



# 2020



## Transportation Department Environmental Performance

Sustainability Strategy Division  
Transportation, The City of Calgary  
May 2021



A sustainable transportation system meets the transportation and other needs of the present without compromising the ability of future generations to meet their needs.

(Transportation Research Board 2004)



## EXECUTIVE SUMMARY

This report was prepared in Q1 2021 by the staff of the Transportation department's Sustainability Strategy division for the information of the Transportation Leadership Team. It also may be of interest to others in City administration, Council and the public. This reporting is presented annually to compile data, analyse trends, and inform leadership of the past year's environmental performance results and emerging issues, challenges and opportunities. It provides information and insight to confirm there is an appropriate alignment of focus and resources across the department and business service lines to meet environmental compliance requirements and organizational goals.

In 2020 the transportation system in Calgary continued to expand, while service delivery was adapted to pandemic-related changes in travel patterns and mobility demand. Environmental performance across the department was strong. Regular audits of operational business units Transportation Infrastructure, Calgary Roads, and Calgary Transit verify that the environmental management systems and processes they have in place are functioning effectively for them to continue to meet legal and policy requirements. The results of internal audits and also external audits performed annually by contracted third parties in 2020 confirm there are good environmental practices and innovations employed in the development and operation of our transportation system, both internal to the organization and throughout the contracted services supply chain. In summary:

- Environmental management systems were confirmed to be well integrated with daily operations and long-term business planning functions within Calgary Roads, Calgary Transit, and Transportation Infrastructure.
- The total energy supply required to operate the transportation system decreased by 12 per cent year-over-year, with reduced public transit service in line with reduced demand/ridership attributable to the pandemic.
- Transit fleet right-sizing, conversion of street-lighting to LED, and other energy saving initiatives helped to minimize transportation system energy consumption, and combined with The City's renewable energy supply contract they allowed an expanding transportation system to limit greenhouse gas emissions to 97 kilotonnes (down from 117 kt the year prior).
- Department-wide efforts in planning, developing, operating – and in 2020, adapting – transportation infrastructure and services enabled a wide range of mobility options for Calgarians, with continued implementation of the cycling strategy, pedestrian strategy, EV strategy, and RouteAhead transit strategy.
- Residents of Calgary and region enjoy good air quality and good water quality in the Bow River, with noted concerns being dust and sediment from land development, other construction activities and unpaved surfaces.
- Potential pollutants were well managed through the effective implementation of plans for erosion and sediment control, construction site management, and working in areas of existing soil and groundwater contamination.
- The environmental management of road salts continued to be an area of focus with operational practice changes and pilots underway to minimize the use of salt and its inadvertent release to the environment; Calgary Roads benchmarks well against other road authorities nationally in meeting its voluntary compliance targets.
- Waste materials produced from transportation operations, construction and demolition, and in the public realm are increasingly diverted from landfill through reuse and recycling, including a portion of street sweepings.
- Biodiversity conservation measures addressed key habitats, invasive weeds, wild bees, migratory birds and wildlife with 2020 marking a pivotal shift for Calgary Roads in “naturalizing” boulevards and major roadways.

The year 2020 was notable for being the first 10 months of the global COVID-19 pandemic with related public health measures, significant changes in travel patterns, and corresponding changes in service delivery by The City. While some transportation system development and operational activities were relatively unchanged under this scenario, public transit service demand and corresponding supply were dramatically different than in past years – ridership in 2020 was 48 per cent of 2019 levels, averaged over the full year – and that resulted in significantly reduced energy use in terms of traction power for the light rail transit system and fuel consumption for the bus fleet.

The following dashboard indicates performance trends and current status for each of the operational business units in their continuing implementation of the Calgary Transportation Plan and in alignment with The City's environmental and sustainability policies. More detailed information on these programs and actions, and on select initiatives of the Transportation Planning and Green Line lines of business, are presented in this report under related headings.

#### Calgary Transit:

Action	2014	2015	2016	2017	2018	2019	2020	Status
Environmental management system	→	→	→	→	→	→	↗	●
Energy management	→	↗	↗	→	→	→	→	⊙
Pollution prevention	↗	→	↗	→	→	→	→	●
Water management	→	↗	↗	→	↘	↗	→	●
Waste management	→	→	↗	→	↗	→	→	●
Biodiversity conservation	→	→	→	↘	→	→	→	●

#### Roads:

Action	2014	2015	2016	2017	2018	2019	2020	Status
Environmental management system	↗	→	↗	↗	→	→	→	●
Energy management	↗	↗	→	→	→	→	→	●
Pollution prevention	→	↘	→	→	→	↗	→	⊙
Water management	→	→	→	→	→	→	→	●
Waste management	→	→	→	→	↗	→	→	●
Biodiversity conservation	→	→	→	→	→	→	↗	●

#### Transportation Infrastructure:

Action	2014	2015	2016	2017	2018	2019	2020	Status
Environmental management system	↗	↗	↗	→	→	→	→	●
Energy management	→	→	→	→	→	→	→	●
Pollution prevention	↗	→	→	→	→	→	→	●
Water management	→	→	→	→	→	→	→	●
Waste management	→	→	→	→	→	→	→	●
Biodiversity conservation	→	→	→	→	→	→	→	●

Trend favourable ↗ Trend unfavourable ↘ Trending same → On track ● Issue or Challenge ⊙ On hold ○

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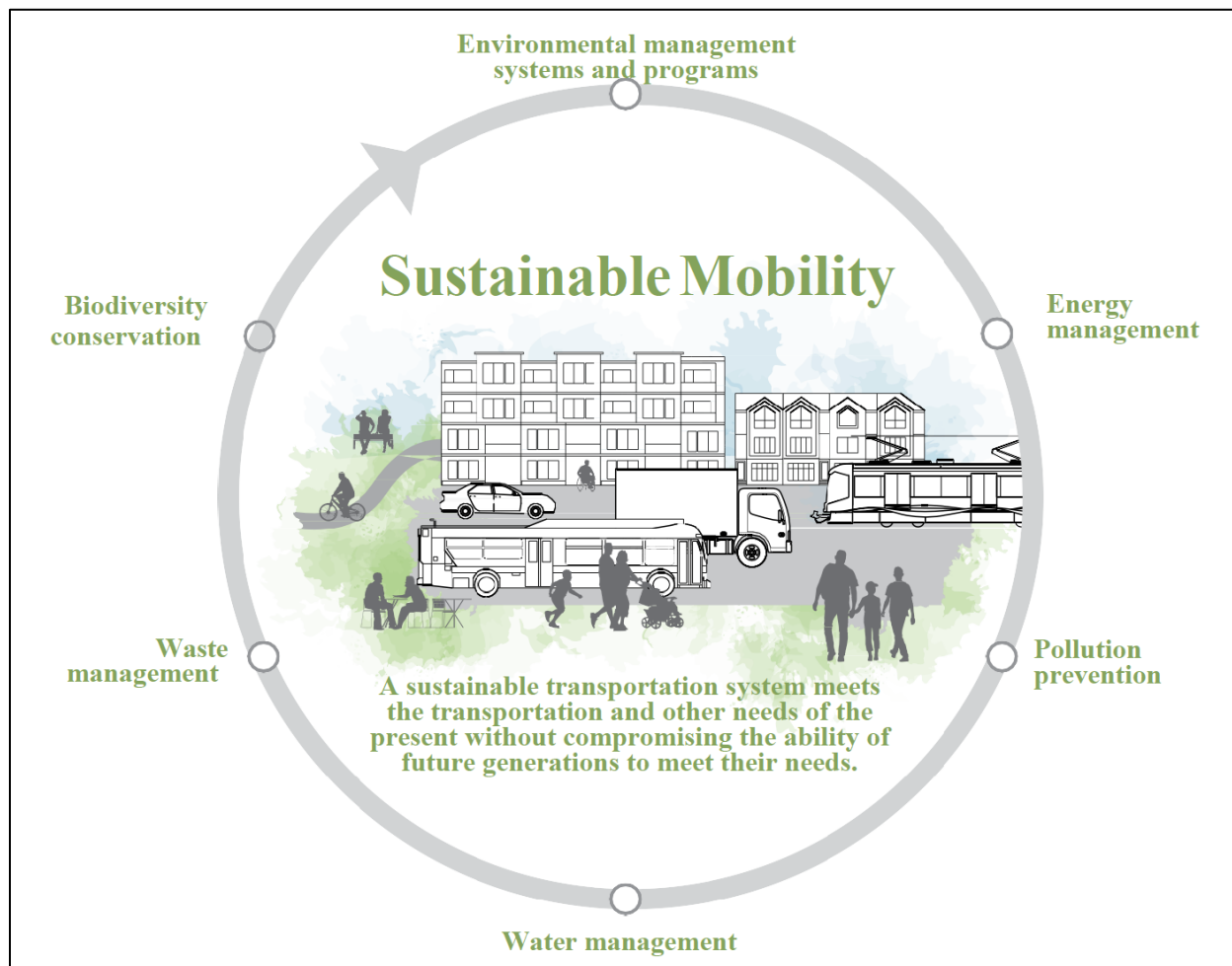
### APPENDIX 1 – Transportation Energy Profile



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## 1. Introduction

This report was prepared in Q1 2021 by the staff of the Transportation department's Sustainability Strategy division for the information of the Transportation Leadership Team. It also may be of interest to others in City administration, Council and the public. This reporting is presented annually to inform leadership of the past year's environmental performance results and emerging issues, challenges and opportunities. It provides information and insight to confirm there is an appropriate focus and alignment of resources across the business service lines to meet environmental compliance requirements and organizational goals. This report includes summary information from regulatory reporting, and also it presents a roll-up of progress reports that are shared on a regular basis throughout the year with Transportation leadership to provide them with direct line-of-sight to operational staff and all programs and activities having environmental aspects (i.e. potential impacts and opportunities). This information is compiled for reference, planning and decision-making.



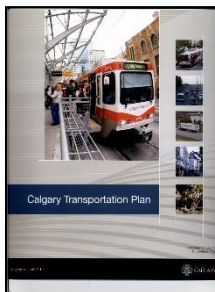
*Figure 1:  
Environmental sustainability themes selected for performance reporting by the  
operational business units of City of Calgary Transportation department*



With the over-arching goal of the department being to enable multi-modal mobility, there are several key environmental considerations (Fig.1) for the different Transportation business units and lines of service. The thematic sections of this annual performance report present details on each of these areas of our focus and effort (i.e. what we do, and collectively how well we do it) in advancing environmental sustainability.

The sustainability dashboard presented within the Executive Summary indicates environmental performance trends and current status. It is a qualitative assessment that relies on expert knowledge and professional judgement as supported by performance data and narrative information presented in this report. The dashboard trendlines span successive 3-year and 4-year business plans, so they reflect “best fit” with performance criteria that evolved in step with changes in business plan focus and objectives. Progress updates and select performance results for environmental management and related activities across the department are presented for the year 2020, with reference made to departmental outcomes, strategies, and performance measures outlined in the One Calgary 2019-2022 business plan. Citizen priorities are reflected in Council’s strategic direction for “A City That Moves” (having key value dimensions of safety, accessibility, connectivity, responsiveness, and reliability of the transportation system) and “A Healthy and Green City” (key dimensions being climate resilience, water quantity and quality, and green space) being most relevant to this reporting.

## 2. Advancing Environmental Sustainability



The *Calgary Transportation Plan* (CTP) has “Advance environmental sustainability” as one of its seven primary goals, with its supporting objectives more specifically being to “protect **air**, **land**, **water** and **biodiversity** in the planning, design, operation and maintenance of all transportation infrastructure”. Consistent with the plan’s stated goal and objectives, there are several CTP policies that direct the efforts of the departmental environmental sustainability team in supporting the various Transportation (and broader Corporate) lines of business and service delivery to the citizens of Calgary.

The overall transportation goal presented in the *Municipal Development Plan* (MDP) is:

***“To develop an integrated, multi-modal transportation system that supports land use, provides increased mobility choices for citizens, promotes vibrant connected communities, protects the natural environment, and supports a prosperous and competitive economy”.***

The *City of Calgary Environmental Policy* states the importance of “The 3 C’s” corporately, namely to:

- Comply with legislation;
- Conserve resources and prevent pollution; and
- Continually improve our environmental performance.

The department’s three operational business units – Calgary Roads, Calgary Transit, and Transportation Infrastructure (TI) – all have positions filled with qualified environmental staff who provide internal client service on all environmental aspects of the transportation business. The Transportation department has a unique governance and reporting structure having environmental sustainability represented in its leadership, and having direct lines of sight between strategic leadership and tactical effort at the operational level, to better enable the “triple bottom line” (i.e. social, environmental, and financial aspects) being considered in



planning, decision-making, and execution. This report focuses on the efforts and results of work done in the operational business units to advance environmental sustainability.

Also included in this report are updates on select programs and initiatives within the Transportation Planning business unit, being concerned with “sustainability” defined more broadly to address active modes of travel, the shared public realms of roadways, and their integration with other land uses. Transportation planning is closely coordinated with land use planning (as guided by the MDP) to enable transit-oriented development and promote “smart growth”. The MDP-CTP monitoring and reporting program, and various other data collection and reporting mechanisms including those within Calgary Transit, are valuable sources of data that are distinct from, and complementary to, the information presented in this report.

### 3. Environmental Management Systems

The operational business units of Transportation for more than a decade have earned and maintained separate registrations to the International Standards Organization (ISO) program for environmental management systems. Annual audits of these management systems are conducted by an independent third party auditor, and every three years their functional effectiveness is validated for ongoing registration to the



ISO 14001 Standard. Each business unit also is subject to an annual ISO/compliance internal audit led by Environmental & Safety Management (ESM). Additionally, Calgary Transit conducts its own facility inspections on a quarterly basis to review hazardous materials storage and labelling, secondary containment and spill release reporting.

In 2020 the three registered business units demonstrated continued satisfactory performance with no “major non-conformance” (indicating a significant deviation from the management system) to the ISO standard. There were several positive audit conclusions related to continuing improvements and sound environmental practices indicating that the management systems promote environmental protection during the construction, operation and ongoing maintenance of our transportation system. The environmental management systems also are demonstrated to be well integrated with daily operations and long-term business planning functions. Special mention goes to Calgary Transit for their first external audit result of ZERO major or minor non-conformances.

Audit results in 2020 confirmed that mature, properly functioning environmental management systems are in place within Transportation, and there is sound stewardship throughout the contracted services supply chain.

The Transportation Planning business unit is not registered to the ISO standard for environmental management, given the non-operational (i.e. primarily office-bound) nature of its work and associated low risk for adverse environmental effects. In 2018 the Green Line Light Rail Transit (LRT) initiative was created as a new, fifth distinct business unit within Transportation (note: as of 2020, the Green Line now operates under a separate governance structure outside the department) that was not anticipated to be ISO registered; instead, in January 2019 the decision was made to pursue certification for Green Line under the “Envision” sustainability rating system as an alternative environmental management guidance system that is suitable for linear infrastructure that will be designed, built and possibly financed by contracted third parties.

## 4. Energy Management

### 4.1 Corporate energy strategy and GHG emissions reduction goal

The City of Calgary consumes energy from various renewable and non-renewable sources in delivering a wide range of public services to Calgarians. Corporate energy use in recent years has increased in step with annual population growth, with energy accounting for approximately 4 per cent of The City's total operating expenses. An integrated Corporate Energy Plan was completed in 2016 that set energy performance targets on specific timelines. In June 2018 a Climate Resilience Strategy was adopted by Council, including an action plan for achieving greenhouse gas (GHG) emission reductions through changes in energy supply and consumption.

The combustion of fossil fuels by buses and other fleet vehicles, and natural gas used for heating buildings and facilities, are primary sources of GHG emissions. Reducing fossil fuel consumption by shifting to renewable or lower carbon sources of energy, combined with energy efficiency and conservation measures, are key to reducing GHG emissions. The City previously had established a target to reduce corporate GHG emissions to 20 per cent below 2005 levels by 2020, and 80 per cent below 2005 levels by 2050, consistent with commitments made under the 2009 Calgary Climate Change Accord. However, both corporate and city-wide GHG emissions continued to increase between 2009 and 2019.

### 4.2 Transportation energy profile

The current energy supply mix of the Transportation department comprises mainly electricity, natural gas, diesel fuel and gasoline. There are lesser components of compressed natural gas (CNG), thermal energy from combined heat and power (CHP) systems, solar power, and propane in the energy supply mix (Fig.2). The provincial grid-supplied electricity is considered to have zero associated GHG emissions because of The City's purchase of renewable energy certificates, primarily tied to wind power generation in southern Alberta.

Data describing energy consumption and associated costs for the department and separately for operational Transportation business units are presented in Appendix 1. The full data set used to produce the charts and performance metrics was collected and compiled for analysis by The City's Energy Management Office.

In summary, in 2020 Transportation had a 12 per cent decrease in energy consumption year-over-year, with total energy consumption from all energy supply sources of 570,070 megawatt hours equivalent (MWh) at a cost of \$59.4 million (Figs. App. 1-1, 1-2). The reduced energy use is primarily attributable to reduced public transit service in line with reduced ridership attributable to the pandemic.

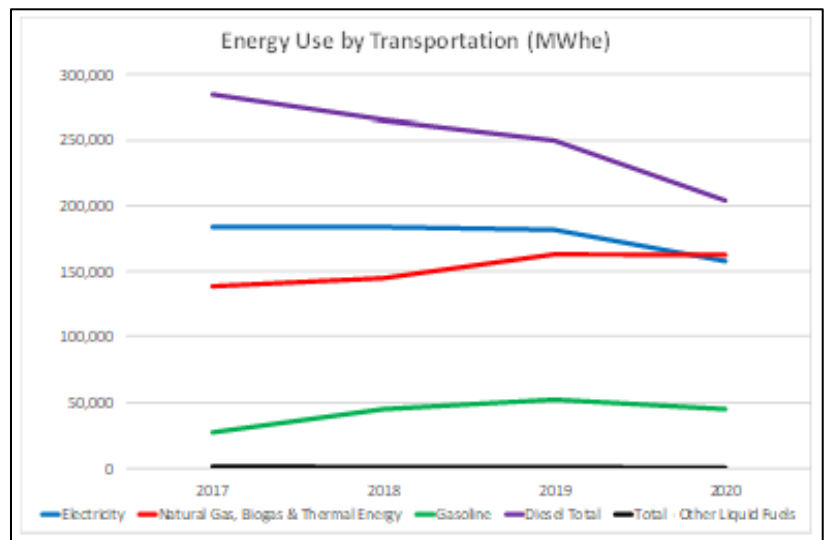


Figure 2: Transportation energy use by supply type, 2017-2020

Within the department, Calgary Transit has the highest consumption of fossil fuels for fleet vehicles and facility space heating, accounting for about half of the department's total energy costs and the vast majority of its GHG emissions in a typical year (based on energy reporting for 2017-2019). In 2020 with adjusted bus services Calgary Transit's fossil fuel costs were down to 39 per cent of the department's total energy costs, while fossil fuel supply for Roads fleet remained the same as the year prior at approximately 6 per cent of departmental energy costs and associated GHG emissions. Unit prices for grid-supplied electricity were up in 2020, with the light rail transit (LRT) traction power system and electricity draw from transit facilities accounting for 35 per cent of departmental energy costs, and with the operation by Calgary Roads of the street lighting and traffic signal systems throughout the city being 19 per cent of total energy costs in 2020 (up 8 per cent from 2019).

#### 4.3 Energy and emissions reductions effort and results

Absolute reductions in Corporate energy consumption are a challenge to achieve in a growing city with an expanding transportation system. However, even with increases in The City's energy consumption needed to grow public transit service and ridership, greater community-wide GHG emissions reductions can be achieved with a significant shift in travel mode-split away from single occupancy vehicles, and toward active modes and public transit which is much more energy efficient. Analysis completed in support of Green Line LRT business case development (Report C2016-0115) reveals that energy efficiency gains are achieved with only 18 passengers riding on CTrain, which is the "break even" point for LRT to save energy compared with 18 automobiles. At maximum capacity, the LRT is 58 times more energy efficient than driving, and similarly transit buses are more energy efficient than automobiles when there are passenger economies of scale.

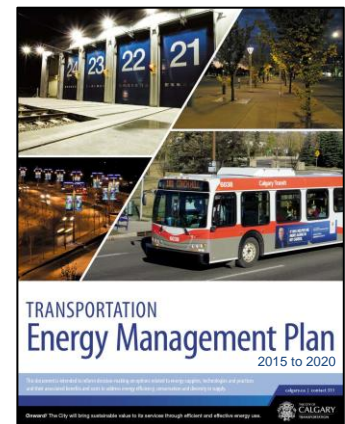
In recent years Calgary Transit has had marginal increases in electricity and natural gas consumption, with some of that likely explained by the additional space heating needs with the opening of the new Stoney CNG Transit Facility and the operation of the CNG buses.

The following programs and initiatives addressed energy use and GHG emissions in 2020.

##### ***Energy management plan implementation***

A departmental energy management plan was completed in 2014 to inform decision-making on options related to energy supplies, evolving technologies and practices, and their associated benefits and costs with the aim of improving energy literacy, energy efficiency and conservation, energy supply diversification, and cost control over the longer term. Implementation of the Transportation Energy Management Plan has entailed research, internal engagement, business case development and investigation into funding sources and financing mechanisms for potential capital investments and program changes within Calgary Transit and Roads business units.

One of the most significant initiatives undertaken was the conversion of over 80,000 street light fixtures throughout the city from high pressure sodium to light emitting diode (LED) luminaires, to achieve payback on capital investment in less than 10 years through reduced maintenance and reduced energy consumption. With the average wattage per fixture being reduced from 187 Watts to 90 Watts



between 2014 and 2019, a 49 per cent reduction in energy use was achieved over 5 years from street lights alone and additional energy and cost savings were achieved by converting to LED for decorative light fixtures and to lighting at Transit maintenance and public parking facilities.

Several other opportunities identified in the plan have advanced into the realm of execution and operation with some highlights presented below. A refresh of the departmental energy management plan is one component of a pending new corporate-wide energy and emissions plan underway in 2021.

### ***Fleet right-sizing***

Calgary Transit has an ongoing program of “right-sizing” the fleet for optimized service, increased fuel efficiency, and reduced GHG emissions. The standard 40-foot diesel-fueled buses are getting lifecycle replacements on certain routes with gasoline-fueled ARBOC shuttles that are 30 feet in length with seating for 23 passengers, having a modern design that is lighter and more fuel efficient.

### ***Shifting to lower carbon fuels***

Calgary Transit through involvement with the Canadian Urban Transit Association and other industry networks monitors the evolution of technology and product availability for its fleet. The fleet comprises approximately 1,000 buses and shuttles, mostly fuelled by diesel and gasoline plus a growing number of CNG buses. Shifting to CNG fuel from diesel is motivated by fuel cost savings and by a commitment to continual improvement in environmental performance. There are significantly reduced tailpipe emissions, including nitrogen oxides (NOx) that contribute to smog formation, and there are also reduced GHG emissions<sup>1</sup>. The Nova CNG buses have electric engine cooling technology that helps reduce fuel consumption and lifecycle costs. With 26 more buses added to the growing CNG fleet in 2020, there are currently 114 CNG buses operating out of the new Stoney CNG Transit facility.

With the aim of shifting to lower carbon fuels, between 2017 and 2019 Calgary Transit and Corporate Analytics & Innovation business units worked collaboratively in conducting a comprehensive TBL analysis of potential costs and benefits of electrifying a portion of our transit fleet, and investigating the feasibility and operational aspects of different types of battery charging infrastructure for transit. Having previously made an unsuccessful bid to secure partner funding for a proposed trial of battery-powered electric buses (“e-buses”), and with feasibility studies and due diligence work having been advanced in the interim, The City was awarded \$7 million from Emissions Reduction Alberta in March 2019 toward the pilot of an e-bus system done through matching-fund partnership. Planning and procurement for components of the e-bus pilot project got underway in 2020, with the pilot anticipated to run 2022-2024. On an ongoing basis Calgary Transit also is monitoring the developments at transit agencies in other jurisdictions, including City of Edmonton, who are investing in e-buses on a pilot or limited scale basis. The infrastructure and power supply implications of e-buses scaled up to the level of an entire fleet are not yet well understood.

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<sup>1</sup> While the actual combustion of CNG fuel has reduced GHG emissions compared with diesel fuel, the compression required for CNG (to boost from 550 psi to 3500 psi) normally may offset the reduction to a degree; however, compression is powered by electricity, and The City has GHG emissions-free electricity supply as described above.

### ***Electric vehicle technology***

The Transportation department in 2020 continued to monitor research and pilot applications of electrification, shared mobility, mobility-as-a-service and other emerging trends and technologies for advancing environmental sustainability in our transportation system. Further electrification of urban transportation systems will help to drive down GHG emissions with the gradual phase-out of coal-fired generation plants and a corresponding increase of wind, solar and other sources of lower carbon energy supply to the electricity grid.

In addition to the e-bus technology described above, The City aims to facilitate the adoption of electric vehicles (EVs) more broadly for personal use by Calgarians, for commercial fleets and for its own service fleets. Within the Roads business unit a hybrid electric/natural gas powered street sweeper was in trial use during the 2020 spring clean up program, with sweeper performance tracked and compared against the conventional sweepers to help inform future equipment procurement decisions. (Of the 31 sweepers used in 2020 including rentals, 28 are considered conventional, with dual engines; the other 3 rental sweepers are new generation, single engine sweepers that use 30 per cent less fuel with corresponding reduced GHG emissions). Implementation of the 2018 strategy for facilitating the uptake of EVs by Calgarians continued in 2020, with actions including:

- Partnering with other public and private sector organizations to implement a local and regional EV charging infrastructure system, along with an EV education program for the public and businesses;
- Collaborating with City of Edmonton and Government of Alberta, the local development industry, and utility companies to improve options for home charging of EVs;
- Monitoring and providing input to other orders of government on new EV-specific policies; and
- Streamlining municipal and utility processes to facilitate the uptake of EV projects.

There are more than 100 privately owned “Level 2” charging stations (which can fully charge a vehicle in about 8 hours) operating across Calgary, and also several Direct Current Fast Charging (DCFC) stations located at car dealerships and at least one with public access. Additionally, the Calgary Parking Authority (CPA) has Level 2 charging stations installed across their network of downtown parkades. A project to install 20 EV charging stations at select Calgary Transit park and ride facilities and recreation centres got underway in 2020, with funding contributed by Natural Resources Canada and Enmax (at no capital cost to The City). That project is scheduled for completion in 2021. The City is exploring opportunities for other community EV charging infrastructure (e.g. “community charging hubs”).

To facilitate trips on a more regional basis, the “Peaks to Prairies” southern Alberta electric vehicle charging network was designed and implemented as a collaboration of The City of Calgary, the Alberta Southwest Regional Economic Development Alliance, SouthGrow Regional Initiative, City of Lethbridge, City of Medicine Hat and Medicine Hat College. There is now a network of DCFC and backup Level 2 stations operating at sites across southern Alberta, including at major entry points to Calgary near the Stoney Trail ring road.

At the policy level, amendments to the Calgary Transportation Plan addressing vehicle electrification were proposed by Administration in 2020, including the following new policies in Section 3.12: “(d) The City should participate in and promote initiatives aimed at expanding the availability of publicly accessible electric vehicle charging stations;” (e) “The City should take steps to achieve a transition of the entire fleet of vehicles in Calgary to zero-emissions vehicles by 2050.” The amendments were approved by Council in February 2021.



### ***“Green building” design of transit facilities***

The Stoney CNG Bus Storage and Transit Facility, delivered through a Design-Build-Finance-Maintain procurement model of public-private partnership, had entered into operational service in March 2019. The state-of-the-art facility provides indoor storage and servicing for diesel buses and for a new and expanding fleet of buses fuelled by compressed natural gas, with a design capacity of 450 full size buses in total. Achieving a LEED Gold facility rating, the facility is water and energy efficient; it includes a combined heat and power (CHP) system that utilizes waste heat, and also is designed to accommodate solar photovoltaic panels on the roof. The energy consumption required for gas compression on site is much reduced with a 550 pound per square inch feed off the ATCO high pressure gas line nearby.

On 30 January 2020 the Stoney CNG Transit Facility was selected as the winner of the Alberta Green Building Excellence for New Construction Award, recognized for its sustainability and innovation including low carbon aspects that Calgary Transit, Transportation Infrastructure, and Corporate Analytics & Innovation business units had collaborated on very closely to plan and ultimately realize through a P3 partnership.

### ***Energy and cost savings from upgraded LRT track & way infrastructure***

Track switch heaters are LRT wayside equipment fuelled by natural gas that clear snow from track switches to facilitate their proper functioning during snow events. There are 135 track switch heaters in the LRT network that are operated either manually or remotely. The heaters are often left running for extended periods, even during dry and warmer weather, due to lack of dedicated resources to adjust or remotely monitor switch operations. Calgary Transit Track & Way (T&W) division investigated the possibility of reducing switch heater operational costs and natural gas consumption by installing an automated system of snow detection and rail thermostats to trigger the ON/OFF operation of the gas-fired switch heaters based on inputs from these devices. Following a trial application of the technology completed in 2019, Calgary Transit in 2020 initiated an expanded pilot project in 2020 with the contribution from the Federation of Canadian Municipalities of \$300,000 in matching funds to upgrade 11 existing track switch heaters to more efficient models and install 100 units of snow detection and rail thermostat systems. This is an innovation among Canadian municipalities.



The LRT track switch heater pilot project has the potential to offer a wide range of environmental and economic benefits, which include but not limited to, reducing energy consumption by approximately 75% (19,500 GJ/year), reducing the LRT system’s annual GHG emissions by 1,000 tonnes, and reducing exposure to carbon pricing and natural gas fuel price volatility. This pilot project will also create potential operational cost savings of \$112,000, which will offset the initial costs in less than five years.

### ***Emphasizing the “green” in Green Line LRT infrastructure***

Planning, preliminary engineering, land acquisition, utility relocation and preparations for procurement continue in support of Green Line LRT development. The decision was made in 2019 to adopt the “Envision” sustainable infrastructure rating system (consistent with the recently updated Sustainable Building Policy) as guidance for achieving sustainability opportunities in the development and operation of the Green Line. With respect to climate change considerations, use of the Envision framework will assist the project delivery team in optimizing project resilience and sustainability performance. In planning, design and procurement of the project there will be systematic consideration of opportunities to:

- reduce overall operational energy consumption throughout the project life
- reduce GHG and air pollutant emissions
- meet operational energy needs through renewable energy sources
- specify the commissioning and monitoring of energy systems to promote energy efficient functioning
- reduce the net embodied carbon of materials used over the life of the project
- develop a comprehensive climate change vulnerability assessment, and evaluate associated risks
- support increased project and community resilience to climate change.

With respect to reducing the net embodied carbon, the Sustainability Strategy division since 2018 has attended industry presentations to familiarize with the cement industry association’s stated ambition to reduce GHG emissions associated with new construction. We continue to follow developments in the potential for low carbon cements used in concrete, and for CO<sub>2</sub> sequestration in concrete. The potential merits of “CO<sub>2</sub> mineralized concrete” in applications including Green Line and other transportation infrastructure (e.g. bridges, sidewalks) is the subject of ongoing discussion, research and pilot application as of Q1 2021.

Transportation system operations in 2020 are estimated to have generated a total of 97 kilotonnes of GHGs, or carbon dioxide equivalent (kt CO<sub>2</sub>e), based on consumption of 412,579 megawatt hours equivalent (MWh<sub>e</sub>) of fossil fuels on a department-wide basis. That represents a 17 per cent decrease in GHGs year-over-year.

### **4.4 Land use and mobility aspects of energy consumption**

Throughout 2020 the CTP and MDP were under review by a dedicated team of staff from Transportation Planning and Calgary Growth Strategies to identify the policy changes and updates needed to make Calgary better for more people over the next 20 years. Key updates to the policy included greater emphasis placed on climate action and electrification of personal mobility, and these were approved by Council in February 2021.

Publicly available information suggests that transportation activities of all types account for about 30 per cent of GHG emissions in our city, and 80 per cent of those emissions are generated by light duty passenger vehicles. Land use and mobility changes over time that reduce dependence on personal vehicles - enabling shorter trips, and more trips to be made by active modes or public transit - help to offset the increases in energy consumption and related GHG emissions associated with population growth. Enabling Calgarians to shift more of their short trips towards walking, cycling, and other forms of “wheeling” will also help to reduce local air



pollution, noise pollution, stormwater runoff volumes, and traffic congestion. Select initiatives are briefly described below to highlight the department-wide efforts in planning, developing and operating key infrastructure and enhancing services to enable travel mode-shifting.

### ***Pedestrian strategy implementation***

Throughout 2020 the Liveable Streets division of Transportation Planning continued to lead implementation of Step Forward, Calgary's pedestrian strategy that was approved by Council in 2016. The strategy identifies 49 actions to help make Calgary safer, more comfortable and more interesting for walking. Approximately 20 per cent of the actions are considered complete, or mostly complete, or no longer relevant, and 45 per cent remain in progress with the balance (about 35 per cent) not yet funded or initiated. More information on these and related initiatives are presented under sub-headings below.

### ***Cycling strategy implementation***

City of Calgary Council approved the Cycling Strategy in 2011 and since then has collected data on its implementation and associated ridership. Implementation of the Cycling Strategy continued in 2020, with the current extent of the city-wide cycling network summarized in Figure 3 below. Various types of on-street cycling infrastructure and shared facilities comprise one-third (33 per cent) of the total 1,515 km cycling network in Calgary, with the balance comprising off-street, multi-use pathways. The addition of more painted bicycle lanes on roadways is one component of the network that falls far short of the established target for 2020, and also the extent of protected cycle track also falls short of target, as the addition of marked bike routes and off-street pathways were assigned higher relative priority. The 1,500 km target for the total network was achieved.

*Figure 3: Cycling infrastructure*

<b>Bicycle Facility Type (kilometres)</b>	<b>Baseline (2009)</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>Target (by 2020)</b>
Total cycling network	1,065	1,213	1,266	1,320	1,319	1,336	<b>1,515</b>	1,500
Pathways (off street)	710	813	866	900	905	918	1,022	900
Bikeways (on street)	355	396	400	414	414	418	493	600
• Bike routes	328	345	341	346	344	344	405	370
• Shared lanes	15	15.1	17.5	18.8	18.8	19.5	21	20
• Bicycle lanes	12	29.4	33.7	42.5	44.6	46.2	57	180
• Cycle track	0	6.6	7.1	7.2	7.2	8.7	12	30

### ***Infrastructure investments supporting active modes***

Key infrastructure investments made in 2020 to support the pedestrian and cycling strategies included:

- Multi-Use Pathway along 42 Av SE
- Cycle track installed along 24 Av NW (14 St – 19 St)
- Cycle track installed along 2 St SW (12 Av – 26 Av)
- Bike lane installed on 9 Av SE (15 St – Inglewood Bird Sanctuary)
- Cycle track and sidewalk installed along 9 Av SE (6 St – Elbow River Pathway)
- Pedestrian improvements on 11 St and 12 St SE (10 Av – 26 Av)

### ***The “5A Network”***

Complementary to the pedestrian and cycling strategies, the “Always Available for All Ages and Abilities” (5A) Network concept was approved by Council in 2020 through the Next20 update of the Calgary Transportation Plan. The 5A Network is a city-wide plan for a network of pathways and bikeways that are protected from motor vehicle traffic, designed to meet the safe mobility needs of people of all ages and abilities. The 5A Network will provide a consistent, reliable user experience through improved lighting and year-round maintenance.

### ***Micromobility***

Having active mode infrastructure in place, and with its adjustment and expansion ongoing, another key element of the cycling strategy is to facilitate “shared mobility” (eg. share bikes) and the use of various personal mobility devices which in industry jargon is being referred to as “micromobility”. In recent years there have been a variety of mobility devices appearing on sidewalks, streets and pathways including electric scooters and skateboards, all of which fall into the category of micromobility. The shared mobility pilot program (2018-2020) is a private sector-funded venture that is enabled by the City with changes made to traffic bylaws and data analysis conducted to understand and manage (through municipal permit conditions) certain aspects of the commercial operations with an emphasis on public safety. At the outset of the pilot, a permit process for dockless bike share initially had been developed for operations to begin in 2018, with 375 electric-assist bikes made available downtown that year. Greater than anticipated uptake of shared mobility drew further commercial interest in the local bike shared mobility market, the range for bike share operations was expanded, and shared e-scooters were introduced in 2019.

Data compiled at the end of 2020 confirms that the pilot program has been popular with Calgarians, with the shared e-scooters being even more popular than the shared e-bikes, with a combined total of 1.9 million rides taken and over 200,000 unique users of shared mobility services. Citizen survey results indicate that approximately one-third of e-scooter trips replace what would have been a car trip.

### ***Active and Safe Routes to School program***

Following completion of a successful pilot in 2019, the Active and Safe Routes to School program, developed in collaboration with Alberta Transportation and Ever Active Schools, on-boarded 10 new schools in 2020. Despite disruptions due to COVID-19 the program continued to grow. On-boarded schools remained with the program, a full complement of new schools registered for 2021, and a new trial focused on active travel for high schools began. Necessary infrastructure improvements, including signage changes and curb extensions, are scheduled for implementation in 2021.

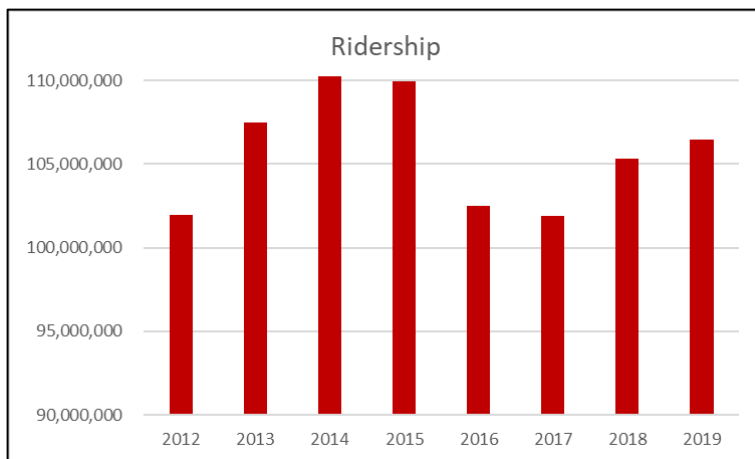


*Winter Walk Day at Manmeet Singh Buller School*

Ever Active Schools also launched the “Explore your 2.4” initiative in the spring of 2020 in response to the abrupt change to at-home learning after the pandemic began. This initiative focused on increasing levels of physical activity for students and caregivers both, by encouraging active travel within the 2.4 km walk zone around schools. After the reopening of schools, some incorporated “Explore Your 2.4” into their curriculum.

### ***Transit network expansion***

Calgary’s light rail transit (LRT) network currently comprises a total 56 km line length and 45 stations. The transit network originally focused on moving customers in and out of downtown. From 1996 to 2018 the number of people entering downtown by all modes on a daily basis increased by 21 per cent, while the number of people travelling by transit doubled. As Calgary looks to develop multiple activity centres outside downtown, the transit system is evolving to serve dispersed trips in all corners of Calgary.



*Figure 4: Annual transit ridership, 2012-2019*

Calgary City Council in 2013 approved RouteAhead as a 30-year strategic plan for Calgary Transit. Since its adoption, Calgary Transit has made strides to improve and expand transit service in all areas of the City, with a keen focus on customer experience. Calgary Transit reached the 100 million passenger mark in 2012 for the first time and continued to see ridership surpass that milestone through to 2019 (Fig. 4). (The drop in ridership in 2016-2017 presumably reflects the economic downturn and associated job losses downtown in that period).

Implementation of the MAX network and Transit Service Reviews (TSR) in 2018-2019, with four new Bus Rapid Transit (BRT) routes facilitating crosstown connections and improving the customer experience, transformed Calgary's rapid transit network and contributed to a 3.5 per cent increase in ridership in 2018.

Land use and transit planning are becoming more integrated to influence Calgary's physical form, and to make transit service more viable. Compact urban form supports quality transit, while transit provision can lead development and support intensification. This evolution to match transit and land use increases transit use and mode choice, contributing to environmental sustainability through reduced car dependence.

In 2020, while the COVID-19 pandemic negatively affected transit ridership and revenue, Calgary Transit's resilience was evident through supplying mobility options for over 100,000 daily customers during lockdown. Calgary Transit implemented enhanced cleaning and social distancing to improve safety, adapting and learning constantly to implement change effectively. In the face of a pandemic, Calgary Transit continued to improve transit service during times of uncertainty.

Council approved an updated RouteAhead project prioritization list for rapid transit in December 2020. Ridership, customer experience, social, economic, and environmental considerations were key in prioritization, with GHG emissions reductions and proximity to activity centres included as environmental criteria. Prioritization of these capital projects is the next step in the evolution of Calgary's rapid transit network (Fig. 5).

Calgary Transit continued to expand service offerings in 2020 through the introduction of OnDemand, a pilot project offering on-demand shared ride transit service in Carrington, Livingston, and West Calgary. OnDemand provides an opportunity to introduce cost-effective and efficient transit service to developing communities, and a customized service model in areas with low ridership. The pilot surpassed the project goal of 620 rides per week, with 848 rides per week recorded in February 2020, and with 15 per cent of riders being new users of Calgary Transit services.

2020 also saw Calgary Transit explore innovative technologies. MyFare, a mobile phone-based app enabling customers to buy and display their fare using their smartphone, launched in July with



Figure 5: Evolution of Calgary's rapid transit network

significant uptake. Between the July 1 launch date and December 2020, monthly revenues from MyFare represented 15 per cent of total transit revenues. Over 1 million fare products were activated using My Fare in 2020, and there were more than 65,000 downloads of the new application. The first phase of MyFare includes regular fare products; however, Calgary Transit is working to integrate other fare products into the app.

Through increased collaboration with our neighbours and the region, Calgary Transit is working to influence transit use and mode share beyond our municipal boundaries by helping develop the Calgary Metropolitan Region Growth and Servicing Plans and expanding Calgary Transit service to Chestermere. Extending Calgary Transit service to Chestermere would enable reduced personal vehicle use by commuters, making the car optional even for long distance regional trips.

While progress towards the vision in RouteAhead and the CTP has been made, transit service hours and access to the primary transit network indicators are far short of targets, which may be explained by operating budgets not keeping pace due to the economic downturn in the 2015-2020 period. A substantial increase in transit service is needed for transit to become a preferred mode choice of Calgarians and to achieve the CTP targets of 3.7 service hours per capita and 15-20 per cent of trips. Additionally, investments in technology and further capital improvements will promote increased transit ridership.

Work continued throughout 2020 in support of future Green Line LRT development, involving land acquisition, preliminary engineering, utility relocation, “climate lens” assessments for reporting to federal government, stakeholder engagement, and preparations for procurement. Also in planning stages of development are the Airport Connector and Blue Line NE LRT extensions.

## **5. Pollution Prevention**

The development and operation of a city-wide transportation system presents many circumstances where pollutants can be inadvertently released to the environment, potentially affecting the quality of air, soil, groundwater and surface water. Pollution prevention measures and substance release reporting and response protocols are well documented both corporately and in environmental management systems. For specific activities, releases and materials there are municipal, provincial and federal regulatory reporting requirements.

### **5.1 NPRI reporting**

The National Pollutant Release Inventory (NPRI) program under the *Canadian Environmental Protection Act, 1999* requires that facilities meeting specified criteria report annually to Environment Canada on the release, transfer or disposal of NPRI substances that are manufactured, processed or used at the facilities. This regulatory requirement applies to the Roads business unit as owner/operator of three facilities:

- The asphalt plant at Manchester yard, for carbon monoxide (CO), fine particulate matter less than 2.5 microns diameter (PM<sub>2.5</sub>), and larger diameter particulate matter (PM<sub>10</sub>);
- The aggregate crushing operation at Spyhill, for PM<sub>2.5</sub>, PM<sub>10</sub>, and total particulate matter (TPM) which includes the requirement of reporting dust emissions from unpaved roads; and
- The Traffic Field Operations (TFO) sign shop, for toluene used in sign production.

Annual NRPI reporting for these three facilities is due June 01 of each year and as result, at the time of preparation of this report in Q1 2021, data for 2020 was not yet available. The most current available information from 2019 is presented in this report (Fig. 6). All quantities are calculated estimates.

*Figure 6: National Pollutant Release Inventory (NPRI) Reporting for Calgary Roads, 2018 & 2019*

Substance	Air Emissions (tonnes)		Per cent Change (%)	Recycled (tonnes)		Per cent Change (%)
	2019	2018		2019	2018	
Manchester asphalt plant						
CO	18.833	20.979	-10.2	-	-	-
PM <sub>10</sub>	5.273	6.022	-12.4	-	-	-
PM <sub>2.5</sub>	1.607	1.827	-12.0	-	-	-
Spyhill aggregate operation						
TPM	25.057	27.831	-10.0	-	-	-
PM <sub>10</sub>	12.029	14.464	16.8	-	-	-
PM <sub>2.5</sub>	2.409	2.997	-19.6	-	-	-
Traffic Field Operations (TFO) Sign Shop						
Toluene	0.208	0.234	-11.3	4.024	5.072	-20.7

The following operational changes at each of the Roads facilities may help explain year-over-year changes in emissions that potentially affect local air quality:

- At Manchester: asphalt production was down 10 per cent (from 104,449 tonnes in 2018); and annual aggregate handling quantities decreased by approximately 13 per cent year over year
- At Spyhill, aggregate production was down 22 per cent (from 286,602 tonnes in 2018)
- At TFO there was a decrease in the total amount of toluene used

## 5.2 Air quality

### *Current state and transportation influence*

Air pollutants emanate from a wide range of natural, industrial, community and mobile emission sources. The air quality of the Calgary area is monitored by Calgary Region Airshed Zone (CRAZ), a non-profit association with members representing municipal, provincial and federal governments, non-governmental organizations, industries, and the general public. CRAZ employs three continuous monitoring stations - in downtown, NW and SE locations - to analyze meteorological and air quality parameters including those most strongly associated with transportation: nitrogen oxides (NO<sub>x</sub>), ground-level ozone (O<sub>3</sub>), carbon monoxide (CO), PM<sub>2.5</sub> (primarily associated with very fine dust, pollens, smoke, and combustion engines, and linked with adverse human health effects) and PM<sub>10</sub>. Transportation sources account for the majority of NO<sub>x</sub> and CO emissions. These and other pollutants undergo complex chemical reactions in the atmosphere to form O<sub>3</sub> which contributes to smog.



Automated measurements of ambient concentrations for each parameter are made continuously and averaged on an hourly basis. The Environmental Monitoring and Science Division of Alberta Environment & Parks began operation in 2017 of an additional continuous monitoring station (similar to that pictured at right) north of Calgary, in Airdrie.

There is also a broader network of 40 passive monitoring stations throughout the CRAZ region that rely on simpler technology to sample air quality for a smaller number of parameters on a monthly basis, used to help understand the geographic variation in pollution.



The Air Quality Health Index (AQHI) and the Canadian Ambient Air Quality Standards (CAAQS) are two of the tools used to assess air quality in Alberta, the former as a communications tool and the latter used to monitor and measure long-term trends in air quality and to assign management actions. The AQHI converts hourly measurements for different parameters to a number from 1 to 10, with a higher number indicating a greater health risk, for public information on current or predicted air quality conditions. The CAAQS assessment calculates metrics over three-year periods and excludes exceptional events such as smoke from forest fires, for use in identifying and managing pollutants considering their potential risk to human health and environment.

An emissions inventory prepared for CRAZ identified fine dust as the main driver of elevated particulate matter affecting air quality in Calgary and region, not vehicle combustion, based on 2008 data. These fine particulates are identified as being primarily fugitive emissions from construction sites. The transportation sector is an additional source (approximately 30 per cent) of particulate matter. However, further analysis reveals the transportation sub-sector category of “unpaved roads” (i.e. gravel roads, alleys, parking lots) accounts for virtually all of those emissions. Passenger vehicles contribute negligibly (1.1 per cent) and heavy duty vehicles (transport trucks, service trucks, buses, etc.) contribute 2.6 per cent of transportation sector PM<sub>2.5</sub> emissions.

Canada’s Air Pollutant Emission Inventory (APEI) compiles data from various sources for 17 common pollutants and in February 2020 the APEI report summarized information for the 1990-2018 period, indicating that transportation-related pollutant emissions (e.g. NO<sub>x</sub>, CO, VOCs) continued a downward trend and were significantly reduced compared to historical levels, with the exception of fine particulate emissions (PM<sub>2.5</sub>) originating from unpaved roads and construction. The downward trend in tailpipe emissions – notable in spite of a considerable increase in the number of passenger vehicles on the road over time - is explained by effective regulations on fuel and engines, according to APEI reporting.

Alberta's annual reporting on the CAAQS summarizes the status for ambient concentrations of fine particulate matter and ground-level ozone, indicating that standards were achieved in the South Saskatchewan air zone based on the data from three ambient monitoring stations including one in Calgary. However, the monitoring results still trigger the need for management planning for PM<sub>2.5</sub> and NO<sub>2</sub> under the Air Quality Management Framework established for the South Saskatchewan Regional Plan. New CAAQS standards for NO<sub>2</sub> were introduced in 2020.



In summary, residents of Calgary and region enjoy good air quality, generally consistent with the air quality objectives established for PM<sub>2.5</sub>, NO<sub>2</sub>, CO, and O<sub>3</sub>. Factors affecting air quality are the type and rate of pollutant emissions from various sources, and the ability of the atmosphere to disperse these pollutants by way of wind, temperature, turbulence and the changes in these elements resulting from local topography.

### ***Air quality protection and control efforts***

The following Transportation programs and initiatives in 2019 addressed air pollution:

- Minimizing dust from transportation operations facilities;
- Minimizing dust from transportation infrastructure development sites and unpaved surfaces;
- Reducing the emissions of transit buses;
- Reducing traffic congestion and vehicle idling; and
- Providing additional mobility options.

At Spyhill crushing operation managed by Roads, excavation of fines is the major source of dust generation. Due to the location of these operations, westerly and northwesterly winds can significantly affect dust levels. Roads have standard operational controls in place that involve daily water application on unpaved surfaces for dust suppression during operations, and the use of personal protective equipment by workers on site.

On construction sites, the largest of which are managed by TI, with smaller capital projects (i.e. upgrades, rehabilitation and maintenance) managed by Calgary Transit and Roads, air quality is addressed primarily through the design and application of erosion and sediment control (ESC) measures. Project managers and inspectors in TI are required to demonstrate basic training and competency in ESC. A stated objective of TI's environmental management system is that construction projects meeting certain criteria are to have professionally prepared ESC designs that are acceptable to The City, and implemented appropriately, to minimize dust and prevent pollution of waterbodies with turbid runoff from construction sites. There were 134 customer service requests (CSRs) related to the environment (13 per cent of total CSRs) logged for TI projects in 2020. The specific nature of those CSRs included noise, dust, mud, weeds, vibration, and tree removal concerns. All of the CSRs were addressed and closed with no outstanding requests remaining in Q1 2021.

Calgary Transit's bus fleet comprises a mix of New Flyer Excelsior brand buses having diesel particulate filters (DPF) and related emissions control technology, gasoline fuelled community shuttles, and a growing fleet of Nova compressed natural gas (CNG) fuelled buses. The business case for shifting a portion of the fleet to CNG was built on investigations into the relative operability, operating and maintenance costs, fuel cost, noise, and tailpipe and GHG emissions of diesel and CNG buses. There are significantly reduced tailpipe emissions, of NO<sub>x</sub> (contributing to smog formation) in particular, from CNG buses. As described above in section 4.3 under the heading of "Shifting to lower carbon fuels", Calgary Transit continues to explore



emerging technologies like electric battery powered buses to achieve, among other benefits, reduced GHG emissions as well as reduced tailpipe emissions affecting local air quality.

The Transportation Planning and Roads business units collaborate in conceiving, implementing and monitoring the results of projects that address traffic congestion through the optimization of traffic signals and the deployment of intelligent transportation systems. The Traffic Engineering group regularly evaluates and adjusts the timing of traffic signals in key travel corridors based on current traffic data and updated models. By improving signal coordination and traffic signal phase timings, this program affects the idling time of hundreds of thousands of vehicles daily; it is influential to both traffic congestion and air quality.

In 2020 a wide variety of work was continued or initiated to better provide Calgarians with mobility options through expansion of infrastructure and services. Initiatives that promote travel mode-shifting will result in reduced fossil fuel consumption on a community-wide basis and, in turn, reduced emissions of air pollutants and GHGs. These initiatives are described above in section 4.4 under the heading of “Land use and mobility aspects of energy consumption”. Many of these and related initiatives are described in still greater detail through the MDP-CTP monitoring and reporting program and Calgary Transit data reporting.

### **5.3 Soil and groundwater quality**

Various activities in the operational business units of Transportation have the potential to affect soil and groundwater quality. The environmental management systems and personnel for these business units identify such risks and opportunities, and help to manage them through the implementation of various processes and procedures to maintain regulatory compliance. The specific pollutants and contaminant pathways that are most relevant for soil and groundwater contamination in a transportation context are:

- Hydrocarbon-based substances (e.g. fuel, hydraulic fluid, form oil) released from fleet vehicles, construction equipment, or storage tanks at operational work places and construction sites;
- Hydrocarbon contamination resulting from past land uses, encountered during construction;
- Salt and saline runoff from Roads winter maintenance materials storage facilities and roadways.

#### ***Environmental screening and studies***

Through all phases of transportation system planning, development, and operation, efforts are made to ensure any interface of natural environment and environmental processes are understood and considered. These may include functional planning studies, for example, identifying potential environmental sensitivities like wetlands and contaminated sites that may influence roadway alignment or other planning and design choices. Prior to construction, environmental screening is routinely completed (typically an internal service provided by ESM’s Risk & Liability division) to identify potential soil and groundwater concerns associated with past land uses of a site. External consultant support is retained as required to provide specialist environmental consulting services that include the assessment of environmental risks and impacts, and their mitigation or management.

Environmental Construction Operations (ECO) Plans are developed, implemented, and audited (i.e. through periodic compliance inspections) on City projects to minimize adverse environmental effects of construction activities and promote due consideration for environmental protection by contractors, where required as per

The City of Calgary's ECO Plan Policy and associated decision criteria. The related ECO Plan Implementation Procedure specifies how these plans are to be submitted to the ESM business unit for review and acceptance prior to construction start. As part of TI's due diligence, the ECO Plans are internally reviewed by TI environmental staff to confirm that environmental aspects are appropriately addressed. Due to the typically very short time frame between award of contract and start of construction, contractors are challenged to provide their inputs to finalize ECO Plans and have ESM review and approval completed (usually completed in 14 days) prior to the construction activities. Accordingly, TI's internal performance target for ECO Plans, as referenced in TI's environmental management system, is: "100% of TI projects requiring ECO Plans have ECO Plans, reviewed internally by TI environmental specialist and submitted to ESM prior to start of construction".

Fifteen of the 16 new TI projects launched in 2020 had ECO Plans in place and submitted to ESM for acceptance prior to construction. The contractor for the 50<sup>th</sup> Ave and 50 ST SW connection project was not able to deliver a revised version of the ECO plan on time and construction had to start even before TI's internal review and submission to ESM. However, TI's environmental specialist worked with the contractor to fully understand the ECO plan requirements and City's environmental expectations. The late internal approval of the ECO plan was noted as an audit finding for the project. All of the 8 projects that required erosion and sediment control (ESC) plans had those plans accepted by Water Resources and in place prior to construction.

Transportation Infrastructure's EnviroSystem target of having acceptable plans in place at start of construction for 100 per cent of "projects requiring environmental construction operations plans" was not achieved in 2020; instead, appropriate plans were in place for 94 per cent (15/16) of projects, and risks were managed.

### ***Substance releases affecting soil and groundwater quality***

Transportation Infrastructure recorded 29 substance releases in 2020 (vs 30 in 2019), of which 12 were releases of turbid runoff to the storm system (as detailed below under the Surface Water Quality heading). None of the other minor releases required reporting to Alberta Environment and Parks (AEP) as having potential to adversely affect soil or groundwater quality.

Calgary Transit substance releases are addressed below, under the Surface Water Quality heading, as releases typically are from buses onto roadways with potential discharge to the storm sewer.

Calgary Roads recorded 34 minor releases in 2020, of which 7 were reportable to AEP. The reportable releases were minor in nature involving small quantities of hydraulic oil or other hydrocarbons spilled on unpaved surfaces, with any larger releases (greater than 30 liters) to paved surfaces kept contained. There were approximately 25 per cent fewer releases year over year. Hydraulic hose failures continue to be the cause of most substance releases. Roads keeps its operational staff well trained to professionally respond to any releases by arranging spill and release response trainings every 3 years, with regular spill drills in between as refresher training to test awareness and capability. There are ongoing soil and groundwater monitoring programs for Roads material storage yards and snow dumps, and additional reporting to AEP for releases to the storm sewer during street sweeping, as described in sections below.

### ***Salt storage and handling at facilities***

The storage and handling of salt and abrasive materials in the vicinity of Roads maintenance yards present potential risks to soil and groundwater quality, and also to surface water quality (addressed in the following section of this report). Regular monitoring performed at these locations and reported annually indicates trends of generally increasing localized concentrations of chlorides in the soil and groundwater.

The salt storage depots and maintenance facilities at Roads are managed in accordance with applicable regulatory requirements, Codes of Practice and BMP guidance documents. Consistent with the best management practices established by Transportation Association of Canada (TAC) to satisfy the Code of Practice for the Environmental Management of Road Salts (established under the *Canadian Environmental Protection Act 1999*), Roads has developed, implemented, and updated annually a “Road Salt Management Plan” to guide its storage and use of chlorides and traction materials. In 2014, Environment Canada issued a set of performance indicators and national targets associated with the Code of Practice after completing a five-year review of progress that indicated the effectiveness of the Code to date in promoting uptake of best practices, and identified actions that could be considered for further improvement.

The City of Calgary has demonstrated and reported on continual improvements in practices and technologies it employs for road salt management, and was able to meet all voluntary national compliance targets for 2020.

As a best management practice Roads stores pure road salt (sodium chloride) in structures on impermeable pads. (Some of the salt storage silos at maintenance facilities require replacement). While some of the salt-treated abrasive material also is stored in structures, a significant quantity is stored in outdoor stockpiles. For outdoor storage the abrasive materials are mixed with approximately 2 per cent salt to prevent clumping.



These pickle piles are exposed to weather, with the result that salt can be leached from the piles during rain and/or snow melt events and be carried by runoff to water retention ponds or other drainage infrastructure. Custom fitted tarpaulins (pictured at left) were used to cover all pickle piles in 2020, between mid-May and late September, on a continued trial basis to explore their feasibility as a low cost approach to achieve the national targets. Approximately 80 per cent of salt-treated abrasives were stored under cover of tarps seasonally, with 100 per cent under cover during wettest months.

Additionally, Roads Maintenance division took the following steps in 2020 to continually improve the environmental management of road salts during storage and handling:

- Approximately 80 per cent of treated abrasives were stored under cover during winter operations in 2020, relative to 2015 when only 33 per cent were under cover. In 2020, all remaining outside treated material was covered with custom tarps from May through September. This practice was first implemented in 2019 with preliminary indications of reduced chloride leaching. Monthly water

samples collected in 2019 and 2020 from sites with storm ponds and tarped material also indicate reduced chlorides in stormwater. Further evidence of this was collected during 2020; the 24<sup>th</sup> St Depot had the most consecutive number of months (six) with water samples below guideline on record. Further data will be collected in 2021.

- A complementary change in operational practice had been introduced in 2017 involving a reduction in the quantity of abrasives being processed and stored at maintenance yards, and in the distribution of material between districts according to the type and availability of facilities including covered storage and storm water detention ponds. Over 41,000 tonnes of material had been stockpiled city-wide for the 2016/2017 SNIC season, and that was reduced the following year to 25,000 tonnes. In 2019 and again in 2020, approximately 25,000 tonnes were stockpiled for the SNIC season but only 12,000 tonnes were stored outside during the off season and those materials were covered.
- The concentration of chlorides blended into the abrasives was further reduced to 2 per cent in 2019 (from 3 per cent in 2018, and 4 per cent prior to 2016) for outdoor storage, further reducing the exposure of chlorides to the environment during storage and use. A trial during the 2019/2020 season had untreated abrasives stored outside at 194<sup>th</sup> depot to determine effectiveness; unfortunately, the untreated product was found to freeze and clump, rendering the product unusable during snow events as it would plug or block the chute of the sander and not discharge onto the road surface.
- The Road Salt Management Plan was reviewed and updated to reflect current practices and the results of effectiveness monitoring and pilot projects.
- Ongoing participation and sharing of best practices within the national Road Salt Working Group (led by Environment and Climate Change Canada) and Transportation Association of Canada.

Ongoing groundwater monitoring programs continue at the following Roads depots: Confederation Park, Bearspaw, 24th ST, Richmond Green, Manchester, and the Pumphouse and Highfield snow dumps. The consultants retained to do this monitoring for The City meet jointly with staff from ESM and Roads on an annual basis to share results of the ongoing investigations and discuss potential concerns and identified risks. Environmental site assessments were completed at Saddleridge, Haddon Road, Spring Gardens, and 194<sup>th</sup> Ave depots in 2020 to characterize current conditions and establish ongoing soil and groundwater management strategies for those additional locations, with consideration given to potentially sensitive receptors and associated environmental liabilities. Groundwater chemistry on the sites was found to be generally consistent with recent historic results, with a number of analytes above the applicable guideline. Assessment of the management strategies continues at these sites.

### ***Maintenance facilities requiring capital investment***

Implementing the full suite of best management practices at identified point sources of pollution will require capital improvements made at Roads depots to further manage and minimize salt losses. Calgary Roads and Facilities Management in 2018 had jointly developed the “Roads Strategic Accommodation Master Plan” that assessed current conditions of district assets and presented a prioritized list of capital improvement projects to feed into the budget request process for the 2019-2022 business cycle. Elevated levels of chlorides and total suspended solids in storm runoff sampled at Manchester and Haddon Road maintenance yards had identified them as priorities for infrastructure upgrades. Conceptual plans for those 2 locations, and associated high level



cost estimates to construct storage structures and storm water retention ponds, are complete and pending funding. A material storage structure and storm water retention pond upgrades/construction also were costed for Spring Gardens and Confederation Park depots.

Capital funding of \$21.48M to upgrade infrastructure on a priority basis had been approved in November 2018 budget deliberations. However, relative priorities for investment were re-evaluated considering that key infrastructure in several locations has degraded to the point of near structural failure; salt storage structures at Saddleridge (pictured at right) and 194<sup>th</sup> Ave were added to the list of condemned structures in 2019. Accordingly, on a priority basis several salt storage structures were scheduled for repair or replacement in 2020. Most recent capital funding has allowed for a project to proceed at the Manchester yards that will significantly improve the chloride management. At project completion, both salt and treated abrasives will be stored, unloaded, and loaded indoors. The condemned salt structure at 194<sup>th</sup> was replaced in 2020. Saddleridge will undergo a similar salt and treated abrasive materials structure replacement during the 2021 construction season, and will be operational by fall 2021.



Roads and Facilities Management jointly developed a “Roads Strategic Accommodation Master Plan” that characterized the current condition of our internal district assets and included a prioritized list of capital improvement projects that fed into the budget request process for the 2019-2022 business cycle. A master plan for Haddon Road depot was approved in the fall of 2020 that will inform site infrastructure upgrades intended to last 30-40 years.

#### 5.4 Surface water quality

Water quality in the Bow and Elbow Rivers in the Calgary area is affected by many natural events and anthropogenic sources, including weather systems, snowmelt, land development and various land and water uses across a spectrum of industrial, commercial, residential, and agricultural activities. Control measures and BMPs are employed to reduce TSS loading in the Bow River and thereby minimize any significant adverse effects on the receiving environment, consistent with The City’s Total Loading Management Plan registered with AEP. Transportation has adopted a general approach to “low impact” development practices including erosion and sediment control BMPs for construction projects, and other controls include use of retention ponds to remove pollutants from storm water runoff. Transportation-related factors affecting surface water quality include any significant volumes of untreated runoff from: transportation infrastructure development sites; unpaved roads, lanes/alleys, and parking lots; facilities such as Roads maintenance depots and processing plants; and paved roadways having snow and ice control materials and residues on them.

Key pollutants affecting waterbodies that are under the control of Transportation staff and contractors are:

- Sediment laden storm runoff from construction sites and unpaved roads, lanes and parking lots;
- Release of other substances resulting from construction activities and operations; and
- Salt and saline runoff from Roads winter maintenance materials storage facilities and from roadways.

### ***Substance releases affecting surface water quality***

Transportation Infrastructure initiated 16 new capital projects in 2020 and all were guided by ECO Plans and, where required, ESC plans. There were 12 reported releases of turbid runoff to the storm system, which are considered unauthorized releases and required to have “7 day” detailed reporting submitted to the regulator. These events occurred during intermittent heavy rainfall during the months of May, June and July 2020. Lessons learned were completed for all of these releases and shared with TI project managers.

Calgary Transit substance releases typically are antifreeze or hydrocarbon releases from buses onto roadways or paved surfaces at transit facilities, some having the potential to discharge to the storm sewer. In 2020 Calgary Transit recorded 98 substance releases with 3 that required reporting to AEP owing to the release of antifreeze (less than 10 litres) reaching a stormwater catch basin, and 1 release that required reporting due to it being larger volume spill (100 litres) even though it was contained to paved surfaces and cleaned up. The causes of substance releases include facility equipment failure (1 release), vehicle accidents (2 releases), and most common of all, vehicle mechanical failure (95 of 98 total releases in 2020). Transit operators are trained in spill response, and all buses and shuttle vehicles are equipped with spill kits. To save costs on purchase of new spill kits, Calgary Transit in 2020 re-supplied the spill kits in-house.

Within its facilities Calgary Transit uses approximately 10,000 kg of floor absorbent products annually. These products are used for cleaning up vehicle fluids such as antifreeze, oil, and grease on the shop floors of bus maintenance facilities to prevent these pollutants from entering sanitary or storm water systems. Following technical review and field testing of available products in 2019 the highest rated product was initially introduced to Transit Victoria Park garage and subsequently it was well received by Spring Gardens garage in early 2020. The high absorbency and low density of this new absorbent product will help decrease the amount of oily solid waste generated by bus maintenance facilities and reduce disposal costs in the long term.

### ***Sediments originating from gravel lanes***

The Sustainability Strategy division of Transportation has for several years worked closely with management and specialist staff across the Utilities and Environmental Protection department to better understand the generation and movement of sediment through municipal infrastructure to downstream receiving environments. A previous collaborative project had produced a sediment inventory, and in 2020 a related consultant study was completed: the Gravel Lane Total Suspended Solids (TSS) Abatement Study. Storm water measurements and modelling performed by Water Resources had



demonstrated that gravel-surfaced lanes in the transportation network are disproportionately large sources of stormwater pollution (i.e. TSS, and sediments in particular); gravel lanes generate up to 11% of the sediment loading to local waterways from only 1.4 per cent of the municipal land base. The City’s Total Loading Management Plan, a requirement of wastewater approvals under the provincial Environmental Protection and



Enhancement Act, is a planning tool used to derive loading objectives for stormwater infrastructure and wastewater treatment plants and to manage associated water quality impacts on the Bow River.

From an operational perspective, gravel lane maintenance demands and costs have been increasing for Calgary Roads and similarly Water Resources is facing increasing costs for maintenance of storm sewer and storm ponds due to accumulations of gravel and finer sediments contributed from gravel lanes.

A robust Triple Bottom Line (TBL) assessment tool was developed and applied as a key component of the consultant study to compare the relative costs, benefits (including but not limited to downstream water quality benefits) and feasibility of conventional and alternative treatments for back lanes, including gravel surfacing, asphalt paving, chip seal, permeable paving stones, and other treatments with the aim of identifying the strongest value proposition for both retrofit solutions and greenfield development. Based on the TBL tool outcomes in 2020, pilot sites for three treatment options (including full depth asphalt, chip seal, and quality gravel) were selected and construction specifications developed to test and validate the proposed alternative treatments as a second phase of this study. The lane surface treatment pilot program has been partially funded with work planned for the construction season of 2021.

An additional outcome of the TBL project has been to look at greenfield site conditions separately and develop recommendations for newly constructed back lanes. The TBL tool identified asphalt and chip seal as the highest-rated treatments under that condition, unless specific site conditions or development preferences identify the need for specialty products. Possibly policy changes to new-build lanes are supported by the outcome of this project work.

### ***Spring clean-up of roadways***

During the winter season large quantities of abrasive material (sanding chips approximately 6.5 mm in diameter) and salt are applied to roadways for traction and de-icing purposes. Roadways also accumulate sediments transported from gravel lanes and adjacent areas in addition to leaf fall and other organic matter and debris. The Roads Maintenance spring clean-up (SCU) program involves streets sweepers deployed in spring throughout the city to remove these accumulated materials and associated pollutants (including lead, zinc, and polyaromatic hydrocarbons that bind to finer sediments) from roadways and thereby minimize their transport through storm water infrastructure to local waterways during rain events. A sediment inventory completed in 2016 revealed that for the 4-year period 2011-2015 an average of 40,845 tonnes of materials were applied annually to roadways as winter abrasives, and an average of 41,875 tonnes of materials were collected during spring clean up for landfill disposal. (Recent pilot programs for recycling and re-use of a portion of street sweepings are described below under the Waste Management heading). The mass balance assessment acknowledged they were not entirely the same materials removed from the roadway as were applied, with significant organics and fine sediment included in the street sweepings, but this information does validate that the SCU program meaningfully contributes to downstream water quality and habitat protection.

### ***Saline runoff from roadways to water bodies***

Salt applied to roadways throughout the city for winter road maintenance and public safety purposes represents a non-point source of pollution. Winter road salt application practices used by Calgary Roads are

consistent with the national Code of Practice. Roads Maintenance division took the following steps in 2020 to continually improve the environmental management of road salts and minimize increases in salinity of surface water bodies:

- Salt brine (23 per cent salt concentration) use has been increased over pure salt in certain applications with the intent to reduce the total amount of salt required and/or released into the environment.
- An expanded trial of Beet55 brine continues with 30,000 liters purchased in 2017/2018, and 170,000 liters purchased over the last two SNIC seasons, allowing for a significant reduction in salt use; one tandem load with a sander will apply about 7,000 kg of salt compared with one drip tank loaded with 5500 liters of beet brine (the equivalent of 980 kg of salt).
- The use of electronic controllers onboard sanders for salt application to roadways and the use of pre-wetting techniques, consistent with the national Code of Practice
- Ongoing participation and sharing of best practices within the national Road Salt Working Group, led by Environment and Climate Change Canada, and Transportation Association of Canada.

#### ***Real time data collection on sanding trucks***

For the 2019/2020 SNIC season, 100 per cent of the snowplow/sanding vehicle fleet had ground speed-oriented electronic controllers in use to apply salt and sand on roadways at appropriate quantities. Control boxes on sanders are remotely monitored and adjusted to apply only what is necessary, with pre-determined control gate settings (setting the amount of salt or pickle material per kilometre) based on studies and regular calibrations to minimize over salting or over sanding. Historically, limited information was easily available describing the types and quantities of material applied to roads during a snow event; data was captured by on-board data loggers using a memory stick that had to be manually removed and decoded. By integrating the data logging with the Common Fleet Operating System and Automatic Vehicle Location systems on fleet vehicles Calgary Roads has been developing the capability to view type of material, rate of material application and manual override, coupled with speed, time, location and direction of travel information. This enables an accurate method of real time data collection, also viewing the data in real time and running a dashboard style of report (e.g. by date, route, material type) for any reporting requirements. These upgrades will allow for further refinement to application rates and allow Calgary Roads to use less and less material.

#### ***Water quality monitoring and management by Calgary Roads***

Certain operational activities that use or pump water to the storm sewer were required to have analytical testing performed as a condition of annual drainage activity approvals. Discharges from Roads routine maintenance activities such as bridge washing, dewatering of excavations, and street sweeper backflushing were sampled and analysed in the field for turbidity and pH in 2020 to characterize and manage water quality associated with this work.

The five surface water retention ponds at Roads maintenance yards were sampled monthly in 2020. Chloride concentrations were generally within historical ranges and well below guideline. The reported concentrations from Spring Gardens collected during the summer months were decreasing until treated material was temporarily stored outside due to operational requirements mid-summer. Chloride concentrations at 24<sup>th</sup> St were below guideline for six consecutive months; this is unprecedented, and it corresponded with the tarp

installation, providing further evidence of the effectiveness of tarping. In 2020, Calgary Roads undertook several initiatives to manage water quality at these ponds:

- All salt-treated abrasive material that was stockpiled outside of covered structures was covered instead with custom tarps from mid-May until late September.
- Asphalt-lined storm water ponds at Spring Gardens OWC and 24th Street depot are drained and cleaned of accumulated sediments (and associated chlorides) when possible. This will continue to form part of our standard operational practice.

Discharge permits for these five retention ponds that were revoked in 2014 by Water Resources due to elevated chlorides are re-instated on an annual basis, subject to demonstration of continuous improvement in the management of chlorides at district yards. Given the temporary nature of discharge permit exemptions, and the known costs of collection and appropriate disposal of saline water from the retention ponds using vacuum trucks (exceeding \$1 million during 2014/2015), Roads continues its efforts to identify other potential disposal mechanisms or water treatment solutions. Roads, in association with Water Resources, is looking for cost effective methods to deal with the saline water from these ponds for coming years.

## **6. Water Management**

Water management for the purposes of this report refers to the efficient and sustainable use of water, in terms of water quantities and consumption. (Managing water quality is addressed in the previous section). The two major sources of water supply in Calgary are Bow River and Elbow River. The Council priority of “A healthy and green city” is addressed in business plan and budget reporting with various strategies and related performance measures including those relating to water quantity and river withdrawals that apply to the Utilities and Environmental Protection department. While there are no water management targets or performance measures that apply to Transportation, it is noted that “The City must evaluate innovative ways to affordably reduce environmental impact when delivering transportation projects and services”<sup>2</sup> generally.

Water use management aspects that are most relevant in a transportation context are:

- Water consumption at facilities; and
- Storm water management.

### **6.1 Water consumption at facilities**

Calgary Transit continues to explore opportunities to reduce water consumption from operations including bus and train washes, offices, and maintenance facilities in retrofits and new builds. The most significant water use efficiency reductions achieved to date are attributed to the installation (in 2014 and 2015) of wash water recycling systems at Spring Gardens for buses and shuttles, and at Anderson Garage and Oliver Bowen Maintenance Facility (OBMF) for light rail vehicles. Approximately 70 per cent of wash water is reused after

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<sup>2</sup> Action Plan “A healthy and green city” Indicators document.

each wash. The new Stoney CNG Transit Facility has three automated bus washes that will recycle wash water. The Victoria Park bus maintenance facility does not have such a system.

Currently, the only reliable water data is the Monthly Water Report provided by the Energy Management Office (EMO) from meter readings from the main water supply into each facility. Trend data indicates there were significant year-over-year reductions in water use (or increases in water use efficiency) at the Spring Gardens facility, for a total of approximately \$75,000 in cost savings over two years (Fig. 7). There were lesser reductions at two facilities, and more or less the same water consumption at two other facilities.

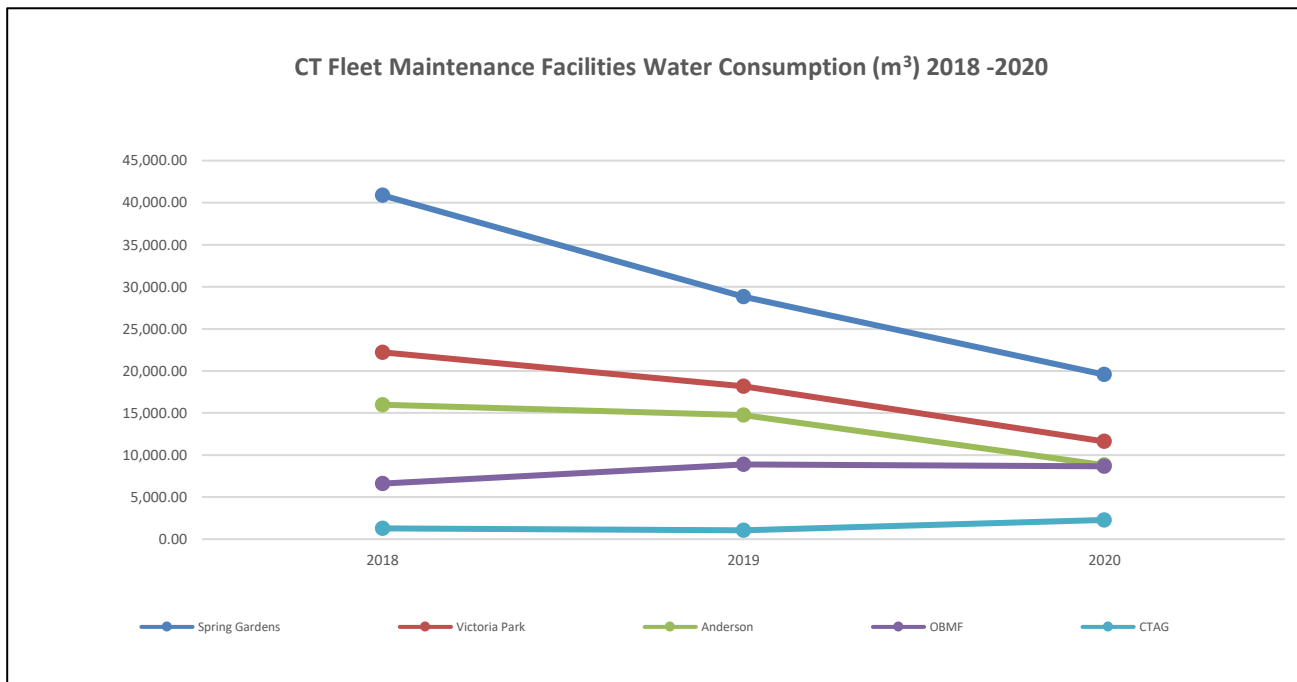


Figure 7: Transit facility water use trends 2018 - 2020

Water use audits had been conducted in 2019 at Spring Gardens, Victoria Park, Anderson, and OBMF garages to identify opportunities to further reduce water consumption and improve water use efficiency. While bus and train wash systems may be the most significant consumptive uses at facilities, the audits revealed there is insufficient data available to determine volumes of water used within the facilities, and the actual efficiency of the vehicle wash systems. Implementation of water use monitoring programs will help Transit better understand and manage water use, and identify opportunities to reduce consumption and save money. To that end, Calgary Transit launched water use monitoring programs at facilities starting in January 2020. As of Q1 2021, the monitoring data collected to date is incoherent, indicating the need to source more accurate and disaggregated data on water use within each of the facilities. Consideration is being given to upgrading the existing water meters to automated ones that better enable us to determine areas of water use, further identify possible areas for water cost savings, and expose leakages and possible water-thefts.

## 6.2 Storm water management

In designing and building transportation infrastructure, the TI business unit routinely works with Water Resources and external partners to develop the necessary storm water management infrastructure. With consideration given to sustainability, innovative stormwater infrastructure and “low impact development” opportunities are pursued where feasible and appropriate<sup>3</sup>. While no such innovations were introduced in 2020, examples of such approaches taken in recent capital projects (detailed in previous annual reporting) include the 17th Ave Reconstruction project where Silva™ cells were installed to allow for more space for tree roots and rainfall infiltration, the 194 Ave project where extensive efforts were made to protect wetland functionality at Priddis Slough, and the Stoney CNG Transit Facility site that includes a protected wetland feature.

Transportation department staff participated in the development by Water Resources of an updated storm water management strategy in 2019 and 2020, and in related work being led by Resilience and Infrastructure Calgary that addresses green storm water infrastructure and other natural assets and ecosystem services.

## 7. Waste Management

Waste materials generated from Transportation lines of business can be categorized as: construction and demolition (C&D) waste from construction projects; mixed waste at operational facilities; and waste from office workplaces. The latter two fall into the industrial, commercial and institutional (ICI) sector category.

### 7.1 Corporate waste reduction strategy and targets

The City of Calgary’s “80/20 by 2020” waste diversion strategy (2007) had targeted the diversion of 80 per cent of all waste materials from landfill, through a combination of recycling, composting and waste-to-energy technology supported by public and stakeholder education and the provision of blue cart and green cart services. Subsequently in 2015 the targets and timelines were adjusted with Council approving a revised target of 70 per cent waste diversion by year 2025, averaged across all sectors:

- Single family residential - 70 per cent
- Multi-family residential - 65 per cent
- Businesses and organizations (ICI) - 75 per cent
- Construction and demolition (C&D) - 40 per cent.

With existing private sector demand for materials such as concrete, asphalt and scrap metals plus pricing incentives in place to encourage sorting and recycling of other designated materials such as clean wood and cardboard (these materials are assessed at a significantly reduced tipping fee at City landfills compared with unsorted basic sanitary waste), C&D waste may be more readily and cost-effectively recycled than ever before.

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<sup>3</sup> Lessons learned on the 17<sup>th</sup> Ave Reconstruction project are that green storm water infrastructure features of the type described are more feasibly installed in greenfield sites than on brownfield reconstruction projects, as there were several utility conflicts during installation which introduced project schedule delays and negatively affected construction phasing.

## **7.2 Waste reduction efforts and results**

### ***Waste in the public realm***

As of November 1, 2016, businesses and organizations including The City of Calgary were required to recycle the same materials as we do in our homes toward the target of 70% waste diversion from landfill by 2025. While significant progress has been made in recycling within City facilities, the public waste disposed of in City-owned public spaces was identified as a gap within our bylaw requirements. Departmental environmental performance reporting in 2018 and 2019 describe in some detail the audits done of waste in the public realm, and measures taken by Calgary Transit and Calgary Roads to address the audit findings and recommendations. In 2020, Calgary Transit redistributed bins at LRT stations and bus loops to achieve an equal distribution of garbage (black) and recycling (blue) bins for public waste disposal at those locations. Calgary Roads placed 1 additional recycling bin and 3 garbage bins in 2020 in ongoing efforts to achieve a 2:1 ratio (more black bins than blue) in public-facing locations they are responsible for.

### ***Calgary Transit operations***

The 4-stream waste stations installed at transit garages and office buildings are being utilized appropriately. Environmental staff continue to provide waste reduction awareness and reminders to their colleagues through EnviroNews publication, posters and inspections, helping to make waste diversion efforts successful.

With respect to waste materials from service lanes and other operational areas in facilities, unfortunately there is no data available to determine waste diversion results. The Waste & Recycling Services business unit has been unable to provide weigh scale data for waste materials hauled from transit facilities in recent years.

On a more positive note, Calgary Transit in collaboration with Waste & Recycling Services launched a corrugated plastic recycling program in 2020. More than 1,000 corrugated plastic signs were used annually by the Transit data team to provide customers with important information such as route and schedule changes, and after use they had been disposed as garbage. The new recycling program helps reduce waste volumes to landfill and provides raw materials for the production of new signs or other products.

### ***Calgary Transit e-waste recycling***

On an annual basis the environmental staff of Calgary Transit facilitate the collection of household and office electronic waste (computers, accessories, etc.) from staff for appropriate disposal via the Alberta Recycling Management Authority. Voluntary participation in this initiative is well promoted as the “e-waste roundup”.

Calgary Transit’s annual e-waste roundup held in June 2020 resulted in triple the material collected the previous year, with over 9 tonnes of electronic waste collected and the proceeds ( \$2,760) of this initiative being donated to City of Calgary United Way to support programs that help vulnerable Calgarians.

### ***Calgary Roads Operations***

Waste materials generated by Calgary Roads derive from several different construction and rehabilitation activities and sources, managed in 2020 as follows:

- Roads Local Improvement Sidewalks program recycled 100 per cent of concrete, asphalt materials, and top soil totalling 2,912 cubic meters
- Roads Contract Services recycled close to 100 per cent of the concrete, asphalt, soil, gravel, and plastic generated during project activities; only 16 tonnes of the 138,540 tonnes of material in total went directly to landfill for disposal
- Roads Maintenance recycled 61.1 tonnes of concrete, wood, cardboard and metals during the Crowchild Trail Safety Repairs project, resulting in 94 per cent of waste being diverted from landfill
- Plants repurposed 3,016 tonnes of asphalt milling chips, mostly through sale to external customers.

### ***Street sweepings material reuse***

A street sweepings material reuse pilot had been underway seasonally at Bearspaw operational workplace centre since 2017, with the aim of diverting this waste stream from landfill in the future. A Trommel SM726 dry screen had been utilized to process 1,000 tonnes of sweepings that had been collected and stockpiled during spring clean up activities. Analytical testing of the screened material showed that all parameters other than copper were below Residential Tier 1 criteria. The screened sweepings were mixed in with the fresh pickle on a 30:70 ratio, following gradation testing, with 215 tonnes of residual waste material (with organics and other fine materials included) being disposed of at landfill. The recycled sweepings had been applied to roadways on a trial basis, and operations crews reported there was no difference in the effectiveness of mixed aggregate material versus pure pickle. Accordingly, the pilot was extended to the present day.

The street sweeping recycling pilot continued in 2020 with approximately 370 tonnes of sweepings processed, with 250 tonnes of usable abrasive product being generated. For the 2020/21 winter season, this recycled product was used to fill community-use sandboxes located at Calgary Fire Department stations. Although initial calculations suggest the product generated from the screening do not represent a cost savings at current landfill tipping rates, the pilot will continue on a small scale to inform potential process improvements.

### ***Transportation Infrastructure construction***

TI has long demonstrated leadership within The City of Calgary for its construction and demolition waste reuse/recycling program, working with contractors to direct and enforce (using contract standard and special conditions) their sorting of waste material streams and tracking of material quantities recycled using standardized reporting tools. It has become “standard practice” on TI project sites that C&D materials are either sorted on-site, in separate marked bins as space allows, or off-site, for diversion from landfill through reuse and recycling. While the corporate target for C&D waste diversion is 40 per cent, TI has a business unit specific target of 99 per cent diversion. In 2020, TI diverted from landfill 161,600 tonnes of C&D materials.

Transportation Infrastructure’s waste diversion target of 99 per cent of project construction waste diverted from landfill was exceeded with an actual diversion rate of 99.5 per cent in 2020.



## 8. Biodiversity Conservation

Biodiversity refers to the variety and complexity of life and habitats that are endemic or native to a given region. Urban development will negatively affect the natural (physical and biological) environment on a local and possibly regional scale, both directly through habitat loss and indirectly through habitat fragmentation and loss of diversity in native plant and animal species over time. With The City of Calgary being signatory to the Durban Commitment: Local Governments for Biodiversity, Council in 2015 approved *Our BiodiverCity, Calgary's 10-year Biodiversity Strategic Plan*. The plan was prepared by Calgary Parks with significant contributions from Corporate partners including Transportation through the General Manager's Office.

Transportation business units play an active role in the conservation of biodiversity during planning, development and operation of the transportation system in Calgary. Long range transportation planning studies are scoped to identify biophysical features and environmentally significant areas with the aim of minimizing the loss of biodiversity through adjustments to route alignment where possible and appropriate mitigation measures applied to design and construction. Environmental construction operations plans guide all work done on the major linear construction projects and facilities, and these plans include guidance on tree protection, migratory birds, aquatic habitat and water quality protection. Throughout construction and during operation of the transportation system invasive plant species are monitored and controlled by means of mowing, hand-pulling, herbicide application and other approaches through integrated pest management.

### 8.1 Habitat management

Previous annual reporting described in some detail the 194 Ave Extension project at Priddis Slough as an illustrative example of how biophysical assessment and habitat management activities are undertaken in the course of transportation infrastructure development. The project involved the extension of 194 Ave SE from Macleod Trail SE to Sheriff King St across the width of Priddis Slough, one of the Calgary's largest permanent waterbodies. This east-west connector for the community of Silverado initially was conceived of as a causeway on an earth fill embankment that would bisect the wetland. However, biophysical assessment and consultation with Parks indicated the wetland and surrounding areas represent important habitats and a wildlife movement corridor. Accordingly, a project design objective to maintain the connectivity and functionality of this wildlife habitat was established. The constructed causeway incorporated a bridge to provide for the free movement of terrestrial wildlife and semi-aquatic species. Small terrestrial mammals and bold wildlife like coyotes also may utilize an additional oversized steel culvert tunnel, incorporated to provide pedestrian and cyclist access through the west end of the causeway structure, to move between habitats to the north and south.

An innovative and inexpensive monitoring program was executed in 2020 to determine how wildlife moved through and around these structures for purposes of adaptive management and informing future designs.



Motion-triggered camera traps were placed in spring 2020 in four locations along the 194 Ave causeway to detect the presence of wildlife and document their species diversity and movement patterns. In partnership with the Miistakis Institute, members of the Transportation Sustainability Strategy division reviewed thousands of still images collected over the course of 3 seasons to identify moose (pictured below), mule deer, white-tailed deer, coyote, hare and weasel in the vicinity. However, none of the cameras captured the movement of animals through the constructed wildlife passage. Research from the well known wildlife highway crossings in



Banff National Park and elsewhere demonstrates there is a learning curve to animals becoming comfortable enough to use such structures – sometimes several years - which varies by species and individuals. With only one year of monitoring data available to date, including some winter snow-tracking surveys completed in recent months to supplement the camera captures, we are not yet well positioned to describe wildlife occurrence in the area and their use of the structure.

### ***Wetland protection at 88 St SE extension project***

Transportation Infrastructure’s 88 Street SE extension project underway in 2020 involved widening the existing south leg of 88 Street SE from four lanes to six lanes and adding four new lanes to the gravel road between Stoney Trail and 196<sup>th</sup> Ave SE. Several wetlands and three semi-permanent, seasonal wetlands were located within the project area. TI adopted the pro-habitat approach of “avoid-minimize-replace” during the planning and design of the road structure: significant efforts were made in design to avoid impacts to these wetlands; efforts were made to mitigate or minimize impacts deemed to be unavoidable; and finally, if the impacts were unavoidable and significant, wetland removal was considered, with compensation for replacement. With the above approach, only one small, seasonal wetland located fully within the dedicated road right-of-way was completely removed. Small portions of two other wetlands were removed and a robust erosion and sediment control plan (with control measures to protect and minimize the impacts of construction on the wetlands) was implemented on the project. The contractor executed a monitoring and inspection program to ensure the ESC controls were effective and well maintained. With this strategy, TI was able to preserve the majority of the wetlands area in its original form.



### ***Road right-of-way as habitat***

Roads Maintenance boulevard division, through collaboration with Calgary Parks, the University of Calgary and Mount Royal University in 2017-2018 had pursued a novel yet practical approach to biodiversity conservation with the development of a “pollinator-friendly corridor” extending from Macleod Trail to Bow Bottom Trail. Calgary’s first “bee boulevard” comprised changes in landscaping in the centre median of Canyon Meadows Drive SE and (on Parks land adjacent to the south of the road) the installation of salvaged trees, sandstone boulders, and sand as structural habitat elements for bees and other pollinators. Native flowers beds were planted, and informational kiosks were also installed to facilitate public awareness and appreciation. That initiative in particular, and other small trial projects involving the propagation of native species for landscaping, have stimulated public discussion and further investigation within City administration on the potential for broader application of such methods in lower maintenance landscaping for the purposes of achieving potential cost savings, while at the same time creating value in terms of habitats and biodiversity.

Service reviews were undertaken late in 2019 to inform budget deliberations, with current boulevard mowing practices being the subject of one such sub-service review. Approximately 1,000 hectares of roadside land (i.e. the equivalent of about 1,000 soccer fields) throughout the city are mowed 4 times per year as a means of controlling the spread of weeds, the growth of woody vegetation affecting travel sightlines, and maintaining a “trim” aesthetic. Close review of this service identified no “low hanging fruit” in terms of potential cost savings. However, it was determined that more rigorous investigation into practices and innovations in the emerging field of “road ecology” and pollinator habitat enhancement would be beneficial to build a business case for a potential future change in roadside landscaping and maintenance practices.

Calgary City Council in February 2020 awarded \$450,000 of Council Innovation Funding to Transportation to design and execute a 3-year pilot project in roadside naturalization. This work was underway throughout 2020, involving the assembly of a project technical team of experts and practitioners from the Transportation department, Calgary Parks, the University of Calgary and the private sector for project planning and design.

As of Q1 2021, a competitive process for native landscaping services is near concluded for a pilot treatment involving the conversion of 5 hectares of roadside land from existing turfgrass to an urban meadow, and scientific field studies are underway to assess the plant communities and associated pollinator habitats of other roadside lands with varying maintenance regimes throughout the city. With Calgary having achieved official designation as a Bee City in December 2019, this pilot project is well timed and positioned to identify ways in which The City might usefully naturalize more open spaces such as road rights-of-way to create additional habitat for pollinators in general, and in a particular for 3 species of wild bumblebee that have been confirmed locally and are listed as threatened (Western bumblebee and Yellow-banded bumblebee) or endangered (Gypsy cuckoo bumblebee, pictured).





In parallel with this pilot project, The City contributed funding and leadership to a pooled-fund project of the Transportation Association of Canada in 2020 that resulted in the development of a compendium of beneficial practices for the management and enhancement of road ecology that is North American in scope. Other jurisdictions, in particular provincial road agencies in BC and Ontario and US State Departments of Transportation, have for many years been leading these emerging areas of practice including mitigating wildlife-vehicle collisions and enhancing pollinator habitats along roads.

## 8.2 Control of regulated weeds

The three operational business units of Transportation, with support from Parks as needed, conduct weed surveys and control in public land areas under their stewardship. Calgary Roads Boulevard Maintenance division, who work closely with the Parks Integrated Pest Management (IPM) division, perform annual invasive species inspections on City owned land, including roadsides, Roads depots and Spyhill gravel pit. Aggressive weedy species are prone to spread on development sites, on stockpiles and along transportation rights-of-way. The focus of inspections is to target and control regulated weeds on the City lands, therefore limiting off-site transfer of weeds and weeds seeds through transport of gravel and other materials. Inspections are performed following the North American Weed Management Association's guidelines for gravel pit inspections.

In 2020, Calgary Roads seasonal crews hand-pulled, collected and appropriately disposed of a total of 403 large bags of regulated weeds (an increase of 25% over 2019) predominately comprising nodding thistle, black henbane, yellow clematis, and burdock.

Calgary Transit with support from Parks IPM conducted plant health and safety interventions at 5 transit facilities and at the Spring Gardens complex in 2020. Weed and pest control was performed where and as required with a total of 63.55 hectares of land treated with pesticides per the Pest Management Policy.

In addition to their regular weed inspection and conventional control activities on project sites, TI for the first time in 2020 partnered with Parks IPM to use a herd of approximately 100 goats to remove by grazing the Leafy spurge infestation from an area of land under its stewardship south of 194 Ave SE. The photos below show a portion of the site both before and after the goats spent a few days there (Fig. 8).



*Figure 8: Innovative biological weed control on a site under TI stewardship in 2020*

### 8.3 Migratory birds protection

Migratory birds utilize almost every natural and man-made habitat found in Canada, and they are federally protected during breeding/nesting season. Under the *Migratory Birds Convention Act, 1994*, and its supporting *Regulations* there is an absolute prohibition on the disturbance to nesting migratory birds, their eggs, and their nests; in other words there is no regulatory provision to allow for their incidental take (i.e. no permits or approvals for their disturbance) during activities that support the development, construction, maintenance and operation of transportation facilities. The specific activities having highest potential for interaction with migratory birds include road construction, roadside vegetation management, and bridge maintenance work.

For most capital construction projects managed by TI, trees requiring removal that are identified as potential habitat for migratory birds are removed prior to breeding and nesting periods, typically between April 15 to August 15, with the prior approval of Urban Forestry and Urban Conservation divisions of Calgary Parks. Additionally, bird deterrent methods are applied including advance mowing of grass, cattail, and bushes in the project area to minimize opportunities for migratory birds to establish nests there. These and other measures and site specific guidance may be identified in ECO plans. Bridge washing and maintenance activities conducted by Roads staff and contractors also must planned and executed to prevent disturbance to migratory birds and their nests. An important aspect of migratory bird protection on work sites is the training and awareness of staff, contractors and consultants.

Deliverables from a Transportation Association of Canada member pooled fund project that The City of Calgary had participated in provide operational guidance for the protection of migratory birds in planning and executing vegetation management activities and the maintenance of bridges and culverts. These guidance documents were introduced to the Roads maintenance division, and also were shared internally in 2019 and 2020 to help inform the development of additional related materials by Parks to be used to guide their operational activities and their support of other activities across the City of Calgary organization.



#### ***Protecting migratory birds at the Airport Trail interchanges project site***

The Airport Trail Interchanges project consists of two new grade-separated interchanges being constructed along Airport Trail at 19 Street NE and Barlow Trail NE to replace the current at-grade intersections in these locations. One of the components of this project involved the dewatering and removal of two existing waterbodies. During early summer 2020, migratory bird nesting activity was identified at one of the waterbodies (a stormwater pond) that was planned to be completely removed. A total of three water-bird nests and one American coot nest were observed (with eggs) within the cattails at the west side of the waterbody. Accordingly, the project contractor, with technical guidance from TI's environmental staff, created

a plan that included establishing a buffer zone around the birds' nests and constructing a mechanically stabilized earth (MSE) wall within the waterbody to control and minimize any project-related effects on the birds' nests attributable to fluctuating water level from dewatering and other construction activities. Additionally a turbidity curtain was to be installed between the nests and MSE wall. However, a hail storm on June 13 was observed to have significantly damaged these birds' nests, after which the birds did not rebuild their nests and presumably relocated elsewhere. Construction activities resumed in the area only after a bird survey was done by a qualified biologist to ensure no disturbance to migratory birds, their eggs, or their nests.

## 9. How We Do Our Work

The above sections of this annual performance report describe the types of programs and activities that are undertaken to advance environmental sustainability within the Transportation lines of business, and the results achieved from these efforts. Council, citizens and stakeholders expect a high degree of environmental stewardship in City operations, delivered for the best possible value. Accordingly, we seek to optimize, innovate, collaborate, and continually improve.

Our continuing registration to the ISO 14001 Standard for environmental management systems is one important element contributing to a consistent focus and diligence in advancing environmental sustainability, while another may be our unique organizational structure and governance as a Transportation department. Under the recently updated ISO 14001 (2015) Standard, there is increased emphasis on leadership engagement in environmental management activities, and on identifying and addressing both internal and external stakeholder interests in the work we do and how well we do it, among other changes.

Our efforts to advance environmental sustainability within Transportation involve ongoing coordination and collaboration internal to The City, primarily with:

- Water Resources business unit
- Parks business unit
- Environmental and Safety Management business unit
- Energy Management Office, Corporate Analytics and Innovation business unit
- Resilience and Infrastructure Calgary business unit
- Waste and Recycling Services business unit
- Calgary Growth Strategies business unit
- Intergovernmental and Corporate Services
- Law Department
- Corporate Environmental Network.

External to The City, our efforts also involve information sharing and ongoing collaborations with interested parties and networks that include:

- University of Calgary
- The City of Edmonton



- TransLink (Metro Vancouver)
- Alberta Road Builders and Heavy Construction Association
- Transportation Association of Canada (TAC)
- Canadian Urban Transit Association (CUTA)
- Calgary Region Airshed Zone (CRAZ)
- The Miistakis Institute
- Pollinator Partnerships Canada
- Alberta Environment and Parks
- Environment and Climate Change Canada.

Staff of the Sustainability Strategy division and other divisions of the Transportation department also engage in educational and community outreach activities by invite to share information, insights and expertise gained from the work of advancing environmental sustainability in a municipal transportation system.

#### **10. Benchmarking Against Other Organizations**

The City of Calgary can reference municipal benchmarks to enable comparison with other Canadian cities on aspects of our transportation system, but currently there are no available data describing environmental management performance that is specific to transportation. Only select corporate metrics are available for comparison (e.g. Ontario Municipal CAOs Benchmarking Initiative). Other municipalities who are members of the Transportation Association of Canada are not currently positioned to access or share such information.

- Through ongoing work of TAC's Urban Transportation Council since 1994 there have been Urban Transportation Indicators (UTI) surveys undertaken every five years, with data being collected and compiled as indicators of "progress towards sustainable transportation" across 33 census metropolitan areas in Canada.
- The UTI-5 report (Kriger *et al* 2015) presents findings for over 90 indicators including metrics that are reported on for Calgary Transportation Plan implementation monitoring (e.g. travel mode split, land use density).
- The Federation of Canadian Municipalities (FCM) does not collect and compile such information.
- Within the specific context of transit (e.g. ridership rates, service hours per capita) Calgary Transit can benchmark against other members of the Canadian Urban Transit Association (CUTA), but that does not enable comparison of key environmental performance results.

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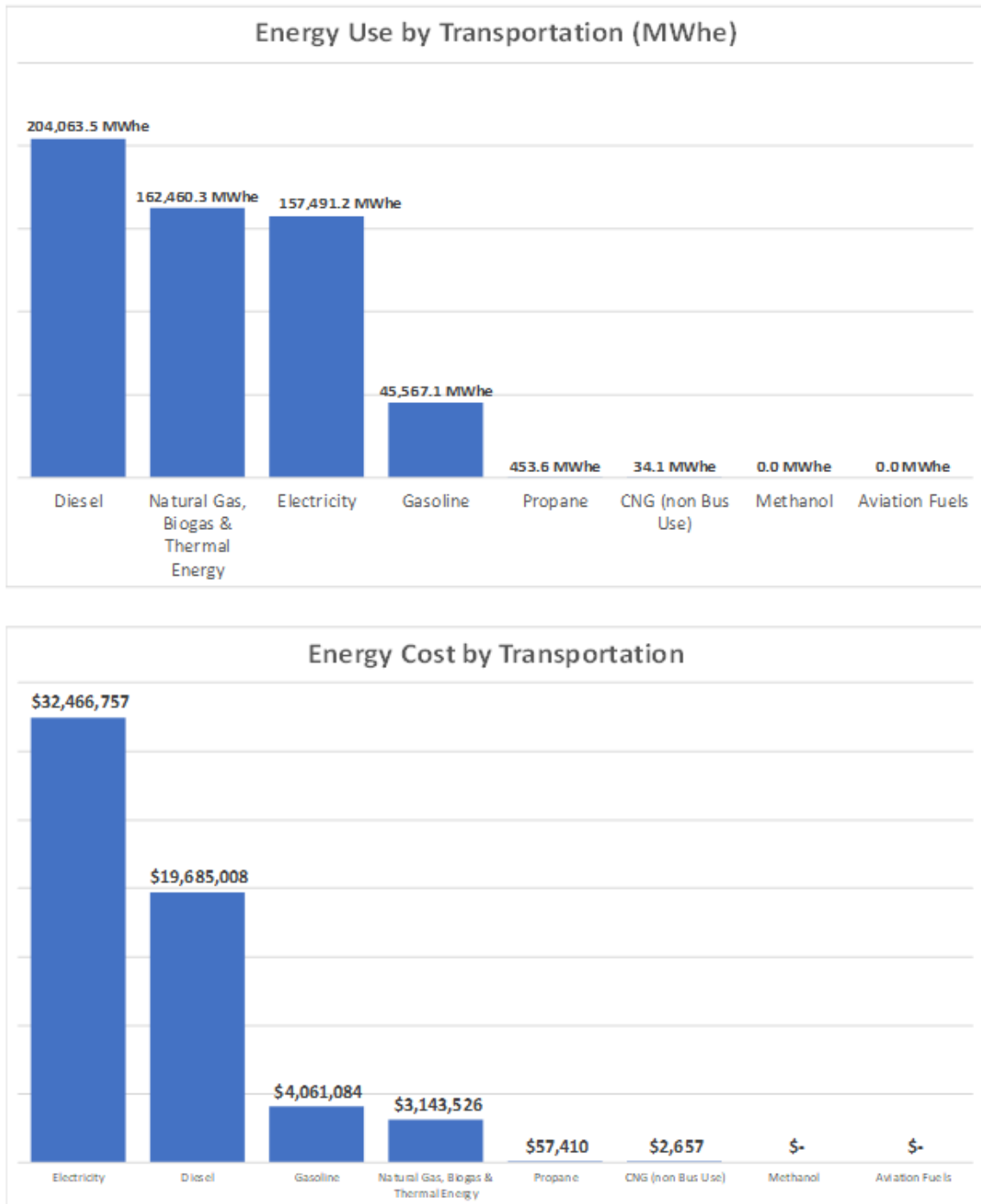
The information contained in these appendices is compiled from data available as of March 11, 2021. The source for most of the energy consumption and cost data for grid electricity and natural gas supply to The City of Calgary is ENMAX Energy invoice data. Data for district energy use (thermal energy), combined heat and power (CHP) systems, and The City's solar systems are separately metered with energy use and costs being compiled monthly. The values reported here may be adjusted over the next several months as data is finalized by the service providers.

Fuel consumption and cost information is a challenging consolidation of various data sources, from automated database queries, Excel reports and drills on Account Payables, to manual encoding of scanned invoices. Some data quality and encoding issues have been identified, so that there may be some variance of costs with those reported on The City's Peoplesoft system.

The departmental totals (Figs. App. 1-1 and 1-2) include energy use that is attributed to the non-operational business units for construction management (where, for example, Transportation Infrastructure has facilities under their stewardship on a temporary basis) but these values are not presented separately as they are not comparable on an annual basis. Electricity consumption values vary slightly between the charts and data tables as a result of energy transformed by the CHP unit at Spring Gardens and Stoney CNG Transit facility; charts show the energy used by the CHP as natural gas, while the tables show the natural gas input, the electricity produced, and the heat produced. The tables show the complete picture per commodity and the charts show the correct energy balance.

Also note that the energy use profile charts are presented in two ways: 1) with values shown using the typical units for each type of energy supply (e.g. litres of diesel fuel, gigajoules of electricity) which can be cross referenced to the supporting data summaries; and 2) shown in equivalent terms, where values were converted to "megawatt hours equivalent" to enable a visual comparison of relative energy consumption across the different types of energy supply.

**Figure App.1-1: Energy Consumption and Cost Profiles – Department Total**



## APPENDIX 1 – TRANSPORTATION ENERGY PROFILE

**Figure App.1-2: Energy Consumption and Cost Data – Department Total**

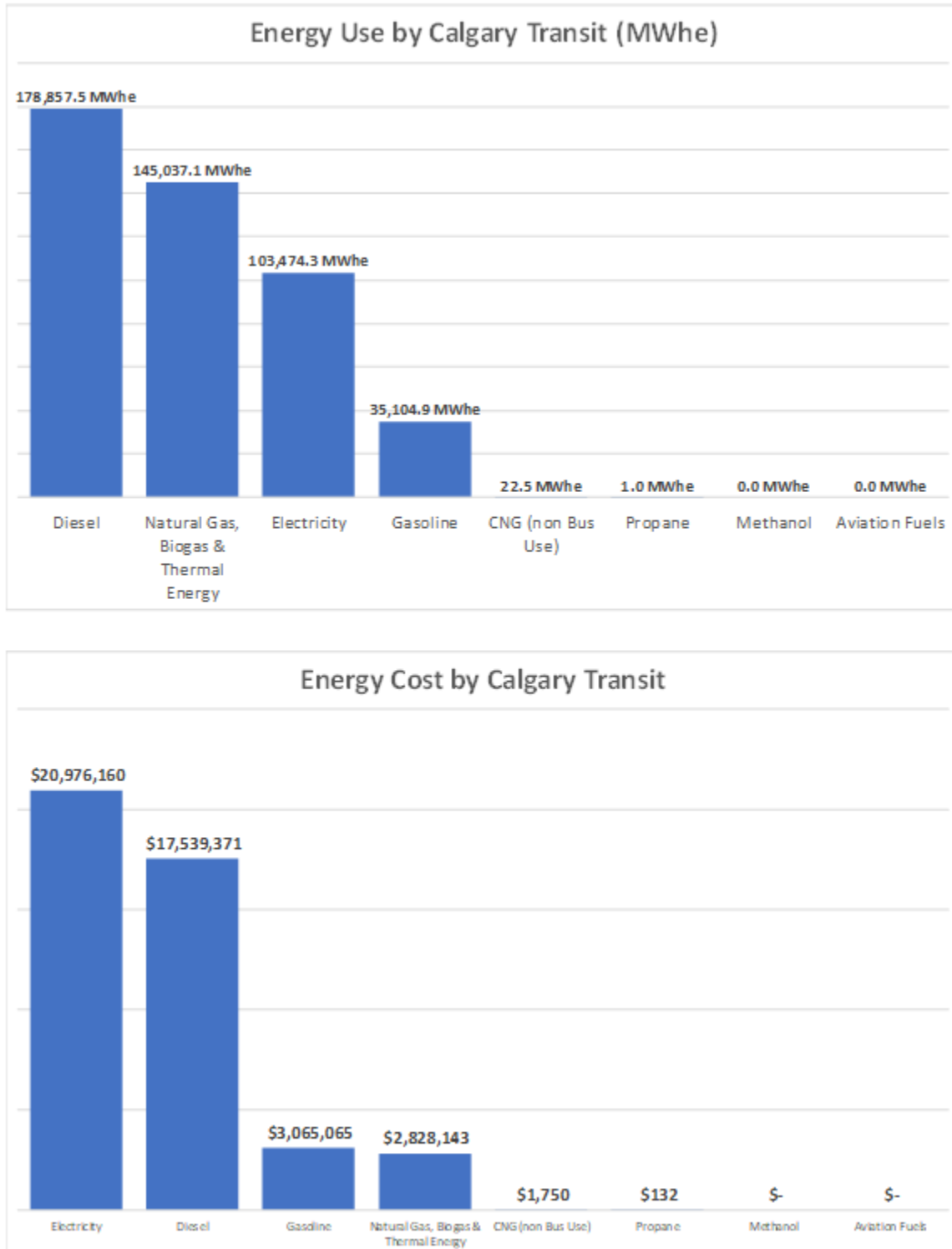
### Energy Use by Transportation (MWhe)

	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>
Diesel	281,404.7	261,037.3	245,904.4	199,519.9
<u>Marked Diesel</u>	<u>3,270.0</u>	<u>3,901.5</u>	<u>3,977.8</u>	<u>4,543.6</u>
Diesel Total	284,674.7	264,938.8	249,882.2	204,063.5
Gasoline	27,680.5	45,275.2	52,972.4	45,567.1
Grid Electricity Purchases	183,869.8	183,927.3	181,730.8	157,452.7
Solar PV	0.4	19.5	34.9	41.2
<u>Solar PV Exports</u>	<u>(0.4)</u>	<u>(0.8)</u>	<u>(1.1)</u>	<u>(2.7)</u>
Electricity	183,869.8	183,946.0	181,764.5	157,491.2
Natural Gas (CHP Use)	6,400.4	3,829.5	5,039.4	6,666.5
Natural Gas (Non CHP Use)	131,967.1	140,863.9	157,976.4	155,793.9
Bio Gas	-	-	-	-
Solar Thermal	-	-	-	-
District Energy	-	-	-	-
Natural Gas, Biogas & Thermal Energy	138,367.5	144,693.4	163,015.7	162,460.3
CNG (non Bus Use)	875.9	195.1	180.0	34.1
Av gas 100ll	-	-	-	-
Jet a1	-	-	-	-
Methanol	-	-	-	-
<u>Propane</u>	<u>764.6</u>	<u>672.0</u>	<u>768.0</u>	<u>453.6</u>
Total - Other Liquid Fuels	1,640.6	867.1	948.0	487.7
Total Energy Use	636,233.1	639,720.5	648,583.0	570,069.7

### Energy Cost by Transportation

	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>
Diesel	\$ 25,669,341	\$ 26,736,939	\$ 24,793,219	\$ 19,349,730
<u>Marked Diesel</u>	<u>\$ 288,132</u>	<u>\$ 430,640</u>	<u>\$ 379,328</u>	<u>\$ 335,278</u>
Diesel Total	\$ 25,957,473	\$ 27,167,579	\$ 25,172,547	\$ 19,685,008
Gasoline	\$ 2,920,940	\$ 5,599,493	\$ 5,673,258	\$ 4,061,084
Grid Electricity Purchases	\$ 30,916,978	\$ 32,435,106	\$ 35,066,253	\$ 32,060,116
Solar PV	\$ -	\$ -	\$ -	\$ -
Solar PV Exports	\$ (7)	\$ (118)	\$ (80)	\$ (150)
CHP Electricity Production	\$ 73,057	\$ 41,602	\$ 173,237	\$ 424,302
<u>CHP Electricity Exports</u>	<u>\$ -</u>	<u>\$ -</u>	<u>\$ (10,504)</u>	<u>\$ (17,511)</u>
Electricity	\$ 30,990,028	\$ 32,476,590	\$ 35,228,906	\$ 32,466,757
Natural Gas (CHP Use)	\$ 139,207	\$ 69,533	\$ 69,110	\$ 123,385
Natural Gas (Non CHP Use)	\$ 2,636,942	\$ 2,425,059	\$ 2,653,996	\$ 3,013,705
Bio Gas	\$ -	\$ -	\$ -	\$ -
District Energy	\$ -	\$ -	\$ -	\$ -
CHP Thermal Purchases	\$ 16,353	\$ 12,242	\$ 10,957	\$ 6,436
Solar Thermal	\$ -	\$ -	\$ -	\$ -
Natural Gas, Biogas & Thermal Energy	\$ 2,792,501	\$ 2,506,834	\$ 2,734,062	\$ 3,143,526
CNG (non Bus Use)	\$ 68,245	\$ 15,203	\$ 14,027	\$ 2,657
Av gas 100ll	\$ -	\$ -	\$ -	\$ -
Jet a1	\$ -	\$ -	\$ -	\$ -
Methanol	\$ -	\$ -	\$ -	\$ -
<u>Propane</u>	<u>\$ 100,402</u>	<u>\$ 80,685</u>	<u>\$ 93,384</u>	<u>\$ 57,410</u>
Total - Other Liquid Fuels	\$ 168,647	\$ 95,888	\$ 107,411	\$ 60,066
Total Energy Use	\$ 62,829,589	\$ 67,846,384	\$ 68,916,184	\$ 59,416,440

Figure App.1-3: Energy Consumption and Cost Profiles – Calgary Transit





## APPENDIX 1 – TRANSPORTATION ENERGY PROFILE

**Figure App.1-4: Energy Consumption and Cost Data – Calgary Transit**

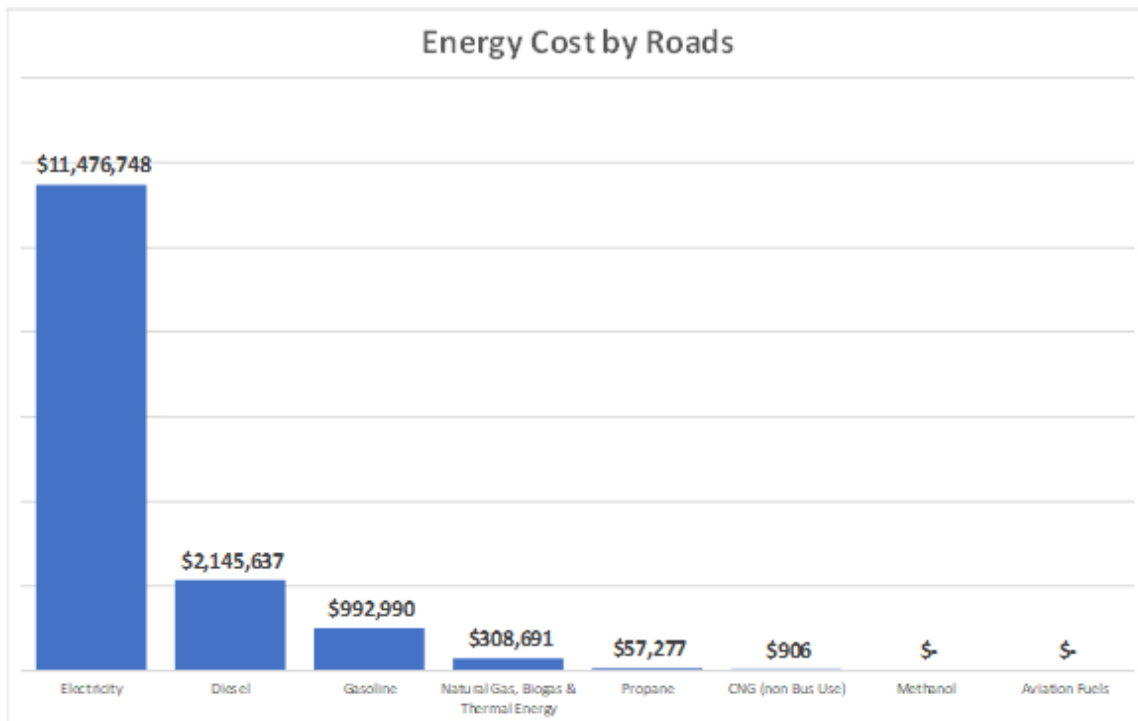
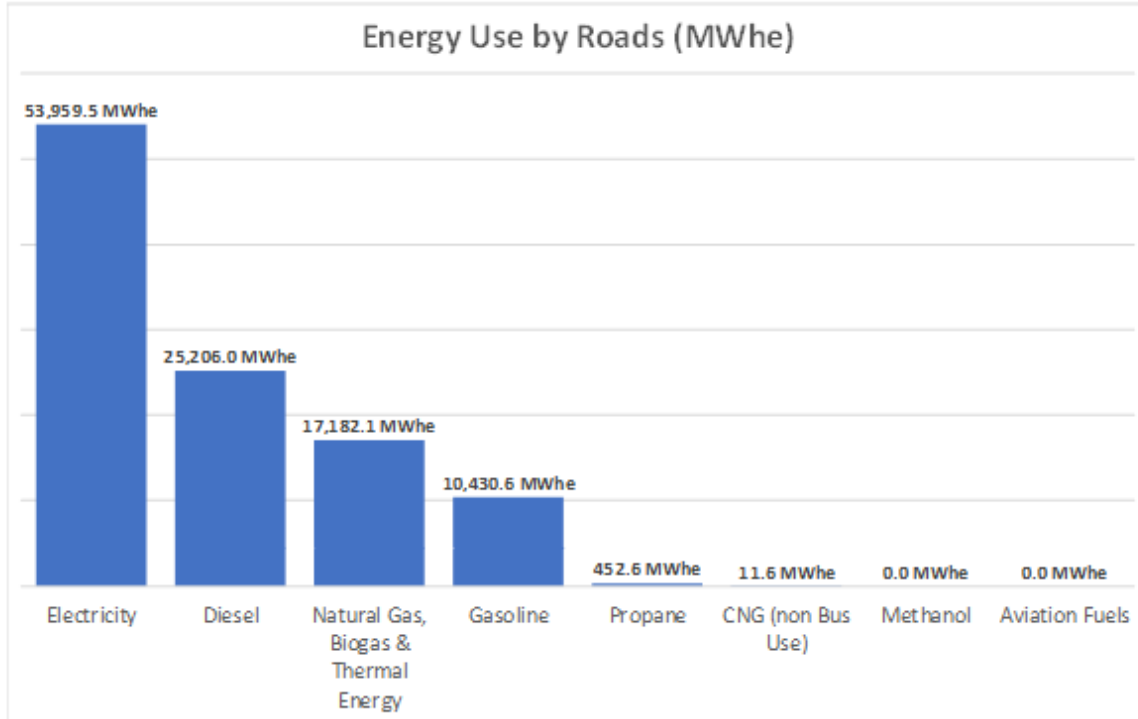
### Energy Use by Calgary Transit (MWhe)

	2017	2018	2019	2020
Diesel	259,016.8	237,597.5	224,403.7	178,772.6
<u>Marked Diesel</u>	<u>49.4</u>	<u>29.9</u>	<u>61.8</u>	<u>84.9</u>
Diesel Total	259,066.2	237,627.3	224,465.5	178,857.5
Gasoline	15,551.3	33,389.6	42,190.7	35,104.9
Grid Electricity Purchases	118,201.8	124,308.1	125,116.1	103,435.9
Solar PV	0.4	19.5	34.9	41.2
<u>Solar PV Exports</u>	<u>(0.4)</u>	<u>(0.8)</u>	<u>(1.1)</u>	<u>(2.7)</u>
Electricity	118,201.8	124,326.8	125,149.9	103,474.3
Natural Gas (CHP Use)	6,400.4	3,829.5	5,039.4	6,666.5
Natural Gas (Non CHP Use)	115,342.8	125,205.2	142,051.6	138,370.7
Bio Gas	-	-	-	-
Solar Thermal	-	-	-	-
District Energy	-	-	-	-
Natural Gas, Biogas & Thermal Energy	121,743.2	129,034.7	147,091.0	145,037.1
CNG (non Bus Use)	875.9	195.1	180.0	22.5
Av gas 100ll	-	-	-	-
Jet a1	-	-	-	-
Methanol	-	-	-	-
<u>Propane</u>	<u>8.8</u>	<u>23.8</u>	<u>9.0</u>	<u>1.0</u>
Total - Other Liquid Fuels	884.7	218.9	189.1	23.5
Total Energy Use	515,447.2	524,597.3	539,086.1	462,497.3

### Energy Cost by Calgary Transit

	2017	2018	2019	2020
Diesel	\$ 23,360,139	\$ 23,887,929	\$ 22,490,573	\$ 17,533,306
<u>Marked Diesel</u>	<u>\$ 4,005</u>	<u>\$ 3,220</u>	<u>\$ 6,007</u>	<u>\$ 6,065</u>
Diesel Total	\$ 23,364,143	\$ 23,891,149	\$ 22,496,580	\$ 17,539,371
Gasoline	\$ 1,639,747	\$ 4,123,769	\$ 4,398,964	\$ 3,065,065
Grid Electricity Purchases	\$ 19,870,673	\$ 21,827,155	\$ 23,413,969	\$ 20,569,519
Solar PV	\$ -	\$ -	\$ -	\$ -
Solar PV Exports	\$ (7)	\$ (118)	\$ (80)	\$ (150)
CHP Electricity Production	\$ 73,057	\$ 41,602	\$ 173,237	\$ 424,302
CHP Electricity Exports	\$ -	\$ -	\$ (10,504)	\$ (17,511)
Electricity	\$ 19,943,723	\$ 21,868,639	\$ 23,576,623	\$ 20,976,160
Natural Gas (CHP Use)	\$ 139,207	\$ 69,533	\$ 69,110	\$ 123,385
Natural Gas (Non CHP Use)	\$ 2,333,243	\$ 2,185,064	\$ 2,449,145	\$ 2,698,322
Bio Gas	\$ -	\$ -	\$ -	\$ -
District Energy	\$ -	\$ -	\$ -	\$ -
CHP Thermal Purchases	\$ 16,353	\$ 12,242	\$ 10,957	\$ 6,436
Solar Thermal	\$ -	\$ -	\$ -	\$ -
Natural Gas, Biogas & Thermal Energy	\$ 2,488,803	\$ 2,266,840	\$ 2,529,211	\$ 2,828,143
CNG (non Bus Use)	\$ 68,245	\$ 15,203	\$ 14,027	\$ 1,750
Av gas 100ll	\$ -	\$ -	\$ -	\$ -
Jet a1	\$ -	\$ -	\$ -	\$ -
Methanol	\$ -	\$ -	\$ -	\$ -
<u>Propane</u>	<u>\$ 1,120</u>	<u>\$ 2,841</u>	<u>\$ 824</u>	<u>\$ 132</u>
Total - Other Liquid Fuels	\$ 69,365	\$ 18,044	\$ 14,851	\$ 1,883
Total Energy Use	\$ 47,505,781	\$ 52,168,441	\$ 53,016,229	\$ 44,410,621

Figure App.1-5: Energy Consumption and Cost Profiles – Calgary Roads



**Figure App.1-6: Energy Consumption and Cost Data – Calgary Roads**

## Energy Use by Roads (MWh)

	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>
Diesel	22,387.9	23,439.8	21,500.7	20,747.3
<u>Marked Diesel</u>	<u>3,220.6</u>	<u>3,871.6</u>	<u>3,916.0</u>	<u>4,458.7</u>
Diesel Total	25,608.5	27,311.4	25,416.7	25,206.0
Gasoline	12,070.2	11,824.8	10,736.3	10,430.6
Grid Electricity Purchases	65,618.7	59,539.4	56,522.8	53,959.5
Solar PV	-	-	-	-
<u>Solar PV Exports</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Electricity	65,618.7	59,539.4	56,522.8	53,959.5
Natural Gas (CHP Use)	-	-	-	-
Natural Gas (Non CHP Use)	16,203.7	15,142.8	15,438.9	17,182.1
Bio Gas	-	-	-	-
Solar Thermal	-	-	-	-
District Energy	-	-	-	-
Natural Gas, Biogas & Thermal Energy	16,203.7	15,142.8	15,438.9	17,182.1
CNG (non Bus Use)	-	-	-	11.6
Av gas 100ll	-	-	-	-
Jet a1	-	-	-	-
Methanol	-	-	-	-
<u>Propane</u>	<u>755.8</u>	<u>648.2</u>	<u>759.0</u>	<u>452.6</u>
Total - Other Liquid Fuels	755.8	648.2	759.0	464.2
Total Energy Use	120,257.0	114,466.6	108,873.7	107,242.4

## Energy Cost by Roads

	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>
Diesel	\$ 2,309,203	\$ 2,849,011	\$ 2,302,646	\$ 1,816,424
<u>Marked Diesel</u>	<u>\$ 284,127</u>	<u>\$ 427,419</u>	<u>\$ 373,321</u>	<u>\$ 329,213</u>
Diesel Total	\$ 2,593,330	\$ 3,276,430	\$ 2,675,967	\$ 2,145,637
Gasoline	\$ 1,275,008	\$ 1,468,996	\$ 1,269,146	\$ 992,990
Grid Electricity Purchases	\$ 11,033,753	\$ 10,590,712	\$ 11,633,721	\$ 11,476,748
Solar PV	\$ -	\$ -	\$ -	\$ -
Solar PV Exports	\$ -	\$ -	\$ -	\$ -
CHP Electricity Production	\$ -	\$ -	\$ -	\$ -
<u>CHP Electricity Exports</u>	<u>\$ -</u>	<u>\$ -</u>	<u>\$ -</u>	<u>\$ -</u>
Electricity	\$ 11,033,753	\$ 10,590,712	\$ 11,633,721	\$ 11,476,748
Natural Gas (CHP Use)	\$ -	\$ -	\$ -	\$ -
Natural Gas (Non CHP Use)	\$ 292,318	\$ 228,975	\$ 193,301	\$ 308,691
Bio Gas	\$ -	\$ -	\$ -	\$ -
District Energy	\$ -	\$ -	\$ -	\$ -
CHP Thermal Purchases	\$ -	\$ -	\$ -	\$ -
Solar Thermal	\$ -	\$ -	\$ -	\$ -
Natural Gas, Biogas & Thermal Energy	\$ 292,318	\$ 228,975	\$ 193,301	\$ 308,691
CNG (non Bus Use)	\$ -	\$ -	\$ -	\$ 906
Av gas 100ll	\$ -	\$ -	\$ -	\$ -
Jet a1	\$ -	\$ -	\$ -	\$ -
Methanol	\$ -	\$ -	\$ -	\$ -
<u>Propane</u>	<u>\$ 99,282</u>	<u>\$ 77,844</u>	<u>\$ 92,560</u>	<u>\$ 57,277</u>
Total - Other Liquid Fuels	\$ 99,282	\$ 77,844	\$ 92,560	\$ 58,184
Total Energy Use	\$ 15,293,690	\$ 15,642,958	\$ 15,864,694	\$ 14,982,250