TORONTO

REPORT FOR ACTION

Congestion Management Plan – Semi-Annual Update

Date: November 14, 2017
To: Public Works and Infrastructure Committee
From: General Manager, Transportation Services
Wards: All

SUMMARY

This report provides a status update for projects being undertaken as part of the Congestion Management Plan (the 'CMP'). The CMP was originally adopted by City Council in 2013, and was updated in November of 2015 (to cover the period 2016 through 2020), to better manage traffic congestion on Toronto's streets and expressways without the need for major infrastructure expansion or introducing additional physical capacity.

The CMP focuses on nine key strategies for tackling traffic, including the use of intelligent transportation systems (ITS), undertaking congestion and engineering studies, providing enhanced incident and event response, improving construction coordination, implementing better curb side management, supporting all modes of transportation, making available increased and real-time traveller information, updating the City's Transportation Operations Centre, and maintaining ITS infrastructure to ensure a "state of good repair".

City Council has directed the General Manager, Transportation Services, to report back to the Public Works and Infrastructure Committee periodically on the status of the CMP.

In the current status reporting period (Q2 2016 to Q3 2017, inclusive), there was:

- A total of twenty-eight (28) projects completed;
- A total of ten (10) projects active;
- A total of three (3) projects in procurement;
- A total of seven (7) projects in development (being prepared for procurement) at the; and
- Four research project partnerships with local universities that have been completed or initiated during the review period under the 'Framework for External Research Collaborations for Transportation Services'.

RECOMMENDATIONS

The General Manager of Transportation Services recommends that:

1. The Public Works and Infrastructure Committee receive this report for information.

FINANCIAL IMPACT

There are no financial implications resulting from adoption of the recommendation contained in this report.

The Acting Chief Financial Officer has reviewed this report and agrees with the financial impact information.

DECISION HISTORY

At its meeting of December 16-18, 2013, City Council endorsed in principle a five-year Congestion Management Plan (CMP) to manage congestion in the City of Toronto.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.PW27.12

At its meeting of April 9, 2014, Public Works and Infrastructure Committee requested the Deputy City Manager, Cluster B, to report to the Public Works and Infrastructure Committee on an annual basis on the research projects undertaken using the authority under Schedule A of the Financial Control By-law.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2014.PW30.6

At its meeting of January 6, 2015, Public Works and Infrastructure Committee received a CMP Status Update and directed the General Manager, Transportation Services, to (a) provide regular CMP updates, (b) report back on opportunities to share information between the Transportation Operations Centre and similar operations centres amongst the City's operational partners, and (c) report back on how to best measure the overall impact of the Congestion Management Plan.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2015.PW1.4

At its meeting of June 17, 2015, Public Works and Infrastructure Committee received a CMP Status Update for Q2 2015.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2015.PW6.4

At its meeting of City Council on November 3-4, 2015, City Council endorsed in principle the updated Congestion Management Plan (2016-2020) and directed the General Manager, Transportation Services, to report back to the Public Works and Infrastructure Committee semi-annually on the Congestion Management Plan.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2015.PW8.1

At its meeting of June 20, 2016, Public Works and Infrastructure Committee received a CMP Status Update for Q1 2016.
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.PW14.6

COMMENTS

The City of Toronto continues to see significant growth, increased development adjacent to rights-of-way and an unprecedented investment in our infrastructure - all of which have placed increased demands on our road network - resulting in increased congestion.

To address these issues, the Congestion Management Plan (2016-2020) is comprised of a series of projects completed over a multi-year period (currently scheduled 2016-2020). Attachment 1 to this report provides a CMP Status Table for the Q2 2016 to Q3 2017 review period that illustrates:

- projects that have been completed in the review period;
- projects that were awarded or were underway during the review period;
- projects that were in procurement as of the end of the review period; and
- projects that are in development as of the end of the review period.

These projects have been prioritized according to needs and budget availability, and are scheduled to be completed per the timelines described herein. This does not represent the total number of projects within the CMP, as the City has already completed a significant number of projects (see Attachment 2) and there are a number of projects that are not scheduled to start until future years.

Completed Projects

The following projects were completed in the review period (Q2 2016 through to Q3 2017):

- **Big Data Innovation and Analysis -** Commercially-available real-time and historical traffic data provides the City's Big Data Innovation Team with traffic information and analytical tools leading to a greater understanding of traffic conditions across the City's arterial road network. A contract to acquire this data was awarded in Q2 2016 and the data was purchased in Q2 2016. This purchase included optional years that may see the agreement continue through 2020.

- **Traffic Management Centre - Field Signal Communication Upgrades** - We completed upgrading communication infrastructure between the Traffic Management Centre (TMC) and 229 field signal controllers in Q3 2016. This project dealt with the conversion from legacy hard-wired communications to cellular communications between traffic signal controllers and head-end systems. In addition to facilitating the remote modification of signal timing, a significant benefit of this project was the reduction of operating costs.

- **Emergency Vehicle Pre-emption (EVP) -** An industry scan of current Emergency Vehicle Pre-emption (EVP) technology and best practices was completed in Q3 2016. EVP technology manipulates traffic signal displays so emergency vehicles have a greater opportunity for a green traffic signal when approaching and crossing a signalized intersection. In this way, EVP reduces overall response times for emergency vehicles. Transportation Services and Toronto Fire are currently evaluating potential applications for this technology in Toronto.

- **Install New Traffic Control Signals -** Two projects were completed for the installation of new traffic control signals as per Council approved requests. Twenty (20) new traffic control signals were installed by Q4 2016. Thirteen (13) new traffic control signals were installed by Q4 2017.

- **Install New CCTV Cameras -** CCTV traffic monitoring cameras are used to detect and confirm problems on the road, to work with emergency responders to clear incidents, and for traveller information. Thirty-five (35) new cameras were commissioned in Q4 2016. To date, there are approximately 218 traffic monitoring cameras in the field (on expressways and arterials).

- **Complete Concept of Operations for the TOC -** A 'Concept of Operations' project for the City's Transportation Operations Centre (TOC) was completed in Q4 2016. This was an operational planning tool for the TOC to define its operating vision out to 2030, define its intended operational processes, and identify the supporting system and personnel needs. This project will result more efficient procedures in the TOC, reduced time-to-clearance for on-street incidents, a more proactive to traffic signal timing changes, and a closer working relationship between the TC and its operating partners (e.g. TTC, Toronto Police, MTO, etc.)

- **Transit Signal Priority (TSP)** - A review of Transit Signal Priority (TSP) industry best practices was completed in Q4 2016. Transportation Services worked with the Toronto Transit Commission to review the technologies available in the industry. This will inform our future system design efforts for next-generation transit priority operations in Toronto.

- **Conduct TAP Pilot -** In Q3/Q4 2016, the City conducted a pilot program to apply 'traffic assistive personnel' (TAP) at key congested intersections. For the pilot, Toronto Police Service personnel were employed to enforce traffic by-laws, provide traffic control, and break gridlock conditions to reduce congestion and improve pedestrian safety. The pilot was a success and provided lessons learned that will be applied in the planned 'Traffic Wardens' program roll-out, planned for deployment in 2018.

- **Install Uninterruptible Power Supply** - Twenty-eight (28) Uninterruptible Power Supply (UPS) units were installed at signalized intersections from Q2 2016 to Q1 2017. The installation of UPS allows the City to maintain traffic signal operations (and improve safety) at key intersections during brown-out and power failure conditions. This brings the total number to 75 UPS units installed in the field to-date.

- **Upgrade the DVP CCTV Subsystem** - The CCTV Subsystem for the Don Valley Parkway (DVP) was upgraded by Q1 2017. This project dealt with upgrading the existing analog CCTV cameras to digital (i.e. IP) technology. In addition to the analog cameras being obsolete, use of the IP cameras:
  - Lowers maintenance costs;
  - Consolidates the City's DVP communications network (i.e. fibre optics);
  - Streamlines the CCTV subsystems compatibility with the City's Video Management System; and
  - Facilitates broadcast media partners' access to our video feeds.

- **Update Operations Contract for the TOC -** The operations contract for the City's 'RESCU' Transportation Operations Centre (TOC) concluded at the end of February 2017. An RFP to select the next TOC operation service for the TMC was awarded in Q3 2016 with start of operations at the beginning of March 2017. This Operations Contract supplies the personnel within the TOC who:
  - watch for, and manage incidents when they occur on our streets;
  - dispatch the clean-up crews to the field;
  - play a coordinating role between the TTC, Toronto Police and the City's Road Operations personnel; and
  - send out traveller information to broadcast media and other private sector partners (e.g. local TV and radio, Waze, etc.).

- **Develop a Traveller Information Strategy -** A traveller information strategy was developed to inform the City of Toronto how to best engage its customers and provide effective travel information by leveraging new technologies and delivery methods (e.g. social media, smart phone apps, etc.). The contract was awarded in Q1 2016, and was completed in Q1 2017. Early wins have included the update of the City's website to provide enhanced road closure information, the push of the City's Bluetooth travel times via open data, and the recently completed Waze agreement.

- **Create an Enterprise Data Warehouse -** An Enterprise Data Warehouse (EDW) is a central repository of integrated transportation-related data that can support multi-purpose decision making and traveller information, enrich customer services, and efficiently address enquiries. A contract to assess Transportation Services business needs for an EDW and develop a conceptual EDW design was awarded in Q1 2016. The assignment was completed in Q2 2017. The City is currently considering next-steps in regards to the future design/build of the Warehouse.

- **Update Traffic Signal Timings** - The updating of traffic signal timings improves traffic flow and reduces vehicle emissions, fuel consumption, stops, and overall vehicle delay. Traffic signal timings were updated along 17 corridors (357 signals) in 2016 and this project was completed in Q2 2017.

- **Install new Portable Variable Message Signs -** Three Portable Variable Message Signs (PVMS) were purchased for traffic and construction management and in support of Lower Don flooding events in Q2 2017. The signs are mobile and solar

powered with rechargeable batteries, and messaging on the signs is remotely communicated from the Transportation Operations Centre via cellular service.

- **Update 'No Stopping' Regulations -** City staff analyzed the TTC Automatic Vehicle Location (AVL) data, and in Q4 2015, proposed to City Council to extend the current 'No Stopping' regulation times at certain locations in the downtown area. This review process started in Q1 2015 and the installations were completed in Q4 2015. City staff have been monitoring the results of these changes, and identified and produced a report for further deployment opportunities to City Council in Q2 2017.

- **Traveller Information Screens at TPA Lots -** Installed Traveller Information Screens at the Toronto Parking Authority's (TPA's) Church Street Garage to disseminate travel time information on the Don Valley Parkway (DVP), Lake Shore Boulevard & Gardiner expressway to the public via Variable Message Signs (VMS'). TPA's car park (CP43) at Esplanade has multiple exit points. This project dealt with the installation of two (2) VMS' displaying travel time information to public leaving the facility at the Market Street and Church Street exits. This project was awarded in Q4 2016 and was completed in Q3 2017.

- **Illuminated (LED Blank-Out)** - Illuminated (LED Blank-Out) signs supporting time-of-day turn restrictions help drivers to recognize active turning restrictions, thereby improving bylaw compliance and traffic flow. A contract to install 68 illuminated time-of-day turn restriction signs at 17 signalized intersections was awarded in Q4 2016 and was completed by Q3 2017.

- **Active Traffic Management (ATM)** - Active Traffic Management (ATM) is the practice of implementing dynamic and proactive operational tactics using technologies such as variable speed limits, reversible lanes, and hard shoulder running, to increase peak capacity, smooth traffic flows and/or reduce collisions. A contract to identify opportunities to apply ATM Strategies on Toronto's expressways and arterial roads was awarded in Q1 2016. This assignment was completed in Q3 2017.

- **Waze Partnership -** The City of Toronto is working with Waze to mutually exchange data for accessing crowd-sourced event information & communicating information to users. The City completed the agreement with Waze in Q3 2017.

- **TPS/TOC Operations Pilot -** Toronto Police Services (TPS) was in the Transportation Operations Centre (TOC) during weekday mornings for a six (6) week pilot project to improve incident response and management. The pilot demonstrated benefits by having direct TOC communication with TPS. This allowed for quicker declaration and response to incidents and better dissemination of traveller information to the public. TPS and the TOC will continue to collaborate while TPS will look at ways to improve communication access to the TOC. This pilot project completed in Q4 2017.

- **Curbside Management Strategy -** A contract to develop a Curbside Management Strategy was awarded in Q3 2015. Investigating the same downtown area used in the City's earlier Downtown Transportation Operations Study (DTOS), this project determined means of introducing flexible use of curb space to better meet downtown road user needs, while supporting effective traffic management strategies and maximizing the use of the road allowance. This project was completed in Q4 2017, and a separate report to Public Works and Infrastructure Committee is scheduled for November 2017.

- **Traffic Signal Actuation** - Eighty (80) non-intrusive detection devices for traffic signal actuation were installed in 2017, with all related work completed by Q4 2017. These detectors mitigate congestion and intrusive detection failures when road cuts occur.

- **Preparation for Autonomous Vehicles -** In anticipation of the introduction of autonomous vehicles, the City has established an Autonomous Vehicles Working Group to investigate and plan for what is expected to be a disruptive technology. The CMP supports a portion of Transportation Division's Autonomous Vehicles planning efforts. In this review period, the CMP funded a 'Non-Passenger Autonomous Vehicle Workshop' for City sector-leaders, consumer research conducted by Ryerson University to assess consumer attitudes towards autonomous vehicles, and a Municipal Code Review to assess the potential impacts of autonomous vehicles. This was awarded in Q3 2016 and is currently on-going.

- **Quick Clear Squads** - As a pilot, the City deployed 'Quick Clear Squads' during the afternoon rush hour and evening to expedite the clearance of temporary lane blockages on the Gardiner Expressway and the Don Valley Parkway. The pilot results from Q3/Q4 2017 indicate a reduction in clearance times resulting in a reduction congestion, and an improvement in safety. The success of the pilot is expected to result in an on-going program.

A full listing of the Congestion Management Plan accomplishments to-date (2014-2017) is included in Attachment 2.

Active Projects at the End of the Review Period
The following projects were active during the review period (Q2 2016 through to Q3 2017)::

- **Install New CCTV Cameras -**A contract for the installation of 46 CCTV traffic monitoring cameras was awarded in Q2 2017, and the project is expected to be completed by Q4 2017. Further installations (approximately 120 cameras) are planned over the next three to four years.

- **Update Traffic Signal Timings** - The updating of traffic signal timings as part of pro-active Traffic Signal Coordination Reviews improves traffic flow and reduces vehicle emissions, fuel consumption, stops, and overall vehicle delay. Traffic signal timings are being updated along 13 corridors (281 signals) in 2017. This project is 60% complete to date with an estimated completion in Q2 2018.

- **Signal Infrastructure for Connected Vehicles -** The City is working on third party connections to signal control systems in support of connected vehicle functionality. This connected vehicle data portal provides data related to intersection inventory and real-time status updates. Third parties will be able to access the portal via the City's Open Data platform to obtain an inventory of intersections and real-time traffic signal status updates. This service is expected to be deployed by Q3 2018.

- **Upgrade of the ATMS -** The upgrade of the City of Toronto's Advanced Traffic Management System (ATMS) will allow the City of Toronto's Transportation Operations Centre (TOC) to better manage traffic conditions, implement traffic management strategies, and communicate traveller information to road users. The implementation including testing and training is currently underway, and the system is expected to be ready for TOC operator usage in Q3 2018.

- **Upgrade to Smart Signals -** An upgrade to the City's adaptive ("smart") traffic signal control technology will improve traffic flow and reduce maintenance costs relative to the existing legacy system. The pilot deployment will involve testing two different systems in two study areas at a total of 22 intersections. The bids for the two pilot study areas have been received and the contract is expected to be awarded in Q4 2017, with contract execution in Q4 2017. The installation for the two pilot study areas is expected to be completed by Q3 2018. The pilot evaluations will continue through to Q3 2018.

- **State of Good Repair Upgrades -** To ensure a "state of good repair" and to maintain and meet operational requirements, the City of Toronto constantly upgrades/replaces field equipment and devices. This includes communication links, traffic signal controllers, timers, variable message sign modems, cameras, etc.).

- **Bluetooth Travel Times -** The City uses Bluetooth technology/ roadside sensors to determine travel time information. Travel time information is disseminated to the public via Variable Message Signs (VMS') and/or used for traffic analyses. The City currently has 70+ units installed in the field, and new units are installed on an on-going basis.

- **Website Updates -** The transportation pages on the toronto.ca website are currently being improved in Q4 2017 (for better usability, enhanced accessibility, etc.).

Projects in Procurement at the End of the Review Period

In this category, the following provides the status for projects that were in procurement, and about to be awarded, at the end of the review period (Q2 2016 through to Q3 2017):

- **Smart Work Zones** - A mobile trailer equipped with cameras, Bluetooth sensor and Variable Message Sign (VMS) will improve traveller information and traffic management in City of Toronto work zones with limited deployment spaces. A contract to purchase one (1) semi-customized 'Smart Work Zone' trailer for piloting is to be awarded in Q4 2017. The trailer delivery is expected in Q2 2018. The City's internal pilot will be planned and coordinated in parallel with the trailer procurement.

- **Lower Don Traffic Management System** -The City is currently designing a system to better manage traffic on Bayview Extension (and adjacent streets) during Lower Don River flooding events, and during planned and emergency closures of the Don Valley Parkway. The system will allow the City to open and close these roads earlier, better monitor and manage the area (including adjacent roadways), and provide detour signing for redirected traffic. The bids for consulting design services have been received and the contract is expect to be awarded in Q4 2017. The final design is expected to be completed in Q2 2018.

- **Threat and Risk Assessment** - The City of Toronto issued a RFP to conduct a Threat and Risk Assessment (TRA) for the City's Intelligent Transportation Systems (ITS) and related infrastructure, including the operations, maintenance, and processes pertaining to those systems and infrastructure. This TRA will identify the risks facing the City's ITS and related infrastructure, and recommend appropriate levels of protection from these risks. These recommendations would later be implemented by the City's Transportation Division to ensure these systems and infrastructure are safe and protected from viruses, cyberattacks, loss of communication, or interruptions. The TRA is expected to be awarded in Q4 2017 and is expected to be completed in Q4 2018.

Projects in Development at the End of the Review Period
In this category, the following provides the status for projects that are currently being readied for procurement, or that are currently being completed in-house:

- **Update Traffic Signal Timings -** The updating of traffic signal timings as part of pro-active Traffic Signal Coordination Reviews improves traffic flow and reduces vehicle emissions, fuel consumption, stops, and overall vehicle delay. A contract is in preparation to update traffic signal timings along approximately 8 corridors (about 204 signals) in 2018. It is anticipated that the agreement will start by Q2 2018 and be completed by Q4 2018.

- **Illuminated (LED Blank-Out) Signs** - Illuminated (LED Blank-Out) signs supporting time-of-day turn restrictions help drivers to recognize active turning restrictions, thereby improving by-law compliance and traffic flow. A contract is in preparation to install approximately 40 illuminated time-of-day turn restriction signs at about 20 signalized intersections. It is anticipated that the agreement will start by Q2 2018 and be completed by Q4 2018.

- **Traffic Signal Actuation** -Installations of detection devices for traffic signal actuation are planned for 2018. These assist in the efficient operation of traffic control signals, which reduces congestion. It is anticipated that this agreement will start by Q2 2018 and be completed by Q4 2018.

- **Lower Don Traffic Management System** - As a follow-up to the Lower Don Traffic Management System design to be completed in Q2 2018, the City is currently developing the documentation for the deployment of this system. It is anticipated that the agreement will start by Q2 2018 and be completed by Q3 2019.

- **Transit Signal Priority -** In 2016, the City completed a review of the Transit Signal Priority technologies options available within the industry. We are currently planning a follow-up assignment, with the Toronto Transit Commission, to establish a common vision for the provision of transit signal priority in the City of Toronto, and a common understanding of the technologies to be employed for this purpose. It is anticipated that the agreement will start by Q2 2018 and be completed by Q4 2019.

- **Emergency Vehicle Pre-Emption -** Transportation Services is working with Toronto Fire Services and Ambulance Services on a new Emergency Vehicle Pre-Emption (EVP) Strategy. A consulting assignment will be needed to prepare a design to support the strategy. It is anticipated that the design contract agreement will start by Q3 2018 and be completed by Q4 2019.

- **Traffic Wardens Program**- Following the City's successful pilot of 'traffic assistive personnel' in Q3/Q4 2016, the City is currently preparing for the procurement of a full-time Traffic Wardens program. The goal at this time is to deploy in 2018, but this is dependent on the timeline for Toronto Police Services to designate these Wardens as Special Constables. It is anticipated that this will remain an on-going program.

External Research Collaborations
Per Public Works and Infrastructure Committee direction, the following outlines the research projects undertaken using the authority under Schedule A of the Financial Control By-law:

- **Automated Vehicles -** Transportation Services funded a University of Toronto research project in 2015 to investigate the state of the art in automated vehicle technology and the industry trends in related policy, planning and investment options. This study has equipped City decision makers with the latest knowledge pertaining to the onset of vehicle automation. The study was completed in Q2 2016.

- **Unmanned Aerial Vehicles (UAV)** - Transportation Services recently funded a project with the University to Toronto to pilot the use of Unmanned Aerial Vehicles (UAV) to monitor traffic caused by the closure of roads for planned events. Traffic signal timing changes were made based on traffic observed by the UAV to help alleviate congestion. The project was awarded in Q3 2017 and completed in Q4 2017. The pilot project was a success and will result in a white paper in Q1 2018 featuring lessons learned and potential next steps.

- **Use of Before-After Methods with "Big Data"**- Transportation Services is currently working with Ryerson University to identify and test the potential use of before-after methods with "Big Data" to assess the links between policy and transportation system performance. This project will provide the City with feedback and methodologies to improve our before-after methods for various data related studies. The project was awarded in Q2 2016 and is expected to be completed by Q4 2017.

- **Spatial-Temporal Trends for Traffic -** Transportation Services is also working with the University of Toronto to develop spatial-temporal trends for traffic on the entire road network of the City of Toronto, based on count data collected. The outcome of this project will be providing the data needed to produce congestion metrics as part of the Congestion Management Plan and improve traffic volume collection and monitoring needed as part of the Road Safety Plan. The project was awarded in Q1 2017 and is expected to be completed in Q2 2018.

CONTACT

Ashley Curtis
Senior Strategic Director, Capital Projects
Transportation Services Division
Telephone: 416-338-6583
Email: ashley.curtis@toronto.ca

SIGNATURE

_____
Barbara Gray
General Manager, Transportation Services

ATTACHMENTS

Attachment 1 – Congestion Management Plan Accomplishments To-Date

Attachment No. 1 – Congestion Management Plan Accomplishments To-Date

Congestion Management Plan accomplishments since its initiation at the start of 2014 are described here, organized per the categories used in the Plan:

1. Incident and Event Management

- Deployed the "Steer it – Clear it" Program (2014)
- Installed 17 Expressway variable message signs (2014)
- Deployed travel time information on our variable message signs on both the Gardiner Expressway and Don Valley Parkway (2014)
- Completed renovation of the Transportation Operations Centre including major update of video monitoring tools (2014)
- Completed Freeway Service Patrol Feasibility Study (2015)
- Piloted arterial-based travel time messages (2015)
- Completed a new Concept of Operations for the Transportation Operations Centre (2016)
- Completed Emergency Vehicle Pre-emption Strategy (2016)
- Installed 75 uninterruptable power supplies installed for key signalized intersections (2014-2017)
- Installed 144 traffic monitoring cameras on arterial roads (2014-2017)
- Installed 108 LED Blank-out signs to improve turn prohibition compliance (2014-2017)
- Completed a Data Warehouse Strategy (2017)
- Completed Active Traffic Management Industry Review (2017)
- Updated RESCU Transportation Operations Centre (TOC) Operation Service Contract (2017)
- Toronto Police Services in the Transportation Operations Centre (2017)
- Deployment of Quick Clear Squads during the morning rush hour to expedite the clearance of temporary lane blockages on the Gardiner Expressway (2017)

2. Arterial Traffic Operations

- Deployed Pilot "Courier Zones" in Downtown Toronto (2014)
- Completed operational review of SCOOT adaptive traffic signal control (2014)
- Installed new Traffic Control Signals as follows:
- 20 new traffic control signals in 2016
- 13 new traffic control signals in 2017
- Completed 'Priority Corridor' traffic signal timing optimization studies as follows:
- 7 corridors (224 signals) in 2014
- 11 corridors (337 signals) in 2015
- 17 corridors (357 signals) in 2016
- 13 corridors (281 signals) in 2017
- Installation (on-going) of Bluetooth traffic flow detection in support of traffic studies and provision of travel time on variable message signs.
- Review Downtown Peak Hour Stop Restrictions on Transit Routes (2017)

3. Construction Coordination

- Increased road and lane disruption enforcement (2015)
- Purchase of three portable variable message signs for construction management and in support of Lower Don flooding events (2017)

4. Curb-side Management

- Completion of Downtown Transportation Operations Study (2014)
- Pilot of Traffic Assistive Personnel (2016)
- Completion of Curbside Management Plan (2017)

5. Traveller Information

- Deployed Traffic Reports via Twitter (2014)
- Completely redesigned & redeveloped the Road Restrictions website (2015)
- Completed an Advanced Traveller Information Services Strategy (2017)
- Completed an Enterprise Data Warehouse (EDW) Needs Assessment and Preliminary Design (2017)
- Installation of Traveller Information Screens at TPA Church Street Garage (2017)

6. Smart Cities / Big Data

- Initiation (2015) & on-going support for Transportation Services' unit investigating autonomous vehicle preparedness
- Initiation (2015) & on-going support for the City's first 'Big Data Innovation Team', used to pro-actively analyze data for infrastructure investments and road network strategy decision making
- Deployed 'Big Data' real-time and historical data via commercial purchase (2016)
- Piloted use of unattended aerial vehicles for traffic management potential (2015-2017)
- Completion of agreement with Waze (for accessing crowd-sourced event information and communicating information to users) pending resolution of Legal agreement (2017)

7. Support of All Modes of Transportation

- Completed Transit Signal Priority Strategy Update (2016)
- On-going deployment of transit signal priority (as requested across the City)
- Provision of on-going staffing support for ECLRT, King Street Pilot, and transit signal priority policy development

8. State of Good Repair

- Upgraded the Systems Maintenance & Testing Lab (2014)
- Upgraded W.R. Allen Road 'Queue End Warning' traffic monitoring cameras and related communications (2015)
- Investigation of Automated Vehicle Technology and Industry Trends in related Policy, Planning and Investment Options (2016)
- Upgraded Communication Infrastructure between TMC and 229 Field Signal Controllers (2016)
- Upgraded traffic flow and traffic volume detection capabilities (2014-2017)
- Upgraded CCTV Subsystem for the Don Valley Parkway (2017)
- Detection updates (2017)
- On-going upgrades to field equipment (e.g. communication links, traffic signal controllers, variable message sign modems, cameras, etc.).