including informing CAV operators about the presence of other vehicles, transit, commercial delivery services, etc. The City will continue to use tools to manage traffic, which are expected to be further improved as CAVs emerge.

Actions with the support of the London Transit Commission will encourage the adoption of complementary mobility services including ride-hailing and ridesharing, for the purpose of improving reliability, efficiency, safety, and seamlessness of the public transit network. Other mobility actions by the City will allow for regional partnerships to ensure that London's CAV mobility network is integrated with external road networks and multi-modal transportation networks such as bus, rail, and air travel.

Table 2: Mobility Integration and Efficiency – Goals and Actions

Goals	Actions
2.1 Increased Space Efficiency	2.1.1 Update municipal standards in a way that will encourage rebalancing the right-of-way in support of active transportation. 2.1.2 Evaluate the potential of CAV technology to provide transit priority in London and enhance the existing public transit fleets. 2.1.3 Support first-and-last mile connections to CAV transit and conventional transit. 2.1.4 Develop and implement a policy regarding the integration of automated on-demand transit into the transit system.
2.2 Design Complete Streets	2.2.1 Update Complete Streets documents and policies, including Vision Zero, to reflect the new realities of CAVs. 2.2.2 Apply an equity assessment to traditional data-driven processes to ensure that all mobility modes, including CAVs, are being captured in data collection. 2.2.3 Develop and implement a mechanism to optimize the use of curbside space by CAVs over the course of a day.
2.3 Increase System Seamlessness	2.3.1 Develop and implement CAV policies to support a coordinated Mobility-as-a-Service network, which includes active transportation, to achieve seamless mobility centered on public transit. 2.3.2 Include active transportation in trip planning tools to support a coordinated Mobility-as-a-Service network. 2.3.3 Promote equity and singular payment for trips of multiple modes to support a coordinated Mobility-as-a-Service network. 2.3.4 Develop a municipal carshare parking permit policy that includes shared CAVs. 2.3.5 Create a working group with adjacent municipalities to encourage seamless integration of CAV technology, mobility services, and data sharing. 2.3.6 Include City representation on national and provincial CAV committees.

Goals	Actions
	2.3.7 Advocate for regional system integration of CAV networks.
2.4 Urban Goods Movement	2.4.1 Develop and implement a policy and mechanism to manage urban goods movement in CAVs including non-passenger vehicles.
2.5 Mobility Network Efficiency and Performance	2.5.1 Monitor traffic operations to identify opportunities and challenges introduced during the transition to CAV adoption. 2.5.2 Explore research, tools, and techniques to manage the mix of human-driven vehicles and CAVs. 2.5.3 Develop a program to support connected infrastructure technologies in ways that will optimize the existing transportation network capacity in a cost-effective manner. 2.5.4 Develop a policy to increase the role of some street classifications as facilitators for CAV access to adjacent buildings.
2.6 Transportation Demand Management	2.6.1 Implement strategies to decrease individual CAV trip demands. 2.6.2 Explore pricing mechanisms that reflect the true costs of infrastructure, congestion, environmental, and safety to improve the appeal of transit ridership and active transportation modes when compared to single occupancy CAV alternatives. 2.6.3 Dedicate pricing revenue to transit and active transportation improvements. 2.6.4 Target peak demand by facilitating active modes, transit, and shared trips. 2.6.5 Explore a pricing mechanism so the cost of on-street parking to the users of both human-driven vehicles and CAVs reflects the economic, social, and environmental impacts. 2.6.6 Explore a regulatory framework or pricing mechanism so the cost of off-street parking to the user of a CAV reflects the economic, social, and environmental impacts.

2.1 INCREASED SPACE EFFICIENCY

The City will harness the widespread adoption of CAVs with the goal of prioritizing trips made by more space-efficient modes of travel (e.g. walking, cycling, transit, etc.). London will take a transit-centric approach which connects all modes of travel including active transportation and CAVs, while prioritizing public transit to provide seamless mobility citywide.

ACTIVE TRANSPORTATION PRIORITY

> Action 2.1.1: Update municipal standards in a way that will encourage rebalancing the right-of-way in support of active transportation.

Adopting CAV technology must complement and not compete with active transportation opportunities. CAVs must be directed towards strategic locations and encouraged in a manner that enhances the existing and planned active transportation network. London will continue to prioritize investment in active transportation to provide for a sustainable, multi-modal mobility network that integrates CAV technology and improves mobility for all.

The National Association of City Transportation Officials' (NACTO) Blueprint for Autonomous Urbanism: Second Edition (2019) supports rebalancing the right-of-way through CAVs, by moving more people in fewer vehicles on less congested streets[10]. Increasingly convenient CAV services and amenities may allow households to reduce vehicle ownership and may result in more trips made by active modes. With reduced reliance on vehicles, space can be used more efficiently for active, sustainable modes, and technology can help manage the public realm dynamically and optimize the existing transportation network.

Active Transportation users include pedestrians and cyclists, as well as those who walk and cycle to transit connections.

[10] National Association of City Transportation Officials' (NACTO) Blueprint for Autonomous Urbanism: Second Edition (2019). Available from: https://nacto.org/publication/bau2/

PUBLIC TRANSIT PRIORITY

> Action 2.1.2: Evaluate the potential of CAV technology to provide transit priority in London and enhance the existing public transit fleets.

Explore ways to integrate CAV technology into the public transportation vehicle fleet by procuring new automated public transit vehicles to broaden the hours of transit operation and provide for more frequent and convenient services (e.g. first mile / last mile connections) that continue to make public transportation a more attractive and cost-effective travel choice. By starting to think early on about how to best incorporate new technologies, the City can improve and modernize its mobility network and public transit fleet to provide for better services and increased reliability.

The City will explore opportunities to provide transit priority for CAV transit fleets and participate in pilot programs and testing for automated public transit or shuttle services.

SUPPORT PUBLIC TRANSIT CONNECTIONS

> Action 2.1.3: Support first-and-last mile connections to CAV transit and conventional transit.

As dispatching of mobility services is sometimes slow and unpredictable, particularly in suburban and rural areas, improving transit reliability through CAV transit fleets will help discourage individuals from switching travel patterns to privately owned CAVs. Municipal programs that support first-and-last mile connections will help support a successful automated public transit system which will lead to optimization of the existing mobility network.

Shared CAV usage should be designed and located strategically to enhance, integrate, and extend the public transportation network. Shared CAVs should be deployed in locations where active transportation and public transportation are not viable options and to extend and connect to the public transit network. The City will investigate ways to utilize shared CAVs to provide first-and-last mile trip connections to the Transit Villages, Rapid Transit Corridors, peripheral neighbourhoods, and other major transit stations where higher-order transit is impractical or unachievable.

AUTOMATED ON-DEMAND TRANSIT

> Action 2.1.4: Develop and implement a policy regarding the integration of automated on-demand transit into the transit system.

On-demand transit consists of shared public or private sector transportation operating either as fixed routes or on-demand via mobile apps. By using 'right-sized' vehicles – either small commuter shuttles or shared fleet vehicles – the on-demand transit model could address the challenge of first-and-last mile connections to transit hubs, while improving mobility to areas that conventional transit cannot serve efficiently.

It should be noted that on-demand transit can be implemented without the specific need for CAV technologies and is being explored for first-and-last mile trips in areas in London, such as Innovation Park.

2.2 DESIGN COMPLETE STREETS

The City will harness the widespread adoption of CAVs to ensure the design of city streets meets the dynamic daily needs for all road users.

STREET DESIGN

> Action 2.2.1: Update Complete Streets documents and policies, including Vision Zero, to reflect the new realities of CAVs.

As London prepares for the introduction of CAVs, the opportunity can be used to rethink how streets are designed and to update existing policies and documents to better reflect the new realities of CAVs. London's Complete Streets Design Manual identifies that the hierarchy of modes will differ depending on the street classification and it is important that the needs of pedestrians, cyclists, transit users and vehicles, and private vehicles are fairly evaluated and considered. Further, other City design standards and guidelines will need to be reviewed and updated at an appropriate time to support the use of CAV technologies.

MULTIMODAL DATA COLLECTION

> Action 2.2.2: Apply an equity assessment to traditional data-driven processes to ensure that all mobility modes, including CAVs, are being captured in data collection.

The safety for all users (particularly physically vulnerable road users) is the highest priority in designing Complete Streets. Appropriate data collection allows for the optimization of mobility for everyone (all modes). With the introduction of CAVs in London, data collection should be done with all modes captured, including CAVs. An equity assessment should be applied to traditional data-driven processes to ensure the travel choices of under-represented, under-served, and physically vulnerable populations are always in the forefront.

FLEXIBLE CURBS

> Action 2.2.3: Develop and implement a mechanism to optimize the use of curbside space by CAVs over the course of a day.

In the future, curbside space may be more responsive and flexible – rather than fixed – as CAV technologies are introduced. Curbside space has the potential to host a variety of different programs and activities that can vary throughout the day or the time of year, including vendors, public seating, digital infrastructure, freight loading, green infrastructure, delivery lockers, market, pick-up/drop-off zones, and transit stops[11].

In the future, the City of London may be able to monitor the amount of time a vehicle uses curb space and broadcast any availability of curb space to CAVs. Through incentives and deterrents, the City of London may be able to further optimize the use of curbside space including though the application of curbside fees and pricing mechanisms.

Pricing the curb would allow for efficient allocation of limited curbside space, ensuring faster turnover of vehicles, increasing access to delivery zones and pick-up/drop-off areas while minimizing the tension for curb space. Pricing could also lead to loading/unloading areas being closer to entrances – a desired advantage for mobility users and necessary to many individuals with mobility challenges.

[11] National Association of City Transportation Officials' (NACTO) Blueprint for Autonomous Urbanism: Second Edition (2019). Available from: https://nacto.org/publication/bau2/

2.3 INCREASE SYSTEM INTEGRATION

The City will harness the widespread adoption of CAVs to aid in the integration of London's mobility network and encourage an improved user experience. The City will explore disincentives for low-occupancy, private passenger CAVs versus incentives for higher occupancy, shared CAVs. Council will be responsible for approving appropriate policy and by-law to be implemented.

MOBILITY-AS-A-SERVICE (MAAS)

> Action 2.3.1: Develop and implement CAV policies to support a coordinated Mobility-as-a-Service network, which includes active transportation, to achieve seamless mobility centered on public transit.
>
> Action 2.3.2: Include active transportation in trip planning tools to support a coordinated Mobility-as-a-Service network.
>
> Action 2.3.3: Promote equity and singular payment for trips of multiple modes to support a coordinated Mobility-as-a-Service network.

CAVs and Mobility-as-a-Service (MaaS) are often referenced in connection with one another, as highly automated vehicles allow for increased flexibility and integration, reduced costs, and potential safety improvements required of mobility services. As the CAV technology progresses and requires less input from a driver, ride-hailing and journey planning through a mobility platform becomes much more convenient[12].

The City will aim to keep pace with the emergence of CAV technologies and begin thinking about how to support a coordinated mobility network to achieve seamless mobility, centred specifically on public transit. Mobility platforms and trip planning tools should also include active transportation options which will provide important first-and-last mile connections for the transit-centric system. The City of London will also explore singular payment for trips of multiple modes, also known as fare integration, which will ensure equity and accessibility to the City's transit-centric network. If there is ease of access to the City's transit services, this option will become more attractive, and can draw users to the transit system.

[12] Ismail N. Mobility-as-a-service: driverless cars leading the next travel revolution. Information Age. 2017-04.

SHARED CAV CARSHARE OWNERSHIP

> Action 2.3.4: Develop a municipal carshare parking permit policy that includes shared CAVs.

CAVs may present an opportunity to expand the carshare ownership model which would support a robust transit system. The advantages of carsharing include reduced vehicle ownership and vehicle travel. The City can support this ownership model through a municipal carshare policy that may explore dedicating parking spaces for shared vehicles and adjusting roadway capacity models to reflect this.

REGIONAL, PROVINCIAL, AND NATIONAL CAV PARTICIPATION

> Action 2.3.5: Create a working group with adjacent municipalities to encourage seamless regional integration of CAV technology, mobility services, and data sharing.
>
> Action 2.3.6: Include City representation on national and provincial CAV committees.
>
> Action 2.3.7: Advocate for regional system integration of CAV networks.

London is the hub of southwestern Ontario and CAVs may often pass-through different jurisdictions and cross municipal boundaries. To maximize compliance and improve traveler experience, London should work with adjacent municipalities to ensure CAV technology, connected infrastructure, mobility services, and data sharing is seamless across the municipal boundaries.

Based on the most recent Google Insights Explorer (2020) data for transportation[13], approximately 60,000 daily trips are made by residents living outside London that travel into the city for work, school, shopping, or other personal and recreational activities. This represents about 8% of total daily trip making demands in the city. The largest impacts are typically felt on the road system leading into the city and along city limits. This shows the importance of coordinating regional transportation options.

The City will also support staff representation on committees tasked with developing or commenting on federal and provincial standards and guidelines for automated vehicle technologies and connected infrastructure.

[13] https://insights.sustainability.google/places/ChIJC5uNqA7yLogRlWsFmmnXxyg/transportation

2.4 URBAN GOODS MOVEMENT

MANAGE CAV GOODS MOVEMENT

> Action 2.4.1: Develop and implement a policy and mechanism to manage urban goods movement in CAVs including non-passenger vehicles.

CAV technology could have a large impact on both public and private urban goods movement[14]. The use of automation to deliver directly to a customer's door could[15]:

- Increase the reliability of the delivery;
- Lessen traffic congestion;
- Reduce the costs associated with parking, labour, and fuel;
- Reduce emissions; and
- Increase productivity substantially with the opportunity for uninterrupted operations.

For example, non-passenger CAVs such as sidewalk delivery robots may be an urban first-and-last mile logistic solution for e-commerce. However, as of February 2022, both Ottawa and Toronto[16] have barred the use of these devices on urban, streets, sidewalks, and bicycle paths pending further direction by the Ministry of Transportation and amendments to the Province's Highway Traffic Act and regulations.

In addition to the benefits outlined above, automated urban goods movement may place more demands on curb space, cause difficulty managing truck movements, and impact other modes of transportation. Sidewalk delivery robots would need to be capable of navigating encounters with pedestrians, dealing with crosswalks, and moving through public spaces like sidewalks, footpaths, and bicycle lanes[17]. Given London's location adjacent to rural areas, consideration should also be given to the usage of automated farm equipment on City-owned roads and potential implications.

Related strategies that may integrate with CAV technologies for goods movement include crowdshipping, mobile depots, and other connected infrastructure means. There

[14] David Kriger Consultants Inc., CPCS. Urban Goods Movement Regional Transportation Plan Legislative Review Backgrounder: Urban Goods Movement. Metrolinx. 2016.
[15] Deng P (Paul). Automated Freight Vehicles: Current Technology, Potential Impacts and Policy Implications. University of Toronto; 2017.
[16] Porter K. Pink delivery robots to get the boot, committee decides. CBC. 2022-02-02. Available from: https://www.cbc.ca/news/canada/ottawa/menard-ottawa-motion-delivery-robots-1.6336596
[17] Pardes A. Postmates' Quest to Build the Delivery Robot of the Future. Wired. 2018-12.

will be a need for the City to explore appropriate bylaws and policies to manage these operations and integrations.

2.5 MOBILITY NETWORK EFFICIENCY AND PERFORMANCE

The City will harness the widespread adoption of CAVs to better manage the real-time conditions of vehicular traffic. The City will use real-time CAV data to manage London's mobility network through resources such as the Transportation Management Centre (TMC). This will help to optimize the capacity of the existing transportation infrastructure.

The data collected as part of these processes will also be used to inform decisions that allow all Londoners to get around more safely and efficiently. The City will also need to consider the nature of the data being collected and how it will be used given the need to protect individual privacy.

TRANSITION TO AUTOMATED VEHICLES – TRAFFIC FLOW

> Action 2.5.1: Monitor traffic operations to identify opportunities and challenges introduced during the transition to CAV adoption.
>
> Action 2.5.2: Explore research, tools, and techniques to manage the mix of human-driven vehicles and CAVs.

Managing the flow of traffic has been an ongoing challenge for transportation authorities even prior to the adoption of CAVs. The emerging mixed operational conditions between human-driven vehicles and CAVs will present new challenges. While some can be anticipated, other challenges may emerge over time that will need to be identified and effectively managed.

There will likely be conflicting expectations between what individual users may view as an "optimal" mobility outcome versus what the City anticipates as an "optimal" system outcome. The complexity of these challenges can also be influenced by other dynamics such as private CAV ownership versus shared ownership and different CAV technologies and manufacturers operating concurrently on London streets.

One solution to reduce traffic speeds, encourage safe driving, and improve traffic flow may become available using CAVs as "pace cars". CAVs are expected to predictably drive at the speed limit and follow other traffic laws – essentially acting as a pacesetter that models safe driving for human-driven vehicles, resulting in calmer traffic flows once a

critical mass point of CAVs is reached[18]. This could also be managed through V2I communications with City infrastructure using dynamic speed management through speed advisories that CAVs would then respond to.

Human drivers are likely to adapt to CAVs in a mixed variety of both positive and negative responses. While the "pace car" scenario may be a positive impact for the mobility network, CAVs throughout the mobility network are likely to be stunted by unpredictable, human-driven vehicles. It is likely that a subset of non-CAV drivers may learn to "take advantage" of predictable CAV behaviours, knowing that CAVs will act in a more conservative, safe manner to avoid collisions, effectively bullying CAVs on public roads[19].

ACTIVE TRAFFIC MANAGEMENT AND COORDINATION

> Action 2.5.3: Develop a program to support connected infrastructure technologies in ways that will optimize the existing transportation network capacity in a cost-effective manner.

Connected infrastructure technologies could help the City move more vehicles through a given segment of road, thereby increasing the efficiency of the existing transportation infrastructure.

First, vehicle-to-vehicle (V2V) communications enabled by connected technology allow cars to communicate and coordinate with each other in real-time.

Second, vehicle-to-infrastructure (V2I) technologies could use sensors to detect how many cars are waiting in each lane and how much time it takes to clear up this traffic. For example, it could communicate with nearby traffic signals through the traffic signal network that will work in tandem to maximize traffic efficiency.

Finally, vehicle-to-network (V2N) or vehicle-to-everything (V2X) systems, allow connected vehicles to communicate with cellular devices and the cloud so that drivers can take advantage of in-vehicle services that assist with traffic updates. Transmission of connected vehicle data allows for real-time active traffic management, relaying information that can enhance the level of predictability for CAVs, improving overall travel time and increasing vehicle densities and flow rates.

[18] Parachute. Pace Car Community Guide 2019-2020. Available from: https://parachute.ca/wp-content/uploads/2019/08/Pace-Car-Community-Guide.pdf
[19] Liu P, Du Y, Wang L, Young J D. Ready to bully automated vehicles on public roads? Accident Analysis and Prevention. Volume 137. 2020. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0001457519312370

STREET CLASSIFICATIONS

> Action 2.5.4: Develop a policy to increase the role of some street classifications as facilitators for CAV access to adjacent buildings.

The City of London street classification system divides London's streets into major classifications[20] as follows:

- Rapid Transit Boulevard
- Provincial Highway
- Expressway
- Main Street
- Urban Thoroughfare
- Civic Boulevard
- Neighbourhood Connector
- Rural Thoroughfare
- Rural Connector

The street classification system ensures that the street network performs most efficiently and safely. Some street classifications provide a higher density of property access which may become challenged by the increased vehicular and curb use brought on by CAV technologies. The City should look to develop a policy to increase the role of some street classifications as facilitators of CAV access to large trip generators, particularly in high-density urban areas. Access lanes could provide space for pick-ups, drop-offs, and deliveries.

For example, areas could be designated in the vicinity of Budweiser Gardens for drop off and pick up during high-demand events and in the interim the CAVs are directed to designated nearby parking facilities for the duration of the event, which may mean limited zero occupancy travel, but may provide improved efficiency and less idling.

[20] City of London. The London Plan. Appendix 1 – Maps. Map 3 – Street Classifications. 2022-05-25. Available from: https://london.ca/sites/default/files/2022-08/10%20-%20Appendix%201%20Maps%20-%20The%20London%20Plan%20-%20July%202022%20AODA.pdf

2.6 TRANSPORTATION DEMAND MANAGEMENT

The City will harness the widespread adoption of CAVs to ensure less acute vehicle demand across the mobility network. In planning for CAVs, the City recognizes that moving people, goods, and services is the key goal.

Transportation Demand Management (TDM) is the wide range of policies, programs, services, and products that influence how, why, when, and where people travel to make travel behaviours more sustainable. TDM can include strategies to improve the efficiency and effectiveness of existing transportation infrastructure in addition to strategies that aim to change travel behaviour. These TDM tools are available to the City in planning for CAVs.

MANAGE INDUCED TRAVEL DEMAND FROM CAVS

> Action 2.6.1: Implement strategies to decrease individual CAV trip demands.

How CAVs will impact travel demand remains to be seen. This plan recognises that transportation choices will vary by individual and household. There are many reasons affecting those transportation choices. In addition, not all Londoners will be able to or want to use CAVs. Managing travel demand is a complex task and many factors influencing individuals' travel choices are and will remain outside the City's control.

The widespread deployment of CAVs may result in the negative impact of increased low-occupant vehicle travel due to several factors including[21]:

- More reliable travel times;
- Improved safety;
- Reduced travel costs for some trips;
- Zero-occupancy vehicles standing and circulating;
- Dispersed land use patterns; and
- Increased mobility for non-drivers.

By increasing passenger comfort and productivity, CAVs could make longer-distance trips (including commutes) more acceptable, leading to more sprawled development.

[21] Litman T. Autonomous Vehicle Implementation Predictions: Implications for Transport Planning. Victoria Transport Policy Institute; 2018.

This could increase households' personal vehicle travel, particularly in suburban and surrounding rural areas.

This could be mitigated both by more distributed or decentralized urban focal points or greater, permanent working from home arrangements characterised in the emerging post-COVID world, lowering GHGs, and environmental impacts. However, there is still uncertainty of the permanence and acceptance of working from home arrangements with white-collar jobs by employers, which is still to be determined in the longer term.

The Association of Pedestrian and Bicycle Professionals (APBP), of which the City is a member, recommends the following action to inform and mitigate CAV use[22]:

> "Work with other agencies to unify around a vehicle occupancy monitoring and pricing policy whereby there would be an inverse cost related to occupancy such that higher costs would be incurred for zero occupant vehicles."

Working with partners will ultimately lead to the goal of decreasing overall travel demands.

INCENTIVES, PRICING, AND REVENUE

> Action 2.6.2: Explore pricing mechanisms that reflect the true costs of infrastructure, congestion, environmental, and safety to improve the appeal of transit ridership and active transportation modes when compared to single occupancy CAV alternatives.
>
> Action 2.6.3: Dedicate pricing revenue to transit and active transportation improvements.

CAVs could affect demand for public transit in several positive ways including:

- Within a given budget, transit agencies could provide more frequent service using smaller vehicles and more flexible routes that deliver passengers closer to their destinations.
- CAV technologies could reduce the costs of providing transit services by reducing the labour component.

[22] Association of Pedestrian and Bicycle Professionals. Policy Statement: Automated Driving Systems. 2020. p.4.

- CAV Mobility-as-a-Service could provide convenient mobility for non-drivers and for travel to/from transit stops, which is particularly effective in suburban and industrial areas where conventional transit is less efficient.

However, CAVs could also lead to a reduction in conventional transit demand, which reduces revenue, cost efficiency, and political support. This could result in reduced service quality. However, new operational models may emerge with CAVs and how "conventional" transit is defined today may similarly change.

The City should implement efficient pricing mechanisms and improve public transit services on busy corridors to both limit traffic congestion and maintain transit system efficiency. For individuals, the City should develop incentives and rewards to encourage public transit ridership (e.g. discounts, passenger comforts, etc.). Pricing mechanisms may be like the existing time of day pricing for electricity services in Ontario that are reflective of the true costs during in high demand periods. The time-of-day pricing results in the collective "evening out" of energy usage and ultimately results in a more efficient electrical grid. Different modes of travel across the mobility network may be more efficient than others and present an opportunity to implement pricing mechanisms that better reflect the true costs of travel at different times of the day.

To encourage more first-and-last mile trips being made by walking and cycling, the City should ensure networks include reliable infrastructure for all ages and abilities and end-of-trip facilities. The City can also develop incentives and rewards to encourage active travel modes.

The full benefits of pricing mechanisms can only be realized when transit or active modes are an attractive option over driving, particularly during peak travel periods. Dedicating revenue to transit and active transportation improvements will encourage use and sustain long-term mode shifts.

PEAK PERIOD MANAGEMENT

> Action 2.6.4: Target peak demand by facilitating active modes, transit, and shared trips.

In addition to addressing general travel demand, City efforts will need to focus on weekday and weekend peak travel periods (i.e. AM and PM peak period commutes and weekend shopping peak periods). There are three types of peak period trips the City can play a direct role in planning for or mitigating:

1. Commute

In addition to facilitating commutes by active modes and transit, the City can encourage the use of carpool matching systems that encourage CAV trip-sharing. As well as encouraging employers to implement shared CAVs to pick up employees along the way. These employees could be from the same workplace and/or from different workplaces located in a similar geographic area.

The City can also address commute trips by encouraging local businesses to shift peak travel periods (i.e. peak travel shifting). In other words, this could mean encouraging flexible work hours for those employees who can or want to shift their schedule. Yet another consideration would be to encourage employers to allow for employees to work from home where possible on at least a part-time basis, like what has been experienced throughout COVID.

2. School Commute

Besides the commute to/from work, travel to/from school is another significant source of trips that occurs primarily during weekday peak travel periods. According to the City's 2016 Household Travel Survey Summary Report[23], trips to school account for 18% of all trips made during the weekday AM peak period.

The City should begin planning for CAV-influenced school trips by designating preferred active transportation routes to discourage families and staff driving to/from school. In addition, the City can create CAV pick up/drop off zones around schools and campuses including for CAV student bus loading zones.

[23] City of London, IBI. 2016 Household Travel Survey Summary Report. 2018-07-11. Available from: http://wats.uwo.ca/TTR_Survey_2016-Report.pdf

There is also a role for the local Active and Safe Routes to School Program[24] to play in encouraging children and their caregivers to actively commute to/from school. Specifically, in educating children and the school community about how to travel to/from school most safely with CAVs on the road.

3. Discretionary Trips

Discretionary trips include trips to shops, appointments, services, and visits with family and friends in another area the City. The choice to take single-occupancy-vehicle (SOV) trips by CAVs should be minimized. Many of the discretionary trips take place on weekends creating a peak that is not traditionally captured in transportation modelling and planning. The City can discourage SOV trips through disincentives, pricing mechanisms, and transit and active transportation incentives.

MANAGE ON-STREET PARKING DEMAND

> Action 2.6.5: Explore a pricing mechanism so the cost of on-street parking to the users of both human-driven vehicles and CAVs reflects the economic, social, and environmental impacts.

Physical and virtual sensors could allow for real-time updates of parking availability to be communicated to CAVs. With the widespread adoption of CAVs, users may no longer have the need to park because vehicles will be able to – through rideshare format – pick up the next customer. Or, if personally owned, vehicles may be able to return home or park themselves at nearby locations. While both examples are expected to free-up curbside space, current parking trends and expert predictions indicate that parking will remain an important street element well into the future[25] .

It should be noted that most CAV passengers will want their vehicles to be available within a few minutes, which will require parking within a kilometre or two of their destination for privately owned vehicles. This may allow more off-site and shared parking, freeing up some on-street parking. Further, a mechanism will need to be in place to provide a means for a CAV to pay for parking, even if their respective owner is not physically present at the parking facility.

[24] http://www.activesaferoutes.ca/
[25] City of Toronto. 2018 Staff Recommended Operating Budget Notes – Toronto Parking Authority. Considered by Budget Committee, 2017-11-10.

MANAGE OFF-STREET PARKING DEMAND

> Action 2.6.6: Explore a regulatory framework or pricing mechanism so the cost of off-street parking to the user of a CAV reflects the economic, social, and environmental impacts.

Studies have been conducted on the impact that CAVs will have on off-street parking designs in the future. According to a study from the University of Toronto, future parking that is designed especially for CAVs could see a decrease in the space required to park vehicles by an average of 60% to a maximum of 90%[26].

As commercial and private parking business models change, the City will need to ensure that there is a policy framework in place to make the most of newly freed-up off-street space once dedicated to parking. Mechanisms the City could explore include:

- Reduce the overall availability of public parking;
- Encourage parking systems that integrate real-time information to maximize capacity;
- Explore more space-efficient parking structures;
- Reduce minimum parking to be included in developments; and
- Explore neighbourhood-scale parking areas.

[26] Nourinejad M, Bahrami S, Roorda MJ. Designing parking facilities for autonomous vehicles. Transportation Research Part B: Methodological. Volume 109. 2018. 110-127. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0191261517305866

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3 ENVIRONMENTAL SUSTAINABILITY

The City will encourage the adoption of CAVs in a manner that incentivizes environmental sustainability across a vehicle's entire lifecycle. Reducing vehicle emissions and waste through incentivizing or promoting zero emission vehicles and sustainable use practices.

To combat the Climate Emergency declared by Council in April 2019, City Staff developed the Climate Emergency Action Plan (CEAP)[27], approved as of April 2022. The CEAP is a community-wide plan intended to achieve three main goals:

- Net-zero community greenhouse gas (GHG) emissions by 2050;
- Improved resilience to climate change impacts; and
- Bring everyone along (e.g., individuals, households, businesses, neighbourhoods).

Over the 2015-2019 period, before COVID-19 impacts, transportation represented about 1.4 million tonnes of greenhouse gas (GHG) emissions per year or about 47 per cent of local GHG emissions. This included in-town trips, trips to/from London, and goods movement[28]. In 2016, trips taken as the driver of an automobile represented 64% of all daily trips made within the greater London area during the weekday peak travel periods.

The CEAP is striving to achieve the following mobility-related results by 2030:

- Walkable, complete neighbourhoods;
- Increased active transportation and transit; and
- More zero emission vehicles.

[27] City of London. Climate Emergency Action Plan. 2022-04. Available from: https://getinvolved.london.ca/climate
[28] City of London. 2019 Community Energy and Greenhouse Gas Emissions Inventory. Available from: https://london.ca/living-london/water-environment/environmental-programs-initiatives

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A customized Climate Emergency Screening Tool (CEST) has been developed for capital transportation projects. The customized CEST is used to guide the screening of projects and programs for key climate emergency issues and opportunities for improvement. Projects that optimize and support sustainable mobility modes were recommended to proceed with consideration of the climate lens outcomes. Similarly, CAV projects and initiatives undertaken in the implementation phase of this plan will need to be evaluated through the CEST lens.

Table 3: Environmental Sustainability – Goals and Actions

Goals	Actions
3.1 Reduce Vehicle Emissions	3.1.1 Develop and implement policy to ensure that CAV operations improve the efficient use of the City's transportation and mobility infrastructure. 3.1.2 Develop and implement policy to minimize zero-occupancy use and encourage shared use of passenger-carrying CAVs. 3.1.3 Develop and implement policy to incentivize zero emission vehicles for passenger and goods movement shared CAV fleets.
3.2 Reduce Vehicle Waste	3.2.1 Develop and implement policy to incentivize "zero waste to landfills" for CAVs used by fleet operators wishing to operate in London to reduce the amount of waste produced across the lifecycle of CAVs operated by these fleets.

3.1 REDUCE VEHICLE EMISSIONS

The City will harness the widespread adoption of CAVs to promote the use of zero emission vehicles, reduce the overall number of vehicles across London's mobility network, and increase the public transit mode share.

EFFICIENT USE OF INFRASTRUCTURE

> Action 3.1.1: Develop and implement policy to ensure that CAV operations improve the efficient use of the City's transportation and mobility infrastructure.
>
> Action 3.1.2 Develop and implement policy to minimize zero-occupancy use and encourage shared use of passenger-carrying CAVs.

CAVs are expected to improve road safety and reduce the impacts of human error, which are expected to result in environmental benefits and improved use of the mobility network. Potential benefits of CAVs to make more efficient use of infrastructure include:

- The ability to use narrower lane widths;
- The need for less physical parking space; and
- The reduction of time and vehicle kilometres travelled (VKT).

For example, CAVs can operate more precisely and therefore can accept a narrower margin of error than human drivers both allowing for closer platooning and spacing with other vehicles, improving operational efficiency for braking, accelerating, and cruising operations. Further, with less on-street parking needs this frees up more space in the public domain and CAVs can proceed off-street to more compact, designated parking areas, reducing circulation in trying to "find" a spot by chance.

However, challenges introduced by the above operations will include some zero-occupancy kilometres travelled and more complex curbside operations to manage.

A CAV with just one passenger offers limited improvement for road congestion over existing conditions today. An empty passenger-carrying CAV on the road can make conditions worse. Passenger-carrying CAV fleet operators should be incentivized to minimize the amount of time on the road with zero passengers and to carry more than one passenger. Personally owned vehicles with CAV capabilities should be limited in operations with zero passengers.

ZERO EMISSION VEHICLES

> Action 3.1.3: Develop and implement policy to incentivize zero emission vehicles for passenger and goods movement shared CAV fleets.

As of 2019, personal vehicles are the leading source of total greenhouse gas emissions in London with almost 1 million tonnes of GHG emissions per year[29]. If both passenger-carrying and goods movement fleet CAVs are powered by zero emission technologies such as battery-electric or hydrogen fuel cells, it could significantly reduce greenhouse gas emissions and critical air pollutants associated with transportation[30].

Ride-hailing, taxi vehicles, and goods delivery vehicles typically drive many more kilometres, contributing more greenhouse gas emissions per year than the average personal vehicle. For this reason, incentivizing that shared automated vehicle fleets use zero emission vehicles will support a significant reduction to local greenhouse gas emissions. CAV fleet operators will also need to take in to account the electrical vehicle charging needs for their CAV fleets.

3.2 REDUCE VEHICLE WASTE

The City will harness the widespread adoption of CAVs to minimize waste generated from vehicle upgrades and automated fleets.

VEHICLE WASTE REDUCTION

> Action 3.2.1: Develop and implement policy to incentivize “zero waste to landfills” for CAVs used by fleet operators wishing to operate in London to reduce the amount of waste produced across the lifecycle of CAVs operated by these fleets.

The amount of waste that CAVs could generate over their lifecycles is unknown as CAVs will likely require different kinds of maintenance routines compared against conventional vehicles. Waste streams arising from the disposal of rare-earth minerals used in electric motors and especially lithium-ion batteries may pose new waste management challenges[31]. However, the widespread adoption of CAVs is expected to

[29] City of London. Climate Emergency Action Plan. P.A-26. 2022-04. Available from: https://getinvolved.london.ca/climate
[30] City of Toronto. TransformTO: Climate Action for a Healthy, Equitable and Prosperous Toronto Report #2 – The Pathway to a Low Carbon Future. Environment & Energy. Adopted by City Council 2017-07-04.
[31] Taiebat M, Brown AL, Safford HR, Qu S, Xu M. A review on energy, environmental, and sustainability implications of connected and automated vehicles. Environmental Science & Technology 2018 52 (20), 11449-11465 DOI: 10.1021/acs.est.8b00127. 2018-09-07. Available from: https://pubs.acs.org/doi/10.1021/acs.est.8b00127

significantly reduce the number of collisions on Canadian roads due to CAVs assuming an increasing number of automated functions[32]. Fewer collisions would result in fewer fuel spills because of collisions and less material wastage will be reduced from damaging and repairing vehicles.

CAVs have the potential to encourage a shift in the current ownership model from more of a private ownership model for personal transportation to an increased shared ownership model. If shared ownership models or Mobility-as-a-Service (MaaS) become more wide-spread, the quantity of total vehicles may become fewer and that will reflect less material consumption for car production.

The potential of shared fleets was demonstrated during a study that was conducted among 10,000 car-sharing users in 2013 where approximately 7-10% had decided to drop plans to buy a car and opted into renting instead[33]. This potential for the reduction in waste from an increased prevalence in shared fleet companies has the potential to be amplified with the introduction of CAVs. Shared fleet CAV companies will be able to get more time and use out of their vehicles due to efficient movement and fuel usage. However, this could also result in shorter vehicle lifespans, increased obsolescence, increased zero-occupancy kilometres travelled (ZKT), and other unintended consequences to the environmental waste impacts of CAVs.

The potential introduction of City policies that support the use of environmentally preferable products and services by local CAV fleet operators could reduce greenhouse gas emissions and waste over the lifecycle of the CAV. Environmentally preferable products should have beneficial characteristics including that the product[34]:

- Complies with the latest environmental, health, and safety legislation where applicable;
- Reduces waste and makes efficient use of resources;
- Reduces polluting by-products and/or safety hazards during manufacture, use, and disposal;
- Is reusable or contains reusable parts;

[32] Canada. Parliament. Senate. Standing Committee on Transport and Communications. Driving Change: Technology and the Future of the Automated Vehicle. 2018. P.29. Available from: https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf
[33] Martin E, Shaheen S. Impacts of car2go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions: An Analysis of Five North American Cities. Transportation Sustainability Research Center (TSRC) at University of California, Berkeley. 2016.
[34] Toronto Transit Commission. Green Procurement Policy. 2022. Available from: https://www.ttc.ca/transparency-and-accountability/policies/Materials-and-Procurement-Policies/green-procurement-policy

- Is recyclable in whole or in part;
- Contains recycled materials;
- Has a long service-life, can be economically and effectively repaired, refurbished, or upgraded; and
- Promotes the responsible use of zero-emission fuels or electricity.

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4 SOCIAL EQUITY AND HEALTH

The City will encourage the adoption of CAVs in a manner that improves accessibility, social equity, and prioritizes health and safety for all Londoners.

An intentional focus on equity and inclusion is required to ensure that the introduction of CAVs to the City's mobility network does not introduce new forms of discrimination or accessibility concerns.

Transportation allows people to not only access amenities of daily life, but also to participate in employment, social, and physical activities, connect with family and friends, and contribute to their communities. Access to transportation is also a key factor for positively influencing aging. By embedding a social equity perspective, the introduction of CAVs can unlock new mobility options for Londoners that:

- Currently do not drive due to accessibility restrictions or age limitations and could experience a higher degree of personal freedom through shared CAV use that will allow them to travel on their own;
- Are underserved by the existing mobility network, and, though CAVs, could be provided access to new, more affordable, and faster ways of getting around, connecting them to opportunities across the City; and
- May benefit from an increased perception of safety through drop-offs closer to destination points that could be more easily accommodated with CAVs.

Without a social equity perspective, new mobility business models may not account for the needs of all and may subject certain individuals to price barriers, reduced choice, and poorer service quality. In addition, the potential health benefits of CAVs (e.g. improved safety, reduced noise, etc.) may not be distributed across all neighbourhoods equitably.

This plan aims to alleviate these concerns, building from City strategies focussed on accessibility and socioeconomic equity. This Social Equity and Health section focusses on ensuring barrier-free access for all mobility network users, as well as providing equitable service levels to all neighbourhoods for all trip types.

Table 4: Social Equity and Health – Goals and Actions

Goals	Actions
4.1 Ensure Barrier Free Access for All	4.1.1 Develop and implement a mechanism to provide an appropriate level of barrier-free access to public transit CAVs and ensure that unnecessary limitations are avoided. 4.1.2 Develop and implement policies to ensure that shared fleet companies including CAVs provide an appropriate level of barrier-free access and ensure that unnecessary limitations are avoided. 4.1.3 Identify challenges that individuals with differing abilities may face when accessing shared CAV fleets and public transit. 4.1.4 Develop and implement policy that reduces barriers to gaining technology to access CAVs. 4.1.5 Develop and implement policy and identify resources to support equitable access to CAVs. 4.1.6 Provide access to CAV information and services in multiple languages and formats.
4.2 Increase Mobility Equity	4.2.1 Develop and implement a mechanism to coordinate mobility services to provide equitable service for all trip types. 4.2.2 Develop an engagement strategy to consult key stakeholders in policy development, consultations, implementation, and monitoring of CAV services. 4.2.3 Ensure the Equity and Inclusion and Gender Lenses are utilized in the development of municipal CAV services. 4.2.4 Develop and implement a mechanism for shared CAV fleet companies to report on equitable performance standards and monitor CAV activity data to identify and respond to potentially discriminatory practices. 4.2.5 Develop and implement mechanisms for collecting ongoing feedback from customers to improve overall access to shared CAVs. 4.2.6 Ensure policies that achieve transportation network efficiency objectives do not result in preferential treatment for certain groups.

Goals	Actions
4.3 Promote Health and Safety	4.3.1 Engage with the Middlesex-London Health Unit or similar health agencies to implement monitoring programs to maximize CAV benefits and minimize risks to the public. 4.3.2 Ensure CAVs are continually monitored with the highest regard for personal safety.

4.1 ENSURE BARRIER FREE ACCESS FOR ALL

The City will harness the widespread adoption of CAVs and will ensure all residents have barrier-free access to mobility services.

IDENTIFY AND REMOVE BARRIERS

> Action 4.1.1: Develop and implement a mechanism to provide an appropriate level of barrier-free access to public transit CAVs and ensure that unnecessary limitations are avoided.
>
> Action 4.1.2: Develop and implement policies to ensure that shared fleet companies including CAVs provide an appropriate level of barrier-free access and ensure that unnecessary limitations are avoided.
>
> Action 4.1.3: Identify challenges that individuals with differing abilities may face when accessing shared CAV fleets and public transit.

Individuals living with mobility restrictions or disabilities may experience reduced access to transportation services compared to others. The City is required to adhere to applicable accessibility standards to help support these individuals where feasible. The London Transit Commission's accessible travel network provides customers with disabilities with the freedom and flexibility to travel throughout the City. All conventional bus services are low-floor and accessible. Operator assistance with mobility device securement is available on all buses.

To provide full accessibility in the absence of a driver, CAVs may require advanced robotics for ramp deployment, mobility device securement, and related tasks. Passenger communications and a video link (or similar) to an operations centre for passenger assistance and security should be provided. Discussions will be required to determine how to provide the best user experience to riders of transit CAVs, which may require an on-board attendant.

Specialized Transit services in London provide door-to-door, pre-booked service for individuals requiring fully accessible transportation service. The ability to provide customers of various abilities the freedom and dignity of moving around the community must be maintained in future delivery of these types of services.

While current taxicabs and private transportation company vehicles have human operators available to assist passengers in and out of the vehicle, shared CAVs may result in being inaccessible to many individuals who require extra assistance and do not have their own dedicated support person. A solution may be to require a certain percentage of vehicles be fully accessible and able to accommodate mobility devices.

Onboard attendants (i.e. on public transit and taxi) could provide assistance tailored to the specific needs of customers, including loading and unloading mobility aides and parcels and/or helping individuals get from door-to-door. Such conceptual operating models will need to be explored from a business perspective to consider the best approach with guidance from industry and government best practices.

PROMOTE EQUITABLE ACCESS

> Action 4.1.4: Develop and implement policy that reduces barriers to gaining technology to access CAVs.
>
> Action 4.1.5: Develop and implement policy and identify resources to support equitable access to CAVs.

Individuals living with low income often have few options when it comes to how and when they can access transit for the necessities of daily life, including getting to workplaces. Individuals living with low income are also most likely to find themselves on the wrong side of the "digital divide", lacking access to internet and mobile technology that will be required as CAV technology becomes mainstream. Therefore, municipal investment in automated vehicle infrastructure must be undertaken in an equitable manner that will benefit and improve the experiences of all users, not just those that can afford it.

The City of London's income-related transit program offers a monthly bus pass at a reduced rate for eligible residents whose income is below the low-income cut-off. Eligible participants in receipt of Social Assistance (i.e. Ontario Works and Ontario Disability Support Program (ODSP)) may receive transportation funding support for needs ranging from medical appointments to employment and education. Provincial policy must be followed in providing transportation benefits, which includes issuing funds for the lowest-cost mode of transportation outside of any extenuating circumstances. For transit and shared CAV services to successfully serve all individuals, these services must ensure that technology is not a barrier to access and that they are affordably and predictably priced to serve London's low-income population.

ACCESS FOR NEWCOMERS AND NON-ENGLISH SPEAKERS

> Action 4.1.6: Provide access to CAV information and services in multiple languages and formats.

London is increasingly becoming more diverse and by 2050 it is expected that a vast majority of population growth will be through immigration. London needs to be welcoming to all newcomers and reduce systemic barriers that could impede one's ability to participate fully in the community where they live, work, and play.

Continuing to provide information and access to transportation services in multiple languages and formats will be required throughout the introduction of CAV technology in London. This could include ensuring mobile applications used for booking services are multi-lingual, and onboard announcements are in plain language, with clear enunciation and spoken slowly enough to be understood. Instructions on how to utilize the mobility network within London should also be developed in multiple languages.

The City will need to monitor the changing employment landscape such that the introduction of CAV technologies will not have a disproportionate impact on certain socio-economic groups (e.g. newcomers working in the transportation industry).

4.2 INCREASE MOBILITY EQUITY

The City will harness the widespread adoption of CAVs to ensure reasonably equitable service levels to all neighbourhoods regardless of trip type, vehicle class, or ownership.

EQUITABLE SERVICE COVERAGE

> Action 4.2.1: Develop and implement a mechanism to coordinate mobility services to provide equitable service for all trip types.

London residents live and work differently than they did when much of the existing mobility network was built. Changes in employment and land use patterns mean that workdays and commutes are very different than they were in the past. While CAVs may provide benefits to improving equitable service coverage, fully automated vehicles are not a required feature for LTC and other service providers to explore and implement alternative service delivery models today with human-driven vehicles.

For this reason, the City and the LTC are exploring various initiatives such as:

- Potential increased conventional transit service in the industrial areas along Exeter Road, the Wilton Grove area, the Airport area, and Sovereign Road; and
- Alternative service delivery models for the Innovation Park Area.

An affordable, accessible, and reliable mobility network connects people to jobs, services, and civic life. CAVs – whether operated by public transit agencies or mobility-as-a-service companies – should be able to enhance the overall transportation network and create a completely connected city. CAVs provide an opportunity to expand the accessibility of shared transit services deeper within neighbourhoods that may not be serviced currently and to service employment zones not currently accessible by public transit.

ENGAGEMENT AND FEEDBACK STRATEGY

> Action 4.2.2: Develop an engagement strategy to consult key stakeholders in policy development, consultations, implementation, and monitoring of CAV services.
>
> Action 4.2.3: Ensure the Equity and Inclusion and Gender Lenses are utilized in the development of municipal CAV services.
>
> Action 4.2.4: Develop and implement a mechanism for shared CAV fleet companies to report on equitable performance standards and monitor CAV activity data to identify and respond to potentially discriminatory practices.
>
> Action 4.2.5: Develop and implement mechanisms for collecting ongoing feedback from customers to improve overall access to shared CAVs.

Automated decision-making through mobility platforms may introduce alternative forms of discrimination – both intentionally and unintentionally – that will need to be continually monitored and addressed. Potentially unfair outcomes will result if certain groups consistently experience differential pricing, reduced choice, and poorer service quality when using mobility services. Therefore, it will be essential to develop and implement a continual monitoring system to identify, track, and mitigate against inequitable outcomes as quickly as possible and hold mobility service providers accountable. For example, LTC service standards will need to be updated as deemed necessary based on the emergence of related CAV technologies.

One way to ensure that policies and processes are fair is to engage those with lived experiences to contribute to the creation and continued operation of CAV systems and services in London. Outreach to diverse and underrepresented groups including older adults, newcomers and immigrants, visible minorities, Indigenous persons, LGBTQ+, persons living with low incomes, and persons with disabilities will ensure barriers are identified and strategies to mitigate them are implemented. This will not only create a mutual understanding of community needs, but it will also create a more fair, inclusive, and accessible mobility network that can serve all Londoners' needs.

The City of London currently utilizes tools outlined in the Equity and Inclusion Lens and Gender Lens to ensure that any policies, programs, and services are non-discriminatory, accessible, and do not have an adverse impact on equity seeking groups. Updated equity policies and tools will be utilized throughout the development of CAV technology in London.

Ongoing assessments such as customer service reviews, accessibility audits, safety audits, etc. should be created to ensure any barriers to access are addressed during the development of the CAV systems and services, continuing as the system is implemented.

EQUITABLE ACCESS

> Action 4.2.6: Ensure policies that achieve transportation network efficiency objectives do not result in preferential treatment for certain groups.

London's CAV transportation network should not provide preferential treatment for certain groups of users based on their ability to pay for or otherwise access a premium service or membership. This approach would not prevent the City from providing preferential treatment to certain modes or occupancy types if they achieve certain policy objectives (e.g. reducing congestion, pollution, or protecting vulnerable road users) as it already does.

Today, for example, transit and emergency response vehicles receive regulated (i.e. policy-supportive) priority on the road network and will continue to do so in the future. It is expected that private passenger CAVs or fleet services (taxis) will be governed by privately owned algorithms, but policies should be developed that would prevent these personal vehicles or fleet vehicles from being given unregulated priority in traffic.

Equitable access to the mobility network is currently being explored under the City's upcoming Mobility Master Plan (MMP) including its vision, goals, and prioritization of sustainable modes of travel.

4.3 PROMOTE HEALTH AND SAFETY

The City will harness the widespread adoption of CAVs that will promote equitable health outcomes.

HEALTH MOBILITY

> Action 4.3.1: Engage with the Middlesex-London Health Unit or similar health agencies to implement monitoring programs to maximize CAV benefits and minimize risks to the public.

Health Equity is the principle that all people should be given the opportunity to reach their full health potential and not be disadvantaged from doing so based on race, ethnicity, religion, gender, age, social class, socioeconomic status, or other socially determined circumstances.

In achieving this aim, the City should provide equitable distribution of resources needed for health, access to opportunities, and support offered to people negatively impacted.

It is recognized that there are many unknowns associated with the potential impacts of CAVs due to the ever-evolving technology and policy landscapes. Therefore, monitoring will be important throughout any implementation stage to maximize the benefits of CAVs and mitigate risks and harms to the public.

For further details on potential CAV health impacts, please see the white paper prepared by the Middlesex-London Health Unit (MLHU) in **Appendix D**. The MLHU paper details relevant topics including road safety, health, social health and equity, and environment and climate, highlighting both potential benefits and risks associated with CAV technologies.

PERSONAL SAFETY

> Action 4.3.2: Ensure CAVs are continually monitored with the highest regard for personal safety.

Ensuring the safety of both CAV users and other road users in the vicinity by developing comprehensive, adaptable emergency and safety procedures, and conducting regular safety audits throughout the mobility network will be required. It is expected that all passenger amenities (i.e. benches, stops, etc.) are also designed to the highest safety standards possible, particularly in shared CAV models. The safety of women and girls in London has been mandated by Council a high priority and designs and audits will be

undertaken using a gender lens, like LTC's existing Travel Safe program[35] which provides passengers stops closer to their destination when requested. Consideration for how the system will be utilized by unaccompanied individuals under the age of 18 should also be investigated.

[35] https://www.londontransit.ca/our-services/travel-safe/

5 DATA PRIVACY, SECURITY, AND GOVERNANCE

The City will support and enhance data privacy and transportation network security with a particular focus on the City's collection and use of information generated by CAVs and related systems where authorized by law. Actions will focus on protecting privacy and security through policy and by-law, providing oversight and evaluation, and incorporating privacy principles into any potential collection and use of information generated by CAVs. Further, data gathered should be used to inform the implementation and evaluation of this plan and to improve how the City delivers services.

Data privacy, security, and governance plays a key role in a free society and is an essential element in maintaining public trust. The City is committed to protecting the privacy of individuals and will ensure that security and governance principles play a key role in this process including the values of openness, accessibility, and transparency. These needs are even more apparent with the increasing prevalence of cyber-attacks and other cyber crimes.

With the emergence of CAVs, the volume, velocity, variety, veracity, and value of the "big data"[36] generated and transmitted between vehicles, infrastructure, connected devices, and third-party repositories will increase substantially[37]. However, realizing some of the potential benefits to transportation management, traveller information, safety, compliance, and more – is dependent on establishing stringent standards and clear guidelines around the data interacting and transacting with these vehicles[38].

The City is subject to the Municipal Freedom of Information and Protection of Privacy Act (MFIPPA), which provides a right of access to records in the custody or under the control of the City and requires that the City adheres to the privacy protection provisions under the Act[39]. However, contemporary issues of data governance and ownership still need to be resolved and standards must be in place to protect the data of individuals using CAVs and the general public outside of the vehicle.

[36] https://www.geeksforgeeks.org/5-vs-of-big-data/
[37] Canada. Parliament. Senate. Standing Committee on Transport and Communications. Driving Change: Technology and the Future of the Automated Vehicle. 2018. P.29. Available from: https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf
[38] Deloitte. Connected and Autonomous Vehicles in Ontario: Implications for Data Access, Ownership, Privacy and Security. 2018. Available from: https://www2.deloitte.com/ca/en/pages/consulting/articles/connectedvehiculesontario.html
[39] Municipal Freedom of Information and Protection of Privacy Act, R.S.O. 1990, c.M.56. 2019.

In addition to legislative requirements to ensure privacy, Privacy by Design principles (see **Appendix B**) provide a strong foundation to lead CAV technology developers to take proactive steps to ensure the user's privacy is protected to the maximum extent[40]. Privacy by Design means privacy is seamlessly integrated into products, services, and system designs by default. Protecting public data becomes a guiding force in the user experience, taking the same level of importance as functionality[41].

The future of urban, data-driven mobility depends on the City, private mobility companies, and the public having confidence that their data is being used in the way it is intended, under a robust data governance model.

[40] Cavoukian A. Privacy by Design: The 7 Foundational Principles. 2011-01. Available from: https://www.ipc.on.ca/wp-content/uploads/Resources/7foundationalprinciples.pdf
[41] OneTrust. The 7 Principles of Privacy by Design. 2021-04-06. Available from: https://www.onetrust.com/blog/principles-of-privacy-by-design/

Table 5: Data Privacy, Security, and Governance – Goals and Actions

Goals	Actions
5.1 Protect Public Privacy	5.1.1 Develop and implement a policy framework and Corporate procurement standards to address privacy aspects associated with the City's collection, use, disclosure, and retention of personal information. 5.1.2 Develop and implement an enterprise CAV assurance framework that reflects the City's authority over, and oversight of, data privacy protection across multiple dimensions and domains. 5.1.3 Complete a Privacy Impact Assessment prior to implementing any City initiated CAV program to ensure compliance with MFIPPA. 5.1.4 Develop and implement policies to ensure automated transit vehicle riders understand what personal information is accessed and collected from them by the City. 5.1.5 Develop and implement standard guidelines for the City through which the sufficiency of CAV data privacy protections and information security can be verified.
5.2 Business Intelligence	5.2.1 Identify and support stakeholders within the City, LTC, LPS, and other related agencies that may require CAV business intelligence including relevant data governance models. 5.2.2 Identify and support external stakeholders that may require CAV business intelligence including relevant data governance models.

Goals	Actions
	5.2.3 Develop and implement a policy and mechanism to collect CAV data from third parties. This data should support improved road safety, traffic management, transportation planning, asset management, transportation network security, and other mobility network needs. 5.2.4 Develop and implement robust tools and staff resources to support new data streams from CAVs once benefits justify those investments.

5.1 PROTECT PUBLIC PRIVACY

The City will focus on a robust mechanism for the governance of data (e.g. personal information, georeferenced data, etc.) generated by driving automation systems, and either collected by or provided to the City, is in place prior to the widespread adoption of CAVs. This will ensure that the privacy protection principles set out in MFIPPA are adhered to and will serve to protect the privacy of mobility network users and their personal information.

POLICY FRAMEWORK, PROCUREMENT STANDARDS, AND PRIVACY OVERSIGHT

> Action 5.1.1: Develop and implement a policy framework and Corporate procurement standards to address privacy aspects associated with the City's collection, use, disclosure, and retention of personal information.
>
> Action 5.1.2: Develop and implement an enterprise CAV assurance framework that reflects the City's authority over, and oversight of, data privacy protection across multiple dimensions and domains.

CAVs will create new real-time data connections between vehicles, infrastructure, connected devices, and third-party data repositories. This data can be extremely beneficial from a transportation planning perspective. However, realizing some of the potential benefits to traffic management, traveller information, safety, enforcement and more – is dependent on establishing robust standards and clear guidelines around data ownership and the protection of personal information.

The City and the public need to be confident that their privacy is being protected and that their data is being used in a manner which they have consented to. Additionally, residents should be able to generally understand how these technologies work and the purposes they serve. One way this could be accomplished is through signage that highlights what type of data is being collected in and around the CAV and how it will be used[42].This would be generally available for publicly-owned assets, such as CAV transit, but may be more discreetly agreed to as part of end user agreements with third-party mobility providers, such as with software applications today.

For systems operating within the City's specific control and oversight, all systems would need to be designed, implemented, and maintained based on industry standards specific

[42] Sidewalk Labs. Designing for Digital Transparency in the Public Realm. 2019.

to CAV-related technologies. Prior to integration with City systems, these other systems would be reviewed and approved by the City.

An enterprise CAV assurance framework will ensure that the data privacy and protection aspects of this technology, including threats to the enterprise itself are addressed through an overarching, programmatic approach. An enterprise consists of the people, processes, environment, and automated information systems associated with CAVs and to have a successful assurance framework for this, the capability to withstand attack should be true across all components[43].

DATA PRIVACY STANDARDS

> Action 5.1.3: Complete a Privacy Impact Assessment prior to implementing any City initiated CAV program to ensure compliance with MFIPPA.

The City will complete a Privacy Impact Assessment in response to any CAV related program it initiates. This means addressing privacy and protection of personal information principles at the initial design stages and throughout the development process of new products, processes, or services that involve processing personal information. Further, practicing the seven foundational Privacy by Design principles will be a cornerstone of any CAV-related program[44].

PRIVACY STANDARDS: AUTOMATED TRANSIT VEHICLES

> Action 5.1.4: Develop and implement policies to ensure automated transit vehicle riders understand what personal information is accessed and collected from them by the City.

LTC vehicles today are equipped with video cameras to ensure the safety and security of employees, customers, and property. Recognizing the need to minimize privacy intrusion, LTC currently does not allow any unauthorized copies of data/images in any format (i.e. hardcopy, electronic, etc.) to be taken from the video recording system. LTC will take all reasonable measures to ensure that if connected technologies (e.g. V2X) are introduced into transit vehicles, personal information is not accessible by malicious agents.

[43] Landoll DJ, Williams JR. An Enterprise Assurance Framework. In: Proceedings of the 5th International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises (WET ICE'96). Washington, DC, USA: IEEE Computer Society. 1996. p.118.
[44] Cavoukian A. Privacy by Design: The 7 Foundational Principles. 2011-01. Available from: https://www.ipc.on.ca/wp-content/uploads/Resources/7foundationalprinciples.pdf

PRIVACY AND INFORMATION SECURITY SERVICES

> Action 5.1.5: Develop and implement standard guidelines for the City through which the sufficiency of CAV data privacy protections and information security can be verified.

CAVs, along with their supporting technologies, bring with them increased capabilities and demand for interconnectedness, data analytics, and sharing of information to deliver a better customer experience as well as increased use of cloud computing and mobile devices[45]. However, these better experiences also bring risks: privacy breaches are becoming more common, whether due to human error, employee indiscretion, or cyber-attacks.

To address these challenges, the City should consider adopting a Privacy by Design or similar process – either directly or through a trusted third-party – which would assess CAV products, services, processes, or systems against the privacy by design principles and related privacy protection requirements in MFIPPA, (e.g. through a risk scorecard technique) that meet a threshold of privacy standards. Any process being implemented would similarly be required to undergo appropriate information security assessments to help the City identify and manage known risks to CAV technologies and City infrastructure.

By doing so, the City would ensure privacy and security through every phase of the data lifecycle (e.g. collection, use, disclosure, retention, storage, disposal, or destruction) and foster greater public trust by demonstrating that personal information is secure, and that privacy is being well managed and continuously updated.

5.2 BUSINESS INTELLIGENCE

The City will consider a robust mechanism for business intelligence that enables anonymized data preparation, mining, management, and visualization for CAV resources relevant to City business. Business intelligence tools and processes will allow the City to identify actionable information from raw data, facilitating data-driven decision-making within the City[46].

[45] Privacy and Big Data Institute, Deloitte Canada L.L.P. Privacy by Design Assessment and Certification.
[46] IBM. What is Business Intelligence? 2022. Available from: https://www.ibm.com/analytics/business-intelligence

IDENTIFYING INTERNAL STAKEHOLDERS

> Action 5.2.1: Identify and support stakeholders within the City, LTC, LPS, and other related agencies that may require CAV business intelligence including relevant data governance models.

The emergence of CAV technology will allow for greater business intelligence for a variety of stakeholders within the City. While respecting privacy and anonymity, the City will develop relevant governance models to better serve data-driven decision-making, which will in-turn help internal agencies better direct resources.

IDENTIFYING EXTERNAL STAKEHOLDERS

> Action 5.2.2: Identify and support external stakeholders that may require CAV business intelligence including relevant data governance models.

External stakeholders will likely be interested in data to inform their business intelligence within London. The City may wish to consider sharing certain open data with third parties, provided they comply with data governance models and privacy considerations.

COLLECTION OF DATA FROM THIRD PARTIES

> Action 5.2.3: Develop and implement a policy and mechanism to collect CAV data from third parties. This data should support improved road safety, traffic management, transportation planning, asset management, transportation network security, and other mobility network needs.

CAVs will be a rich source of data due to their high-quality sensors, fast processing capabilities, and extensive travel. These vehicles will be able to collect everything from hyper-local weather data to the quality of road-side lighting, that can be shared with the appropriate parties in the network to assist in their day-to-day activities[47].

The City could potentially be informed when mobility network infrastructure needs to be fixed, providing savings, faster response times, and greater public benefit. Regardless of how fast CAVs are introduced, policy will be needed to shape how this data is shared, impacted by the operational and regulatory requirements from each level of government.

[47] Marshall B. Why smart transportation needs data sharing. Autonomous Vehicle International. 2018-12-21. Available from: https://www.autonomousvehicleinternational.com/opinion/why-smart-transport-needs-data-sharing.html

DATA TOOLS

> Action 5.2.4: Develop and implement robust tools and staff resources to support new data streams from CAVs once benefits justify those investments.

Maximizing the benefits of CAV data streams will require the implementation of new data tools and data use processes. The current data tools and staff resources utilized by the City are not anticipated to be sufficient for managing the new data streams that will be realized through the emergence of CAVs. The associated required resources for new data tools will need to be evaluated as the need arises and before the implementation of such data tools. As with any new data tool, consideration should be given to benefits offered by the tool and if the resource investment is appropriate at that time to justify the investment.

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6 LAND USE AND URBAN FORM

The City will plan for the potential impacts and implications of CAVs in the context of sustainable urban form, land use, growth, development, placemaking, and the approved London Plan.

In the same way cities were shaped by railways and trams in the 19th century, and of private cars in the mid-20th century, the rise of CAVs has the potential to shape the urban form over the next century. Moving forward, planning for CAVs must be "proactive to ensure that autonomous vehicle technology is deployed in a way that maximizes public benefit and does not repeat the mistakes of the automobile era"[48].

Land use and transportation within London are inherently linked, and the benefits of adopting CAVs can also impact the City design, land use, and built form. CAVs have the potential to reduce the amount of parking and street space used by automobiles and can humanize cities by making room for more people-friendly infrastructure like parks and bike lanes. To realize the benefits of CAVs, the City will require a concerted effort to plan accordingly, starting now. By not considering the land use implications in London's infrastructure planning and prioritization process, the City risks sub-optimal allocation of infrastructure funding, a privately owned automobile centric focus, and a reactive approach to integration.

Although much of the future of CAV technology is unknown, planning and integration will be undertaken with a focus on equality, flexibility, and resiliency to maximize the benefits and minimize the negative impacts of CAVs. Actions will focus on properly integrating CAVs into compact development patterns, the public transportation network, and complementing the urban structure to deliver quality neighbourhoods, main streets, and streetscapes.

[48] Regional Planning Association. RPA to Cities: Autonomous Vehicles are Coming, Start Preparing Now. 2017-10-08. Available from: https://rpa.org/latest/news/rpa-to-cities-autonomous-vehicles-are-coming-start-preparing-now

Table 6: Land Use and Urban Form – Goals and Actions

Goals	Actions
6.1 Integrate CAV Infrastructure Elements with Land Use	6.1.1 Ensure the provision of CAV supportive facilities is considered through planning and development applications for major residential, commercial, and mixed-use developments. 6.1.2 Ensure the built form is flexible to support CAV technologies and potential future adaptive reuse for alternative non-automobile uses. 6.1.3 Continue to provide a positive and enriching sense of place through the integration of CAV elements within the public realm, streetscape, buildings, and landscape.
6.2 Protect Urban Structure Integrity	6.2.1 Integrate and provide for CAVs at key transportation hubs such as transit villages, the downtown core, the airport, and other areas which serve as mobility hubs. 6.2.2 Prioritize the implementation of shared, on-demand CAV technologies within the Primary Transit Area to encourage compact development and reduced urban sprawl. 6.2.3 Support active transportation and transit because personal private CAV usage may result in increased pressure for urban sprawl.
6.3 Resilient CAV Policy Development and Implementation	6.3.1 Ensure land use planning policy adapts as CAV technology evolves.
6.4 Reclaim Surplus Land	6.4.1 Reclaim lands freed through CAV technologies for alternative uses that result in positive City Building.

6.1 INTEGRATE CAV INFRASTRUCTURE ELEMENTS WITH LAND USE

Continue to deliver high quality neighbourhoods, buildings, public spaces, and streetscapes while integrating CAV infrastructure elements.

PLANNING AND DEVELOPMENT APPLICATIONS

> Action 6.1.1: Ensure the provision of CAV supportive facilities is considered through planning and development applications for major residential, commercial, and mixed-use developments.

As the demand for CAVs grows, there will be an anticipated need for supportive CAV built facilities. The City will remain diligent when reviewing planning and development applications to ensure these supportive CAV facilities are considered and encouraged in areas which City land use planning policies deem appropriate. Additional detailed design review focus shall be given to CAV built facilities within large scale residential, commercial, and mixed-use developments.

BUILT FORM

> Action 6.1.2: Ensure the built form is flexible to support CAV technologies and potential future adaptive reuse for alternative non-automobile uses.

Purpose built CAV facilities should be appropriately integrated into the built form of existing developments and be strategically planned for in large-scale future developments. CAV built facilities should be complimentary to the overall function, shape, and configuration of the built form, as well as encourage a positive relationship to the streetscape and open spaces.

This positive built form can be achieved through the purposeful design of safe drop off or loading areas or through the provision of flexible curbside space. Standalone built CAV facilities should reflect the unique built character of the place type it is located within as prescribed by the London Plan or the relevant secondary or area plan.

Built CAV facilities should also consider the future adaptive reuse for alternative non-automobile uses should there be a shift in transportation modes. Integrating mobility sharing hubs, which offer active transportation options such as bicycle or scooter sharing services, could aid in the long-term transition of these facilities to another non-automobile uses.

SENSE OF PLACE

> Action 6.1.3: Continue to provide a positive and enriching sense of place through the integration of CAV elements within the public realm, streetscape, buildings, and landscape.

The provision of CAV infrastructure elements within the public realm, streetscape, buildings, and landscape should continue to evoke a positive and enriching sense of place. As a result, CAV infrastructure elements should be screened, buried underground (when possible), or integrated into the overall detailed design of a built CAV facility. It is important to consider recognized placemaking landmarks across the City while also preserving the unique sense of place which is established by the London Plan or applicable secondary or area plans.

6.2 PROTECT URBAN STRUCTURE INTEGRITY

The urban structure relates to the physical form of City. Within the London Plan, the urban fabric is defined by the City Structure Plan which illustrates the various frameworks which shape the city.

PLAN FOR CAVS AT KEY MOBILITY HUBS

> Action 6.2.1: Integrate and provide for CAVs at key transportation hubs such as transit villages, the downtown core, the airport, and other areas which serve as mobility hubs.

Integrating CAVs into key mobility hubs is crucial to offering transportation choices, alternatives, and promoting active transportation options. Key transportation hubs, like transit villages, support a variety of highly dense populations and feature mixed-use residential and urban commercial centers. These mobility hubs are connected strategically through an existing transit system.

CAVs should complement mobility hubs and offer increased opportunities to connect and extend service. CAV built facilities within key mobility hubs should provide active transportation options to offer additional mobility choices.

SHARED CAVS IN THE PRIMARY TRANSIT AREA

> Action 6.2.2: Prioritize the implementation of shared, on-demand CAV technologies within the Primary Transit Area to encourage compact development and reduced urban sprawl.

The Primary Transit Area is located within the Urban Growth Boundary (UGB) and within the existing Built Area Boundary of the City. The Primary Transit Area aims to accommodate increasing levels of urban density and higher levels of transit investment. The area also focuses on improvements to the pedestrian realm and investment in active transportation infrastructure.

The wide scale commercialization of CAV technology may result in higher demands for transit investment and present new business and growth opportunities. This commercialization of CAV technology could manifest in new automated delivery, freight transportation businesses, expanded ride-hailing and car sharing business models, or even privatize shuttle transit services.

PLAN STRATEGICALLY FOR GROWTH

> Action 6.2.3: Support active transportation and transit because personal private CAV usage may result in increased pressure for urban sprawl.

Cities are shaped by where people live and how they travel. Mobility options impact the way people make decisions about where to live, work, and recreate. There is a general societal preference and tendency to live within a 30-minute commute from their destination, which is commonly known as "Marchetti's constant"[49]. This is a trend that has persisted throughout the major technological revolutions and may be challenged with the introduction of CAVs. The settlement and development areas should not be expanded as a result of changed behaviour associated with CAVs and an increased willingness to locate in more remote areas of the City.

The UGB should be maintained to clearly contain and limit urban expansion. A key direction of The London Plan is to direct development "inwards and upwards" to ensure development is strategically located to support and benefit from public transit expenditure, to support walkable communities and to ensure infrastructure is efficiently used. New growth should continue to be promoted as intensification and located where

[49] P. Thakur, R. Kinghorn, R. Grace. Urban Form and Function in the Autonomous Era. What shapes cities. p.2. 2016.

it supports transit ridership, walking and biking, and utilize CAVs as a supportive technology.

6.3 RESILIENT CAV POLICY DEVELOPMENT AND IMPLEMENTATION

Resilient public policy aims to establish an equilibrium of balance between current day and future policy needs and challenges as CAV technologies emerge.

EMERGING CAV TECHNOLOGY

> Action 6.3.1: Ensure land use planning policy adapts as CAV technology evolves.

The long-term implications that CAVs will have on municipalities has yet to be realized. The City must remain agile and flexible from a land use planning policy standpoint to maximize the benefits and mitigate the challenges that arise from CAVs. The City will monitor the technological advancements in the field of CAVs and resulting best practice development. A continued and coordinated approach to policy development will include input from industry leaders, provincial stakeholders, and citizens.

6.4 RECLAIM SURPLUS LAND

CAV technology has the potential to create efficiencies in the mobility network which can result in surplus land that is no longer needed for vehicle movement or storage.

SURPLUS LAND USES FOR CITY BUILDING

> Action 6.4.1: Reclaim lands freed through CAV technologies for alternative uses that result in positive City Building.

Surplus land that was previously used for vehicle movement or storage can be reclaimed and repurposed for other uses that result in City Building. The City will monitor the use of land and identify surpluses that arise from efficiencies or redundancies associated with CAV technology to reuse and repurpose when they become available.

We will establish priorities for lands that will become available due to space saving benefits of CAVs based on creating more complete streets and for uses that will result in City Building. Reclaimed land from obsolete parking on streets would be available to transition to CAV supportive infrastructure such as pick-up and drop-off areas or to be repurposed for more human-centric uses. Surplus width along roads should be allocated to increase pedestrian space, create new or enhance existing bike lanes, provide new patio spaces, tree plantings, and street furniture.

Less demand for surface parking lots in the downtown, Old East Village, and institutional campuses including Fanshawe College, Western University, and the hospitals could catalyze development interest for new housing or new affordable housing which could create more equitable land use and provide additional benefits. The City will thoughtfully and efficiently utilize newly available or reclaimed land for a variety of uses that result in City Building and are most appropriate for the area context.

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7 ECONOMIC SUSTAINABILITY

The City will support and enhance sectors related to the development and use of both CAVs and associated technology, with a particular focus on retaining and attracting industries, investment, and employment. Actions related to Economic Sustainability will aim to expand London's regional position as it relates to CAVs.

London is well suited to lead in adopting both the public and commercial use of CAVs. The local presence of institutions including Western University, Fanshawe College, the Canadian Centre for Product Validation, National Research Council (NRC), TechAlliance, Chamber of Commerce, London Economic Development Corporation (LEDC), and Small Business Centre combined with Ontario's automotive manufacturing sector may provide future opportunities for CAV-related research and development. The London region's rapid growth in agri-food production, advanced manufacturing, and logistics, poise London to become a leader in CAV technology use for commercial logistics.

To prepare for an ecosystem of both public and private CAV's, the City of London will continue to follow the economic pillars in the 2019-2023 Council Strategic Plan in relation to CAV's

Table 7: Economic Sustainability – Goals and Actions

Goals	Actions
7.1 Develop a Top-Quality Workforce	7.1.1 Increase access to talent with expertise in CAV technologies that employers require. 7.1.2 Increase collaboration opportunities regarding CAVs between potential employers, post-secondary institutions, and other employment and training agencies.
7.2 Attract New Jobs and Investments	7.2.1 Increase regional partnerships that promote collaboration, innovation, and investment within the CAV industry. 7.2.2 Increase public and private investment in strategic locations and amenities that support the CAV industry and a talented workforce. 7.2.3 Maintain and increase foreign investment attraction, local retention, and entrepreneurship support programs in the field of CAVs.
7.3 Create a Supportive and Thriving Environment	7.3.1 Increase access to supports for CAV-related entrepreneurs, small businesses, and community economic development. 7.3.2 Increase the efficiency and consistency in the City's administrative and regulatory processes related to CAVs. 7.3.3 Increase the availability of serviced land in strategic locations to support the CAV industry.

7.1 DEVELOP A TOP-QUALITY WORKFORCE

The City will harness the widespread adoption of CAVs to ensure a smooth transition in the workforce to meet the needs of tomorrow.

INCREASE ACCESS TO TALENT

> Action 7.1.1: Increase access to talent with expertise in CAV technologies that employers require.

As CAV technologies emerge and become more common place in London, it is likely that employers will need technical expertise required to work with CAVs including their operation, shared fleet management, maintenance, logistics, commercial use, and other yet to be discovered market demands. The City should consider these needs and look for incentives (as appropriate) to help attract and retrain access to such talent as employers discover the skills required to grow the field of CAV expertise within the London region.

INCREASE TRAINING OPPORTUNITIES

> Action 7.1.2: Increase collaboration opportunities regarding CAVs between potential employers, post-secondary institutions, and other employment and training agencies.

Partnerships can be made with the post-secondary and skills training institutions to create and enhance programs that look to attract, train, and retain talent in the necessary fields of CAVs. This could include manufacturing, research, design, and technical support skills. In partnership with the London and Middlesex Local Immigration Partnership and the LEDC, ensure that London employees and employers have a pipeline to the skilled talent they need through skilled immigration recruitment, programs, and connections.

Further, it may be beneficial to consider those employees displaced due to the adoption of CAV technologies including the identification of skills gaps and look for opportunities for re-skilling and training as appropriate through local partnerships and institutions. For example, post-secondary institutions could implement talent development programs that cater to the needs to industries impacted with the adoption of CAV technologies.

Through the establishment of a strong base of CAV talent and expertise across industries, London will be better positioned to attract conventions, conferences, and multi-day events to the city that contribute to the community's economic prosperity in the field of CAVs

7.2 ATTRACT NEW JOBS AND INVESTMENTS

Through proper city design in urban, industrial, and commercial areas, the City can help encourage the widespread adoption of CAV technologies, leading to the attraction and retention of additional investment in the economic sectors related to these technologies.

INCREASE PARTNERSHIPS

> Action 7.2.1: Increase regional partnerships that promote collaboration, innovation, and investment within the CAV industry.

The City will undertake regional planning partnerships with neighbouring municipalities and promote regional connectivity. London currently has strengths in advanced manufacturing and can use this niche ecosystem to encourage CAV research, design, and manufacturing in the region. These partnerships do not need to simply be related to commercial industries and CAV technologies, but also to mobility opportunities as well.

For example, through the growth of recent regional projects such as Middlesex County Connect[50], London can be part of developing strategic partnerships. These partnerships can encourage the adoption of CAVs as part of transit fleets and promote the ability for CAVs to arrive at regional mobility hubs, where users can then proceed via local transit.

INVESTMENT IN STRATEGIC LOCATIONS AND AMENITIES

> Action 7.2.2: Increase public and private investment in strategic locations and amenities that support the CAV industry and a talented workforce.

Through existing Community Improvement Plans as well as the creation of new, CAV-specific plans or addenda, incentives can be considered that will encourage the adoption and investment of CAV technologies in various industries at these strategic locations. Further, investments through incentives, funding, sponsorships, and donations in amenities that support CAV usage will promote the widespread community adoption of CAV technologies as they emerge.

[50] https://middlesex.ca/living-here/community-transportation

ATTRACTION AND RETENTION

> Action 7.2.3: Maintain and increase foreign investment attraction, local retention, and entrepreneurship support programs in the field of CAVs.

Ensure job growth through attraction of new capital from a diverse range of markets and industries to support the field of CAVs. Continue to monitor and pursue relevant investment opportunities that serve London's niche markets and grows local jobs and expertise in CAV technologies.

7.3 CREATE A SUPPORTIVE AND THRIVING ENVIRONMENT

London will continue to create an environment that encourages innovation and investment in start-ups and small businesses in the field of CAVs.

ACCESS TO SUPPORTS

> Action 7.3.1: Increase access to supports for CAV-related entrepreneurs, small businesses, and community economic development.

Support entrepreneurs, start-ups, and scale-up companies in the field of CAVs. Through the City's partnerships with the London Economic Development Corporation, TechAlliance, Small Business Centre, Chamber of Commerce, and their networks to the private sector employers, the City will work to increase access to supports for entrepreneurs, small businesses, and community economic development

EFFICIENCY AND CONSISTENCY

> Action 7.3.2: Increase the efficiency and consistency in the City's administrative and regulatory processes related to CAVs.

As CAV technologies and services emerge across London, the City will need to review it's existing administrative and regulatory processes and look for improvement opportunities to enhance London's competitiveness as a place to do business. This could include such considerations as access and navigation of City services and supports through Service London Business.

SERVICED LAND

> Action 7.3.3: Increase the availability of serviced land in strategic locations to support the CAV industry.

Continue to invest in land acquisition and servicing to encourage in the research and manufacturing of CAVs and associated components like the existing conditions of the automotive industry in the London area. This may include making changes to the City's industrial land development strategy should it be decided to target CAV-specific manufacturers or related industries.

8 CITY FLEET AND SERVICES

The City will enhance its fleet and services through CAVs and related systems for the purpose of improving safety and public service delivery. Actions will evaluate the transformation of fleet vehicles and City services as well as potential impacts to employment and labour needs.

There are several actions that the City needs to prepare internally in order to be ready for the emergence of CAVs and their operations across the mobility network in London.

Similar to the other areas of focus in this plan, the City will need to consider it's specific services and how they are delivered through the use of CAV technologies. This will likely begin with the choice to engage in the use of CAV technologies in various forms as the usage of this emerging technology becomes more appropriate, its safety level is deemed acceptable to City workers and the public, and associated risks with the usage of this technology are appropriately managed.

Even under existing conditions and taking into consideration this strategy, the City will need to identify and futureproof projects today where appropriate for the eventual implementation of CAV technologies, even though this may still be years or even decades away. However, there will still be opportunities for the early emergence of CAV technologies, especially where connected infrastructure is involved.

Because of these efforts, there will be an eventual impact on people services and labour due to the emergence of CAV technologies. Although these impacts may still be years away, the City will need to be thoughtful and proactive in its implementation of CAV technologies to mitigate risks to its people and the long transitional period that will likely last decades.

Table 8: City Fleet and Services – Goals and Actions

Goals	Actions
8.1 City Services and Fleet Vehicles	8.1.1 Ensure the City takes action to integrate CAVs and mitigate employee commutes contributing to congestion. 8.1.2 Develop and implement policies that address potential safety issues and benefits from the use of CAV fleet vehicles. 8.1.3 Develop and implement a mechanism to review and enhance the cost and operational effectiveness of CAV fleet vehicles. 8.1.4 Develop and implement policies and mechanisms to safeguard the operation and data security of CAV fleet vehicles. 8.1.5 Develop and implement the infrastructure to provide charging and fueling services for zero-emission fleet CAVs. 8.1.6 Support the integration of CAV technologies into the London Transit Commission's vehicle fleet. 8.1.7 Manage the transition to CAVs by ensuring long-term contracted services account for the ability to upgrade technology over the contract term. Develop and implement standards for the integration of partial automation into contracted services. 8.1.8 Develop and implement a mechanism to collect urban environmental data from fleet CAVs. This data collection should support improved road safety, traffic management, transportation planning, asset management, and transportation network security, consistent with Privacy by Design principles.
8.2 Future-Proofing	8.2.1 Develop and update the City's travel demand models to accommodate CAV forecast scenarios. 8.2.2 Develop and update new or improved building standards that allow for flexibility in retrofitting buildings for future needs associated with CAVs. 8.2.3 Research emerging practices in updating forecasts and infrastructure investment decisions to accommodate future needs associated with CAVs.

Goals	Actions
	8.2.4 Develop and implement robust indicators to monitor the transition from human-driven vehicles to CAVs as well as their associated impacts on the mobility network and delivery of City services.
8.3 People Services and Labour	8.3.1 Implement working groups between People Services and the City's various unions to understand and respond to emerging labour opportunities and challenges associated with the emergence of CAV technologies. 8.3.2 Support the development and implementation of a transit services business model with increased focus on customer service and the user experience. 8.3.3 Provide staff resourcing as appropriate to support and manage the implementation of CAV initiatives in a timely manner to coincide with the emergence of specific CAV technologies and related inter-governmental laws, policies, and regulations.

8.1 CITY SERVICES AND FLEET VEHICLES

CAV technologies are being developed not only for the passenger and freight sectors, but also for the delivery of public services. Many companies are exploring how automation can contribute to improved traffic safety, worker conditions, system efficiency, and a lower environmental impact. For example, self-driving street cleaning vehicles are being developed internationally that can automatically trace and pick up garbage, as well as trim roadside bushes, while sensing and monitoring the vehicle's vicinity to avoid obstacles in its path[51]. This plan proposes to make the most of developments such as these to improve road and worker safety relating to municipal fleet vehicles and more effective public service delivery.

LEADING BY EXAMPLE

> Action 8.1.1: Ensure the City takes action to integrate CAVs and mitigate employee commutes contributing to congestion.

The City will lead by example by:

- Integrating CAVs into the fleet where financially feasible and where there is a net benefit to the City services provided;
- Incentivizing and encouraging employees to commute by active transportation or transit first, and by implementing parking policies that encourage this; and
- Incentivizing and encouraging employees to travel for work-related business by active transportation or transit first where there is a net benefit to the City services provided.

ROAD SAFETY

> Action 8.1.2: Develop and implement policies that address potential safety issues and benefits from the use of CAV fleet vehicles.

Employees at the City have a duty to protect the interests of the residents of London by carrying out municipal work in a safe and efficient manner and to maintain good public relations with those who use the City roadways. CAVs provide a new opportunity to update vehicles and equipment to contribute to improved road safety.

[51] Xinhua. Chinese firm develops self-driving street cleaning vehicles. ChinaDaily [Internet]. 2018-04-27. Available from: http://www.chinadaily.com.cn/a/201804/27/WS5ae2b5e4a3105cdcf651aeb2.html

VEHICLE EFFECTIVENESS

> Action 8.1.3: Develop and implement a mechanism to review and enhance the cost and operational effectiveness of CAV fleet vehicles.

A business plan will be needed to address City fleet organizational and operational practices and procedures that support the introduction of CAV technology.

VEHICLE SECURITY

> Action 8.1.4: Develop and implement policies and mechanisms to safeguard the operation and data security of CAV fleet vehicles.

CAVs may be vulnerable to exploitation from a cybersecurity perspective by malicious actors. The third-party and cloud service providers through which vehicle-to-vehicle communications (V2V), vehicle-to-infrastructure communications (V2I), and vehicle-to-everything (V2X) communications could take place provide a multitude of attack vectors for a person or entity attempting to gain access[52]. For this reason, potential cybersecurity threats to public sector fleet vehicles (similar to other CAVs) will be considered as CAV features are integrated into their operations.

Operational Technology standards under development by the National Institute of Standards and Technology (NIST) or similar organizations[53] will be the likely source of these security requirements. In order to manage these security risks, the City will need to mandate threshold cybersecurity requirements of fleet capital acquisitions.

VEHICLE CHARGING AND FUELING

> Action 8.1.5: Develop and implement the infrastructure to provide charging and fueling services for zero-emission fleet CAVs.

Regardless of the method of "fuel" for future zero-emission fleet CAVs – whether electricity, hydrogen, or other – the City will need to work with London Hydro and other energy utilities to manage the energy services required to power these fleets. As fleet

[52] Moysa G, Koczerginski M. The Cybersecurity Implications of Driverless Cars. McMillan LLP. 2016-12. Available from: https://mcmillan.ca/insights/the-cybersecurity-implications-of-driverless-cars/
[53] NIST. Guide to Operational Technology (OT) Security: NIST Requests Comments on Draft SP 800-82r3. 2022-04-06. Available from: https://csrc.nist.gov/news/2022/guide-to-operational-technology-ot-security

CAVs begin to meet and address some of these needs, the City will need to ensure that charging and fueling services infrastructure is available.

TRANSIT FLEET VEHICLES

> Action 8.1.6: Support the integration of CAV technologies into the London Transit Commission's vehicle fleet.

Cases for incorporating various technology packages into automated transit should be considered where appropriate and appropriate training provided. For example, an SAE Level 1 or 2 automated transit could assist with: smooth acceleration and deceleration, automatic emergency braking and pedestrian collision avoidance, curb avoidance, precision docking, narrow lane/shoulder operations, green light optimal speed advisory, and platooning. Higher level automation packages could be deployed in maintenance and yard operations as well as shuttle, rapid transit, and mobility-on-demand services (e.g. specialized transit)[54].

CONTRACTED SERVICE VEHICLES

> Action 8.1.7: Manage the transition to CAVs by ensuring long-term contracted services account for the ability to upgrade technology over the contract term. Develop and implement standards for the integration of partial automation into contracted services.

Recognizing that many of the City's services are provided via long-term contracts – the City will consider the transition to CAVs in these partnerships as well, by maintaining its ability to upgrade technology over the contract term, as well as developing and implementing standards for the integration of partial automation that will improve the delivery of contracted services and support safety.

DATA COLLECTION

> Action 8.1.8: Develop and implement a mechanism to collect urban environmental data from fleet CAVs. This data collection should support improved road safety, traffic management, transportation planning, asset management, and transportation network security, consistent with Privacy by Design principles.

Data can be collected from public service vehicles for increased integrity and accountability, including collision reporting, accuracy data, data on the role of the vehicle and the driver, fuel data, and more. This data will be used for the overall

[54] US Department of Transportation. Federal Transit Administration. Strategic Transit Automation Research Plan. 2018.

improvement of service delivery through aspects of vehicle safety, traffic management, and asset management.

8.2 FUTURE-PROOFING

There are many uncertainties around the long-term impacts of driving automation systems that may need to be considered and addressed by the City over the next decade. Studies and modelling exercises can be undertaken to anticipate the future of this technology as it relates to travel demand, planning and investment. This will help proactively generate policy options and solutions to be implemented in the short term, based on the foreseeable future.

TRAVEL DEMAND MODELLING

> Action 8.2.1: Develop and update the City's travel demand models to accommodate CAV forecast scenarios.

Travel Demand Models are computer programs which forecast how people use mobility networks. They are used to test the implications of infrastructure (e.g. the addition of a new road or higher-order transit line), policy (e.g. changes to transit service levels or fare policies), human behaviour (e.g. COVID-19 restrictions), or technology (e.g. CAVs) changes on future travel patterns.

These forecasts of future travel patterns are based on projected land use, demographics, and the region's existing travel patterns, through variables such as population, employment, households, current travel behaviour, big data, and more. Outputs can include traffic volumes for various roadway segments, ridership on transit routes, travel times, accessibility assessments, environmental emission analyses, and road safety analyses.

A variety of modelling tools can be used to understand the impacts of CAVs. A few potential changes that could be considered to expand CAV modelling capabilities include changes to: vehicle ownership (i.e. private vs. shared) and availability, coordinated activity patterns, location choice and land use, mode share, and network supply and performance with mixed or full CAV traffic streams[55].

[55] TRB Special Committee for Travel Forecasting Resources. Autonomous vehicles: Modeling frameworks. TFResource. 2018.

The travel demand modelling action will improve the City's capability to forecast travel behavior changes associated with the introduction of CAVs and the implications of possible CAV-related policies.

BUILDING STANDARDS

> Action 8.2.2: Develop and update new or improved building standards that allow for flexibility in retrofitting buildings for future needs associated with CAVs.

Land use and transportation patterns are inherently linked together and CAVs could radically change both. Some potential impacts to the future of building design with the introduction of CAVs include[56]:

- "Smart" buildings that can communicate with vehicles;
- Increased pick-up and drop-off at buildings that could impact building design;
- Changes to utility infrastructure including electrical charging stations;
- Minimized parking or flexible parking infrastructure for other uses;
- Consideration for CAV vehicle access; and
- Building exits and fire safety considerations.

PLANNING AND INVESTMENT

> Action 8.2.3: Research emerging practices in updating forecasts and infrastructure investment decisions to accommodate future needs associated with CAVs.

CAVs will challenge the existing business models of transportation providers and infrastructure developers. This model includes public authorities incorporating fixed, physical infrastructure with no smart capabilities that can only be used by human-operated vehicles. This system limits the parameters of vehicle advancements including traffic management improvements[57].

Transportation-infrastructure providers will need to consider changes to infrastructure investment based on consumer attitudes related to CAVs. With an uptake in CAV use, highway authorities will need to understand how these vehicles see – whether that includes updating the maintenance of infrastructure or incorporating connected vehicle

[56] Voll S. How connected, self-driving vehicles could change building design. Ideas. 2016-09.
[57] Bamonte TJ. Autonomous Vehicles: Drivers of Change. TM&E. 2013.

technology altogether. In London, this is especially important as it pertains to inclement weather including snow or fog. Assisting these vehicles in "seeing" better by customizing infrastructure to improve its visibility for CAVs, could be a priority in the future. London may have the opportunity to serve in its unique environmental role during inclement conditions in data gathering, testing, and pilots for CAV technologies. There is also an opportunity for infrastructure providers to share information to improve travel for all road users.

The City will monitor emerging practices in updating forecasts and infrastructure investment decisions to ensure that any future needs of CAVs are addressed in the correct timeframe.

MONITORING INDICATORS

> Action 8.2.4: Develop and implement robust indicators to monitor the transition from human-driven vehicles to CAVs as well as their associated impacts on the mobility network and delivery of City services.

This plan is based on the available products and forecasts around when highly automated vehicles will emerge on London's streets. It has been built with the understanding that there is still a lot of uncertainty within this industry – and that the City should focus on taking action on items that are relevant in the short-term.

As CAV technology develops, impacts to the mobility network and delivery of City services will emerge and the City's forecasts around what those may be will likely evolve with the technology. As such, monitoring indicators are an important aspect of measuring the on-going validity of this Plan. City staff will develop and implement indicators to monitor the transition from human-driven vehicles to automated vehicles, as well as their associated impacts on the City of London organization, to ensure that this plan continues to develop with these changes.

8.3 PEOPLE SERVICES AND LABOUR

Like the CAV technologies themselves, there are many uncertainties around the long-term and gradual impacts of these technologies on the labour force due to automation, which raises many questions that cannot be readily answered at this time. This plan looks to monitor these anticipated changes as they emerge and work with affected stakeholder groups to adapt to these emerging CAV technologies.

CITY WORKERS AND LABOUR UNIONS

> Action 8.3.1: Implement working groups between People Services and the City's various unions to understand and respond to emerging labour opportunities and challenges associated with the emergence of CAV technologies.

Working groups will be required to help tackle the challenges of emerging automation and CAV technologies to safeguard employee roles and seek opportunities to leverage existing City services and improve efficiencies in the delivery of services. It is anticipated that while these technologies may be disruptive, they will similarly provide the emergence of new opportunities yet to be understood. For example, in the past century, the demise of the horse and buggy (e.g. blacksmithing, horse livery, etc.) gave way to new opportunities with the automobile not previously seen (e.g. manufacturing, mechanics, etc.).

TRANSIT OPERATORS

> Action 8.3.2: Support the development and implementation of a transit services business model with increased focus on customer service and the user experience.

Although the role of transit operators may change with the emergence of CAV technologies, there may be an opportunity to provide improved customer service and experience for users. For example, some automated vehicle shuttles could include a concierge to aid customers. This could aid everyday users and users that have greater mobility needs to make transit accessible to all and improve the public's experience.

IMPLEMENTATION MANAGEMENT AND LEADERSHIP SUPPORT

> Action 8.3.3: Provide staff resourcing as appropriate to support and manage the implementation of CAV initiatives in a timely manner to coincide with the emergence of specific CAV technologies and related inter-governmental laws, policies, and regulations.

There are still many unknowns in the emergence and implementation of CAV technologies in London and across Ontario. While some CAV implementation initiatives may be years or possibly even decades away, others may emerge more quickly such as through the Province of Ontario's Automated Vehicle Pilot Program[58] or other inter-governmental initiatives where regulation or policy changes may occur within months.

[58] https://www.ontario.ca/page/automated-vehicle-pilot-program

The City needs to be ready and flexible to undertake these challenges and opportunities as they arise to ensure that the public is protected and CAV technologies are operated safety across London's mobility network. Therefore, dedicated City staffing resources need to be knowledgeable of and monitor emerging challenges and opportunities to provide updates and proposals to Council and the Senior Leadership Team.

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APPENDIX A: GUIDING PRINCIPLES AND STRATEGIES

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The entirety of the Connected and Automated Vehicle Plan is built upon background and complementary principles and strategies, both previous and ongoing, developed for and by the City of London. This appendix details these sections, and which Strategic Areas of Focus they reference.

2019-2023 Strategic Plan for the City of London[59] – CAV Plan, Section 2, 3, 6, and 7

Strengthening Our Community

- Londoners have access to the supports they need to be successful.
- Londoners have access to the services and supports that promote well-being, health, and safety in their neighbourhoods and across the city.

Building a Sustainable City

- London has a strong and healthy environment.
- Londoners can move around the city safely and easily in a manner that meets their needs.

Growing Our Economy

- London will develop a top-quality workforce.
- London is a leader in Ontario for attracting new jobs and investments.
- London creates a supportive environment where entrepreneurs, businesses, and talent can thrive.

Creating a Safe London for Women and Girls

- London has enhanced the potential for women and girls to live safe lives.

[59] https://london.ca/sites/default/files/2020-09/2019%20Strategic%20Plan.pdf

Access and Privacy Policy (Amended August 10, 2021)[60] – CAV Plan, Section 5

4.1 Purpose and Policy Statement

Transparency

As identified in the City's Strategic Plan, the promotion of an open and transparent government is important to the City of London.

The City of London is committed to both the routine disclosure and the active dissemination of records when consistent with the principles and rules of the Act.

The City of London will provide access to records and information in accordance with the principles and rules of the Act.

Accountability

The City of London will take reasonable steps to protect the collection, use, access, and disclosure of personal information.

The City of London will facilitate an individual's right of access as well as the ability to correct their personal information in the custody or under the control of the institution, subject to any legislative exemptions.

Age Friendly London Action Plan (2017-2020)[61] – CAV Plan, Section 4

Includes the implementation of 5 core strategies:

- Engage and empower older adults.
- Engage older adults in planning and development of transportation initiatives
- Improve the accessibility of city roads and sidewalks.
- Improve accessibility of public transit.
- Improve transportation options for older adults across the city.

[60] https://london.ca/council-policies/access-privacy-policy
[61] https://london.ca/living-london/community-services/senior-supports/age-friendly-london-network

Climate Emergency Action Plan (2022)[62] – CAV Plan, Section 3 and 8

City Council continues to recognize the importance of climate change mitigation, climate change adaptation, sustainable energy use, related environmental issues, and the need for a more sustainable and resilient city. The Climate Emergency Action Plan will propose aggressive long-range greenhouse gas reduction goals for both municipal operations and the community as a whole to mitigate and adapt to climate change.

As part of the Climate Emergency Action Plan, City staff are committed to exploring opportunities to reduce and/or eliminate fossil fuels used by the City fleet. The procurement process for zero emission vehicles and its eventual adoption by Fleet Services is dependent upon the following factors: operational service levels, product performance, fleet uptime, charging infrastructure, and financial feasibility. As identified in the CEAP, Fleet will report back to council in 2023 on procurement plans required to support the following objectives:

- All new passenger vehicles (cars, vans, SUVs) procured to be electric vehicles or other zero emission vehicles as of 2025
- All new light and medium duty work vehicles and equipment (pick-up trucks, work vans, heavy duty diesel pick-ups) procured to be electric or other zero emission fuel alternatives where available as of 2028
- All external fleet rental and lease contracts be amended to require supply of light and medium duty vehicles and equipment that are electric or other zero emission fuel alternatives as of 2028
- All new heavy-duty vehicles and equipment for the City of London's vehicle fleet be electric or other zero emission fuel alternatives as of 2030, subject to availability and performance

[62] https://ehq-production-canada.s3.ca-central-1.amazonaws.com/a977e064685459374c4eaf9370fc3b7def67ef2d/original/1658839852/02c78ed9061bf7f908c45e5332572f3c_CEAP_April_2022_Final.pdf?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIBJCUKKD4ZO4WUUA%2F20220812%2Fca-central-1%2Fs3%2Faws4_request&X-Amz-Date=20220812T201633Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=4d0f9522a5384e372f359cc261ab85bab8812a1fdec1878ba493bad9797dd51b

- All new City of London hand-held, portable, and light-duty off-road equipment procured to be electric or other zero emission equipment as of 2025

Climate Emergency Declaration (2019)[63] – CAV Plan, Section 8

On April 23, 2019, the following Declaration of a Climate Emergency was approved by City Council.

"Whereas climate change is currently contributing to billions of dollars in property and infrastructure damage worldwide, stressing local and international economies;

Whereas climate change is currently jeopardizing the health and survival of many species and other natural environments worldwide, stressing local and international eco systems;

Whereas climate change is currently harming human populations through rising sea levels and other extraordinary phenomena like intense wildfires worldwide, stressing local and international communities;

Whereas recent international research has indicated a need for massive reduction in carbon emissions in the next 11 years to avoid further and devastating economic, ecological, and societal loss;

Whereas the climate in Canada is warming at twice the rate of the rest of the world, as per Canada's Changing Climate report;

Whereas current initiatives such as the greening of the city's fleet and energy reduction initiatives are not sufficient to meet the targets as defined by the IPCC scientists,

Whereas an emergency can be defined as "an often dangerous situation requiring immediate action"; Whereas municipalities such as Kingston, Vancouver and Hamilton have already declared climate emergencies;

Therefore, a climate emergency BE DECLARED by the City of London for the purposes of naming, framing, and deepening our commitment to protecting our economy, our eco systems, and our community from climate change."

[63] https://london.ca/living-london/water-environment/londons-climate-emergency-declaration

Complete Streets Design Manual (2018)[64] – CAV Plan, Section 2 and 6

London's vision for complete streets is informed by policies 211-218 of The London Plan as well as best practices in the field of complete streets planning and design.

The following statement captures the overarching vision for the London Complete Streets Design Manual:

> 1 London's streets will be designed and upgraded to be more complete.
>
> 2 This means that streets in London will meet the needs of a wide range of users as defined by the place type, feature high-quality pedestrian environments, and integrate seamlessly with transit services, cycling networks, and automobile users.
>
> 3 London's streets will be designed for connectivity and support the use of active and sustainable modes of transportation, and also strongly consider the needs of utility and maintenance providers within the right-of-way.
>
> 4 With this balance of modes, users, and places in mind, all future construction, reconstruction, and rehabilitation projects for streets – both large and small – in London will be influenced by principles of "completeness" in both planning and design.

This vision is the foundation for the design guidance and process tools contained in this Manual. The City's core principles for complete streets build directly upon this vision.

Prioritize safe and accessible options for people

> Streets should be designed to be inclusive and accessible and that the various needs of users of all ages and abilities are accommodate to the maximum degree possible.

2.4 Motor Vehicles

> A heavy reliance on single occupancy vehicle travel results in pollution, congestion, costly infrastructure expansion, a significant proportion of land being devoted to parking, an undesirable public realm, greater risk to

[64] https://london.ca/sites/default/files/2020-09/Complete%20Streets%20Design%20Manual.pdf

vulnerable road users and reduced viability of other travel modes. From a street design perspective, the need to accommodate motor vehicles must therefore be balanced with the need to provide sufficient space for other modes of travel and the desire to create an attractive public realm.

Gender Equity Lens (2017) and Equity and Inclusion Lens (2019) – CAV Plan, Section 4

These lenses are to be used together and will help City staff analyze the impact of policies, programs, and services on residents from diverse communities, background, and identities and adjust those policies to remove any barriers and better serve the community's needs. The use of these policies will assist the Corporation to meet its obligations under the Ontario Human Rights Code (OHRC) and Accessibility for Ontarians with Disabilities Act (AODA) by ensuring that policies, programs, and services are non-discriminatory, accessible, and do not have an adverse impact on equity-seeking groups.

London and Middlesex Local Immigration Partnership Strategic Plan (2022-2025)[65] – CAV Plan, Section 4

This community plan is a collaborative community initiative designed to strengthen the role of our community in serving and integrating immigrants. The plan works to achieve five overarching outcomes: Welcoming Community, Communication and Access to Information, Coordination and Collaboration, Supports and Services for Immigrants and Reduction of Systemic Barriers. Priorities aligned with this initiative include:

Welcoming Community: Encouraging the London and Middlesex community to appreciate diversity and actively work to attract support and retain immigrants. All residents welcome the full participation of newcomers in Canadian society and work together to eliminate racism and discrimination in all forms.

Reduction of Systemic Barriers: Engage all levels of government, funders and institutions to reduce systemic barriers that impede the ability of newcomers to successfully participate in the London and Middlesex community.

This CAV Plan is intended to support this effort by guiding additional mobility options to help reduce the barriers for newcomers in London.

[65] https://london.ca/sites/default/files/2022-05/2022-2025%20LMLIP%20Strategic%20Plan%20.pdf

London City Council adopted Vision Zero principles (2017)[66] – CAV Plan, Section 1

1. No loss of life is acceptable.
2. Traffic fatalities and serious injuries are preventable.
3. We all make mistakes.
4. We are all physically vulnerable when involved in motor vehicle collisions.
5. Eliminating fatalities and serious injuries is a shared responsibility between road users and those who design and maintain our roadways.

London for All: A Roadmap to End Poverty (2016) – CAV Plan, Section 4

This is London's community plan to end poverty in a generation. Poverty is about our entire community. It impacts us all, because a community that experiences poverty can't reach its full potential when people lack or are denied the economic, social or cultural resources to participate. This plan to end poverty in a generation has 8 priority areas and a total of 112 recommendations. This CAV Plan is intended to support this effort by guiding additional mobility options to support participation in the community.

The London Plan (2016)[67] – CAV Plan, Section 2, 3, and 6

60_ Direction #6 Place a new emphasis on creating attractive mobility choices.

222A_ The proportion of building and street frontages used for garages and driveways should be minimized to allow for street trees, provide for on-street parking and support pedestrian and cycling-oriented streetscapes.

362_ Municipal commuter parking facilities will be established at strategic locations, to connect with other mobility choices and services surrounding communities.

364_ Improvements to the mobility network will be planned with an emphasis on active mobility, improved transit services, and Transportation Demand Management (TDM) strategies and targets.

[66] https://london.ca/roadsafety
[67] https://london.ca/government/council-civic-administration/master-plans-strategies/london-plan-official-plan

481_ The City will support the reduction, re-use, recycling, composting and recovery of materials by:

4. Increasing waste diversion through existing technologies and new, emerging and next-generation technologies as they become available, practical, and financially feasible for London.

629_ Information and Communication Technology (ICT) infrastructure should form part, where appropriate, of civic infrastructure, public facilities, public spaces and mobility services.

631_ to encourage resiliency and recognizing the fast pace of change in communications technologies, all civic infrastructure should incorporate a form of ICT infrastructure that is adaptable to change and next-generation technologies.

724_ Green mobility will be promoted by establishing a city structure that supports rapid transit, transit-oriented design, active mobility, transportation demand management, intensification, and cycling infrastructure throughout the city.

729_ Wherever possible, new developments will be planned to be "future ready" to accommodate the future use of solar energy, electric vehicles, and (where applicable) district energy systems. Standards may be developed to require that neighbourhoods or individual buildings are developed to meet specific sustainability measures or standards.

London Road Safety Strategy (2014)[68] – CAV Plan, Section 1

City of London, with its partners on the London Middlesex Road Safety Committee developed the London Road Safety Strategy. It is a multi-disciplinary data-driven strategy that was created with the benefit of public input. The strategy was approved by City Council in March 2014.

The strategy set a measurable near-term goal of a 10% reduction in severe road collisions within five years. That goal was achieved and surpassed.

In May 2017, Council received a status report on the Road Safety Strategy and adopted the Vision Zero principle.

London Strengthening Neighbourhoods Strategy (2017-2020) – CAV Plan, Section 4

The London Strengthening Neighbourhoods Strategy (LSNS) is fundamentally a resident driven strategy that encourages resident participation and engagement to

[68] https://london.ca/roadsafety

help make all of London's neighbourhoods stronger. Neighbourhoods are about people and places, and how they work together to make great places to live, work, and play. Strong neighbourhoods are vibrant, connected, and engaged – they form the backbone of our diverse, inclusive, and welcoming community.

CAVs may provide an opportunity to strengthen neighbourhood connections by providing additional mobility options for the community.

London's Community Diversity and Inclusion Strategy (2017) – CAV Plan, Section 4

Priority 3 – Connect and engage Londoners

Priority 4 – Remove accessibility barriers to services, information, and spaces

Strategy 3 – Ensure that all current and future transportation options are reviewed by, and easily available and accessible to, seniors, persons with disabilities, and newcomers.

Strategy 4 – Include persons with disabilities in policy development, consultations, and implementation processes in order to address different accessibility perspectives.

Strategy 8 – Ensure the safety of the community by developing comprehensive and adaptable emergency and safety procedures and conduct regular safety audits throughout the community.

London's Community Safety and Well-being Plan (In Development) – CAV Plan, Section 4

London's Community Safety and Well-being (CSWB) Plan is currently in development. The plan is guided by a multi-organizational advisory group and built on deep engagement with the community on safety and wellbeing. Thematic priorities that emerged through the consultation include: mental health; substance use; housing; crime; and neighbourhoods. Notably, safe, active transportation options and effective public transportation systems emerged as a key priority through the consultation.

Mobility Master Plan (In Development)[69] – CAV Plan, Section 2, 3, 4, 6, and 8

The new Mobility Master Plan replace the current Smart Moves 2030 Transportation Master Plan and will outline transportation and mobility policies, plans, and programs for the next 25 years. The new Mobility Master Plan will consider new mobility priorities, challenges, and unique lived experiences.

Vision: By 2050, Londoners of all identities, abilities and means will have viable mobility options to allow them to move throughout the city safely and efficiently. The movement of people and goods will be environmentally sustainable, affordable, and supportive of economic growth and development.

Draft Guiding Principles:

Environmentally sustainable: Take bold action to address climate change and design and move in ways that protect and enhance the natural environment.

Equitable: Recognize diverse mobility needs and embed equity into decision making to enable everyone to move through the city.

Integrated, connected, and efficient: Strengthen community and the economy with better access to people, places, goods, and services as London grows.

Smart Moves: 2030 Transportation Master Plan (2013) – CAV Plan, Section 2, 3, and 6

Goal 1. Provide safe, affordable, efficient transportation for everyone

Ensure all residents including those with low incomes, disabilities, the elderly, and others who cannot, or do not, own their own vehicle are provided safe, affordable, reliable, convenient, and efficient transportation options.

Goal 2. Make London's neighbourhoods pedestrian and bicycle friendly

Recognizing the importance of good health to citizens, enhance opportunities to walk and bike in London, which in return will reduce single occupancy vehicle trips.

[69] https://getinvolved.london.ca/mobility-master-plan

Goal 5. Promote reliable, convenient, and seamless transit

Encourage London Transit Commission and other transit operators to provide seamless public transit service within London and between London and outlying towns and communities.

Goal 9. Optimize the existing transportation system

Make the most of what currently exists by preserving and maximizing the use of facilities and services – support new technologies, access management, and transportation system management initiatives. Avoid or defer the need for new infrastructure that does not support this set of goals.

Goal 10. Minimize growth in travel demand

Encourage initiatives and programs that reduce demands on the transportation system, especially at peak hours, or reduce the number of vehicles on the roads while accommodating the same number of people.

Goal 12. Develop parking strategies that reduce single occupant vehicle travel

Develop strategies that reduce the demand for parking in the downtown area, existing and future employment centres, and other activity nodes.

Goal 13. Foster awareness of sustainable transportation

Develop programs and activities that enhance residents' awareness and understanding of the benefits of sustainable transportation.

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APPENDIX B: PRIVACY BY DESIGN

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The seven principles of Privacy by Design[70] are meant to seamlessly integrate into products, services, and system designs by default. Protecting customer data becomes a guiding force in the user experience, taking the same level of importance as functionality. Privacy by Design principles may apply to entire information processes, including:

- System designs
- Organizational priorities
- Project objectives
- Standards and protocols
- Business practices

Principle 1: Proactive not reactive; preventative not remedial

A privacy-first attitude will naturally support a preventative approach to privacy. Instead of reacting to privacy risks or invasions when they happen, the City will actively build processes and procedures to prevent them from occurring in the first place for CAV products and services.

Principal 2: Privacy as the default setting

London residents should not have to worry about their privacy when using CAV products and services – privacy by default ensures they do not have to. The City will set a user's privacy is automatically to the highest level of protection, regardless if a user interacts with the settings of CAV products and services or not. Such default settings include the following:

Collection limitation: Only collect the amount and types of data you're legally allowed to.

Data minimization: Collect only the absolute minimum amount of data necessary, not just for the sake of data collection.

Use, retention, and disclosure limitation: Don't use the collected data for any purpose other than to which the user has agreed; don't keep data after it's

[70] OneTrust. The 7 Principles of Privacy by Design. 2021-04-06. Available from: https://www.onetrust.com/blog/principles-of-privacy-by-design/

no longer needed for the purposes stated to users; and, don't disclose the data unless necessary to achieve the purpose for which it was collected.

Security: Implement appropriate technical and organizational measures (e.g. encryption) to ensure the confidentiality, integrity, and availability of the personal data.

Principle 3: Privacy embedded into design

Protecting user data and privacy shall be integral in building CAV products and services, not just layered on at the end as to detract from the product or service. Every decision and new process developed by the City must be filtered through a privacy-first mindset to promote both functionality and privacy protection.

Principle 4: Full functionality – positive-sum, not zero-sum

A passive, zero-sum approach does not work with Privacy by Design – arguments that suggest that trade-offs must be made with the user experience vs. security protocols. A proactive, positive-sum approach includes integrating privacy into every design element seamlessly. Privacy is increasingly important to end users, not just an issue of legal compliance.

Principle 5: End-to-End Security – Lifecycle Protection

From the point at which users provide private data to the City, to when it can be destroyed after serving its purpose – and everything in between – Privacy by Design ensures the security of CAV data through the processing lifecycle. Full lifecycle protection is where the interdisciplinary nature of Privacy by Design is critical, ensuring information security best practices provide end-to-end data protection. Security also ensures data remains confidential, true to its original form, and accessible during its lifecycle.

Principle 6: Visibility and Transparency – Keep it Open

Openness with users about the City's policies and procedures with CAV products and services will build accountability and trust. Privacy by Design means documenting and communicating actions clearly, consistently, and transparently. These policies and procedures should be supported by an accessible and effective complaint submission and resolution process including independent, third-party verification of your policies and procedures to users.

Principle 7: Respect for User Privacy – Keep it User-Centric

A respect for the user privacy of CAV data involves the City always having user privacy interests in mind and providing the necessary safeguards and features to protect such interests. This respect is critical in every design decision understanding that the best user experience always puts privacy first. This includes the right of each user to manage their own data and seek public engagement in the development of City policies and procedures.

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APPENDIX C: GLOSSARY

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The following definitions provided in this glossary have been developed from key sources such as the City of Toronto[71] and the Transportation Association of Canada[72] as a common lexicon to provide clarity to the concepts discussed herein this plan.

Active Transportation

Human-powered travel, including but not limited to walking, cycling, inline skating, skateboarding, and travel with the use of mobility aids for those who use them. Transit ridership is often considered a form of active mobility because every transit trip begins and ends with a walk.

Advanced Driver Assistance System (ADAS)

An electronic system in motor vehicles that supports driver avoidance of a collision or lessens impact of a collision, using technologies that correspond to the SAE Level 1 or 2 driving automation system (e.g. automatic emergency braking, forward collision warning, adaptive cruise control, lane departure warning, lane keeping assistance, blind spot monitoring, etc.).

Artificial Intelligence

Artificial intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans. The term “artificial intelligence” is used to describe machines that mimic “cognitive” functions that humans associate with other human minds, such as “learning” and “problem solving.

Automated Driving System (ADS)

The hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis, regardless of whether it is limited to a specific operational design domain; this term is used specifically to describe the SAE Level 3, 4 or 5 driving automation system.

[71] City of Toronto. Automated Vehicles Tactical Plan. 2019. P.134.
[72] Transportation Association of Canada. Lexicon of Terms: Connected and Automated Vehicles. 2019-09.

Big Data

This is a term related to extracting meaningful data by analyzing the huge amount of complex, variously formatted data generated at high speed, that cannot be handled, processed by the traditional system. It is often described to be made-up of the 5 V's: Volume, Velocity, Variety, Veracity, Value.

Built Area Boundary or Existing Built Area Boundary

Describes the built area of the City as of 2006. The City Structure Plan shows the Built-Area Boundary. The Built-Area Boundary is fixed in time for the purposes of implementing and monitoring the City's target for intensification. Residential development occurring within the Built-Area Boundary will be considered as intensification for the purposes of meeting the City's intensification target.

Bus Rapid Transit (BRT)

Buses on grade-separated roadways or dedicated lanes to transport passengers without interference from parallel traffic.

City Building

An activity, plan, design, investment, public work, or development that sets the future shape, character, and form of the city.

Climate Emergency Screening Tool (CEST)

A process developed by the City of London that can assist decision-makers on project/policy/strategy development with respect to climate change considerations. The process may result in a modified project or program scope.

Crowdshipping

A one-way delivery network, shipping goods through the voluntary enlistment of people who are already travelling from points A to B to take a package along with them, making a stop along the way to drop it off.

Cybersecurity

The use of processes, practices, hardware, and software to protect networks, computers, programs, and data from attack, damage, or unauthorized access.

First-and-Last Mile

Used to describe the movement of people and/or goods from a starting point to a transportation hub (e.g. transit station, freight distribution hub, etc.) and vice-versa.

Global Positioning System (GPS)

A satellite-based radio-navigation system which can provide precise time and position information.

Greenhouse Gas Emissions (GHG)

Gases in the atmosphere that trap heat from the sun between the earths surface and space. Releasing amounts in excess of what the natural process removes results in the earth warming, contributing to climate change.

Green Light Optimized Speed Advisory (GLOSA)

A connected vehicle advisory system using V2I technologies that notifies the vehicle or driver of the optimal speed to drive in order to maximize exposure to green lights on their journey.

Highway Traffic Act

The Highway Traffic Act is Province of Ontario legislation that, amongst other things, regulates the classification of traffic offenses. It applies to “highways” which include a common or public highway, street, driveway, bridge, viaduct, etc., any part of which is intended for use by the public for the passage of vehicles.

Intelligent Transportation System (ITS)

A combination of leading-edge information and communication technologies applied to improve the safety, efficiency, and sustainability of transportation networks, to reduce traffic congestion and to enhance road user experience.

Light Detection and Ranging (LiDAR)

An on-vehicle technology that uses pulsed lasers to create a detailed, three-dimensional, and 360-degree map of physical objects in the environment.

Mobility-as-a-Service (MaaS)

The integration of transportation services from public and private providers (e.g. public transit, bike share, ride-hail, carshare, scooter, etc.) through a unified gateway (e.g. typically a mobile application) for trip planning, management, and payment.

Mobility Network

A mobility network is about more than just moving goods, services, and people, it is about having access to various transportation options and systems and the quality of that access. In order to achieve mobility – time, affordability, and safety – all need to be considered as necessary ingredients.

Motor Vehicle Safety Act (MVSA)

A Government of Canada act to regulate the manufacture and importation of motor vehicles and motor vehicle equipment to reduce the risk of death, injury and damage to property and the environment.

Municipal Freedom of Information and Protection of Privacy Act (MFIPPA)

A Province of Ontario legislation that defines what information, under the control of institutions, is rightfully available to the public while protecting individuals' privacy and personal information.

Non-OEMs

Companies which do not manufacture their own vehicles but may – for example – modify an existing vehicle by integrating systems from multiple suppliers and coupling that with their own CAV technology stack (i.e. an after market provider).

Ontario Disability Support Program (ODSP)

A Province of Ontario program to provide financial assistant, health care benefits, and employment supports to Ontarians who meet the eligibility requirements.

Ontario Vehicle Innovation Network (OVIN)

A Province of Ontario initiative, delivered through the Ontario Centre of Innovation. A key aspect of Ontario's Automotive Plan, OVIN works to support subject matter experts, post-secondary institutions, and other industry stakeholders to commercialize new products and services in the automotive and transportation sector, and support Ontario's readiness for the adoption and deployment of these technologies.

Original Equipment Manufacturers (OEM)

Any company that manufactures parts for use in new vehicles, but often used to describe automobile manufacturers that assemble and market vehicles under their own brand.

Peak Travel Shifting

Providing incentives to individuals and businesses to broaden and shift travel times outside of peak travel periods (i.e. "rush hour"). For example, this can be accomplished through flexible work start/stop times, working from home, carpooling, etc.

Pedestrian Cross Over (PXO)

A pedestrian crossing facility that includes pavement markings and signage and may include rapid flashing rectangular beacons. Motorists must yield to pedestrians, but pedestrians are also required to check for conflicting traffic prior to crossing.

Pace Car

Automated vehicles that will help set the speed and pace of travel for other automated and manual vehicles alike based on the posted speed limit and other related travel conditions, resulting in improved safety.

Platooning

The coordination of two or more vehicles to decrease headway between them and allow simultaneous acceleration and braking, enabled by wireless communication and automation technologies. This practice can increase effective road capacity, reduce fuel consumption, and lower driver workload.

Primary Transit Area

A centrally located area, as identified in the London Plan, that will accommodate residential intensification, and improvements to transit and active transportation facilities. The goal is for 75% of all intensification to occur within the Primary Transit Area.

Radio Detection and Ranging (RADAR)

RADAR is one sensor type necessary for ADAS to detect and locate the speed and position objects in the presence of interference (i.e. noise, clutter, jamming, etc.).

Rapid Transit Corridors

Rapid Transit Corridors connect the Downtown and Transit Villages with highly urban forms of development, allowing for a broad range of uses and moderate intensity arranged in a linear configuration along rapid transit routes.

Ride Hailing

The act of hailing a private vehicle for the purposes of securing a transportation service. Usually paid for by a time and/or distance-based fee. These services exclude traditional taxis, limousines, and public transportation.

Society of Automotive Engineers (SAE)

The international automotive society responsible for developing the levels of automation definitions as outlined in this plan.

Single Occupancy Vehicle (SOV)

A vehicle carrying only one person with the capacity for more than one person.

Strategic Areas of Focus (SAF)

The core areas of focus for connected and automated vehicle technologies as defined by City of London stakeholders and detailed herein.

Transit Villages

Transit Villages are identified in the London Plan and are major mixed-use destinations with centrally located rapid transit stations.

Transportation Demand Management

The application of a range of measures to affect travel patterns and reduce the demand for motorized forms of transportation.

Transportation Management Centre (TMC)

The central location or "command centre" used to manage transportation operations during peak periods across high-demand corridors within London. Operation includes the management of the traffic signal system (i.e. the advance traffic management system or ATMS), traffic monitoring cameras, transit signal priority system, adaptive traffic signals, travel time monitoring, etc.

Urban Growth Boundary (UGB)

The boundary beyond which urban uses will not be permitted. Generally, this map boundary separates the urban parts of the city from the rural parts of the city.

Vehicle Kilometres Travelled (VKT)

The VKT is a mobility performance indicator of roadway use to understand the relationship between the magnitude of vehicle demands and the number of kilometres of roadway capacity available within the transportation network. It can either be evaluated as a total estimation or a per capita value (i.e. divided by the population of a defined geographical area).

Vehicle-to-Everything (V2X) or Vehicle to Network (V2N)

The exchange of information between vehicles and other parties, including but not limited to, vehicle-to-infrastructure, vehicle-to-pedestrian, and vehicle-to-vehicle communication.

Vehicle-to-Infrastructure (V2I)

The exchange of information between vehicles and infrastructure. For example, V2I may be used to inform vehicles of issues including traffic conditions, traffic signal status, or weather warnings.

Vehicle-to-Vehicle (V2V)

The exchange of information between vehicles, often referring specifically to communication of basic safety messages in the 5.9 GHz band.

Vision Zero

A global movement focused on eliminating deaths and injuries caused by vehicle collisions.

Work From Home (WFH)

The ability to complete the extent and requirements of their primary job or career from a location different then their workplaces address. Also known as remote work.

Zero-Occupancy Kilometers Travelled (ZKT)

Like VKT, ZKT referrers to automated vehicles that contain zero occupants while the vehicle operates within the transportation network.

Zero-occupancy use

An automated vehicle travelling with zero occupants inside the vehicle.

APPENDIX D: SUMMARY OF POTENTIAL HEALTH IMPACTS

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March 5, 2020

Connected and Automated Vehicles (CAV): Summary of Potential Health Impacts Background

The Middlesex-London Health Unit (MLHU) commends the City of London for their leadership and commitment toward continued transportation improvements to increase access and safety for the residents and visitors of London. With the amendment to the *Highway Traffic Act* (HTA) titled *Pilot Project-Automated Vehicles*, Ontario Regulation 306/15[1], the City of London has been diligently monitoring and researching connected and automated vehicles, demonstrated in the development of *the Connected and Autonomous Vehicles: Technical Background report* [2]. We applaud the City of London's interest and the municipal council's resolution and direction to move forward with the development of a strategic plan for a future with connected and automated vehicles (CAVs).

Autonomous or automated vehicles (AVs) use artificial intelligence technology to navigate the environment to be driverless or self-driving vehicles.[2] Although the implementation of this model aims to advance transportation as we know it today, research can only speculate on whether, or to what extent, there will be improvements in road safety, health, social and health equity, the environment, lifestyle, and the built environment; all factors contributing to population health. Therefore, it is imperative to examine the perceived benefits as well as the potential risks as regulatory actions are developed to mitigate the negative impact to the publics' health and safety.

Throughout Canada and the US there are many AV tests and trials that have occurred, are in the process, or are scheduled to occur. The Canadian Automated Vehicles Centre of Excellence (CAVCOE) provides a research report about the various pilots and includes information about specific research studies that involve municipality stakeholders. The report offers best practices guidelines for key areas such as, planning, insurance, data gathering strategy and privacy, partners, communications, operations, technical, safety, paratransit vehicles, etc..[3]

The mission of the Middlesex-London Health Unit is to promote and protect the health of people who live in London and Middlesex County. Ensuring that environments support healthy and safe communities directly impacts the lifestyles and health of Londoners to reduce chronic disease and injuries, as well as support physical, mental and social well-being. With proposed changes to the transportation system and the potential impact on road safety, active transportation, healthy community design, and climate change, MLHU respectfully submits the following for consideration as the City develops its Connected and Automated Vehicle Strategic Plan.

The points below identify potential implications and considerations to the implementation of automated vehicles from a public health perspective. The considerations identified are not exhaustive and are based on current information and understanding of the issue.

Road Safety

Potential Benefits

- AV's will be programmed to follow the rules of the road, including speed limits, and could remove the risks of impaired, distracted, or inattentive drivers.[4]
- Driving is expected to be less stressful for drivers by reducing traffic congestion. There is likely to be lower chance drivers will multitask when driving, and less "road rage" experienced.[4]
- A reduction in collisions and fatalities is anticipated as it has been estimated that 94% of traffic collisions are a result of human error.[4,5,6]
- Well-implemented, AV's provide potential to meet the Vision Zero goal of zero serious injuries and fatalities.

Potential Risks

- The transition period during implementation may initially result in increased collisions as all road users learn to share the road with AV's.[4]
- It is possible that the benefits of AV's may lead to increased preference for personal ownership, thereby increasing AV's on the road[4] negating the potential road safety benefits.

Health

Potential Benefits

- AV's will increase accessibility and connectivity for personal mobility.[7]
- There is the potential for a reduction in mortality and morbidity from decreased pollution with gasoline vehicles being replaced with electrical vehicles.[5]
- A decrease in injuries and fatalities is likely to occur.[4]
- AV's could result in a more stress free, pleasurable transport experience.[7]

Potential Risks

- A potential consequence of AV's as a stress free, convenient, low cost transportation modality is the increased use of AV's and less active transportation.[6]
- AV's could become the preferred mode of travel replacing active transportation and increasing rates of sedentary behaviour.[7]

Social/Health Equity

Potential Benefits

- Access to transportation influences our health and therefore should be equitable for all.[7] AV's have the potential to provide independence to those who are not able to operate a vehicle, improving accessibility and social connection .[4,5,7] Increased ease of travel and opportunities to attend social events, access health care and other services, and complete daily activities within communities can improve social and health inequities.

- Families may be more likely to share a vehicle. The concept of car sharing an electric AV costs less than owning and maintaining a traditional gasoline vehicle, benefiting families economically.[4]
- As a private AV owner of an electric vehicle, cost savings is ¼ of the cost to drive a gasoline vehicle, as there is no maintenance for oil changes, transmissions, and exhaust systems; charging the battery is typically done at night when peak time rates can apply; and there are also financial incentives to own an AV.[8]

Potential Risks

- Increased demand for the convenience of AV's may lead to the displacement of public transit riders and hence municipal resources would have to be reallocated.[4,6]
- Less budget allocation for public transit could lead to people of lower income that use public transit to have less access and longer commutes between destinations[7] worsening social inequalities.
- There are enormous ethical considerations that relate to programming algorithms for AV's, where decisions will have to be made in situations to avoid conflict between vulnerable road users and the passengers of AV's.[6] Therefore, policies, laws, programming algorithms, and regulations need to be fair and equitable toward all road users[6] taking into consideration the current municipality road infrastructure.
- Risk to employment opportunities could occur. There is the potential for increased unemployment due to the reduction of personnel needed for working at traditional jobs such as trucking, taxi services, delivery companies, public transit, vehicle repairs and insurance companies.[4]
- An increase need for higher educated specialized jobs would be required to continue the research, development, programming, and installation of AV's.[4]

Environment/Climate

Potential Benefits

- Reduced greenhouse gas emissions are expected from fewer cars on the road, and less vehicular idling and fuel consumption.[4]
- Since carbon emissions affect air and water and electric powered AV's are less carbon intensive, there would be a benefit to the environment.[7]

Potential Risks

- The features of AV's could increase the demand for personal ownership, increase AV's on the road, and reduce public transit riders.[4]
- The increase use of AV's could cause the need for more road infrastructure changes affecting the natural environment.[7]

Summary and Key Considerations

The considerations highlighted in this document reflect a public health perspective and are based on a review of the literature and information cited. It is recognized that there remain many unknowns to the actual effect that AV's will create due to the evolving technology and policy landscape. This speaks to the importance of continued monitoring throughout any implementation stage to maximize the benefits of AV's and mitigate risks and harms to the public. In summary the key considerations are:

- Positive health outcomes are anticipated from increased road safety and independent mobility.
- A shared or fleet program could contribute to positive health impacts by decreasing the number of vehicles using our transportation system thereby reducing pollution and having a positive effect on climate change.
- Models of implementation that incentivise and increase personal AV ownership will lead to more stress to our transportation system and have the potential to reduce physical activity, increase sedentary behaviour, and widen the gap for social inequities for those who cannot afford vehicle ownership.
- Considerations for all road users and the necessary road infrastructures to provide safe roads are important in municipal decisions.
- Rigorous local testing and piloting of the technology in different scenarios as it is implemented are recommended to reduce the safety threat to road users.
- It will be important to stay informed of the moving landscape of AV's. CAVCOE (2019) developed a *Best Practices for Automated Vehicle Trail in North American Municipalities* report for planning and implementation considerations. Continuing to be informed will support effectively rolling out the implementation of AV's.

There are clear public health benefits of a built environment which is less dependent on single occupancy vehicles, regardless of whether they are automated or manually operated, or powered by electricity or fossil fuel. Transportation and planning policies that are developed and implemented with this objective at the forefront will yield the highest long-term community health benefits.

Thank you for the opportunity to provide input, we look forward to staying abreast of the City of London's work related to connected and automated vehicles.

MLHU contacts for this initiative:

David Pavletic, Manager, Food Safety and Healthy Environments, David.Pavletic@mlhu.on.ca

Rhonda Brittan, Manager, Healthy Communities and Injury Prevention, Rhonda.Brittan@mlhu.on.ca

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Prepared by the Corporation of the City of London
September 2022

Connected and Automated Vehicle Plan

Executive Summary DRAFT

Prepared by the Corporation of the City of London
September 2022

London
CANADA

How will this **Connected** and **Automated Vehicle Plan** be Used?

This Connected and Automated Vehicle (CAV) Plan will be used by decision makerswho are responsible for the implementation and maintenance of public infrastructure which will be impacted by the emergence of CAV technology. This CAV Plan has been prepared in a way that can communicate the City of London's context and unique approach to CAV technology to interested external stakeholders, industry players, and the public.

Part I: Background provides an explanation of the current realities of CAV technology in London and elsewhere and explores anticipated timelines associated with the technology development. It is important to note that given the emerging nature of CAV technology, information provided within this section is subject to change.

Part II: Detailed Actions presents the core areas of focus and actions that may be available to the City of London to consider in response to CAV technology. To implement the actions that have been identified, a subsequent Implementation Plan will need to be developed. The future Implementation Plan will consider each action and identify what is needed to proceed with implementation including triggering events, timelines, and required additional staff and financial resources.

This CAV Plan is proactive in nature, based on the needs to prepare the City for the arrival of CAV technologies in a timely manner. The action items identified in this plan will need to be further developed as part of a future Implementation Plan and looked at through a lens of deliverability, resourcing, and sustainability.

The future Implementation Plan and any proposed programs, projects, and sub-projects will need to be carefully considered in alignment with Council's CAV Plan including Corporate priorities and resourcing.

Purpose, **Vision**, **Mission**, and **Values**

The Purpose, Vision, Mission, and Values are the guiding framework for the Connected and Automated Vehicle Plan and the detailed actions within it. Through internal consultation, the Purpose, Vision, Mission, and Values were adopted by the City's internal working group on December 12, 2019 as follows:

PURPOSE

Why? To better understand and prepare for the introduction of connected and automated vehicles in our community to improve the lives of our citizens and minimize the environmental impact of this technology as it becomes more commonplace.

VISION

What? A sustainable community that integrates connected and automated vehicles into city-building and daily activities by pursuing improved safety, environmental stewardship, and travel mobility options.

MISSION

How? To engage internal and external stakeholders, identify potential implications of connected and automated vehicles, and provide a plan and actions that will proactively prepare for the introduction of connected and automated vehicles.

VALUES

- Alignment with the 2019-2023 Strategic Plan for the City of London
- Alignment with the London Plan
- Climate Emergency Action Plan
- Driven by Community
- Human Health and Community Safety
- Information Security and Privacy
- Integrated Mobility
- Proactive Leadership
- Responsible Governance
- Social Equity
- Supporting Innovation
- Stakeholder Collaboration

Strategic Areas of Focus

Strategic Areas of Focus (SAFs) were developed in collaboration with internal City stakeholders as guideposts to spur discussion in the development of the CAV Plan. The final SAFs constitute the core of the CAV Plan as detailed herein.

For each of the SAFs, broad goals were identified and are listed below. For full details about specific action items under each goal, there is discussion provided in the full CAV Plan document.

1. Road Safety and Security

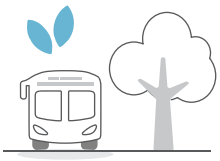
The City will encourage the adoption of CAVs that are supportive of improved road safety. A net benefit to road safety will be achieved through actions that focus on protecting vulnerable users, preventing collisions, updating infrastructure, and improving emergency response. Actions will address both the knowns and unknowns of CAVs and will look at the ideal policies, technology, standards, and training required to achieve improved safety.

1.1 Prevent Collisions
1.2 Update Infrastructure
1.3 Update Emergency Response

2. Mobility Integration and Efficiency

The City will incorporate CAV technology and encourage its adoption within the City's mobility network. Increased infrastructure efficiency will be achieved through an enhanced ability to manage traffic in real-time, allowing individual mobility needs to be served at any given time.

2.1 Increased Space Efficiency
2.2 Design Complete Streets
2.3 Increase System Integration
2.4 Urban Goods Movement
2.5 Mobility Network Efficiency and Performance
2.6 Transportation Demand Management



3. Environmental Sustainability

The City will encourage the adoption of CAVs in a manner that incentivizes environmental sustainability across a vehicle's entire lifecycle. Reducing vehicle emissions and waste through incentivizing or promoting zero emission vehicles and sustainable use practices.

3.1 Reduce Vehicle Emissions
3.2 Reduce Vehicle Waste

4. Social Equity and Health

The City will encourage the adoption of CAVs in a manner that improves accessibility, social equity, and prioritizes health and safety for all Londoners.

4.1 Ensure Barrier Free Access for All
4.2 Increase Mobility Equity
4.3 Promote Health and Safety

5. Data Privacy, Security, and Governance

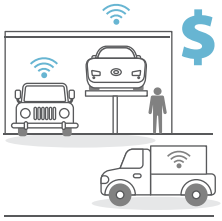
The City will support and enhance data privacy and transportation network security with a particular focus on the City's collection and use of information generated by CAVs and related systems where authorized by law. Actions will focus on protecting privacy and security through policy and by-law, providing oversight and evaluation, and incorporating privacy principles into any potential collection and use of information generated by CAVs. Further, data gathered should be used to inform the implementation and evaluation of this plan and to improve how the City delivers services.

5.1 Protect Public Privacy
5.2 Business Intelligence

6. Land Use and Urban Form

The City will plan for the potential impacts and implications of CAVs in the context of sustainable urban form, land use, growth, development, placemaking, and the approved London Plan.

6.1 Integrate CAV Infrastructure Elements with Land Use
6.2 Protect Urban Structure Integrity
6.3 Resilient CAV Policy Development and Implementation
6.4 Reclaim Surplus Land



7. Economic Sustainability

The City will support and enhance sectors related to the development and use of both CAVs and associated technology, with a particular focus on retaining and attracting industries, investment, and employment. Actions related to Economic Sustainability will aim to expand London's regional position as it relates to CAVs.

7.1 Develop a Top-Quality Workforce
7.2 Attract New Jobs and Investments
7.3 Create a Supportive and Thriving Environment

8. City Fleet and Services

The City will enhance its fleet and services through CAVs and related systems for the purpose of improving safety and public service delivery. Actions will evaluate the transformation of fleet vehicles and City services as well as potential impacts to employment and labour needs.

8.1 City Services and Fleet Vehicles
8.2 Future-Proofing
8.3 People Services and Labour

Prepared by the Corporation of the City of London
September 2022

Integrated Transportation Community Advisory Committee Report

The 1st meeting of the Integrated Transportation Community Advisory Committee December 21, 2022

Attendance

PRESENT: T.Khan (Chair), R. Buchal, D. Foster, A. Husain, T. Kerr, S. Leitch, A. Lubrano III, D. Luthra, M. Malekzadeh, A. Santiago, J. Vareka; H. Lysynski, K. Mason (Committee Clerks)

ABSENT: J. Collie, E. Eady

ALSO PRESENT: J. Pribil; B. Brock, S. Corman, J. Dann, D. Hall, D. MacRae, A. Miller, M. Morris, K. Scherr, R. Spear, J. Stanford, V. Sypien, B. Westlake-Power

The meeting was called to order at 3:01 PM

1. Call to Order

1.1 Disclosures of Pecuniary Interest

That it BE NOTED that no pecuniary interests were disclosed.

2. Scheduled Items

2.1 Fanshawe Park Road and Richmond Street Intersection Improvements

That it BE NOTED that the presentation, as appended to the Agenda, from R. Spear, Dillon Consulting, and the presentation, as appended to the Added Agenda from the Integrated Transportation Community Advisory Committee, with respect to Fanshawe Park Road and Richmond Street Intersection Improvements, was received.

2.2 E-Scooters and Cargo E-bikes

That it BE NOTED that the presentation, as appended to the Agenda, from A. Miller, Senior Transportation Demand Management (TDM) Coordinator, and the presentation, as appended to the Added Agenda, from the Integrated Transportation Community Advisory Committee, with respect to E-Scooters and Cargo E-Bikes, was received.

3. Consent

3.1 5th Report of the Integrated Transportation Community Advisory Committee

That it BE NOTED that the 5th Report of the Integrated Transportation Community Advisory Committee, from the meeting held on November 16, 2022, was received.

3.2 Notice of Planning Application - Zoning By-Law Amendment - 455 Highbury Avenue North

That it BE NOTED that the Notice of Planning Application, dated November 23, 2022, from M. Hynes, Planner I, related to a Zoning By-Law Amendment for the property located at 455 Highbury Avenue North, was received.

3.3 Notice of Planning Application – Zoning By-Law Amendment – 1154 Hamilton Road

That it BE NOTED that the Notice of Planning Application, dated November 30, 2022, from M. Hynes, Planner I, related to a Zoning By-Law Amendment for the property located at 1154 Hamilton Road, was received.

3.4 Notice of Planning Application – Official Plan and Zoning By-law Amendments – 755-815 Wonderland Road South

That it BE NOTED that the Notice of Planning Application, dated December 7, 2022, from S. Wise, Senior Planner, related to Official Plan and Zoning By-Law Amendments for the properties located at 755-815 Wonderland Road South, was received.

3.5 Notice of Study Commencement – Oxford Street West Improvements Municipal Class EA Westdel Bourne to Sanatorium Road

That it BE NOTED that the Notice of Study Commencement, dated December 8, 2022, from E. Guil, Project Manager and K. Jim, Project Manager, related to Oxford Street West Improvements Municipal Class EA Westdel Bourne to Sanitorium Road, was received.

4. Sub-Committees and Working Groups

None.

5. Items for Discussion

5.1 Integrated Transportation Community Advisory Committee Requests - Resume In-Person Meetings in 2023

That the Municipal Council BE REQUESTED to direct the Civic Administration to establish a hybrid meeting process for Integrated Transportation Community Advisory Committee meetings.

5.2 Integrated Transportation Community Advisory Committee Requests - Purchase Zoom License for Sub-Committees

That the Municipal Council BE REQUESTED to direct the Civic Administration to investigate and provide a report back to the Integrated Transportation Community Advisory Committee (ITCAC) with respect to Zoom license purchase(s) for the ITCAC, for sub-committee meeting use.

6. (ADDED) Additional Business

6.1 (ADDED) Notice of Planning Application - Zoning By-Law Amendment - 200 Albert Street

That it BE NOTED that the Notice of Planning Application, dated December 14, 2022, from N. Pasato, Senior Planner, related to a Zoning By-Law Amendment for the property located at 200 Albert Street, was received.

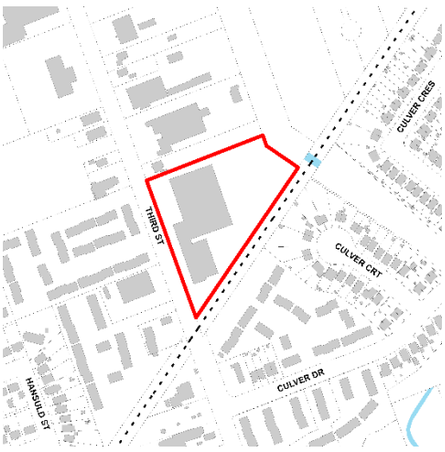
7. Adjournment

The meeting adjourned at 5:16 PM.

PUBLIC MEETING NOTICE

Official Plan and Zoning By-Law Amendment

600 Third Street



File: OZ-9542
Applicant: MHBC Planning (Scott Allen, Partner)

What is Proposed?

Official Plan and Zoning amendment to allow:

- Commercial and limited light industrial uses within the existing building, including a self-storage establishment.
- No external changes to the building are proposed.

YOU ARE INVITED!

Further to the Notice of Application you received on September 7, 2022, you are invited to a public meeting of the Planning and Environment Committee to be held:

Meeting Date and Time: Monday, January 9, 2023, no earlier than 4:30 p.m.

Meeting Location: The Planning and Environment Committee Meetings are hosted in City Hall, Council Chambers; virtual participation is also available, please see City of London website for details.

For more information contact:

Alanna Riley
ariley@london.ca
519-661-CITY (2489) ext. 4579
Planning & Development, City of London,
300 Dufferin Avenue, 6th Floor,
London ON PO BOX 5035 N6A 4L9
File: OZ-9542

london.ca/planapps

To speak to your Ward Councillor:

Councillor Peter Cuddy
pcuddy@london.ca
519-661-CITY (2489) ext. 4003

If you are a landlord, please post a copy of this notice where your tenants can see it. We want to make sure they have a chance to take part.

Date of Notice: December 22, 2022

Application Details

Requested Amendment to The London Plan

To redesignate the subject property from Light Industrial to Industrial Commercial on Map 1 (Place Types) of The London Plan.

Requested Zoning By-law Amendment

To rezone the subject property from ‘Light Industrial (LI1/LI7)’ to ‘Restricted Service Commercial Special Provision (RSC2/RSC4/RSC5(_))’ Zone.

The London Plan and Zoning By-law is available at london.ca.

Current Zoning

Zone: Light Industrial (LI1/LI7) Zone

Permitted Uses:

LI1 Zone: bakeries; business services establishments; laboratories; manufacturing and assembly industries; offices support; paper and allied products industries excluding pulp and paper and paper asphalt roofing industries; pharmaceutical and medical product industries; printing, reproduction and data processing industries; research and development establishments; warehouse establishments; wholesale establishments; custom workshop; brewing on premises establishments; service trade; existing self-storage establishments; artisan workshop; craft brewery; and tow truck business. automobile body shops; automobile repair garages; building or contracting establishments; repair and rental establishments; service and repair establishments; truck sales and service establishments; and custom workshops.

LI7 Zone: automobile body shops; automobile repair garages; building or contracting establishments; repair and rental establishments; service and repair establishments; service trade truck sales and service establishments; custom workshops; and tow truck business.

Height: 15.0 metres

Requested Zoning

Zone: Restricted Service Commercial Special Provision (RSC2/RSC4/RSC5(_)) Zone

Permitted Uses:

RSC2 Zone: animal clinics; automobile rental establishments; automobile repair garages; automobile sales and service establishments; automobile supply stores; automotive uses, restricted; catalogue stores; duplicating shops; home and auto supply stores; home improvement and furnishing stores; kennels; repair and rental establishments; service and repair establishments; studios; taxi establishments; self-storage establishments; tow truck business; bulk beverage stores; dry cleaning and laundry depots; liquor, beer and wine stores; pharmacies; and bulk sales establishments

RSC4 Zone: automobile repair garage; automotive uses, restricted; bake shops; convenience service establishments; convenience stores’ day care centres; duplicating shops; financial institutions; florist shops; personal service establishments; restaurants; video rental establishments; brewing on premises establishment; and self-storage establishments.

RSC5 Zone: auction establishments; bakeries; building or contracting establishments; building supply outlets; bulk sales establishments; dry cleaning and laundry plants; manufacturing and assembly industries with related sales’; garden stores; printing establishments; services trades; support offices; warehouse establishments; wholesale establishments; brewing on premises establishments; commercial school; truck sales and service establishment; industrial mall; self-storage establishment; tow truck business; and impounding yard.

Special Provision(s): to permit the existing minimum interior side yard of 6.6m, whereas 7.5m is required adjacent to a residential zone; a minimum landscaped open space of 5.5%, whereas a minimum of 15% is required where a mix of industrial/commercial uses are proposed; and a maximum lot coverage of 32%, whereas a maximum of 30% is permitted.

Height: 12.0 metres

Planning Policies

Any change to the Zoning By-law must conform to the policies of The London Plan, London’s long-range planning document.

The subject lands are in the Light Industrial Place Type fronting a Neighbourhood Connector in The London Plan, permitting a broad range of industrial uses that are unlikely to impose significant impacts on surrounding light industrial land uses due to their emissions such as noise, odour, particulates, and vibration.

How Can You Participate in the Planning Process?

You have received this Notice because someone has applied to change the Official Plan designation and the zoning of land located within 120 metres of a property you own, or your landlord has posted the public meeting notice in your building. The City reviews and makes decisions on such planning applications in accordance with the requirements of the Planning Act. If you previously provided written or verbal comments about this application, we have considered your comments as part of our review of the application and in the preparation of the planning report and recommendation to the Planning and Environment Committee. The additional ways you can participate in the City's planning review and decision-making process are summarized below.

See More Information

You can review additional information and material about this application by:

- Contacting the City's Planner listed on the first page of this Notice; or
- Viewing the application-specific page at london.ca/planapps
- Opportunities to view any file materials in-person by appointment can be arranged through the file Planner.

Attend This Public Participation Meeting

The Planning and Environment Committee will consider the requested Official Plan and zoning changes at this meeting, which is required by the Planning Act. You will be invited to provide your comments at this public participation meeting. A neighbourhood or community association may exist in your area. If it reflects your views on this application, you may wish to select a representative of the association to speak on your behalf at the public participation meeting. Neighbourhood Associations are listed on the Neighbourgood website. The Planning and Environment Committee will make a recommendation to Council, which will make its decision at a future Council meeting.

What Are Your Legal Rights?

Notification of Council Decision

If you wish to be notified of the decision of the City of London on the proposed official plan amendment and/or zoning by-law amendment, you must make a written request to the City Clerk, 300 Dufferin Ave., P.O. Box 5035, London, ON, N6A 4L9, or at docservices@london.ca. You will also be notified if you speak to the Planning and Environment Committee at the public meeting about this application and leave your name and address with the Clerk of the Committee.

Right to Appeal to the Ontario Land Tribunal

If a person or public body would otherwise have an ability to appeal the decision of the Council of the Corporation of the City of London to the Ontario Land Tribunal but the person or public body does not make oral submissions at a public meeting or make written submissions to the City of London before the proposed official plan amendment is adopted, the person or public body is not entitled to appeal the decision.

If a person or public body does not make oral submissions at a public meeting or make written submissions to the City of London before the proposed official plan amendment is adopted, the person or public body may not be added as a party to the hearing of an appeal before the Ontario Land Tribunal unless, in the opinion of the Tribunal, there are reasonable grounds to add the person or public body as a party.

If a person or public body would otherwise have an ability to appeal the decision of the Council of the Corporation of the City of London to the Ontario Land Tribunal but the person or public body does not make oral submissions at a public meeting or make written submissions to the City of London before the by-law is passed, the person or public body is not entitled to appeal the decision.

If a person or public body does not make oral submissions at a public meeting or make written submissions to the City of London before the by-law is passed, the person or public body may not be added as a party to the hearing of an appeal before the Ontario Land Tribunal unless, in the opinion of the Tribunal, there are reasonable grounds to do so.

For more information go to https://olt.gov.on.ca/appeals-process/forms/.

Notice of Collection of Personal Information

Personal information collected and recorded at the Public Participation Meeting, or through written submissions on this subject, is collected under the authority of the Municipal Act, 2001,

as amended, and the Planning Act, 1990 R.S.O. 1990, c.P.13 and will be used by Members of Council and City of London staff in their consideration of this matter. The written submissions, including names and contact information and the associated reports arising from the public participation process, will be made available to the public, including publishing on the City's website. Video recordings of the Public Participation Meeting may also be posted to the City of London's website. Questions about this collection should be referred to Evelina Skalski, Manager, Records and Information Services 519-661-CITY (2489) ext. 5590.

Accessibility

Alternative accessible formats or communication supports are available upon request. Please contact plandev@london.ca for more information.

Site Concept

Site Concept Plan

The above image represents the applicant's proposal as submitted and may change.